NFPA 1670
Standard on Operations and Training for Technical Rescue Incidents

1999 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

IMPORTANT NOTICE ABOUT THIS DOCUMENT

NFPA codes and standards, of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in its codes and standards.

The NFPA disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making this document available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of this document. Nor does the NFPA list, certify, test or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.

NOTICES

All questions or other communications relating to this document and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA documents during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

Users of this document should be aware that this document may be amended from time to time through the issuance of Tentative Interim Amendments, and that an official NFPA document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments then in effect. In order to determine whether this document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments, consult appropriate NFPA publications such as the *National Fire Codes*® Subscription Service, visit the NFPA website at www.nfpa.org, or contact the NFPA at the address listed above.

A statement, written or oral, that is not processed in accordance with Section 16 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

The NFPA does not take any position with respect to the validity of any patent rights asserted in connection with any items which are mentioned in or are the subject of this document, and the NFPA disclaims liability of the infringement of any patent resulting from the use of or reliance on this document. Users of this document are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Users of this document should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of this document, intend to urge action that is not in compliance with applicable laws, and this document may not be construed as doing so.

Licensing Policy

NFPA 1670

Standard on

Operations and Training for Technical Rescue Incidents

1999 Edition

This edition of NFPA 1670, *Standard on Operations and Training for Technical Rescue Incidents,* was prepared by the Technical Committee on Technical Rescue and acted on by the National Fire Protection Association, Inc., at its Fall Meeting held November 16–18, 1998, in Atlanta, GA. It was issued by the Standards Council on January 15, 1999, with an effective date of February 4, 1999.

This edition of NFPA 1670 was approved as an American National Standard on February 4, 1999.

Origin and Development of NFPA 1670

This is the first edition of this document. The responsibility for NFPA 1470, *Standard on Search and Rescue Training for Structural Collapse Incidents,* 1994 edition, was transferred to the Technical Committee on Technical Rescue, which has prepared a proposed new NFPA 1670, *Standard on Operations and Training for Technical Rescue Incidents.* This document incorporates the scope of NFPA 1470, which has been expanded to include identifying and establishing levels of functional capability for safety and effectively conducting operations at technical rescue incidents.

Technical Committee on Technical Rescue

Leslie D. English, *Chair*
MacMillan Bloedel Packaging Inc., AL [U]

Donald C. Cooper, *Secretary*
City of Cuyahoga Falls Fire Dept., OH [U]
Rep. Emergency Response Inst.

Joseph C. Burris, North Carolina Dept. of Insurance, NC [E]
Hugh Connor, Orem Fire Dept., UT [U]
Rep. Utah Fire and Rescue Academy
I. David Daniels, Seattle Fire Dept., WA [E]
James R. Engram, Colorado Springs Fire Dept., CO [U]
Steve Fleming, Poudre Fire Authority, CO [U]
James A. Frank, CMC Rescue, Inc., CA [M]
Tim Gallagher, Phoenix Fire Dept., AZ [U]
Carl Goodson, Fire Protection Publications, OK [M]
Billie Hall, Washington Township Fire Dept., OH [C]
Ihor M. Holowczynsky, Rescue Tech, Inc., MB, Canada [SE]
George G. Howard, Nassau County Fire Academy, NY [SE]
Steve Hudson, Pigeon Mountain Industries, Inc., GA [M]
Jerry S. Koenig, Falcon Air Force Base Fire Dept., CO [E]
Billy M. Lee, Jr., Champion Int'l Paper Co., FL [U]
Mike McGroarty, City of La Habra Fire Dept., CA [E]
Christopher J. Naum, L. A. Emergency Mgmt. & Training, NY [SE]
John P. O'Connell, Collapse Rescue Systems Inc., NY [SE]
Michael T. Reimer, South Technical Education Center, FL [RT]
Robert E. Rhea, Fairfax County Fire & Rescue, VA [U]
Michael R. Roop, Roco Rescue, Inc., LA [M]
Brian E. Rousseau, New York State Office of Fire Prevention & Control, NY [E]
Chase N. Sargent, Virginia Beach Fire Dept., VA [E]
Robert P. Thornton, City of Mobile Fire Dept., AL [U]
Rep. University of South Alabama (CERT)
William J. Troup, U.S. Fire Administration, MD [SE]
William H. Weems, Safe State Program, AL [SE]
Ernest (Richey) Wright, PMI-Petzl Distribution, Inc., FL [M]

Alternates

Michael G. Brown, Virginia Beach Fire Dept., VA [U]
(Alt. to C. N. Sargent)
Fred J. Jackson, City of Cuyahoga Falls Fire Dept., OH [U]
(Alt. to D. C. Cooper)
John F. McCallum, Jr., Chicago Fire Dept., IL [U]
(Alt. to R. P. Thornton)

Frank Florence, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of this document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on technical rescue techniques, operations, and procedures to develop efficient, proper, and safe utilization of personnel and equipment.

Contents

NFPA 1670

Standard on

Operations and Training for Technical Rescue Incidents

1999 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Appendix A.

Information on referenced publications can be found in Chapter 10 and Appendix C.

Chapter 1 Administration

1-1 Scope.

1-1.1* This standard identifies and establishes levels of functional capability for safely and effectively conducting operations at technical rescue incidents.

1-1.2* The requirements of this standard apply to organizations that provide response to technical rescue incidents.

1-2* Purpose. The purpose of this standard is to assist the authority having jurisdiction (AHJ) in assessing a technical rescue hazard within the response area, to identify the level of operational capability, and to establish operational criteria. The functional capabilities of this standard shall be permitted to be achieved in a variety of ways.

1-3 Definitions.

Abrasion. The damaging effect on rope and other equipment caused by friction-like movement.

Acceptable Entry Conditions. Conditions in a space that must exist to allow entry and to ensure that employees can safely enter into and work within the space.

Accepted Engineering Practices. Those requirements that are compatible with standards of practice required by a registered professional engineer.

Alternate Air System. A secondary air supply system that involves an alternate second-stage regulator provided by either a separate dedicated second-stage or a multipurpose second-stage regulator coupled with a buoyancy compensator inflator valve.

Aluminum Hydraulic Shoring. Pre-engineered shoring system comprised of aluminum hydraulic cylinders (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (walers) and designed specifically to support the sidewalls of an excavation and prevent cave-ins.

Anchor Point. A single, structural component used either alone or in combination with other components to create an anchor system capable of sustaining the actual and potential load on the rope rescue system.

Anchor System. One or more anchor points rigged in such a way as to provide a structurally significant connection point for rope rescue system components.

Angle of Repose. The greatest angle above the horizontal plane at which loose material (such as soil) will lie without sliding.

Approach Assessment. The period of time from the moment when the incident site first becomes visible to the moment when the initial size-up is completed.

Approved.* Acceptable to the authority having jurisdiction.

Ascending (Line). A means of safely traveling up a fixed line with the use of one or more ascent devices.

Ascent Device. An auxiliary equipment system component that is a friction or mechanical device utilized alone or in combination with other mechanical devices to allow ascending a fixed rope.

Assessment Phase (Size-Up). The process of assessing the conditions, the scene, and the subject's condition and ability to assist in his or her own rescue.

Attendant.* A term used to describe U.S. federally regulated industrial workers who are qualified to be stationed outside one or more confined spaces, who monitor authorized entrants, and who perform all of the following duties:

(a) Remain outside the confined space during entry operations until relieved by another attendant
(b) Summon rescue and other needed resources as soon as the attendant determines that authorized entrants might need assistance to escape from confined space hazards
(c) Perform nonentry rescues as specified by the rescue procedure listed on the permit *(see Entry Permit)*

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Authorized Entrant.* A term used to describe U.S. federally regulated industrial workers who are designated to enter confined spaces and who meet the following training requirements for each specific space they enter:

(a) *Hazard Recognition.* The ability to recognize the signs and symptoms of exposure to a hazardous material or atmosphere within the space and to understand the consequences of exposure and the mode of transmission (i.e., injection, ingestion, inhalation, or absorption) for the hazard.

(b) *Communications.* The ability to carry out the method by which rescue services are to be summoned in the event of an emergency, the method by which the entrant will communicate with the attendant on the outside of the space, and a backup method of communication should the primary system fail.

(c)* *Personal Protective Equipment (PPE).* The ability to use all PPE appropriate for the confined space.

(d)* *Self-Rescue.* The ability to carry out the method by which the entrant will escape from the space should an emergency occur.

Auxiliary Rope Rescue Equipment. System components, other than life-safety rope and harnesses, that are load-bearing accessories — including, but not limited to, ascending devices, carabiners, descent control devices, rope grab devices, and snap-links — designed to be utilized for rescue.

Avalanche.* A mass of snow — sometimes containing ice, water, and debris — that slides down a mountainside.

Belay.* The method by which a potential fall distance is controlled to minimize damage to equipment and/or injury to a live load.

Bell-Bottom Pier Hole. A type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a bell shape.

Benching or Benching System. A method of protecting employees from cave-ins by excavating the side of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Bend. A knot that joins two ropes or webbing pieces together.

Bight. The open loop in a rope or piece of webbing formed when it is doubled back on itself.

Blanking and Blinding. A form of hydraulic energy isolation that is the absolute closure of a pipe, line, or duct by fastening a solid plate (such as a spectacle blind or skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure within the pipe, line, or duct with no leakage beyond the plate.

Body/Property Recovery. An operation involving the retrieval of either the remains of a deceased victim or property, but in no case a living person.

Cave-In. The separation of a mass of soil or rock material from the side of an excavation or trench, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

Collapse Zone. See Rescue Area.

Compass. A device that uses the earth's magnetic field to indicate relative direction.

Competent Person. One who is capable of identifying existing and predictable conditions in the surroundings or in the working area that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate such conditions.

Compound Rope Mechanical Advantage System. A combination of individual rope mechanical advantage systems created by stacking the load end of one rope mechanical advantage system onto the haul line of another or others to multiply the forces created by the individual system(s).

Confined Space.* A space that has the following characteristics:

(a) Is large enough and so configured that a person can enter and perform assigned work

(b) Has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits)

(c) Is not designed for continuous human occupancy

(d) Has one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere
2. Contains a material that has the potential for engulfing an entrant
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section
4. Contains any other recognized serious safety or health hazards (including fall, environmental, and equipment hazards)

Confined Space Entry. Ensuing work activities in a confined space. Confined space entry is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

Confined Space Rescue Equipment. The equipment (including life safety rope, Class III harnesses, manually operated lowering and lifting devices, anchoring systems, and other adjunct rescue equipment as appropriate) used for entry-type rescue of persons from confined spaces.

Confined Space Rescue Team.* A combination of individuals (a minimum of six for organizations operating at the technician level and a minimum of four for organizations operating at the operations level) trained, equipped, and available to respond to confined space emergencies. This team shall be trained to one of three proficiency levels: awareness, operational, or technical. A rescue team shall be required to meet the operational or technical levels to qualify as a rescue service dependent upon the type and complexity of the confined space emergency.

Confined Space Retrieval Equipment. See Retrieval Equipment.

Counter Balance. A raising system utilizing a 1:1 mechanical advantage and a weighted object (human or otherwise) to reduce the need for additional force to lift the load.

Cribbing.* Short lengths of robust, usually hardwood, timber, 4×4 inches and 18 to 24 inches long, that are used in a variety of ways, usually in the stabilization of vehicles.

Critical Angle. An angle of 120 degrees or less created between two rope rescue system components wide enough so as to create excessive force on the anchor points to which they are attached.

Critical Incident Stress Debriefing (CISD). See NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program,* A-10-1.2.

Cross Braces (or Struts). The individual horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales. *(See also Shoring.)*

Descending (Line). A means of safely traveling down a fixed line using a descent control device.

Descent Control Device. A rope rescue system component that is a friction or mechanical device utilized with rope to control descent.

Disentanglement. The cutting of a vehicle and/or machinery away from trapped or injured victims.

Dive. An exposure to increased pressure whether underwater or in a hyperbaric chamber.

Dive Operation. A situation requiring divers to complete an assigned task.

Dive Team. An organization of public safety divers and members in training.

Diver. An individual using breathing apparatus that supplies compressed breathing gas at the ambient pressure.

Edge Protection. A means of protecting software components within a rope rescue system from the potentially harmful effects of exposed sharp or abrasive edges.

Emergency Incident. A specific emergency operation.

Emergency Medical Service (EMS). The organization(s) responsible for the care and transport of sick and injured persons to an appropriate emergency care facility. Referred to as Emergency Services in U.S. federal confined space regulations.

Engulfment. The surrounding and effective capture of a person by a fluid (e.g., liquid, finely divided particulate) 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 crushing.

Entry. The action by which a person passes into a confined space. Entry includes ensuing work or rescue activities in that environment and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space, trench, or excavation.

Entry Permit.* A written or printed document, established by an employer, for nonrescue entry into confined spaces.

Entry Team. The group of individuals, with established communications and leadership, assigned to perform work or rescue activities beyond the opening of, and within, the space, trench, or excavation.

Environment.* A collection of characteristics such as weather, altitude, and terrain contained in an area that are unique to a location.

Excavation. Any man-made cut, cavity, trench, or depression in an earth surface, formed by the removal of earth.

Extrication. The removal of trapped victims from a vehicle or machinery.

Face(s). The vertical or inclined earth surface formed as a result of excavation work.

Failure. The breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

Federal Response Plan.* The Federal Response Plan (for Public Law 93-288, as amended) describes the basic mechanisms and structures by which the federal government will mobilize resources and conduct activities to augment state and local disaster and emergency response efforts.

FEMA Task Force Search and Rescue Marking System.* Distinct markings made with international orange spray paint near a collapsed structure's most accessible point of entry.

FEMA Task Force Structure/Hazard Evaluation Marking System.* Distinct markings made with international orange spray paint, after performing a building hazard assessment, near a collapsed structure's most accessible point of entry.

FEMA Task Force Structure Marking System, Structure Identification Within a Geographic Area.* Distinct markings made with international orange spray paint to label buildings with their street number so that personnel can differentiate one building from another.

Fixed Line (Fixed Line System). A rope rescue system consisting of a nonmoving rope attached to an anchor system.

Flammable.* A combustible that is capable of being easily ignited and rapidly consumed by fire.

Flammable Liquid. Any liquid having a flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psi (276 kPa) (absolute) at 100°F (37.8°C).

General Area (or Warm Zone).* An area surrounding the incident site (e.g., collapsed structure or trench) whose size is proportional to the size and nature of the incident. Within the general area, access by people, heavy machinery, and vehicles is limited and strictly controlled.

Grade Pole. A wood or fiberglass pole, either cut to a certain length or provided with markings, used by workers when setting pipes on grade.

Hardware. A rigid mechanical auxiliary rope rescue component that can include, but is not limited to, anchor plates, carabiners, and mechanical ascent and descent control devices.

Harness. See Life Safety Harness.

Hazard Analysis. The process of identifying situations or conditions that have the potential to cause injury to people, damage to property, or damage to the environment.

Hazardous Atmosphere. Any atmosphere that is oxygen deficient, contains a toxic or disease-producing contaminant, or is potentially explosive. A hazardous atmosphere could be immediately dangerous to life and health, but not necessarily.

Hazardous Atmosphere for Confined Space. Any atmosphere that could expose personnel to the risk of death, incapacitation, injury, acute illness, or impairment of the ability to self-rescue, due to one or more of the following causes:

(a) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL)
(b)* Airborne combustible dust at a concentration that meets or exceeds its LFL
(c) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent
(d) Atmospheric concentration of any hazardous substance that could result in exposure to personnel in excess of its dose or permissible exposure limit (PEL)
(e) Any other atmospheric condition that is immediately dangerous to life or health (IDLH)

Heavy Object. An item of such size and weight that it cannot be moved without the use of power tools (e.g., hydraulic lifting devices) or complex mechanical advantage systems.

High Angle. Refers to an environment in which the load is predominately supported by the rope rescue system.

Highline System. A system of using rope suspended between two points for movement of persons or equipment over an area that is a barrier to the rescue operation, including systems capable of movement between points of equal or unequal height.

Hitch. A knot that attaches to or wraps around an object so that when the object is removed, the knot will fall apart.

Immediately Dangerous to Life or Health (IDLH). Any condition that would do one of the following:

(a) Pose an immediate or delayed threat to life
(b) Cause irreversible adverse health effects
(c) Interfere with an individual's ability to escape unaided from a hazardous environment

Imminent Hazard. An act or condition that is judged to present a danger to persons or property and is so immediate and severe that it requires immediate corrective or preventive action.

Incident Command System (ICS). The combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure with responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident (as described in the document *Incident Command System*) or training exercise.

Incident Commander. The person responsible for all decisions relating to the management of the incident. The incident commander is in charge of the incident site.

Incident Management System. The management system or command structure used during emergency operations to identify clearly who is in command of the incident and what roles and responsibilities are assigned to various members.

Incident Response Plan. Written procedures, including standard operating guidelines, for managing an emergency response and operation.

Incident Scene.* The location where activities related to a specific incident are conducted.

Isolation System (or Isolation Devices).* An arrangement of devices, applied with specific techniques, that collectively serve to isolate a victim of a trench or excavation emergency from the surrounding product (e.g., soil, gravel, or sand).

Knot.* A fastening made by tying together lengths of rope or webbing in a prescribed way.

Laser Target. A square or rectangular plastic device used in conjunction with a laser instrument to set the line and grade of pipe.

Life Safety Harness. A system component that is an arrangement of materials secured about the body and used to support a person during rescue.

Life Safety Rope. A compact but flexible, torsionally balanced, continuous structure of fibers produced from strands that are twisted, plaited, or braided together and that serve primarily to support a load or transmit a force from the point of origin to the point of application.

Litter. A transfer device designed to support and protect a victim during movement.

Litter Attendant. A person who both accompanies and physically manages the litter.

Load. That which is being lowered or raised by rope in a high angle system. Some examples include a rescue subject, a rescuer, and subjects in a litter with a litter attendant.

Load Test.* A method of preloading a rope rescue system to ensure all components are set properly to sustain the expected load.

Lockout.* A method for keeping equipment from being set in motion and endangering workers.

Low Angle. Refers to an environment in which the load is predominately supported by itself and not the rope rescue system (e.g., flat land or mild sloping surface).

Lowering System.* A rope rescue system used to lower a load under control.

Machinery. The moving parts of a particular machine.

Maximum Working Load. Weight supported by the life safety rope and system components that must not be exceeded.

Mechanical Advantage (M/A).* A force created through mechanical means including, but not limited to, a system of levers, gearing, or ropes and pulleys usually creating an output force greater than the input force and expressed in terms of a ratio of output force to input force.

Mitigation. Activities taken, either prior to or following an incident, to eliminate or reduce the degree of risk to life and property from hazards.

Multipoint Anchor System. System configuration providing load distribution either proportionately or disproportionately over more than one anchor point. There are basically two categories of multipoint anchor systems:

*Load Distributing Anchor System.** An anchor system established from two or more anchor points that maintains near equal loading on the anchor points despite direction changes on the main line rope and re-establishes a state of near-equal loading on remaining anchor points if any one of them fails. (Also referred to as self-equalizing or self-adjusting.)

*Load Sharing Anchor System.** An anchor system established from two or more anchor points that distributes the load among the anchor points somewhat proportionately but will not adjust to direction changes on the main line rope.

National Search and Rescue Plan.* A document that identifies responsibilities of U.S. federal agencies and serves as the basis for the *National Search and Rescue Manual,* which discusses search and rescue organizations, resources, methods, and techniques utilized by the federal government.

One-Call Utility Location Service. A service from which contractors, emergency service personnel, and others can obtain information on the location of underground utilities in any area.

Oxygen-Deficient Atmosphere. Air atmospheres containing less than 19.5 percent oxygen by volume at one standard atmosphere pressure.

Oxygen-Enriched Atmosphere. Air atmospheres containing more than 23.5 percent oxygen by volume at one standard atmosphere pressure.

Packaging (Patient Packaging). The process of securing a subject in a transfer device, with regard to existing and potential injuries/illness, so as to avoid further harm during movement.

Panel. See Traditional Sheeting and Shoring.

Panel Team. The group of individuals, with established communications and leadership, assigned to construct (if necessary), move, place, and manage panels (traditional sheeting panels) both inside and outside the space, trench, or excavation.

Personal Protective Equipment (PPE).* The equipment provided to shield or isolate personnel from infectious, chemical, physical, and thermal hazards.

Personnel. Any individual participating within the incident scene.

Pier Hole (or Bell-Bottom). A type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a bell shape.

Pre-Entry Briefing. Information passed to all personnel prior to entry into a confined space or trench/excavation environment.

Preparation Phase. All actions and planning conducted prior to the initial receipt of alarm.

Primary Access. The existing opening of doors and/or windows that provide a pathway to the trapped and/or injured victim(s).

Protective System.* A method of protecting employees from cave-ins, from material that could fall or roll from an

excavation face or into an excavation, or from the collapse of adjacent structures.

Public Safety Diver. An individual who performs public safety diving as defined herein.

Public Safety Diving. Underwater diving, related to team operations and training, performed by any member, group, or agency of a community or government-recognized public safety diving or water rescue team.

Pulley. A device with a free-turning, grooved metal wheel (sheave) used to reduce rope friction. Side plates are available for a carabiner to be attached.

Raising System.* A rope rescue system used to raise a load under control.

Rapid Intervention Crew.* At least two members available for rescue of a member or a team if the need arises.

"Reach, Throw, Row, Go." The four sequential steps in water rescue with progressively more risk to the rescuer. Specifically, a "go" rescue involves physically entering the medium (e.g., in the water or on the ice).

Recovery. Activities and programs designed to return the entity to an acceptable condition.

Recovery Mode. Level of operational urgency where there is no chance of rescuing a victim alive.

Redundant Air System. An independent secondary underwater breathing system (i.e., a pony bottle with first and second stage or a pony bottle supplying a bailout block).

Registered Professional Engineer.* A person who is registered as a professional engineer in the state where the work is to be performed.

Rescue. Those activities directed at locating endangered persons at an emergency incident, removing those persons from danger, treating the injured, and providing for transport to an appropriate health care facility.

Rescue Area (or Hot, Danger, or Collapse Zone).* An area surrounding the incident site (e.g., collapsed structure or trench) whose size is proportional to the hazards that exist.

Rescue Attendant. A member of the rescue service who meets all requirements of *attendant* as defined within this standard and who acts in that capacity during a confined space rescue. *(See also Attendant.)*

Rescue Entrant. A person entering a confined space for the specific purpose of rescue. This person shall meet the training requirements of an *authorized entrant* specific to the space to be entered for rescue and shall meet all requirements of members of the *rescue service* as defined within this standard. *(See also Authorized Entrant and Rescue Service.)*

Rescue Equipment. See Confined Space Rescue Equipment.

Rescue Incident. An emergency incident that primarily involves the rescue of persons subject to physical danger and that could include the provision of emergency medical care, but not necessarily.

Rescue Mode. A level of operational urgency where there is a chance that a victim will be rescued alive.

Rescue Service. The confined space rescue team designated by the AHJ to rescue victims from within confined spaces, including operational and technical levels of industrial, municipal, and private sector organizations. All rescue services shall meet the following minimum requirements:

(a) Each member of the rescue service shall be provided with, and trained to use properly, the personal protective equipment and rescue equipment necessary for making rescues from confined spaces according to his or her designated level of competency.

(b) Each member of the rescue service shall be trained to perform the assigned rescue duties corresponding to his or her designated level of competency. Each member of the rescue service shall also receive the training required of authorized rescue entrants.

(c) Each member of the rescue service shall practice making confined space rescues, in accordance with the requirements of 2-1.6 of this document, by means of simulated rescue operations in which they remove dummies, mannequins, or persons from actual confined spaces or from representative confined spaces. Representative confined spaces should — with respect to opening size, configuration, and accessibility — simulate the types of confined spaces from which rescue is to be performed.

(d) Each member of the rescue service shall be certified to the level of first responder or equivalent according to U.S. Department of Transportation (DOT) *First Responder Guidelines*. Each member of the rescue service shall also successfully complete a course in cardiopulmonary resuscitation (CPR) taught through the American Heart Association (AHA) to the level of a "Health Care Provider," through the American Red Cross (ARC) to the "CPR for the Professional Rescuer" level, or through the National Safety Council's equivalent course of study.

(e)* The rescue service shall be capable of responding in a timely manner to rescue summons.

(f) Each member of the rescue service shall be properly equipped, trained, and capable of functioning appropriately to perform confined space rescues within the area for which they are responsible at their designated level of competency. This must be confirmed by an annual evaluation of the rescue service's capabilities to verify that the needed capabilities are present to perform confined space rescues in terms of overall timeliness, training, and equipment and to perform safe and effective rescue in those types of spaces to which the team must respond.

(g) Each member of the rescue service shall be aware of the hazards they could confront when called on to perform rescue within confined spaces for which they are responsible.

(h) If required to provide confined space rescue within U.S. federally regulated industrial facilities, the rescue service shall have access to all confined spaces from which rescue could be necessary so that they can develop appropriate rescue plans and practice rescue operations according to their designated level of competency.

Rescue Team Leader. The person designated within the incident command system as rescue group/division officer responsible for direct supervision of the rescue team operations.

Resource Assessment. The component of the assessment phase that involves the determination for the need for additional resources. Resource assessment can be ongoing throughout the entire incident.

Resources. All personnel and equipment that are available, or potentially available, for assignment to incidents.

Respiratory Protection. Equipment designed to protect the wearer from the inhalation of contaminants.

Response Agency. An organization capable of providing emergency services.

Retrieval Equipment (or Retrieval System).* Combinations of rescue equipment used for nonentry (external) rescue of persons from confined spaces.

Risk. A measure of the probability and severity of adverse effects that result from an exposure to a hazard.

Risk Assessment. An assessment of the likelihood, vulnerability, and magnitude of incidents that could result from exposure to hazards.

Risk/Benefit Analysis.* A decision made by a responder based on a hazard and situation assessment that weighs the risks likely to be taken against the benefits to be gained for taking those risks.

Rope. See Life Safety Rope.

Rope-Based Mechanical Advantage System (Rope Mechanical Advantage System). A rope rescue system component incorporating the reeving of rope through moving pulleys (or similar devices) to create mechanical advantage.

Rope Rescue Equipment. Components used to build rope rescue systems including life safety rope, life safety harnesses, and auxiliary rope rescue equipment.

Rope Rescue System. A system comprised of rope rescue equipment and an appropriate anchor system intended for use in the rescue of a subject.

Safety Diver. An on-site diver available in a sufficient state of readiness to assist another diver in the water.

Safety Officer. An individual qualified by the authority having jurisdiction to maintain a safe working environment.

SAR. Search and rescue.

Search Marking System. A separate and distinct marking system used to identify information related to the location of a victim(s).

Secondary Access. Openings created by rescuers that provide a pathway to trapped and/or injured victims.

Shall. Indicates a mandatory requirement.

Sheeting. The members of a shoring system that support the sides of an excavation and are in turn supported by other members of the shoring system.

Shield (or Shield System).* A structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structures.

Shoring (or Shoring System). A structure such as a metal hydraulic, pneumatic/mechanical, or timber shoring system that supports the sides of an excavation and is designed to prevent cave-ins.

Shoring Team. The group of individuals, with established communications and leadership, assigned to construct, move, place, and manage the shoring or shoring system inside the space, trench, or excavation.

Sides. See Face(s).

Simple Rope Mechanical Advantage System. A rope mechanical advantage system containing the following:

(a) A single rope

(b) One or more moving pulleys (or similar devices), all traveling at the same speed and in the same direction, attached directly or indirectly to the load

(c) In the case of mechanical advantage systems greater than 2:1, one or more stationary pulleys or similar devices

Single-Point Anchor System. An anchor system configuration utilizing a single anchor point to provide the primary support for the rope rescue system. A single-point anchor system includes those anchor systems that utilize one or more additional nonloaded anchor points as backup to the primary anchor point.

Size-Up. A mental process of evaluating the influencing factors at an incident prior to committing resources to a course of action.

Sloping System.* A protecting system that uses inclined excavating to form sides that are inclined away from the excavation so as to prevent cave-in.

Software. A flexible fabric component of rope rescue equipment that can include, but is not limited to, anchor straps, pick-off straps, and rigging slings.

Special Operations. Those emergency incidents to which the responding agency responds that require specific and advanced technical training and specialized tools and equipment.

Standard Operating Guideline. An organizational directive that establishes a course of action or policy.

Standard Operating Procedure. An organizational directive that establishes a standard course of action.

Strongback. See Uprights.

Supplemental Sheeting and Shoring.* Sheeting and shoring operations that involve the use of commercial sheeting/shoring systems and/or isolation devices or that involve cutting and placement of sheeting and shoring when greater than two feet of shoring exists below the bottom of the strongback.

Support System. A structure — such as underpinning, bracing, or shoring — that provides support to an adjacent structure, underground installation, or the sides of an excavation.

Surcharge Loads. Any weight near the lip of the trench that increases the likelihood of instability or secondary cave-in.

Swift Water. Water moving at a rate greater than one knot (1.15 mph).

System Safety Check.* A method of evaluating the safe assembly of a rescue system.

System Stress. Any condition creating excessive force (i.e., exceeding the maximum working load of any component) to components within a rope rescue system that could lead to damage or failure of the system.

Tabulated Data.* Any set of site-specific design data used by a professional engineer to design a protective system at a particular location.

Tagout. A method of tagging, labeling, or otherwise marking an isolation device during hazard abatement operations to prevent accidental removal of the device. *(See also Lockout.)*

Technical Rescue. The application of special knowledge, skills, and equipment to safely resolve unique and/or complex rescue situations.

Technical Rescue Incident.* Complex rescue incidents requiring specially trained personnel and special equipment to complete the mission.

Tender. An individual trained in the responsibilities of diver safety who provides control of search patterns from the surface of the water.

Termination. That portion of incident management in which personnel are involved in documenting safety procedures, site operations, hazards faced, and lessons learned from the incident. Termination is divided into three phases: debriefing the incident, post-incident analysis, and critiquing the incident.

Terrain.* Specific natural and topographical features within an environment.

Terrain Hazard.* Specific terrain feature, or feature-related condition, that exposes one to danger and the potential for injury and/or death.

Testing. The process by which the hazards that could confront entrants of a trench or excavation are identified and evaluated, including specifying tests that are to be performed in a trench or excavation.

Topographical Map. A graphical representation of the earth's surface, drawn to scale and reproduced in two dimensions, that reflects the topographical features of the area depicted.

Traditional Sheeting and Shoring.* The use of 4 ft × 8 ft (1.2 mm × 2.4 mm) sheet panels, with a strongback attachment, supplemented by a variety of conventional shoring options such as hydraulic, screw, and/or pneumatic shores.

Transfer Device. Various devices, including litters and harnesses, used with rope rescue systems to package and allow safe removal of a subject from a specific rescue environment.

Trench (or Trench Excavation).* A narrow (in relation to its length) excavation made below the surface of the earth.

Trench Box (or Trench Shield). A manufactured protection system unit made from steel, fiberglass, or aluminum that is placed in a trench to protect workers from cave-in and that can be moved as a unit. *(See also Shield.)*

Trench Emergency. Any failure of hazard control or monitoring equipment or other event(s) inside or outside a trench or excavation that could endanger entrants within the trench or excavation.

Uprights (or Strongback).* The vertical members of a trench shoring system placed in contact with the earth, usually held in place against sections of sheeting with shores and positioned so that individual members do not contact each other.

Vehicle. A device or structure for transporting persons or things; a conveyance.

Vertical Environment. See High Angle.

Wales (or Walers or Stringers). Horizontal members of a shoring system placed parallel to the excavation face and whose sides bear against the vertical members of a shoring system or earth.

Water Hazard Zone. In water rescue, the zone includes the area covered by water or ice.

Watermanship Skills. Capabilities that include swimming, surface diving, treading water, and staying afloat with a reasonable degree of comfort appropriate to the required task.

Webbing. Woven material of flat or tubular weave in the form of a long strip.

Wilderness.* An uncultivated, uninhabited, and natural area usually, but not necessarily, far from human civilization and trappings.

Wire Rope. Rope made of twisted strands of wire.

Chapter 2 General Requirements

2-1 General.

2-1.1* The AHJ shall establish levels of operational capability needed to conduct operations at technical rescue incidents safely and effectively based on hazard analysis, risk assessment, training level of personnel, and availability of internal and external resources.

2-1.2 The AHJ shall establish written standard operating procedures consistent with one of the following operational levels.

(a) *Awareness.* This level represents the minimum capability of a responder who, in the course of his or her regular job duties, could be called upon to respond to, or could be the first on the scene of, a technical rescue incident. This level can involve search, rescue, and recovery operations. Members of a team at this level are generally not considered rescuers.

(b) *Operations.* This level represents the capability of hazard recognition, equipment use, and techniques necessary to safely and effectively support and participate in a technical rescue incident. This level can involve search, rescue, and recovery operations, but usually operations are carried out under the supervision of technician-level personnel.

(c) *Technician.* This level represents the capability of hazard recognition, equipment use, and techniques necessary to safely and effectively coordinate, perform, and supervise a technical rescue incident. This level can involve search, rescue, and recovery operations.

2-1.3 The AHJ shall establish operational procedures to ensure that technical rescue operations are performed in a safe manner consistent with the identified level of operational capability. In addition, the same techniques used in a rescue operation shall be considered appropriate for training, body recovery, evidence search, and other operations with a level of urgency commensurate with the risk/benefit analysis.

2-1.4 Operational procedures shall not exceed the identified level of capability established in 2-1.1.

2-1.5* Medical care shall be provided for victims of rescue operations and shall be, as a minimum, at the basic life support (BLS) level.

2-1.6 The AHJ shall provide for training in the responsibilities that are commensurate with the identified operational capability of each member. The minimum training for all members shall be at the awareness level. Members expected to perform at a higher operational level shall be trained to that level.

2-1.6.1 The AHJ shall provide for the necessary continuing education to maintain all requirements of the organization's identified level of capability. This shall include annual performance evaluations of the organization based on requirements of this standard.

2-1.6.2* The AHJ shall be responsible for the documentation of all required training. This documentation shall be main-

tained and available for inspection by individual team members and their authorized representatives.

2-1.7 Prior to operating at a technical rescue incident, an organization shall meet the requirements of Chapter 2 of this standard along with one or more of the appropriate requirements of Chapters 3 through 9 for the specific technical rescue incident.

2-1.8 The AHJ shall ensure that there is a standard operating procedure to evacuate members from an area and account for their safety when an imminent hazard condition is discovered. This procedure shall include a method to notify all members in the affected area immediately by any effective means including audible warning devices, visual signals, and radio signals.

2-1.9* The AHJ shall comply with all applicable local, state, and federal laws.

2-1.10 The AHJ shall train appropriate personnel in procedures for invoking relevant components of the National Search and Rescue Plan, The Federal Response Plan, and other state and local response plans.

2-2 Hazard Analysis and Risk Assessment.

2-2.1* The AHJ shall conduct a hazard analysis and risk assessment of the response area and shall determine the feasibility of conducting technical rescue. Potential hazards and their likelihood of causing an incident shall be identified.

2-2.2 The hazard analysis and risk assessment shall include an evaluation of the environmental, physical, social, and cultural factors influencing the scope, frequency, and magnitude of a potential technical rescue incident and the impact they might have on the ability of the AHJ to respond to and to operate safely at those incidents.

2-2.3* The AHJ shall identify the type and availability of internal resources needed for technical rescue incidents and shall maintain a list of these resources.

2-2.4* The AHJ shall identify the type and availability of external resources needed to augment existing capabilities for technical rescue incidents and shall maintain a list of these resources. This list shall be updated at least on an annual basis.

2-2.5* The AHJ shall establish procedures for the acquisition of those external resources needed for technical rescue incidents.

2-2.6 The hazard analysis and risk assessment shall be documented.

2-2.7 The hazard analysis and risk assessment shall be reviewed and updated on a scheduled basis and as operational or organizational changes occur.

2-2.8 The AHJ shall conduct periodic surveys in the organization's response area for the purpose of identifying the types of technical rescues that are most likely to occur.

2-3 Incident Response Planning.

2-3.1 The procedures for a technical rescue emergency response shall be documented in the special operations incident response plan. The plan shall be a formal, written document.

2-3.1.1 Where external resources are required to achieve a desired level of operational capability, mutual aid agreements shall be developed with other organizations.

2-3.2 Copies of the technical rescue incident response plan shall be distributed to agencies, departments, and employees having responsibilities designated in the plan.

2-3.3 A record shall be kept of all holders of the technical rescue incident response plan, and a system shall be implemented for issuing all changes or revisions.

2-3.4 The technical rescue incident response plan shall be approved by the AHJ through a formal, documented approval process and shall be coordinated with participating agencies and organizations.

2-4 Equipment.

2-4.1 Operational Equipment.

2-4.1.1* The AHJ shall ensure that equipment commensurate with the respective operational capabilities for safe and effective operations at technical rescue incidents and training exercises is provided.

2-4.1.2 Training shall be provided to ensure that all equipment is used and maintained in accordance with the manufacturers' instructions.

2-4.1.3 Procedures for the inventory and accountability of all equipment shall be developed and used.

2-4.2 Personal Protective Equipment (PPE).

2-4.2.1 The AHJ shall ensure that the appropriate protective clothing and equipment to provide protection from those hazards to which personnel are exposed or could be exposed is provided. Such protective equipment shall be appropriate to the tasks that are expected to be performed during technical rescue incidents and training exercises.

2-4.2.2 Personnel shall be trained in the care, use, inspection, maintenance, and limitations of the protective clothing and equipment assigned or available for their use.

2-4.2.3 The AHJ shall ensure that all personnel wear and use appropriate personal protective equipment while working in known or suspected hazardous areas during technical rescue incidents and training exercises.

2-4.2.4* The AHJ shall ensure that fresh-air breathing apparatus in the form of supplied air respirators or self-contained breathing apparatus (SCBA) are available when required for technical rescue operations. All apparatus shall be worn in accordance with the manufacturer's recommendations. An adequate supply source providing a minimum of Grade D breathing air shall be provided for all fresh-air breathing apparatus. Supplied air respirators shall be used in conjunction with a self-contained breathing air supply capable of providing enough air for egress in the event of a primary air supply failure.

2-5 Safety.

2-5.1 General.

2-5.1.1 All personnel shall receive training related to the hazards and risks associated with technical rescue operations.

2-5.1.2 All personnel shall receive training for conducting rescue operations in a safe and effective manner while using appropriate PPE.

2-5.1.3 The AHJ shall ensure that members assigned duties and functions at technical rescue incidents and training exercises meet the pertinent requirements of Sections 6-4 and 6-5

of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program.*

2-5.1.4* Where members are operating in positions or performing functions at an incident or training exercise that pose a high potential risk for injury, members qualified in basic life support shall be standing by.

2-5.1.5* Rescuers shall not be armed except when it is required to meet the objectives of the incident as determined by the AHJ.

2-5.2 Safety Officer.

2-5.2.1 At technical rescue training exercises and in actual operations, the incident commander shall assign a safety officer with the specific knowledge and responsibility for the identification, the evaluation, and, when possible, the correction of hazardous conditions and unsafe practices. This assignment shall meet the requirements in Chapter 4 of NFPA 1521, *Standard for Fire Department Safety Officer.*

2-5.2.2* The safety officer shall be readily identifiable.

2-5.3 Incident Management System.

2-5.3.1* The AHJ shall provide for and utilize training on the implementation of an incident management system that meets the requirements in Chapters 2 and 3 of NFPA 1561, *Standard on Fire Department Incident Management System,* with written standard operating procedures applying to all members involved in emergency operations. All members involved in emergency operations shall be familiar with the system.

2-5.3.2 The AHJ shall provide for training on the implementation of an incident personnel accountability system that meets the requirements of Section 2-6 of NFPA 1561, *Standard on Fire Department Incident Management System.*

2-5.3.3 The incident commander shall ensure rotation of personnel to reduce stress and fatigue.

2-5.3.4 The incident commander shall ensure that all personnel are aware of the potential impact of their operations on the safety and welfare of other rescuers, victims, and other activities at the incident site.

2-5.4* Fitness. The AHJ shall ensure that members are psychologically, physically, and medically capable to perform assigned duties and functions at technical rescue incidents and to perform training exercises in accordance with Chapter 8 of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program.*

Chapter 3 Structural Collapse

3-1 General Requirements.

3-1.1 Organizations operating at structural collapse incidents shall meet all the requirements specified in Chapter 2 of this standard.

3-1.2* The AHJ shall evaluate the effects of severe weather, extremely hazardous collapse sites, and other difficult conditions to determine whether their present training program has prepared the organization to operate safely.

3-2 Awareness.

3-2.1 Organizations operating at the awareness level shall meet all awareness-level requirements regarding confined space rescue specified in Section 5-2.

3-2.2 Awareness-level functions at structural collapse incidents shall include the following:

(a)* Size-up of existing and potential conditions at structural collapse incidents
(b)* Identification of the resources necessary to conduct safe and effective structural collapse search and rescue operations
(c)* Development and implementation of procedures for carrying out the emergency response system for structural collapse incidents
(d)* Development and implementation of procedures for carrying out site control and scene management
(e)* Recognition of general hazards associated with structural collapse incidents including the recognition of applicable construction types and categories and the expected behaviors of components and materials in a structural collapse
(f)* Identification of five types of collapse patterns and potential victim locations
(g)* Recognition of the potential for secondary collapse
(h)* Development and implementation of procedures for conducting visual and verbal searches at structural collapse incidents, while using appropriate methods for the specific type of collapse
(i)* Development and implementation of procedures for the recognition and implementation of the FEMA Task Force Search and Rescue Marking System, Building Marking System (structure/hazard evaluation), and Structure Marking System (structure identification within a geographic area)
(j) Development and implementation of procedures for the removal of readily accessible victims from structural collapse incidents

3-3 Operations.

3-3.1 Organizations operating at the operations level shall meet all awareness-level requirements specified in Section 3-2. In addition, members shall be capable of hazard recognition, equipment use, and techniques necessary to operate safely and effectively at structural collapse incidents involving the collapse or failure of light-frame ordinary construction and unreinforced and reinforced masonry construction.

3-3.2 Organizations operating at the operations level shall meet all operations-level requirements regarding rope, confined space, transportation/machinery, and trench specified in Sections 4-3, 5-3, 6-3, and 9-3. Organizations operating at the operations level shall also meet all awareness-level requirements regarding water rescue specified in Section 7-2.

3-3.3 Operations-level functions at structural collapse incidents for light-frame ordinary construction and reinforced and unreinforced masonry construction shall include the development and implementation of the following:

(a) Procedures for recognizing unique collapse or failure hazards
(b)* Procedures for search operations intended to locate victims trapped inside and beneath collapse debris
(c)* Procedures for accessing victims trapped inside and beneath collapse debris

(d)* Procedures for performing extrication operations involving packaging, treating, and removing victims trapped within and beneath collapse debris

(e) Procedures for stabilizing the structure

3-4 Technician.

3-4.1 Organizations operating at the technician level shall meet all operations-level requirements specified in Section 3-3 and all awareness-level requirements specified in Section 3-2. In addition, members shall be capable of hazard recognition, equipment use, and techniques necessary to operate safely and effectively at structural collapse incidents involving the collapse or failure of concrete tilt-up, reinforced concrete, and steel construction.

3-4.2 Organizations operating at the technician level shall meet all technician-level requirements regarding rope, confined space, transportation/machinery, and trench specified in Sections 4-4, 5-4, 6-4, and 9-4.

3-4.3 Technician-level functions at structural collapse incidents for concrete tilt-up, reinforced concrete, and steel construction shall include the development and implementation of the following:

(a) Procedures for recognizing unique collapse or failure hazards

(b)* Procedures for search operations intended to locate victims trapped inside and beneath collapse debris

(c)* Procedures for accessing victims trapped inside and beneath collapse debris

(d)* Procedures for performing extrication operations involving packaging, treating, and removing victims trapped within and beneath collapse debris

(e) Procedures for stabilizing the structure

Chapter 4 Rope Rescue

4-1 General Requirements.

4-1.1 Organizations operating at rope rescue incidents shall meet all the requirements specified in Chapter 2 of this standard.

4-1.2* The AHJ shall evaluate the effects of severe weather, extreme heights, and other difficult conditions to determine whether the present training program has prepared the organization to operate safely.

4-2 Awareness.

4-2.1 Organizations operating at the awareness level shall meet all the requirements of Section 4-2.

4-2.2 Awareness-level functions shall include the following:

(a)* Size-up of existing and potential conditions where rope rescue operations will be performed

(b)* Identification of the resources necessary to conduct safe and effective rope rescue operations

(c)* Development and implementation of procedures for carrying out the emergency response system where rescue is required

(d)* Development and implementation of procedures for carrying out site control and scene management

(e)* Recognition of general hazards associated with rope rescue and the procedures necessary to mitigate these hazards within the general rescue area

(f)* Development and implementation of procedures for the identification and utilization of personal protective equipment assigned for use at a rope rescue incident

4-3 Operations.

4-3.1 Organizations operating at the operations level shall meet all requirements specified in Sections 4-2 and 4-3.

4-3.2 Operations-level functions shall include the development and implementation of the following:

(a) Procedures for the selection, construction, and use of rope-based mechanical advantage systems

(b) Procedures for establishing the need, selecting the proper equipment, and placing edge protection

(c)* Procedures for the safe construction and use of single-point and multipoint anchor systems within the scope of the organization's training

(d) Procedures for the safe selection, construction, and use of an appropriate belay system

(e)* Procedures for selection, construction, and use of a lowering system within the scope of the organization's training

(f)* Procedures for properly tying any knots used by the rope rescue team

(g)* Procedures for assuring safety in rope rescue operations

(h) Procedures for appropriately packaging a patient in a litter

(i) Procedures for the selection, use, and maintenance of proper rope rescue equipment and rope rescue systems

(j)* Procedures for selection, construction, and use of a raising system in the low-angle environment

(k) Procedures for safely ascending and descending a fixed rope within the scope of the organization's training

(l) Procedures for using litter attendants in the low-angle environment

4-4 Technician.

4-4.1 Organizations operating at the technician level shall meet all requirements specified in Sections 4-2, 4-3, and 4-4.

4-4.2 Technician-level functions shall include the development and implementation of the following:

(a) Procedures for the safe construction and use of load distributing anchor systems

(b) Procedures for the selection, construction, and use of a high-line rope system within the scope of the organization's training

(c)* Procedures for the selection, construction, and use of a rope-based raising system in a high-angle environment within the scope of the organization's training

(d) Procedures for passing knots through a rope rescue system

(e) Procedures for using litter attendants in the high-angle environment

Chapter 5 Confined Space

5-1 General Requirements.

5-1.1 Organizations operating at confined space incidents shall meet all the requirements specified in Chapter 2 of this standard.

5-1.2* The AHJ shall evaluate the effects of severe weather, extremely hazardous situations, and other difficult conditions to determine whether the present training program has prepared the organization to operate safely.

5-1.3* Operational Capability. The requirements of this chapter apply to organizations that provide varying degrees of response to confined space emergencies. The scope of this standard includes all confined space rescue incidents and response organizations including those not regulated by U.S. federal mandates.

5-2 Awareness.

5-2.1 Organizations operating at the awareness level shall meet the requirements of Sections 4-2 and 5-2 of this document and Chapter 2 of NFPA 472, *Standard for Professional Competence of Responders to Hazardous Materials Incidents*. Organizations at this level shall be responsible for performing certain nonentry rescue (retrieval) operations.

5-2.2 Awareness-level functions for confined space rescue incidents shall include the following:

(a)* Size-up of existing and potential conditions
(b) Initiation of contact and establishment of communications with victims where possible
(c)* Recognition and identification of the hazards associated with nonentry confined space emergencies
(d)* Recognition of confined spaces
(e)* Procedures to perform a nonentry retrieval
(f)* Procedures for implementing the emergency response system for confined space emergencies
(g)* Procedures for implementing site control and scene management

5-3 Operations.

5-3.1 Organizations operating at the operations level shall meet the requirements of Sections 5-2 and 5-3. The organization at this level shall be responsible for the development and training of a confined space rescue team consistent with the requirements of this section.

5-3.2 Organizations operating at the operations level shall meet all operations-level requirements specified in Section 4-3 and the requirements of a confined space rescue team as defined herein. In addition, organizations operating at the operations level shall meet all requirements specified in Section 9-3.

5-3.3 Operations-level functions for confined space rescue operations shall include the following:

(a)* Procedures for protecting personnel from hazards within the confined space
(b)* Continued size-up of existing and potential conditions
(c)* Procedures for assuring that personnel are capable of appropriately managing the physical and psychological challenges that effect rescuers entering confined spaces
(d)* Identification of the duties of the rescue entrant(s) and back-up rescue entrant(s), rescue attendant, and rescue team leader as defined herein
(e)* Procedures to monitor continuously, or at frequent intervals, the atmosphere in all parts of the space to be entered and to monitor for, in the following order, oxygen content, flammability (LEL/ LFL), and toxicity
(f)* Procedures for entry-type rescues into confined spaces meeting all of the following specific qualifying characteristics:
1.* The internal configuration of the space is clear and unobstructed so retrieval systems can be utilized for rescuers without possibility of entanglement.
2.* The victim can be easily seen from the outside of the space's primary access opening.
3.* Rescuers can pass easily through the access/egress opening(s) with room to spare when PPE is worn in the manner recommended by the manufacturer.
4.* The space can accommodate two or more rescuers in addition to the victim.
5.* All hazards in and around the confined space have been identified, isolated, and controlled.
(g)* Procedures for the safe and effective use of victim packaging devices that could be employed in confined space rescue
(h) Procedures for the transfer of victim information including location, surroundings, condition when found, present condition, and other information pertinent to emergency medical services
(i)* Procedures for planning and implementing an appropriate confined space rescue operation
(j)* Procedures for selection, construction, and use of a rope lowering and raising system in the high-angle environment

5-4 Technician.

5-4.1 Organizations operating at the technician level shall meet the requirements of Sections 5-2, 5-3, and 5-4. The organization at this level shall be responsible for the development and training of a confined space rescue team consistent with the requirements of this section.

5-4.2 Technician-level functions for confined space rescue operations shall include the following:

(a)* Continued size-up of existing and potential conditions
(b)* Procedures to assure that rescue team members shall take part in a medical surveillance program
(c)* Planning response for entry-type confined space rescues in hazardous environments
(d)* Implemention of the planned response

Chapter 6 Vehicle and Machinery

6-1 General Requirements.

6-1.1* Organizations operating at vehicle and/or machinery rescue incidents shall meet all the requirements specified in Chapter 2 of this standard.

6-1.2* The AHJ shall evaluate the effects of severe weather, extremely hazardous situations, and other difficult conditions to determine whether their present training program has prepared the organization to operate safely.

6-2 Awareness.

6-2.1 Organizations operating at the awareness level shall meet all requirements specified in Chapter 2 of NFPA 472, *Standard for Professional Competence of Responders to Hazardous Materials Incidents*.

6-2.2 Awareness-level functions at vehicle and machinery rescue incidents shall include the development and implementation of the following:

(a)* Procedures to conduct a size-up of existing and potential conditions

(b)* Procedures for the identification of the resources necessary to conduct safe and effective operations
(c)* Procedures for implementing the emergency response system for vehicle and/or machinery rescue incidents
(d)* Procedures for implementing site control and scene management
(e)* Recognition of general hazards associated with vehicle and/or machinery rescue incidents
(f) Procedures for the initiation of traffic control

6-3 Operations.

6-3.1 Organizations operating at the operations level shall meet all the requirements specified in Sections 6-2 and 6-3. In addition, members shall be capable of hazard recognition, equipment use, and techniques necessary to operate safely and effectively at incidents involving persons injured or entrapped in a vehicle or machinery.

6-3.2 Organizations operating at the operations level shall meet all requirements specified in Chapter 3 of NFPA 472, *Standard for Professional Competence of Responders to Hazardous Materials Incidents*.

6-3.3 Operations-level functions at vehicle and/or machinery rescue incidents shall include the development and implementation of the following:

(a) Procedures to identify probable victim locations and survivability
(b)* Procedures for making the rescue area safe, including the stabilization and isolation (e.g., lockout/tagout) of all vehicles and/or machinery
(c) Procedures to identify, contain, and stop fuel release
(d) Procedures for the protection of a victim during extrication/disentanglement
(e) Procedures for the packaging of a victim prior to extrication and/or disentanglement
(f) Procedures for accessing victims trapped in a vehicle and/or machinery
(g)* Procedures for performing extrication and disentanglement operations involving packaging, treating, and removing victims trapped in vehicles and/or machinery through the use of hand tools
(h)* Procedures for the mitigation and management of general and specific hazards (i.e., fires and explosions) associated with vehicle and/or machinery rescue incidents
(i) Procedures for the procurement and utilization of the resources necessary to conduct safe and effective vehicle and/or machinery rescue operations
(j) Procedures for maintaining control of traffic at the scene of vehicle and/or machinery rescue incidents

6-4 Technician.

6-4.1 Organizations operating at the technician level shall meet all the requirements specified in Sections 6-2, 6-3, and 6-4. In addition, members shall be capable of hazard recognition, equipment use, and techniques necessary to operate and effectively supervise at vehicle and/or machinery rescue incidents.

6-4.2 Technician-level functions at vehicle and/or machinery rescue incidents shall include the development and implementation of the following:

(a)* Procedures for performing extrication and disentanglement operations involving packaging, treating, and removing victims injured and/or trapped in large/heavy vehicles and/or machinery
(b)* Procedures for the advanced stabilization of unusual vehicle and machinery rescue situations
(c)* Procedures for the use of all specialized rescue equipment immediately available and in use by the organization

Chapter 7 Water

7-1 General Requirements.

7-1.1 Organizations operating at water incidents shall meet all the requirements specified in Chapter 2 of this standard.

7-1.2* The AHJ shall evaluate the effects of severe weather, extreme water conditions, and other difficult conditions to determine whether the present training program has prepared the organization to operate safely.

7-2 Awareness.

7-2.1 Organizations operating at the awareness level shall meet all the requirements in Section 7-2. All members of organizations at the awareness level shall meet the requirements of *competent person* as defined in Section 1-3 of this standard.

7-2.2 Awareness-level functions at water incidents shall include the development and implementation of the following:

(a)* Procedures for implementing the assessment phase
(b)* Procedures for size-up of existing and potential conditions
(c)* Procedures for the identification of the resources necessary to conduct safe and effective water operations
(d)* Procedures for implementing the emergency response system for water incidents
(e)* Procedures for implementing site control and scene management
(f)* Procedures for recognition of general hazards associated with water incidents and the procedures necessary to mitigate these hazards within the general rescue area
(g) Procedures to determine rescue versus body recovery

7-3 Operations.

7-3.1 Organizations operating at the operations level shall meet all the requirements specified in Section 7-2.

7-3.2 For the purposes of this standard, there shall be four separate water-related disciplines for the operations level: dive, ice, surf, and swift water.

7-3.3* Organizations operating at the operations level shall meet all the requirements specified in 7-3.1 through 7-3.5. Organizations operating at the operations level of one or more specific disciplines shall meet the requirements of 7-3.1 through 7-3.5 as they relate to the specific discipline as well as the specific requirements (given in 7-3.6, 7-3.7, 7-3.8, or 7-3.9) of that discipline.

7-3.4* For personnel operating in the hazard zone, the minimum personal protective equipment (PPE) provided shall include the following:

(a) Personal flotation device (PFD)
(b) Thermal protection
(c)* Helmet appropriate for water rescue
(d) Cutting device
(e) Whistle
(f) Contamination protection (as needed)

7-3.5 Operations-level functions at all water incidents shall include the development and implementation of the following:

(a)* Procedures to insure personal safety at water operations
(b)* Procedures to assess water conditions in terms of hazards to the victim and rescuer
(c) Procedures to separate, isolate, secure, and interview witnesses
(d)* Procedures to determine the method of victim entrapment
(e)* Procedures to evaluate the progress of the planned response to ensure the objectives are being met safely, effectively, and efficiently
(f)* Procedures to safely and effectively conduct shore-based rescue operations
(g)* Procedures using throw bags
(h)* Procedures to supply assistance with rigging and mechanical advantage systems to technician-level personnel
(i) Procedures to deploy, operate, and recover any watercraft used by the organization
(j)* Procedures for survival swimming and self-rescue
(k)* Procedures for identifying and managing heat and cold stress to the rescuer while utilizing PPE
(l) Procedures for the safe and effective use of victim packaging devices that could be employed by the organization for water rescue
(m)*Procedures for the transfer of victim information including location, surroundings, condition when found, present condition, and other information pertinent to emergency medical services
(n)* Procedures for boat-assisted and boat-based operations if boats are used by the organization
(o) A plan to meet operational objectives
(p)* Procedures for rapid extrication of accessible victims
(q) Procedures for surface water-based search operations

7-3.6 Dive. Operations-level functions at dive incidents shall include the development and implementation of the following:

(a)* Procedures for the recognition of the unique hazards associated with dive operations
(b)*Procedures for serving as surface support personnel
(c) Procedures for the identification of water characteristics
(d)*Procedures for the operation of surface support equipment used in water operations
(e) Procedures for procuring the necessary equipment to perform dive operations
(f) Procedures for the safe entry and recovery of divers from the water
(g)* Procedures for participating in safe dive operations in any climate the organization can encounter

7-3.7 Ice. Operations-level functions at ice rescue incidents shall include the development and implementation of the following:

(a)* Procedures for the recognition of the unique hazards associated with ice rescue operations
(b)*Procedures for the identification of water and ice characteristics
(c)* Procedures for the operation of surface support equipment used in water/ice rescue operations
(d) Procedures for procuring the necessary equipment to perform ice rescue operations
(e)*Procedures to recognize and deal with a victim's hypothermia
(f) Procedures for the safe entry of divers into the water through an ice hole, if ice diving is performed by the organization

7-3.8 Surf. Operations-level functions at surf rescue incidents shall include the development and implementation of the following:

(a)* Procedures for the recognition of the unique hazards associated with surf rescue operations
(b) Procedures for the operation of surface support equipment used in surf rescue operations
(c) Procedures for procuring the necessary equipment to perform surf rescue operations
(d)*Procedures for self-rescue and survival swimming in surf

7-3.9 Swift Water.

7-3.9.1 Organizations operating at the operations level shall meet all the operations-level requirements specified in Section 4-3 of this standard.

7-3.9.2 Operations-level functions at swift water rescue incidents shall include the development and implementation of the following:

(a)* Procedures to assess moving water conditions, characteristics, and features in terms of hazards to the victim and rescuer
(b) Procedures to determine the method of victim entrapment
(c)* Procedures for using tag lines and tension diagonals (zip lines)
(d)*Procedures for self-rescue and survival swimming in swift water

7-4 Technician.

7-4.1 Organizations operating at the technician level shall meet all the requirements specified in 7-3.1 through 7-3.5.

7-4.2 For the purposes of this standard, there shall be four separate water-related disciplines for the technician level: dive, ice, surf, and swift water.

7-4.3 Organizations operating at the technician level shall meet all the requirements specified in 7-4.1 through 7-4.6. Organizations operating at the technician level of one or more specific disciplines shall meet the requirements of 7-4.1 through 7-4.6 as they relate to the specific discipline as well as the specific requirements (given in 7-4.7, 7-4.8, 7-4.9, or 7-4.10) of that discipline.

7-4.4 Organizations operating at the technician level shall meet all the awareness-level requirements specified in NFPA 472, *Standard for Professional Competence of Responders to Hazardous Materials Incidents*.

7-4.5 Personnel operating within an organization at the technician level shall possess a level of watermanship skill and comfort appropriate to the required task.

7-4.6 Technician-level functions at all water rescues shall include the development and implementation of the following:

(a) Procedures required to plan a response within the capabilities of available resources
(b) Procedures to implement a planned response consistent with the organization's capabilities
(c)* Procedures for conducting both boat-assisted and boat-based rescues
(d)*Procedures to conduct a "go" rescue

7-4.7 Dive.

7-4.7.1* At the entry level and for any specialties utilized by an organization at the technician level, the AHJ shall ensure provision of certification by a nationally recognized agency. The curriculum for such certification shall be oriented toward the needs and operational requirements of public safety diving as defined herein.

7-4.7.2 Annual fundamental SCUBA skill reviews shall be conducted to maintain public safety diver capability.

7-4.7.3 Technician-level functions at dive incidents shall include the development and implementation of the following:

(a)* Procedures for skin and SCUBA diving, including the use of any associated equipment
(b) Procedures for the application of physics and physiology as it relates to the underwater environment
(c)* Procedures for the safe use of dive tables
(d) Procedures for dealing with the various underwater environments with which the rescue diver could come into contact
(e) Procedures for avoiding and dealing with underwater plants and animals
(f) Procedures for the safe conduct and supervision of dive operations
(g) Procedures for the use of relevant search theory and techniques
(h)* Procedures for the identification and management of dive-related maladies including air embolism and decompression sickness
(i) Procedures for recognizing and managing the impact of near-drowning in cold water
(j)* Procedures for effective underwater communication

7-4.8 Ice. Technician-level functions at ice rescue incidents shall include the development and implementation of the following:

(a)* Procedures for self-rescue unique to ice rescue
(b) Procedures for reach, throw, row, and go technique rescues unique to ice rescue
(c) Procedures for the use of watercraft, specialty craft, and specialty equipment unique to ice rescue

7-4.9 Surf. Technician-level functions at surf rescue incidents shall include the development and implementation of the following:

(a) Procedures for reach, throw, row, and go technique rescues unique to surf rescue
(b) Procedures for the use of watercraft, specialty craft, and specialty equipment unique to surf rescue

7-4.10 Swift Water.

7-4.10.1 Organizations operating at the technician level shall meet all the technician-level requirements specified in Section 4-4 of this standard.

7-4.10.2 Technician-level functions at swift water rescues shall include the development and implementation of procedures for the application of rope rescue techniques in the swift water environment.

Chapter 8 Wilderness Search and Rescue

8-1 General Requirements.

8-1.1 Organizations operating at wilderness search and rescue incidents shall meet all the requirements specified in Chapter 2 of this standard.

8-1.2* The AHJ shall evaluate the effects of severe weather, extreme heights, difficult terrain, high-altitude operations, and other difficult conditions to determine whether their present training program has prepared the organization to operate safely.

8-2 Awareness.

8-2.1 Organizations operating at the awareness level shall meet the requirements of Section 8-2.

8-2.2 Members of organizations at the awareness level shall be permitted to assist in support functions on a wilderness search/rescue operation but shall not be deployed into the wilderness.

8-2.3 Awareness-level functions at a wilderness incident shall include the following:

(a)* Conducting a size-up of existing and potential conditions
(b)* Developing and implementing procedures for implementing the emergency response system for wilderness SAR
(c)* Implementing site control and scene management
(d)* Recognizing the general hazards associated with wilderness search and rescue incidents
(e) Recognizing the type of terrain involved in wilderness search and rescue incidents
(f)* Recognizing the limitations of conventional emergency response skills and equipment in various wilderness environments
(g)* Initiating the collection and recording of information necessary to assist operational personnel in a wilderness search and rescue
(h)* Identifying and isolating the reporting party(s) and witnesses

8-3 Operations.

8-3.1 Organizations operating at the operations level shall meet the requirements of Section 8-2. In addition, organizations operating at the operations level shall meet all the requirements specified in Section 4-3.

8-3.2* Operations-level functions performed in the wilderness shall be under the supervision of personnel from technician-level organizations. The AHJ shall establish standard operating procedures that identify the specific environments in which operations-level personnel can safely operate. Outside of these specific environments, personnel from technician-level organizations or special resources shall be utilized.

8-3.3 Operations-level functions at a wilderness incident shall include the following:

(a)* Request of and interface with wilderness search and rescue resources
(b)* Provision of the specialized medical care that is unique to the wilderness environment
(c)* Personal survival, body management, and preparedness for the specific wilderness environments in which the rescuer could become involved

(d) Recognition of the need for, and procedures and equipment for the provision of, environmental protection through clothing systems appropriate for the specific wilderness environments in which the rescuer could become involved

(e)* Selection, care, and use of appropriately packed and carried personal medical and support equipment

(f)* Ability to travel safely through various wilderness environments in which the rescuer could become involved

(g) Land navigation techniques using map and compass as well as any methods of navigation and position reporting utilized by the responding organizations with which the rescuer could become involved

(h) Procurement of any necessary maps and navigational and topographical information

(i) Modification of actions and urgency appropriately for a rescue versus a body recovery

(j) Acquisition of information on current and forecast weather including temperature, precipitation, and winds

(k)* Participation in and support of wilderness search operations intended to locate victims whose exact location is unknown

(l) Access to, as well as extrication of, victims in any specific wilderness environments and terrain encountered in the response area

(m) Utilization, recognition, and identification of all rescue hardware and software used by the responding organizations with which the rescuer could become involved

(n) Ability to work safely in and around any aircraft, watercraft, and special vehicles used for SAR operations

(o)* Recognition of the team's limitations regarding accessing and/or evacuating a victim

8-4 Technician.

8-4.1 Organizations operating at the technician level shall meet the requirements of Sections 8-2 and 8-3. In addition, organizations operating at the technician level shall meet the requirements of Sections 4-4 and 7-2.

8-4.2 Organizations operating at the technician level shall be capable of performing and supervising wilderness technical rescue incidents that involve both search and rescue operations.

8-4.3 Wilderness rescue organizations at the technician level shall not be required to specialize in all aspects of wilderness rescue. The ability of the team to respond at the technician level in one aspect shall not imply the ability to respond at the technician level in all aspects of wilderness rescue.

8-4.4 Technician-level functions at a wilderness incident shall include the following:

(a) Acquisition, utilization, and coordination of search and rescue resources with which the rescuer could become involved

(b) Development of or provision of input to necessary standard operating procedures for anticipated wilderness responses

(c)* Performance of search and rescue operations in the wilderness

(d)* Development of and implementation of an operational plan for search and rescue

Chapter 9 Trench and Excavation

9-1 General Requirements.

9-1.1 Organizations operating at trench and excavation incidents shall meet all the requirements specified in Chapter 2 of this standard.

9-1.2* The AHJ shall evaluate the effects of severe weather, extremely hazardous trench or excavation situations, and other difficult conditions to determine whether their present training program has prepared the organization to operate safely.

9-2 Awareness.

9-2.1 Organizations operating at the awareness level shall meet all requirements specified in Section 5-2 within this standard, the requirements in Chapter 2 of NFPA 472, *Standard for Professional Competence of Responders to Hazardous Materials Incidents,* and the requirements of *competent person* as defined in Section 1-3 of this standard.

9-2.2 Awareness-level functions at trench and excavation emergencies shall include the following:

(a)* Size-up of existing and potential conditions

(b)* Identification of the resources necessary to conduct safe and effective trench and excavation emergency operations

(c)* Development and implementation of procedures for carrying out the emergency response system for trench and excavation emergency incidents

(d)* Development and implementation of procedures for carrying out site control and scene management

(e)* Recognition of general hazards associated with trench and excavation emergency incidents and the procedures necessary to mitigate these hazards within the general rescue area

(f)* Recognition of typical trench and excavation collapse patterns, the reasons trenches and excavations collapse, and the potential for secondary collapse

(g)* Development and implementation of procedures for making a rapid, nonentry extrication of noninjured or minimally injured victim(s)

(h)* Recognition of the unique hazards associated with the weight of soil and its associated entrapping characteristics

9-3 Operations.

9-3.1* Organizations operating at the operations level shall meet all requirements specified in Section 9-2. In addition, members shall be capable of hazard recognition, equipment use, and techniques necessary to operate safely and effectively at trench and excavation emergencies, including the collapse or failure of individual, nonintersecting trenches with an initial depth of 8 ft (2.44 m) or less where no severe environmental conditions exist, digging operations do not involve supplemental sheeting and shoring, and only traditional sheeting and shoring are used.

9-3.2 Organizations operating at the operations level shall meet all requirements specified in Sections 4-3, 5-3, and 6-3.

9-3.3 Operations-level functions at trench and excavation emergencies shall include the following:

(a) Development and implementation of procedures to make an entry into a trench or excavation rescue area

(b)* Recognition of unstable areas associated with trench and excavation emergencies and adjacent structures

(c)* Development and implementation of procedures to identify probable victim locations and survivability

(d)* Development and implementation of procedures for making the rescue area safe, including the identification, construction, application, limitations, and removal of traditional sheeting and shoring using tabulated data and approved engineering practices

(e)* Development and implementation of procedures for initiating a one-call utility location service

(f)* Identification of soil types using accepted visual or manual tests

(g) Development and implementation of procedures to ventilate the trench or excavation space

(h) Identification and recognition of a bell-bottom excavation (pier hole) and its associated unique hazards

(i) Development and implementation of procedures for placing ground pads and protecting the "lip" of a trench or excavation

(j)* Development and implementation procedures to provide entry and egress paths for entry personnel

(k)* Development and implementation procedures for conducting a pre-entry briefing

(l)* Development and implementation procedures for record keeping and documentation during entry operations

(m)* Development and implementation of procedures for implementing and utilizing a rapid intervention team (RIT) as specified in Section 6-5 of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*

(n) Development and implementation of procedures for the selection, utilization, and application of shield systems

(o)* Development and implementation of procedures for the selection, utilization, and application of sloping and benching systems

(p) Identification of the duties of panel teams, entry teams, and shoring teams

(q) Development and implementation of procedures for assessing the mechanism of entrapment and the method of victim removal

(r)* Development and implementation of procedures for performing extrication

9-4 Technician.

9-4.1* Organizations operating at the technician level shall meet all requirements specified in Sections 9-2 and 9-3. In addition, members shall be capable of hazard recognition, equipment use, and techniques necessary to operate safely and effectively at trench and excavation emergencies, including the collapse or failure of individual or intersecting trenches with an initial depth of more than 8 ft (2.4 m) or where severe environmental conditions exist, digging operations involve supplemental sheeting and shoring, or manufactured trench boxes and/or isolation devices would be used.

9-4.2 Organizations operating at the technician level shall meet all requirements specified in Sections 5-4 and 6-4.

9-4.3 Technician-level functions at trench and excavation emergencies shall include the development and implementation of the following:

(a)* Procedures for the identification, construction, application, limitations, and removal of manufactured protective systems using tabulated data and approved engineering practices

(b)* Procedures to continuously, or at frequent intervals, monitor the atmosphere in all parts of the trench to be entered. This monitoring shall be done, in the following order, for oxygen content, flammability (LEL/LFL), and toxicity

(c) Procedures for the identification, construction, application, limitations, and removal of supplemental sheeting and shoring systems designed to create approved protective systems

(d) Procedures for the adjustment of protective systems based on digging operations and environmental conditions

(e)* Procedures for rigging and placement of isolation systems

Chapter 10 Referenced Publications

10-1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix C.

10-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 472, *Standard for Professional Competence of Responders to Hazardous Materials Incidents,* 1997 edition.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program,* 1997 edition.

NFPA 1521, *Standard for Fire Department Safety Officer,* 1997 edition.

NFPA 1561, *Standard on Fire Department Incident Management System,* 1995 edition.

10-1.2 Other Publications.

10-1.2.1 Fire Protection Publications Publication. Fire Protection Publications, Oklahoma State University, Stillwater, OK 74078.

Incident Command System, ISBN 0-87939-051-4, first edition, October 1983.

10-1.2.2 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 29, *Code of Federal Regulations,* Part 1926, Subpart P, Appendix C.

Title 29, *Code of Federal Regulations,* Part 1926.652 (c)(3) and (c)(4) (Shield Systems).

FEMA *US&R Response System,* Appendix C (Task Force Search and Rescue Marking System, Building Marking System, and Structure Marking System).

U.S. Department of Transportation, *First Responder Guidelines.*

Appendix A Explanatory Material

Appendix A is not a part of the requirements of this NFPA document but is included for informational purposes only. This appendix contains explanatory material, numbered to correspond with the applicable text paragraphs.

A-1-1.1 This standard was developed to define levels of preparation and operational capability that should be achieved by any authority having jurisdiction (AHJ) that has responsibility for technical rescue operations. These defined levels provide an outline for a system to manage an incident efficiently and effectively in order to maximize personnel safety, the successful rescue of victims, and the eventual termination of the event.

The system should be followed to increase the capabilities of the AHJ to deal successfully with even the most complex incident. The system progresses from the simple basic awareness level, to the operations level, and finally to the technician level. It should be understood that, as the system expands, the requirements for training, operational skills, management ability, and types and amounts of equipment also expand.

A-1-1.2 These requirements include rescue, fire suppression, and emergency services including agencies such as fire departments, law enforcement, emergency medical services, utility, public works, and rescue organizations.

A-1-2 An organization can achieve its desired level of operational capability through the use of external resources that operate at the desired level of operational capability.

A-1-3 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A-1-3 Attendant. This term can also be used to designate rescue personnel assigned to perform the task of attendant during rescue operations involving entry-type rescue. In this case the term *rescue attendant* is used.

A-1-3 Authority Having Jurisdiction. The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A-1-3 Authorized Entrant. This term can also be used to designate rescue personnel assigned to perform the task of entry during rescue operations. In this case, the term *rescue entrant* is used.

A-1-3(c) Authorized Entrant. *Personal Protective Equipment (PPE).* Proper training and documentation of training in the use of PPE is also necessary.

A-1-3(d) Authorized Entrant. *Self-Rescue.* This escape method includes self-actuated methods (such as climbing a ladder or crawling through a horizontal manway opening) as well as those methods externally applied and operated (such as a hauling system attached to the entrant and operated by the rescue team).

A-1-3 Avalanche. A small, and often harmless, avalanche is called a "sluff."

A-1-3 Belay. This method can be accomplished by a second line in a raise or lowering system or by managing a single line with a friction device in fixed-rope ascent or descent. Belays also protect personnel exposed to the risk of falling who are not otherwise attached to the rope rescue system.

A-1-3 Confined Space. This definition excludes mines and caves or other natural formations, all of which must be addressed by other specialized training and equipment.

A-1-3 Confined Space Rescue Team. While six personnel provide the recommended minimum for most entry-type confined space rescues, the committee recognizes that some of these rescues will not require this number of personnel. The number of personnel required to perform these rescues should be based on the situation, hazards, and degree of difficulty of the situation confronted.

A team is "qualified" by its capability as a team, not by the individual qualifications of its members.

A-1-3 Cribbing. Cribbing can be combined and/or cut to form "wedges" (incline-shaped timber) or "chocks" (stair-step-shaped timber).

A-1-3 Entry Permit. An entry permit authorizes specific employees to enter a confined space and contains specific information as required.

In certain industries, U.S. federal law does not require a permit system even though spaces meeting the characteristics of confined spaces as defined within this standard might be present. In these cases, as well as cases of unauthorized or non-regulated entry into confined spaces, a permit might not be available for reference by the rescue team. The space must be completely assessed before entry can be safely made. U.S. federal law does not require rescuers to have a permit to rescue, although it is advisable for the rescue team to follow similar procedures to ensure safety.

A-1-3 Environment. Examples include desert, alpine/mountain, arctic, rain forest, and sea shore.

A-1-3 Federal Response Plan. To facilitate the provision of federal assistance, the Federal Response Plan breaks federal response into 12 functions that are called emergency support functions or ESFs (ESF #9 is urban search and rescue). The plan is applicable to natural disasters such as earthquakes, hurricanes, typhoons, tornadoes, and volcanic eruptions; technological emergencies involving radiological or hazardous material releases; and other incidents requiring federal assistance under the Stafford Act.

It is designed to address the consequences of any disaster or emergency situation in which there is a need for federal response assistance under authority of the Stafford Act.

A-1-3 FEMA Task Force Search and Rescue Marking System. Markings are made by drawing a 2 ft × 2 ft "X" and denoting in each of the quadrants of the "X" relevant search information (e.g., search status, findings, hazards found, time and date of search, team involved). Figure A-3-2.2(i)(a) illustrates the search marking system. For more information, see FEMA *US&R Response System.*

A-1-3 FEMA Task Force Structure/Hazard Evaluation Marking System. Markings are made by drawing a 2 ft × 2 ft square box and denoting in and around the box specific relevant hazard information (e.g., general level of operation safety, direction of safest entry, time and date of search, hazards found, team involved). Figure A-3-2.2(i)(b) illustrates the structure/hazard evaluation marking system. For more information, see FEMA *US&R Response System.*

A-1-3 FEMA Task Force Structure Marking System, Structure Identification Within a Geographic Area. The primary method of identification includes the existing street name, hundred block, and building number. Structure identification within a geographic area is used to differentiate buildings by groups, such as by block(s) or by jurisdictional area. Figure A-3-2.2(i)(c) illustrates the building ID and location marking system. For more information see *FEMA US&R Response System,* Appendix C, "Task Force Building Marking System."

A-1-3 Flammable. Flammables can be solids, liquids, or gases that exhibit these qualities.

A-1-3 General Area (or Warm Zone). Sometimes general area is generally defined as the area 300 ft (90 m) in all directions from the incident site.

A-1-3(b) Hazardous Atmosphere for Confined Space. Hazardous atmosphere for confined space can be estimated by observing the density of the concentration. In general, if the concentration of dust obscures vision at a distance of 5 ft (1.52 m) or less, it could be within its flammable range.

A-1-3 Incident Scene. The incident scene includes the entire area subject to incident-related hazards and all areas used by incident personnel and equipment in proximity to the incident.

A-1-3 Isolation System (or Isolation Devices). Examples of isolation devices include concrete or steel pipe, corrugated pipe, concrete vaults, or other pre-engineered structures that sufficiently isolate and protect the victim.

A-1-3 Knot. Knots include bights, bends, and hitches.

A-1-3 Load Test. A load test is generally performed by multiple personnel to exert force on the system at the load attachment point in the manner of function before life loading.

A-1-3 Lockout. Usually a disconnect switch, circuit breaker, valve, or other energy-isolating mechanism is used to hold equipment in a safe position. However, this can include other means of keeping equipment from being set in motion and endangering workers, including the use of guards when other mechanisms are not available. The use of guards can violate federal lockout/tagout regulations in federally regulated facilities. Lockout is usually performed in combination with a tagout procedure.

A-1-3 Lowering System. Lowering systems should incorporate a mechanism to prevent the uncontrolled descent of the load during the lowering operation. This mechanism can reduce the need for excessive physical force to control the lowering operation.

A-1-3 Mechanical Advantage (M/A). Mechanical advantage usually expressed in terms of a ratio of output force to input force. For example, a rope mechanical advantage system that requires only 10 pounds of input force to produce 30 pounds of output force has a 3:1 mechanical advantage (30 force pounds to 10 force pounds, 3:1). Likewise, a system that requires 30 pounds of input force to produce 30 pounds of output force has a 1:1 mechanical advantage. There is no such thing as zero mechanical advantage. Other factors can effect the efficiency of a mechanical advantage system including friction and drag created by the equipment. For purposes of this document, these factors are not considered and so the mechanical advantage is theoretical rather than actual. Although others exist, rope-based mechanical advantage systems are most practically classified as simple or compound.

A-1-3 Multipoint Anchor System *(Load Distributing Anchor System and Load Sharing Anchor System).* Both load distributing anchor systems and load sharing anchor systems should be configured so as to limit the resulting drop that occurs as the result of an anchor point failure.

A-1-3 National Search and Rescue Plan. According to this plan, all maritime or navigable water search and rescue (SAR) is the responsibility of the U.S. Coast Guard, and all inland SAR is the responsibility of the U.S. Air Force.

A-1-3 Personal Protective Equipment (PPE). PPE includes protective apparel (e.g., clothing, footwear, gloves, and headgear) as well as personal protective devices (e.g., goggles, faceshields, hearing protectors, and respirators). Adequate PPE should protect the respiratory system, skin, eyes, face, hands, feet, body, and ears.

A-1-3 Protective System. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

A-1-3 Raising System. Raising systems should incorporate a mechanical means to prevent the load from falling should the primary control mechanism be released during the raising operation.

A-1-3 Rapid Intervention Crew. Rapid intervention crews should be fully equipped with the appropriate personal protective equipment (PPE), protective clothing, and any specialized rescue equipment that might be needed given the specifics of the operation under way.

A-1-3 Registered Professional Engineer. However, a registered professional engineer registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for manufactured protective systems or tabulated data to be used in the construction of protective systems.

A-1-3 Rescue Area (or Hot, Danger, or Collapse Zone). Sometimes rescue area is generally defined as an area 50 ft (15 m) in all directions from the incident site, or a distance in all directions equal to the height of the structure involved in the collapse plus a third.

A-1-3(e) Rescue Service. The term *timely* is based on many factors such as perceived danger of the original entry (e.g., possible supplied breathing air required), distance to definitive medical care, capabilities of responding emergency medical services, and so forth. In trauma-related injuries, the "golden hour" principle can be used to determine how quickly the rescue service should be able to respond in order to deliver the patient to the appropriate treatment facility within an hour of onset of injuries. The rescue service should have a goal of responding to these emergencies within 15 minutes of the time they receive notification.

A-1-3 Retrieval Equipment (or Retrieval System). In U.S. federally regulated industrial facilities, these systems are required whenever an authorized entrant enters a confined space unless the retrieval system would increase the overall risk of entry or would not contribute to the rescue of the entrant. For confined space rescue operations, these systems should be in place prior to entry (into vertical or horizontal spaces) in such a manner that retrieval of rescue entrants can begin immediately in the event of an emergency. Retrieval systems can also be used to act as fall-arresting devices for rescue personnel.

A-1-3 Risk/Benefit Analysis. Traditionally in search and rescue, this analysis involves the assessment of the general status of the victim(s) in order to apply the proper urgency to the situation (rescue versus body recovery). A live victim suggests a rescue and its associated high level of urgency. A deceased victim, however, is a body recovery that suggests a far less urgent response.

A-1-3 Shield (or Shield System). Shields can be permanent structures that are designed to be portable and moved along. Shields can be either manufactured or job-built in accordance with 29 *CFR* 1926.652 (c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

A-1-3 Sloping System. The angle of incline required to prevent a cave-in varies with the differences in such factors as soil type, environmental conditions of exposure, and application of surcharge loads. *(See also Angle of Repose.)*

A-1-3 Supplemental Sheeting and Shoring. Supplemental sheeting and shoring requires additional training beyond that of traditional sheeting and shoring.

A-1-3 System Safety Check. The system safety check should have the following three components:

(a) *Physical/Visual Check.* Personnel should carefully review all system components to ensure proper assembly.

(b) *Load Test.* Personnel should pre-load the system in a safe manner (e.g., standing away from edges while pre-loading).

(c) *Audible/Visual Confirmation.* A signal should be issued by the person performing the system safety check following the first two steps that confirms their completion. The signal should address other rescuers utilizing the system and should be acknowledged by one or more of them.

A-1-3 Tabulated Data. The term is also applied to six tables found in Appendix C of 29 *CFR* 1926, Subpart P.

A-1-3 Technical Rescue Incident. Technical rescue incidents can include water rescue, rope rescue, confined space rescue, wilderness search and rescue, trench rescue, vehicle and machinery rescue, dive search and rescue, collapse rescue, and other rescue operations requiring specialized training.

A-1-3 Terrain. Examples include cliffs, steep slopes, rivers, streams, valleys, fields, mountainside, and beach.

A-1-3 Terrain Hazard. Examples include cliffs, caves, wells, mines, avalanche, and rock slides.

A-1-3 Traditional Sheeting and Shoring. Some newer style sheeting and shoring might not require a strongback attachment (refer to manufacturer recommendations).

A-1-3 Trench (or Trench Excavation). In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is no greater than 15 ft (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 ft (4.6 m) or less, the excavation is also considered a trench.

A-1-3 Uprights (or Strongback). Uprights placed so that the individual members are closely spaced, in contact with, or interconnected to each other are considered "sheeting."

A-1-3 Wilderness. The wilderness often includes a collection of various environments such as forests, mountains, deserts, natural parks, animal refuges, rain forests, and so forth. Depending on terrain and environmental factors, the wilderness can be as little as a few minutes into the backcountry or less than a few feet off the roadway. Incidents with only a short access time could require an extended evacuation and thus qualify as a wilderness incident.

A-2-1.1 Safe operations at technical rescue incidents should include the assessment and acquisition of external resources required for situations beyond the operational capability of the organization. An example might include a situation in a confined space or trench requiring a technician-level hazardous materials response capability.

A-2-1.5 BLS is the minimum level of medical care required; advanced life support (ALS) is recommended. The AHJ should consider the development of an advanced capability in medical response to reflect the needs of the technical rescue environment.

The AHJ, in addition to BLS training, should provide training in the treatment of the following medical conditions:

(a) *Cervical/Spinal Immobilization.* Training should be integrated with systems for vertical and horizontal patient evacuations (e.g., patient packaged onto a stokes stretcher and secured to provide spinal immobilization).

(b) *Crush Injury Syndrome.* Training should include recognition, evaluation, and treatment, prior to extrication, of victims with symptoms or mechanism of injury potential.

(c) *Amputation.* Amputation should be considered as a last resort, but rescuers should be aware of the possibility. Incident managers also should be aware of the proper procedures to be followed in their community, including interaction with local medical doctors.

(d) *Infection Control.* Training should include education in protective equipment (e.g., gloves, masks, PPE), protective procedures (e.g., avoiding contaminants and pollutants), and appropriate decontamination following possible exposures, as specified in NFPA 1581, *Standard on Fire Department Infection Control Program,* or in OSHA's "Blood-Borne Pathogens" standard (29 *CFR* 1910.1030).

(e) *Critical Incident Stress.* Training should include information on personal well-being, with emphasis on preconditioning, pacing of effort, proper diet and rest, and emotional and

psychological diversions during long-term operations. Personnel should be trained to recognize the signs and symptoms of critical incident stress. Scene managers should be trained in the value of rehabilitation efforts during extended operations for the safety and continued efficiency of their personnel.

A-2-1.6.2 This documentation shall contain each recipients name, the signatures or initials of the trainers, the dates of training, an outline of the training conducted, and resource materials used to develop the training.

A-2-1.9 Legal considerations impact on many phases of a technical rescue incident (e.g., confined space regulations, use/maintenance of SCBA, right of entry laws during a search, right to privacy laws during an investigation). Whatever the capacity in which a rescuer functions (public or private), it is important that the rescuer be informed regarding all relevant legal restrictions, requirements, obligations, standards, and duties. Failure to do so could jeopardize the reliability of any investigation or operation and could subject the rescuer to civil liability or criminal prosecution.

A-2-2.1 A hazard and risk assessment is an evaluation and analysis of the environment and physical factors influencing the scope, frequency, and magnitude of technical rescue incidents and the impact and influence they can have on the ability of the AHJ to respond to and safely operate at these incidents.

The goal and terminal objectives of the hazard and risk assessment are to increase the awareness of the AHJ and to provide a focus toward conditions and factors associated with potential technical rescue responses.

The hazard and risk assessment can be associated closely with similar functional and format methodology, as might be incorporated in a master plan or strategic deployment study. It is not the intent of this standard to encumber the AHJ in its undertaking of a detailed and extensive analysis of each technical rescue environment within the jurisdiction, but this standard is meant to be a document that provides means for a deliberate and objective examination of common or unique factors that can be identified, correlated, or highlighted to aid in the development of technical rescue capabilities and to determine their necessary level of expertise in order to provide risk reduction.

A-2-2.3 As part of the risk assessment, the AHJ should identify the types of internal resources immediately available, within the operational structure of the organization, that could be utilized for technical rescue incident response. The resources should include the availability of personnel; training levels of personnel; professional specialty or trade skills; and type, quantity, and location of equipment, appliances, and tools applicable to technical rescue incident response.

A-2-2.4 The research and documentation of available external resources that can augment the internal capabilities of the AHJ form a crucial component in its overall ability to respond and operate at technical rescue incidents.

Due to the potential complexity of related technical rescue incidents and the variety of conditions and factors that can exist at site-specific or large-scale incidents, external resource allocation and deployment becomes a necessity in order to support the search and rescue function. The AHJ can develop a comprehensive list of those resources that can aid the responding agency by first identifying those factors that currently can limit its overall response capability by using the hazard and risk assessment evaluation. Once limitations or resource deficiencies are identified, the AHJ can develop a resource database by reviewing those firms or businesses that are located within the jurisdiction. The telephone directory for the jurisdiction is an excellent reference that provides general categories and listing headings for companies, firms, and agencies that can become sources for resource allocation.

The identification of area needs can be associated with four general categories. These include, but are not limited to, the following:

(a) Technical services
(b) Equipment
(c) Supplies
(d) Services

In addition, the AHJ should identify and contact local professional societies, associations, and trade groups that can become excellent sources for technical support and resource development.

Such professional groups include the following:

(a) American Institute of Architects (AIA)
(b) American Society of Consulting Engineers (ASCE)
(c) Association of Building Contractors (ABC)
(d) Local or regional builders exchange
(e) Construction Specification Institute (CSI)
(f) American Society of Safety Engineers (ASSE)
(g) American Public Works Association (APWA)
(h) Association of General Contractors (AGC)
(i) International Association of Bridge, Structural and Ornamental Iron Workers
(j) National Association of Demolition Contractors

The development of a community resource directory based upon these contacts documents and makes readily available the variety of resources that might be needed in the event of a technical rescue incident. The community resource directory should include information on each firm, company, or agency appearing in the directory. A profile of the specialized resource(s) available, along with contact person(s) information, including telephone numbers for both home and work, also should be included.

Although the compiled data can be entered and stored on a computer database, a binder or book-formatted system should be used to adapt easily for field use. The use of lap-top computer notebooks with disk-formatted data can also prove useful, and consideration should be given to the longevity and portability provided by battery packs.

A Memorandum of Agreement (MOA) should be developed that outlines specifications for equipment and resource allocation, availability of services and procedures for procurement, and subsequent financial reimbursement for services or equipment supplied.

In addition to the types of resources previously identified, the AHJ also should consider the development of a resource guide for the procurement of technical services from individuals associated with specific groups or agencies. This resource guide could include profiles of personnel, such as canine handlers, search dogs, technical rescue specialists, industrial hygienists, riggers, and so forth, who, on an on-call basis, could respond and augment on-scene resources.

The AHJ should not disregard resource acquisition requests to agencies and groups outside the immediate boundaries of the jurisdiction. Regional, statewide, and national resource identification could be developed based on the overall projected needs identified by evaluation of the hazard and risk assessment.

Depending on the size and magnitude of the on-scene incident, resource availability might not be adequate for incident logistical needs, or the resources might be affected by whatever caused the incident, especially where a large area within the jurisdiction is part of the overall incident conditions. Such could be the case in an earthquake, hurricane, flooding, or other large-scale natural disaster.

Regional, multistate, or national deployment of specialized rescue teams or task forces should be considered in the development of the overall resource directory in order to provide additional capabilities as incident conditions and incident magnitude necessitate.

A-2-2.5 The intent of this provision is to establish procedures to enable the incident commander to obtain the necessary resources to augment the internal capabilities of the AHJ. These resources can include, but are not limited to, the following:

(a) Mutual aid agreements

(b) Agreements with the private sector, including the following:

1. Organizations specializing in the specific skills and/or equipment required to resolve the incident
2. Special equipment supply companies
3. Related technical specialists
4. Communications
5. Food service
6. Sanitation

(c) Memorandums of Agreement (MOA) with other public, state, or federal agencies

A-2-4.1.1 Specific specialized equipment that might be required for safe technical rescue operations includes the following:

(a) Supplied line breathing apparatus (SLBA), supplied air breathing apparatus (SABA), and supplied air respirator (SAR), all of which should meet the requirements of 29 *CFR* 1910.146, "Permit-Required Confined Spaces"

(b) Personal alert safety system (PASS), which should meet the requirements of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program,* and NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)*

(c) Life safety ropes and system components, which should meet the requirements of NFPA 1500 and NFPA 1983, *Standard on Fire Service Life Safety Rope and System Components*

(d) Communications equipment, which should meet the requirements of 29 *CFR* 1910.146

(e) Lighting equipment (e.g., flashlights, helmet-mounted lamps), which should be, depending on the situation, intrinsically safe or explosion proof as defined by 29 *CFR* 1910.146

The AHJ should evaluate the appropriateness of the equipment at an emergency incident with regard to the existing hazards.

A-2-4.2.4 Depending on local conditions, divers should consider the use of compressed gas air (CGA) Grade E air.

A-2-5.1.4 BLS is the minimum level required; ALS is recommended.

A-2-5.1.5 Interagency cooperation is essential to the successful mitigation of many technical rescue incidents. Personnel from fire, rescue, EMS, and law enforcement can be involved in an operation at all levels, from recognition through command. It is recommended that all agencies involved in rescue review and/or develop policies regarding control of firearms. In the end, some emergency responders called to the scene of an incident can be armed. The complete exclusion of firearms might not always be practical and/or feasible on the incident scene but is generally recommended.

A-2-5.2.2 Some organizations use helmets, helmet appliques, or vests with fluorescent retro reflective material to readily identify the safety officer(s). Where the safety officer is not trained to the level at which the organization is operating, a member of the organization with discipline-specific technical expertise should be appointed to serve as an assistant safety officer.

A-2-5.3.1 The incident management system utilized at all technical rescue incidents should be structured to address the unique groups, divisions, or branches that can be necessary to effectively manage the specific type of incident (e.g., structural collapse, trench/excavation cave-in).

Managing external influences such as family, news media, and political entities includes instructing subordinates in how to deal with them should they be encountered.

NFPA 1561, *Standard on Fire Department Incident Management System,* in 3-2.2.1, describes the use of an information officer (a member of the command staff) to address these types of influences. Where encounters with family, news media, or political influences are likely, such a function should be filled as soon as possible.

A-2-5.4 The AHJ should address the possibility of members of the organization having physical and/or psychological disorders (e.g., physical disabilities, fear of heights, fear of enclosed spaces) that can impair their ability to perform rescue in a specific environment.

A-3-1.2 In all types of structural collapse rescue incidents, the potential exists for extenuating circumstances that would require expertise beyond the normal capability of the organization to safely operate. Examples of these situations include, but are not limited to, multiple collapse sites, large number of victims, numerous deeply buried victims, multiple complications (e.g., both deeply buried victims and multiple sites), involvement of hazardous/toxic substances, or severe environmental conditions (e.g., snow and rain). These conditions should be evaluated during the initial risk assessment and on an incident-by-incident basis.

A-3-2.2(a) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(a) Scope and magnitude of the incident
(b) Risk and benefit analysis
(c) Number and size of structures affected
(d) Integrity and stability of structures affected
(e) Occupancy types (e.g., residential, mercantile)
(f) Number of known and potential victims
(g) Access to the scene
(h) Environmental factors
(i) Available and necessary resources

A-3-2.2(b) The intent of this provision is to establish procedures to enable the incident commander to obtain the necessary resources to augment the internal capabilities of the AHJ. These resources can include, but are not limited to, the following:

(a) Mutual aid agreements

(b) Agreements with the private sector, including the following:

1. Construction industry

2. Demolition industry
3. Heavy equipment operators
4. Special equipment supply companies
5. Hardware, lumber, and construction suppliers
6. Consulting engineers and architects
7. Related technical specialists
8. Communications
9. Food service
10. Sanitation

(c) Memorandums of Agreement (MOA) with other public, state, or federal agencies

A-3-2.2(c) The emergency response system includes, but is not limited to, operations- and technician-level personnel, as well as local, state, and federal resources.

A-3-2.2(d) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A-3-2.2(e) General hazards associated with search and rescue operations at structural collapses can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members.

(a) *Utilities.* Control of the utilities in and around a structural collapse is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services in order to provide a safe environment in which to operate and to ensure the safety of victims. The following utilities should be considered when providing training:

1. Electrical services (primary and secondary)
2. Gas, propane, fuel oil, or other alternative energy sources (primary systems)
3. Water
4. Sanitary systems
5. Communications
6. Secondary service systems (i.e., compressed, medical, or industrial gases)

(b) *Hazardous Materials.* Collapsed structures might include various materials unique to an occupancy that, when released during a structural collapse, could pose a hazard to victims and responders. The AHJ should provide members with training in the recognition of potential hazardous materials releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials in order to conduct operations safely and effectively.

(c) *Personal Hazards.* At the site of any structural collapse, there are many dangers that pose personal injury hazards to the responders. The AHJ should train members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards in order to help ensure their safety. Every member should be made aware of hazards such as trips, falls, blows, punctures, impalement, and so forth.

(d) *Confined Space.* Some structural collapses necessitate a confined space rescue. Responding personnel should be familiar with and trained in confined space rescue requirements and techniques. The AHJ should determine the applicable laws and standards related to confined space rescue and should provide training to members in confined space rescue.

(e) *Other Hazards.* There are numerous other hazards associated with structural collapses. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide members with training and awareness of these other hazards in order to perform rescue operations safely and effectively.

Hazard recognition training should include the following as a minimum:

(a) Recognition of building materials and structural components associated with light-frame ordinary construction

(b) Recognition of unstable collapse and failure zones of light-frame ordinary construction

(c) Recognition of collapse patterns and probable victim locations associated with light-frame ordinary construction

Four Categories of Building Construction.

The construction categories, types, and occupancy usage of various structures might necessitate the utilization of a variety of different techniques and material. The four construction categories that the rescuer most likely will encounter in collapse situations are light-frame, heavy wall, heavy floor, and precast concrete construction. These four categories usually comprise the majority of structures affected by a collapse.

(a) *Light-Frame Construction.*

1. Materials used for light-frame construction are generally lightweight and provide a high degree of structural flexibility in response to forces such as earthquakes, hurricanes, tornados, and so forth.
2. These structures typically are constructed with skeletal structural frame systems of wood or light-gauge steel components that provide support to the floor and roof assemblies.
3. Examples of this construction type include wood frame structures used for residential, multiple low-rise, and light commercial occupancies up to four stories in height. Light-gauge steel frame buildings include commercial, business, and light manufacturing occupancies and facilities.

(b) *Heavy Wall Construction.*

1. Materials used for heavy wall construction are generally heavy and utilize an interdependent structural or monolithic system. These types of materials and their assemblies tend to produce a structural system that is inherently rigid.
2. This construction type usually is built without a skeletal structural frame. It utilizes a heavy wall support and assembly system that provides support for the floors and roof areas.
3. Occupancies utilizing tilt-up concrete construction are typically one to three stories in height and consist of multiple, monolithic concrete wall panel assemblies. They also use an interdependent girder, column, and beam system for providing lateral wall support of floor and roof assemblies. Such occupancies typically include commercial, mercantile, and industrial usage. Materials other than concrete now are being utilized in tilt-up construction.
4. Examples of this type of construction include reinforced and unreinforced masonry buildings typically of low-rise construction, one to six stories in height, and of any occupancy type.

(c) *Heavy Floor Construction.*

1. Structures of heavy floor construction are built utilizing cast-in-place concrete construction consisting of flat slab panel, waffle, or two-way concrete slab assemblies. Pretensioned or post-tensioned reinforcing steel rebar or cable systems are common components used for structural integrity. The vertical structural supports include integrated concrete columns, concrete enclosed steel frame, or steel frame, which carry the load of all floor and roof assemblies. This type of structure includes heavy timber construction that might use steel rods for reinforcement.
2. The reinforcing steel along with the varying thicknesses of concrete structural slab and girder supports utilized in this construction assembly pose significant concerns with respect to breaching and void penetration.
3. The loss of reinforcement capability and the integrity of structural loading capacity of the floor and wall assemblies create significant safety and operational considerations during collapse operations.
4. Structural steel frame construction utilizes a skeletal framing system consisting of large-load-carrying girders, beams, and columns for structural support. These components represent a substantial weight factor for individual and assembly components. Floor systems consist of cast-in-place concrete slabs of varying thicknesses poured onto metal pan or structural metal floor decks and also might include precast and post-tensioned concrete plank systems. These concrete/metal pan floor assemblies are supported by the structural steel framing system.
5. The exterior construction might consist of metal or masonry veneer, curtain wall, or composite material panel systems. Additionally, precast concrete or stone-clad panel systems might be present.
6. Multiple assembly or component failures might be present in a collapse situation where isolated or multiple collapse conditions or collapse configurations exist.
7. Examples of this type of construction include offices, schools, apartments, hospitals, parking structures, and multipurpose facilities. Heights vary from single-story to high-rise structures.

(d) *Precast Construction.*

1. Structures of precast construction are built utilizing modular precast concrete components that include floors, walls, columns, and other subcomponents that are field-connected at the site.
2. Individual concrete components utilize imbedded steel reinforcing rods and welded wire mesh for structural integrity and might utilize either steel beam and column or concrete framing systems for the overall structural assembly and building enclosure.
3. These structures rely on single or multipoint connections for floor and wall enclosure assembly and are a safety and operational concern during collapse operations.
4. Examples of this type of construction include commercial, mercantile, office, and multiuse or multifunction structures, including parking structures and large occupancy facilities.

Table A-3-2.2(e) lists the four model construction codes and standards commonly adopted within the United States and is provided to aid the AHJ in identifying the relationship of NFPA 1670 construction/collapse types to their applicable code. These model codes are referenced to classification Types I through V as specified in NFPA 220, *Standard on Types of Building Construction.*

Table A-3-2.2(e) Fire-Resistive Building Types

Reference	Fire-Resistive[1]		Noncombustible[1]			Ordinary[1]		Heavy Timber[1]	Wood[1]	
NFPA 220[2,3]	Type I		Type II			Type III		Type IV	Type V	
	443	332	222	111	000	211	200	2HH	111	000
BOCA[4]	Type I		Type II			Type III		Type IV	Type V	
	1A	1B	2A	2B	2C	3A	3B	4	5A	5B
UBC[5]	Type I		Type II			Type III		Type IV	Type V	
	P		P	P	NP	P	NP		P	NP
SBC[6]	Type I	Type II	Type IV			Type V		Type III	Type VI	
	433	332	P	NP	P	NP	2HH	P	NP	

[1]The table headings for fire-resistive, noncombustible, ordinary, heavy timber, and wood construction do not represent any special construction code classification but are meant to provide an easily recognizable general construction type reference.
[2]See NFPA 220, *Standard on Types of Building Construction,* for common definitions of construction Types I through V.
[3]The three-digit arabic numbers that appear beneath each construction type heading designate the fire resistance rating requirements for certain structural elements specified in NFPA 220, *Standard on Types of Building Construction.* They are provided in this table as a reference and to indicate their relationship to each type of construction.
[4]Construction types are referenced to the BOCA *National Building Code* for correlation with fire-resistive rating requirements for each construction type.
[5]Construction types are referenced to UBC, *Uniform Building Code.* The designations P and NP stand for "protected" and "not protected," respectively, as used within the UBC.
[6]Construction types are referenced to SBC, *Standard Building Code.* The designations P (protected) and NP (not protected) are used in order to provide correlation with *Uniform Building Code* information.

Construction/code classifications		Fire-resistive	Non-combustible	Ordinary	Heavy timber	Wood
NFPA 220 classifications		I	II	III	IV	V
NFPA 1670 Construction/collapse types	Light frame					
	Heavy wall					
	Heavy floor					
	Precast concrete					

Figure A-3-2.2(e) Construction code classifications by building type.

Figure A-3-2.2(e) is intended to identify construction/collapse types according to the classifications of NFPA 220, *Standard on Types of Building Construction,* and is not part of any fire-resistive or fire rating/assembly requirement. In this table, the NFPA 1670 construction/collapse types are referenced to NFPA 220 to allow rapid correlation of construction code classification with the associated construction/collapse type. Depending upon occupancy, usage, and actual size of the structure, some construction code classifications can exhibit characteristics of other than specifically correlated construction/collapse types.

A-3-2.2(f) Collapse patterns and potential victim locations include the following:

(a) *Lean-to.* A lean-to is formed when one or more of the supporting walls or floor joists breaks or separates at one end, causing one end of the floor(s) to rest on the lower floor(s) or collapse debris. Potential areas where victims might be located are under the suspended floor and on top of the floor at the lowest level. *[See Figure A-3-2.2(f)(a).]*

(b) *V.* A "V" is formed when heavy loads cause the floor(s) to collapse near the center. Potential areas where victims might be located are under the two suspended floor pieces and on top of the floor in the middle of the V. *[See Figure A-3-2.2(f)(b).]*

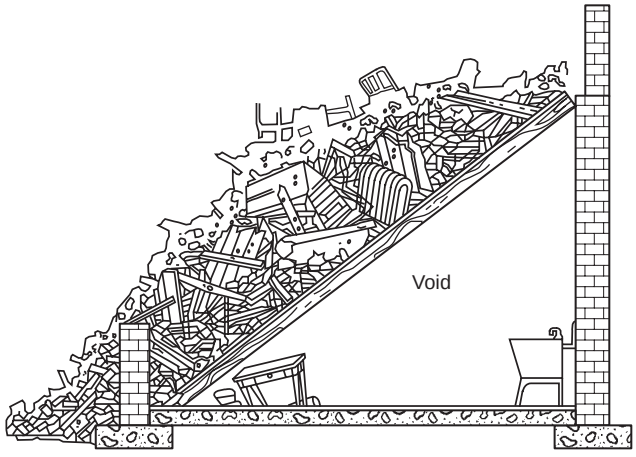


Figure A-3-2.2(f)(a) Lean-to floor collapse. ***(Courtesy of U.S. Department of Civil Defense)***

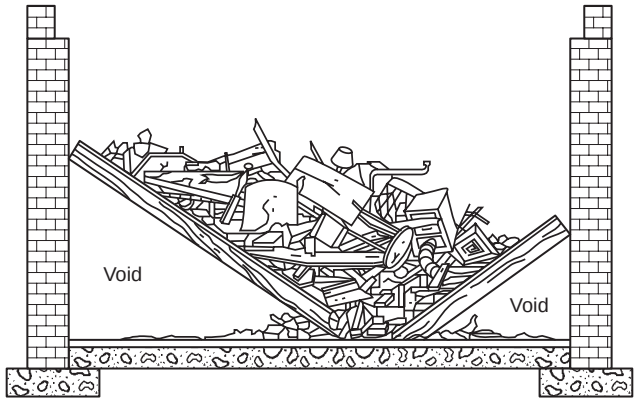


Figure A-3-2.2(f)(b) V-shape floor collapse. ***(Courtesy of U.S. Department of Civil Defense)***

(c) *Pancake.* A pancake is formed when the bearing wall(s) or column(s) fails completely and an upper floor(s) drops onto a lower floor(s), causing it to collapse in a similar manner. Potential areas where victims might be located are under the floors and in voids formed by building contents and debris wedged between the floors. *[See Figure A-3-2.2(f)(c).]*

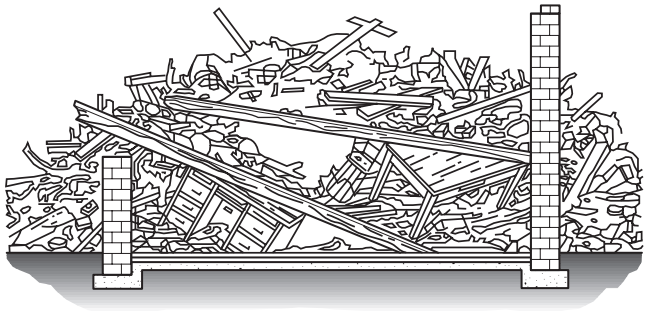


Figure A-3-2.2(f)(c) Pancake floor collapse. ***(Courtesy of U.S. Department of Civil Defense)***

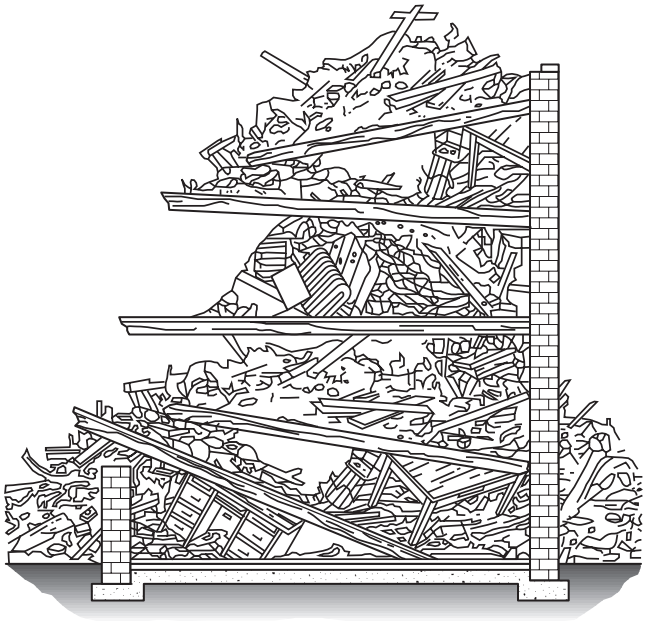


Figure A-3-2.2(f)(d) Cantilever floor collapse. ***(Courtesy of U.S. Department of Civil Defense)***

(d) *Cantilever.* A cantilever is formed when one end of the floor(s) hangs free because one or more walls have failed and the other end of the floor(s) is still attached to the wall(s). Potential areas where victims might be located are on top of or under the floors. *[See Figure A-3-2.2(f)(d).]*

(e) *A-frame.* An A-frame occurs when flooring separates from the exterior bearing walls but still is supported by one or more interior bearing walls or nonbearing partitions. The highest survival rate for trapped victims will be near the interior partitioning. Other victims will be located in the debris near both exterior walls. *[See Figure A-3-2.2(f)(e).]*

A-3-2.2(g) Indications of potential for secondary collapse include the following:

(a) Leaning walls
(b) Smoke or water seeping through joints
(c) Unusual sounds (e.g., creaking, groaning)
(d) Recurring aftershocks
(e) Sagging floor or roof assemblies
(f) Missing, strained, or damaged points of connection of structural elements
(g) Excessive loading of structural elements
(h) Sliding plaster and airborne dust
(i) Separating walls
(j) Lack of water runoff
(k) Racked or twisted structure
(l) Building vibration

A-3-2.2(h) Procedures for conducting searches should include, at a minimum, visual and verbal methods.

Search and rescue operations in the structural collapse environment should include close interaction of all incident management system elements for safe and effective victim extrications. Search operations for locating victims should be initiated early at a structural collapse incident. Structural collapse search operations should conform to an accepted system for victim search strategy and tactics in order to achieve optimum performance and effectiveness. The following recommendations provide current tactical capabilities and general strategies that can assist personnel in productive search operations.

Structural collapse operations are one of the most difficult rescue situations likely to be encountered. Depending on the complexity of the search and rescue activity, personnel might need to spend large amounts of precious time on small numbers of difficult rescues. It is important to establish whether or not rescue personnel are involved with a live victim, since time should not be wasted in such unproductive missions as the removal of dead bodies while live victims might be saved.

A-3-2.2(i) Structure/hazards evaluation and search assessment procedures are designed to identify specific information pertinent to each affected building. Either of these analyses can be completed independently of the other, although the structure/hazards evaluation normally is completed first. Symbols should be drawn conspicuously with orange spray paint. *(See FEMA US&R Response System, Appendix C, "Task Force Building Marking System.")*

One of the initial strategic concerns for personnel is the need to analyze the structure(s) involved in any collapse situation. This is especially true where there is more than one structure involved, as in cases of devastating earthquakes, hurricanes, or other natural or man-made disasters. The determination of the condition of the structure, hazards, and

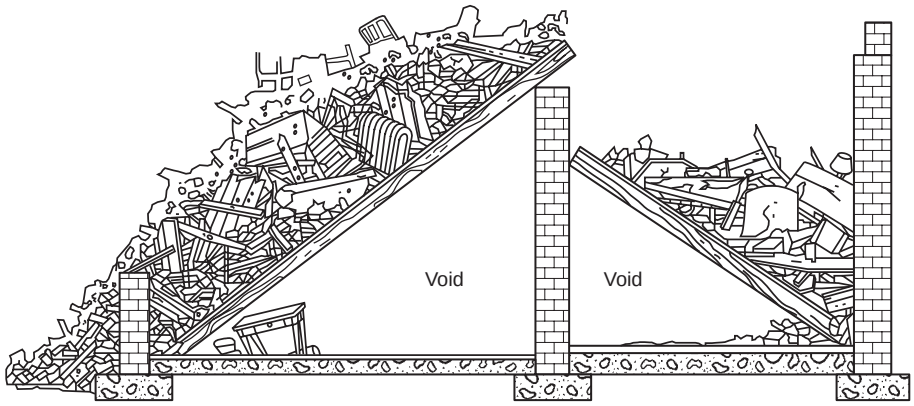


Figure A-3-2.2(f)(e) A-frame floor collapse.

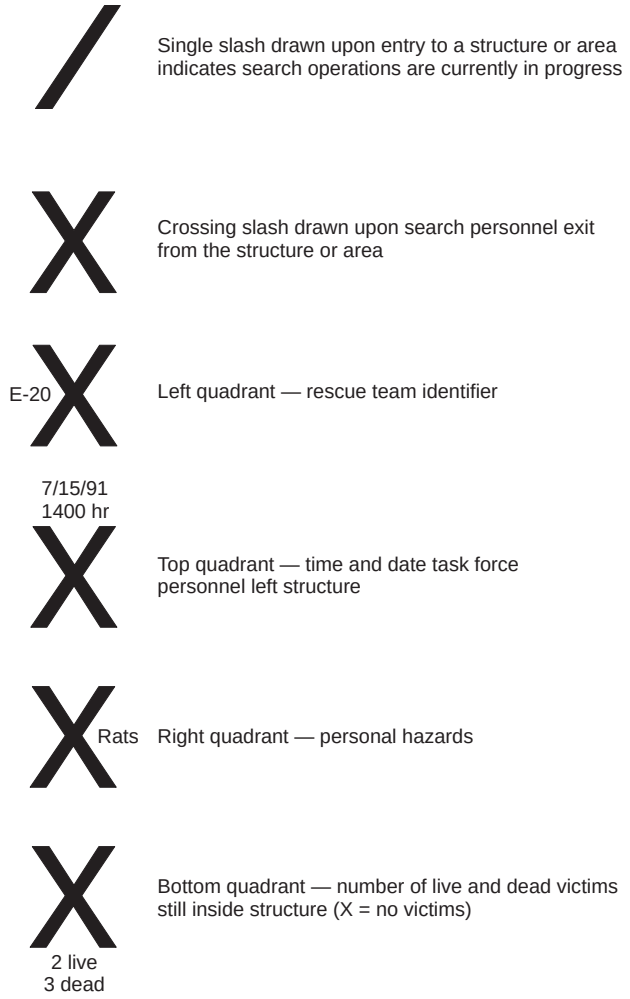


Figure A-3-2.2(i)(a) FEMA task force search and rescue marking system.

occupancy prior to the event will affect the overall search and rescue strategy.

It is imperative that the information derived from a coordinated building triage and marking system be consolidated by the AHJ at any structural collapse event. This information not only should be used to identify operational priorities but also should be forwarded to the incident commander to assist in the overall assessment of the event.

(a) *FEMA Task Force Search and Rescue Marking System.* Distinct markings should be made within the four quadrants of an "X" to denote clearly the search status and findings during the search. Figure A-3-2.2(i)(a) illustrates the search marking system.

An "X" measuring 2 ft × 2 ft (0.6 m × 0.6 m) should be spray-painted in the color orange. The information for each quadrant should be written in the quadrant using carpenter's chalk or a lumber crayon.

In addition, search personnel should mark the exact location of a victim(s) with orange spray paint. Surveyor's tape can be used as a flag to identify the appropriate area in conjunction with the spray paint. To reduce needless duplication of search efforts, markings should be made at each point of entry or separate area of the structure. Where updated information

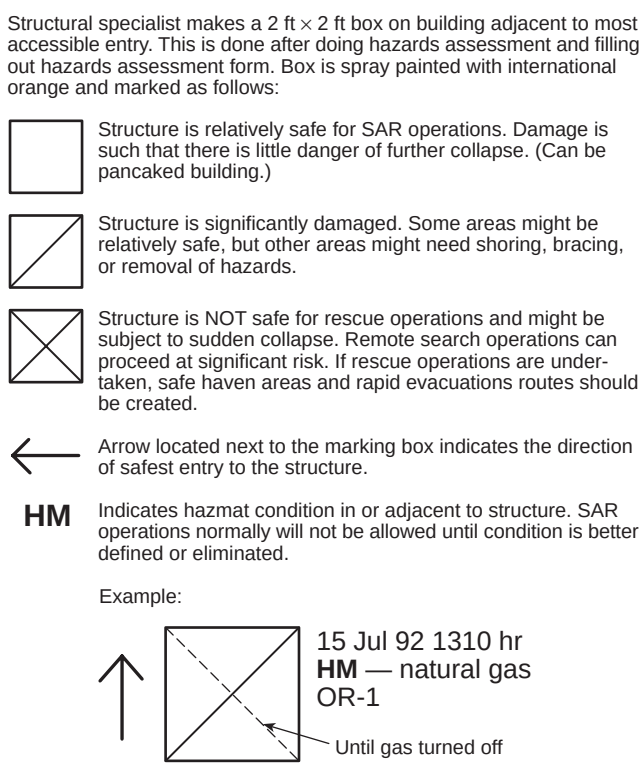


Figure A-3-2.2(i)(b) Task force building marking system structure/hazard evaluation.

of previously searched structures is needed, the old information should be crossed out and the most recent information should be indicated below or next to the old, using the marking system.

(b) *FEMA Task Force Building Marking System (Structure/Hazard Evaluation).* This system is designed to identify specific hazards associated with any collapsed structure. Personnel should be cognizant of the nationally accepted marking system and should be proficient in the use of the system. *(See FEMA US&R Response System, Appendix D, "Structure Triage, Assessment & Marking System.")*

After performing a building hazard assessment, the responder uses international orange spray paint to make a 2 ft × 2 ft square box on the building adjacent to the most accessible point of entry. Figure A-3-2.2(i)(b) illustrates the search marking system.

An empty box indicates the building is relatively safe for search and rescue operations and that damage is such that there is little danger of further collapse. One diagonal line in the box indicates the structure is significantly damaged and that some areas may need shoring, bracing, or removal of hazards in spite of the fact that some areas may be safe. Two diagonal lines in the box (an "X") indicate that the building is not safe for search and rescue operations and may be subject to sudden collapse. An arrow next to the marking box indicates the direction of safest entry to the structure. To the right of the marking box, text is used to indicate the time and date of the search, the team designation, and hazard(s) found. The letters HM to the right of the box (in the text area) indicate a hazmat condition in or adjacent to the structure. When HM is used, search and rescue operations normally will not be allowed until the condition is better defined or eliminated.

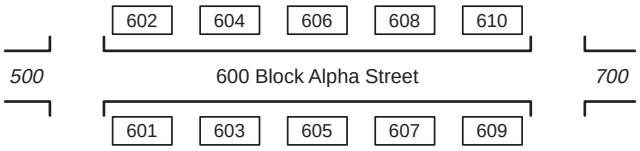
An important duty of a structure triage team is to clearly differentiate buildings in groupings such as by block(s) or jurisdictional areas/sectors. This geographic (area/sector) identification of buildings would be consolidated at the command post and used to deploy search and rescue personnel and/or track structure/hazard evaluation and search assessment information.

It is imperative that each structure within a geographic area is clearly defined. This identification will assist both in the specific ongoing search and rescue effort and in the long-term post-disaster identification of the site. This identification is important from a technical documentation perspective regarding the specific events that took place at a given site. Structure identification has a significant impact on overall scene safety and the safety of task force personnel.

It is important to clearly identify each separate structure within a geographic area when information is being disseminated to other operational entities. The primary method of identification should be the existing street name, hundred block, and building number. Obviously, such identification is not always possible due to post-disaster site conditions. In these situations, it is important that the task force personnel implement the following system for structure identification.

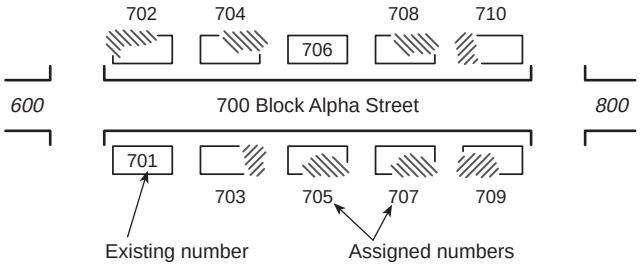
This system builds upon the normal pre-disaster street name, hundred block, and building number. As task force personnel establish a need to identify a structure within a given block they will do the following:

1. Each structure should be identified by existing street name and building number.

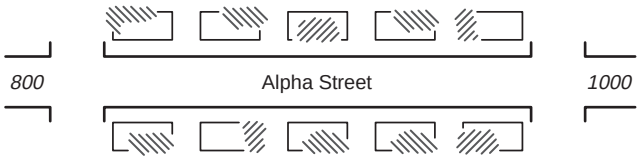


2. If some previously existing numbers have been obliterated, an attempt should be made to re-establish the numbering system based upon one or more structures that still display an existing number.

3. The damaged building(s) would be assigned numbers to separately identify them as indicated. The front of the structure(s) in question should be clearly marked with the new numbers being assigned using international orange spray paint.



4. If no number is identifiable in a given block then task force personnel will identify the street name and the hundred block for the area in question on other structures in proximity to the site in question.



5. In this case, structures will be assigned the appropriate numbers to designate and differentiate them. The front of the structure(s) in question should be clearly marked with the new number being assigned using international orange spray paint.

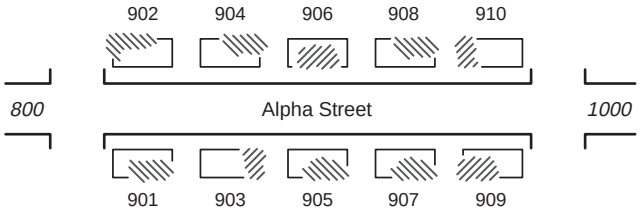


Figure A-3-2.2(i)(c) Task force structure marking system structure identification within a geographic area.

(c) *FEMA Task Force Structure Marking System (Structure Identification Within a Geographical Area).* Structure identification within a geographic area is used to differentiate buildings by groups, such as by block(s) or jurisdictional area. This geographic area identification should be consolidated at the command post of the AHJ and used to deploy search and rescue personnel. *[See Figure A-3-2.2(i)(c).]*

International orange spray paint is used to mark buildings with their street number so that personnel can differentiate one building from another. Existing numbers should be used to fill in any unknown numbers. If all numbers are unknown, arbitrary numbers can be used (odd and even used on opposite sides of the street). The primary method of identification should include the existing street name, hundred block, and building number. Such identification is not always possible due to post-disaster conditions. *(See FEMA US&R Response System, Appendix D, "Structure Triage, Assessment & Marking System.")*

A standard approach to describing each building's layout is also used. The street side of the building is side one. Subsequent sides (2, 3, 4) are labeled in a clockwise direction around the building. Internally, quadrants are described starting with the front left corner (while standing at the front, street side of the building) and labeled with letters starting with "A." Subsequent quadrants (B, C, D, E) are labeled in a clockwise direction around the interior of the building with the core (center) being labeled "E." Stories are labeled 1, 2, 3, and so forth, and basements are designated B1, B2, B3, and so forth.

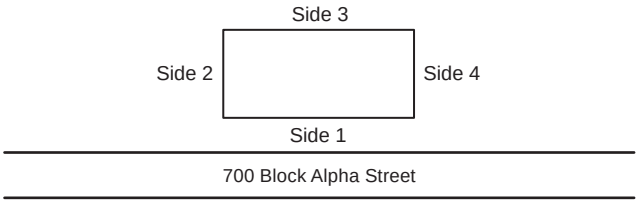
It is imperative that personnel clearly identify each structure within a geographic area. This identification will assist both in the specific ongoing search and rescue effort and the long-term, post-disaster identification of the site. *[See Figure A-3-2.2(i)(d).]*

A-3-3.3(b) Operations personnel should be capable of obtaining and utilizing one or more of the following resources:

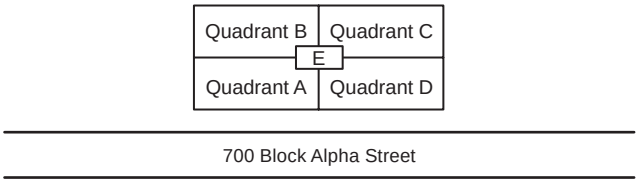
(a) Structural collapse search dogs
(b) Search cameras
(c) Acoustic/seismic instruments (listening devices)
(d) Thermal imaging (infrared) devices
(e) Other technical search devices

It is also important to identify locations within a single structure.

1. The address side of the structure is defined as Side 1. Other sides of the structure are assigned numerically in a clockwise manner from Side 1.



2. The interior of the structure will be divided into quadrants. The quadrants are identified alphabetically in a clockwise manner starting from where the Side 1 and Side 2 perimeter meet. The center core, where all four quadrants meet, will be identified as Quadrant E (i.e., central core lobby).



3. Multistory buildings must have each floor clearly identified. If not clearly discernible, the floors are numbered as referenced from the exterior. The grade level floor would be designated Floor 1 and, moving upward the second floor would be Floor 2, and so forth. Conversely, the first floor below grade level would be B-1, the second B-2, and so forth.

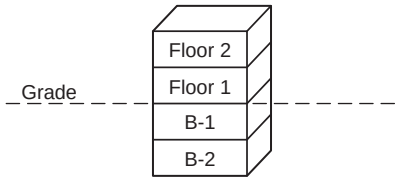


Figure A-3-2.2(i)(d) Task force structure marking system structure identification within a geographic area — single structure.

Search operations should incorporate a variety of technical and nontechnical methods that might provide personnel with the only viable method to locate victims and determine their status.

The AHJ should identify as many forms of technical and nontechnical search capabilities available at the local, regional, state, or national level that are commensurate with its needs. In addition to the basic operational level of capability, search methods should include, but not be limited to, the following:

(a) *Structural Collapse Search Dogs.* This involves the use of air-scent dog and handler teams trained and equipped to specifically search collapsed structures. The dog and handler work as a team to identify the location and status of victims buried beneath rubble or structural components. It is important that the AHJ differentiate between structural collapse search dogs and other "air-scenting" dogs such as those used to search for drugs and explosives, cadaver dogs, and police K-9.

(b) *Electronic Search.* This involves the use of acoustic/seismic devices and includes the deployment of an array of two or more pickup probes around the perimeter of a collapsed structure or void area.

(c) *Search Cameras.* This involves the placement of a search camera device within a void area to search "visually" a previously nonvisible collapse zone. To use this device, ancillary tools such as rotary hammers, drills, or breakers are needed to create an opening through which the camera can be passed.

(d) *Air Sampling.* Identification of high concentrations of CO_2, for example, might indicate the presence of a live victim.

Once the AHJ has identified the location and the availability of these search options, a system should be developed to place them into operation at a structural collapse incident.

In conjunction with the capability of the AHJ to place into operation one or more of the previously described search methods, personnel should implement a strategic and tactical plan for the use of these devices as quickly as possible. Personnel should coordinate all available and viable tactical capabilities into a logical plan of operation.

It is essential that the AHJ employ every possible search method to ensure that its members are able to locate viable victims before committing rescue resources to any prolonged (although well-intentioned) operation.

A-3-3.3(c) Access training shall include, but shall not be limited to, the following:

(a) Techniques to lift safely and effectively structural components of walls, floors, or roofs

(b) Shoring techniques to safely and effectively construct temporary structures needed to stabilize and support structural components to prevent movement of walls, floors, or roofs

(c) Breaching techniques to safely and effectively create openings in structural components of walls, floors, or roofs

(d) Operation of appropriate tools and equipment to accomplish the above tasks safely and effectively

A-3-3.3(d) Extrication operations at a structural collapse incident necessitate a coordinated effort that includes search, rescue, and medical capabilities. Personnel should have a working knowledge of general extrication tactics and procedures. These tactics and procedures should be flexible enough to address the specific situation and problems encountered. The AHJ should provide the appropriate training and equipment necessary to complete an extrication operation safely and effectively. These should include the following:

(a) *Manual.* Training should be provided in safe lifting techniques necessary to move manageable sections of debris and interior contents displaced by partial or complete structural collapse.

(b) *Hand Tools.* Tools and training necessary to move debris, room contents, and structural components displaced by partial or complete structural collapse should be provided. Hand tools should include, but not be limited to, pry bars, bolt cutters, jacks, and sledge hammers. Training requirements should be coordinated with the hand tool inventory.

Extrication training should include the following, as a minimum:

(a) Packaging victims within confined areas

(b) Removing victims from elevated or below-grade areas

(c) Providing initial medical treatment to victims

(d) Operating appropriate tools and equipment to accomplish the above tasks safely and effectively

A-3-4.3(b) See A-3-3.3(b).

A-3-4.3(c) Generally in concrete tilt-up, reinforced concrete, and steel construction, locating and extricating victims is more complicated than in light-frame, ordinary construction or reinforced and unreinforced masonry construction. As structural components, materials, and weights increase, the ability to breach, stabilize, and operate within such a structural collapse becomes more hazardous, complicated, and time consuming.

The overall ability of the AHJ to function safely and effectively is greatly dependent upon the prompt availability of appropriate tools, equipment, and supplies to accomplish operations.

In concrete tilt-up, reinforced concrete, and steel construction, personnel should understand that the tools needed change depending on the type of structure involved. Structural collapse incidents involving these categories of construction necessitate the use of tools and equipment specifically designed for these materials, including the following:

(a) Masonry saws and blades
(b) Rotary hammers and breakers
(c) Air bags
(d) Dump trucks and front-end loaders
(e) Concrete saws and blades
(f) Pneumatic and hydraulic drills, hammers, and breakers
(g) Cranes
(h) Burning and cutting equipment such as oxyacetylene and exothermic or plasma cutters
(i) Bolting and anchoring systems

Power tools (e.g., air bags, hydraulic spreaders and rams, and power saws) and training necessary to breach, cut, bore, and lift structural components displaced by partial or total structural collapse should be provided.

A-3-4.3(d) See A-3-3.3(d).

A-4-1.2 In all types of technical rescue incidents, the potential exists for extenuating circumstances that would require expertise beyond the normal capability of the organization to safely operate. Examples of these situations include lowering and raising operations requiring significant obstacle negotiation, descending or ascending operations from extreme heights, or severe environmental conditions (e.g., snow and rain). These conditions should be evaluated during the initial risk assessment and on an incident-by-incident basis.

A-4-2.2(a) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(a) Scope, magnitude, and nature of the incident
(b) Location and number of victims
(c) Risk versus benefit analysis (body recovery versus rescue)
(d) Access to the scene
(e) Environmental factors
(f) Available/necessary resources
(g) Patient contact when it can be performed without endangering either responders or victims

A-4-2.2(b) See A-3-2.2(b).

A-4-2.2(c) The emergency response system includes, but is not limited to, operations- and technician-level personnel, as well as local, state, and federal resources.

A-4-2.2(d) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This process might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A-4-2.2(e) General hazards associated with rope rescue operations can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members.

(a) *Fall Hazards.* Rope rescue incidents are often required in areas where elevation differential exists. Therefore, the possibility of someone falling, or something falling on someone, should always be considered and mitigated.

(b) *Other Hazards.* There are numerous other hazards associated with rope rescue operations. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide members with training and awareness of these other hazards in order to perform rescue operations safely and effectively.

The "general area" around a rope rescue scene is the entire area within 300 ft (91.44 m) (or more, as established by the incident commander). Making the general area safe includes, but is not necessarily limited to, the following:

(a) Controlling/limiting traffic and sources of vibration in the area, including shutting down all vehicles and equipment
(b) Controlling/limiting access to the area by unnecessary personnel
(c) Identifying hazards and removing and/or reducing their impact

A-4-2.2(f) Other than that described in 2-4.2, specific PPE necessary for safe rope rescue operations can include, but not be limited to, the following:

(a) Harnesses
(b) Gloves appropriate for rope rescue work
(c) Helmets designed for climbing and rope rescue work

A-4-3.2(c) An "anchor system" includes, if necessary, an appropriate and proper backup.

Anchor systems can include, but are not limited to, the use of portable anchor systems (either improvised or commercial) such as A-frames, bipods, tripods, pickets, and gin poles.

A-4-3.2(e) The skills and procedures required to select, construct, and use a lowering system vary greatly depending on environmental factors and elevation differential (height). Therefore, rescuers should be trained to perform these procedures under the environmental (e.g., snow, darkness, wind) and elevation (e.g., potential height) conditions.

A-4-3.2(f) Rescuers should be able to identify a tied knot. Specific knots, hitches, and bends that can be useful include the following:

(a) Bowline
(b) Figure-eight family of knots and bends
(c) Grapevine or double fisherman's knot
(d) Water knot
(e) Barrel knot
(f) Any knots, hitches, or bends used by the organization

A-4-3.2(g) Safety procedures should include, as a minimum, the following:

(a) Edge protection
(b) Belays
(c) Critical angles in rope systems
(d) System stresses
(e) Safety checks
(f) Other safety assurances

A-4-3.2(j) A counter-balance system is a type of raising system *(see definitions in Chapter 1).*

A-4-4.2(c) See A-4-3.2(j).

A-5-1.2 In all types of confined space rescue incidents, the potential exists for extenuating circumstances that would require expertise beyond the normal capability of the organization to safely operate. Examples of these situations can include, but are not limited to, deep or isolated spaces, multiple complicating hazards (e.g., water, chemicals, and extreme height in a space), failure of essential equipment, or severe environmental conditions (e.g., snow and rain). These conditions should be evaluated during the initial risk assessment and on an incident-by-incident basis.

A-5-1.3 While much of this chapter applies to confined space rescue in industrial settings, it is intended for all incidents involving confined spaces as defined within this standard.

A-5-2.2(a) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(a) Scope, magnitude, and nature of the incident
(b) Location, number, and condition of victims
(c) Risk versus benefit analysis (body recovery versus rescue)
(d) Access to the scene
(e) Environmental factors
(f) Available/necessary resources
(g) Establishment of control perimeter

A site safety plan can also provide useful information for consideration during size-up and should include the following:

(a) Rescue team notification
(b) Acceptable entry conditions for rescue
(c) Hazard analysis
(d) Risk analysis of hazards
(e) Site map
(f) Hazard abatement (including control zones, ventilation, and lockout/tagout procedures)
(g) Use of buddy system (when applicable)
(h) Communications (e.g., site, rescue attendant to rescue entrant)
(i) Command post
(j) Incident management organizational chart
(k) Standard operating guidelines
(l) Safe work practices
(m) Medical assistance
(n) Pre-entry safety briefings
(o) Pre-/post-entry physicals (if indicated)

A-5-2.2(c) Hazards can include, but are not limited to, the following:

(a) Hazardous atmospheres
(b) Hazardous chemicals
(c) Temperature extremes

Some methods of recognition and assessment of hazards associated with confined spaces include, but are not limited to, the following:

(a) Assessment of the perimeter surrounding the confined space incident to determine the presence of or potential for a hazardous condition that could pose a risk to rescuers during approach
(b) Recognition of the need for decontamination of a patient or responder who might have been exposed to a hazardous material as per NFPA 471, *Recommended Practice for Responding to Hazardous Materials Incidents,* NFPA 472, *Standard for Professional Competence of Responders to Hazardous Materials Incidents,* and 29 *CFR* 1910.120, *U.S. Federal OSHA Standard on Hazardous Waste Operations and Emergency Response* (HAZWOPER).
(c) Recognition of the need for a confined space rescue service or additional resources when nonentry retrieval is not possible
(d) Notification of the designated rescue service and other resources necessary for initiation of confined space rescue
(e) Recognition of hazardous atmospheres or materials through visual assessment and information received from on-site personnel

A-5-2.2(d) The term *confined space* as defined within this standard is synonymous with the term *permit-required confined space* or *permit space* used by many U.S. federally regulated agencies.

A-5-2.2(e) Retrieval includes the operation of common nonentry retrieval systems. Examples include simple winch and block devices used in conjunction with tripods, quadpods, or other manufactured portable anchor systems. A nonentry retrieval can simply involve operating the crank on a winch/tripod system when anchors and protection systems are already in place.

A-5-2.2(f) The emergency response system includes, but is not limited to, operations- and technician-level personnel, as well as necessary local, state, and federal resources. In addition, the system includes procurement of on-site information resources such as witnesses, industrial entry supervisors, industrial facility managers, engineers, or other responsible persons. Printed on-site information resources available at many U.S. federally regulated industrial facilities can include, but is not limited to, the following:

(a) Entry permit
(b) Material safety data sheets (MSDS)
(c) Other site work permits

A-5-2.2(g) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This process might include management of all civilian and nonemergency personnel and establishment of operational zones and site security. The organization should also assure through written standard operating guidelines that the scene is rendered safe at the termination of the incident.

A-5-3.3(a) Specific procedures for mitigating hazards at confined space rescue can include, but are certainly not limited to, consideration of the following:

(a) Personal protective equipment (PPE)
(b) Fall protection
(c) Harnesses
(d) Lockout/tagout procedures
(e) Hazard assessment
(f) Scene assessment

Procedures to perform a confined space hazard assessment include, but are not limited to, the following:

(a) Identification of the important industrial documentation, where available, useful in hazard assessment. This includes entry permits, lockout/tagout procedures and checklists, and hot work permits.

(b) Selection of all applicable information necessary for emergency responders from a material safety data sheet (MSDS).

(c) PPE for the hazard as per NFPA 472, *Standard for Professional Competence of Responders to Hazardous Materials Incidents,* and 29 *CFR* 1910.120, *U.S. Federal OSHA Standard on Hazardous Waste Operations and Emergency Response* (HAZWOPER).

Procedures to perform a scene assessment in order to determine the magnitude of the problem in terms of life safety can include, but are not limited to, the following:

(a) The type, size, access, and internal configuration of the confined space
(b) Information regarding current and potential hazards that threaten victims and rescuers
(c) A risk versus benefit analysis concerning the threat to rescuers in relation to the viability of victims

Figure A-5-3.3(a) shows predefined of confined spaces normally found in an industrial setting. Classifying spaces by "types" can be used to prepare a rescue training plan to include representative permit spaces for practicing rescue operations as specified by OSHA. These types focus mainly on the OSHA-specified criteria of opening size, configuration, and accessibility. Another important factor to consider is the internal configuration (congested or noncongested) of the permit required confined space.

The following are definitions for types of confined spaces normally found in an industrial setting, as shown in Figure A-5-3.3(a).

(a) *Diagonal Portal.* Plane of manway or portal is at an angle (between perpendicular and parallel to the ground). To be considered as a vertical entry/horizontal portal.

(b) *Elevated Portal.* Bottom of passageway is 4 ft (1.22 m) or higher from ground level.

(c) *Horizontal Entry.* Access passageway is entered traveling parallel to ground level through a vertical portal.

(d) *Manway or Portal.* An internal or external opening large enough for a person to pass through.

(e) *Rectangular/Square Portal.* A four-sided opening with four right angles. Opening size is determined by measuring the shortest side of the opening.

(f) *Rounded/Oval Portal.* A circular or elliptical opening; also any polygon not having exactly four sides. Opening size is determined by measuring the smallest inside diameter.

(g) *Vertical Entry.* Access passageway is entered traveling perpendicular to ground level through a horizontal portal.

A-5-3.3(b) The assessment at this level should include, but not be limited to, the initial and continuous evaluation of the following:

(a) Hazards such as engulfment potential, environmental (e.g., chemical, atmospheric, temperature), harmful forms of energy (e.g., electrical, mechanical, movement due to gravity, hydraulic), configuration hazards (e.g., diverging walls, entrapment, obstructions, trip/fall hazards), and so forth
(b) Risk versus benefit analysis (body recovery versus rescue)
(c) Available/necessary additional resources
(d) Establishment of control zones
(e) Magnitude of the hazard and isolation procedures
(f) Effectiveness of the nonentry or qualifying entry-type rescue
(g) Overall safety of rescue operations
(h) Level of rescue response (appropriate for the type of rescue being attempted)
(i) Current and projected status of the planned response
(j) Personnel accountability

A-5-3.3(c) The AHJ should address the possibility of members of the organization having physical and/or psychological disorders (e.g., physical disabilities, fear of heights, fear of enclosed spaces) that could impair their ability to perform rescue in confined spaces.

A-5-3.3(d) Roles, functions, and responsibilities for these team positions should be consistent with the organization's standard operating guidelines for confined space rescue.

A-5-3.3(e) Personnel meeting the requirements of NFPA 472, *Standard for Professional Competence of Responders to Hazardous Materials Incidents,* should perform the monitoring procedures even if such personnel are not part of the rescue team.

Monitoring the atmosphere can include the following considerations:

(a) Acceptable limits for oxygen concentration in air should be between 19.5 percent and 23.5 percent. An oxygen-enriched atmosphere is considered to be greater than 23.5 percent and poses a flammability hazard. An oxygen deficient atmosphere is considered to be lower than 19.5 percent and can lead to asphyxiation without fresh-air breathing apparatus.

(b) Flammability is measured as a percentage of a material's lower explosive limit (LEL) or lower flammable limit (LFL). Rescuers should not enter confined spaces containing atmospheres greater than 10 percent of a material's LEL regardless of the personal protective equipment worn. There is no adequate protection for an explosion within a confined space.

(c) Acceptable toxicity levels are specific to the hazardous material involved, and chemical properties should be assessed to determine the level of the hazard for a given environment and time frame.

The confined space rescue team at the operations level should have available resources capable of understanding the assessment tools necessary for analysis and identification of hazardous conditions within confined spaces and interpretation of that data. This capability should include at least the following:

(a) Identification of the hazards found within confined spaces and understanding how those hazards influence victim viability and rescue/recovery operations

(b) Selection and use of monitoring equipment to assess the following hazards:

1. Oxygen-deficient atmospheres
2. Oxygen-enriched atmospheres
3. Flammable environments
4. Toxic exposures
5. Radioactive exposures
6. Corrosive exposures

CS TYPE 1 / 1E — elevated
Portal size: Less than 24 in.
Configuration: Round / oval
Accessibility: Horizontal entry (vertical portal)

CS TYPE 2 / 2E — elevated
Portal size: 24 in. or larger
Configuration: Round / oval
Accessibility: Horizontal entry (vertical portal)

CS TYPE 3 / 3E — elevated
Portal size: Less than 24 in.
Configuration: Square / rectangle
Accessibility: Horizontal entry (vertical portal)

CS TYPE 4 / 4E — elevated
Portal size: 24 in. or larger
Configuration: Square / rectangle
Accessibility: Horizontal entry (vertical portal)

***CS TYPE 5 / 5E** — elevated
Portal size: Less than 24 in.
Configuration: Round / oval
Accessibility: Vertical top entry (horizontal portal)

***CS TYPE 6 / 6E** — elevated
Portal size: 24 in. or larger
Configuration: Round / oval
Accessibility: Vertical top entry (horizontal portal)

***CS TYPE 7 / 7E** — elevated
Portal size: Less than 24 in.
Configuration: Square / rectangle
Accessibility: Vertical top entry (horizontal portal)

***CS TYPE 8 / 8E** — elevated
Portal size: 24 in. or larger
Configuration: Square / rectangle
Accessibility: Vertical top entry (horizontal portal)

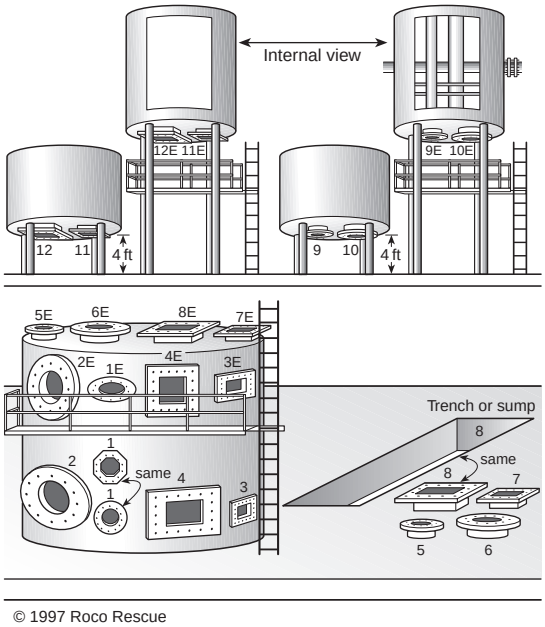
CS TYPE 9 / 9E — elevated
Portal size: Less than 24 in.
Configuration: Round / oval
Accessibility: Vertical bottom entry (horizontal portal)

CS TYPE 10 / 10E — elevated
Portal size: 24 in. or larger
Configuration: Round / oval
Accessibility: Vertical bottom entry (horizontal portal)

CS TYPE 11 / 11E — elevated
Portal size: Less than 24 in.
Configuration: Square / rectangle
Accessibility: Vertical bottom entry (horizontal portal)

CS TYPE 12 / 12E — elevated
Portal size: 24 in. or larger
Configuration: Square / rectangle
Accessibility: Vertical bottom entry (horizontal portal)

** Could include open sumps, pits, tanks trenches, and so forth.*



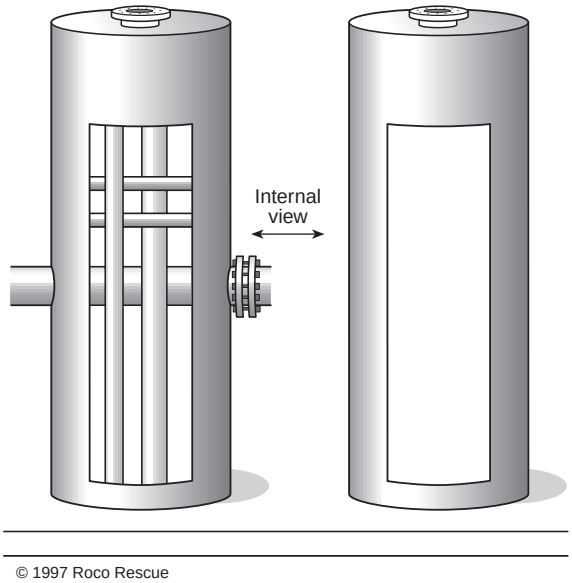


Figure A-5-3.3(a) Confined space types for rescue training purposes.

(c) Understanding of the limiting factors associated with the selection and use of the atmospheric and chemical monitoring equipment provided by the AHJ for confined space emergencies. This equipment could include, but is not limited to, the following:

1. Calorimetric tubes
2. Oxygen concentration monitor (continuous reading, remote sampling)
3. Combustible gas monitor (continuous reading, remote sampling)
4. Specific toxicity monitor (continuous reading, remote sampling)
5. Multigas atmospheric monitors (continuous reading, remote sampling)
6. Passive dosimeter
7. pH papers, pH meters, and pH strips
8. Radiation detection instruments

The factors given in 1 through 8 include, but are not limited to, calibration, proper operation, response time, detection range, relative response, sensitivity, selectivity, inherent safety, environmental conditions, and nature of hazard.

(d) Utilization and evaluation of reference terms and resources to include, but not be limited to, the following:

1. Lethal concentration-50 (LC-50)
2. Lethal dose-50 (LD-50)
3. Permissible exposure limit (PEL)
4. Threshold limit value (TLV)
5. Threshold limit value-short term exposure limit (TLV-STEL)
6. Threshold limit value-time weighted average (TLV-TWA)
7. Immediately dangerous to life and health (IDLH)
8. Material safety data sheets
9. Reference manuals
10. Computerized reference databases
11. Technical information centers
12. Technical information specialists
13. Monitoring equipment

A-5-3.3(f) The intent of this paragraph is to restrict entries made by operations-level organizations to those that would absolutely minimize risk to rescue entrants. It is the intent of this document that operations-level teams not perform hazardous entries.

A-5-3.3(f)(1) The intention of this paragraph is to limit the danger of entanglement.

A-5-3.3(f)(2) The intention of this paragraph is to ensure that the attendant can maintain direct observation of the entrants at all times, making recognition of problems more rapid.

A-5-3.3(f)(3) The intention of this paragraph is to allow for easier retrieval of rescue entrants should this become necessary and to provide for passage through the opening without removal of necessary personal protective equipment, including fresh-air breathing apparatus.

A-5-3.3(f)(4) The intention of this paragraph is to allow a "buddy system" to be employed, providing potentially faster response to a problem with one of the rescue entrants.

A-5-3.3(f)(5) The intention of this paragraph is to ensure that hazards to rescuers in organizations at this level are kept to an absolute minimum.

A-5-3.3(g) Packaging devices that can be used in confined spaces include, but are not limited to, the following:

(a) Full spine immobilization devices
(b) Short spine immobilization devices
(c) Cervical spine immobilization devices
(d) Litters
(e) Prefabricated full-body harnesses
(f) Tied full-body harnesses
(g) Wrist loops (wristlets)

A-5-3.3(i) Guidelines for initial response planning within the quantity and capability of available personnel and equipment should include, but are not limited to, the following:

(a) Response objectives for confined space emergencies
(b) Nonentry rescue options
(c) Entry-type rescue options
(d) Determination of whether rescuer and equipment capabilities are appropriate for available rescue options
(e) Needs analysis and procedures for providing emergency decontamination to victims suspected of being contaminated with a hazardous material

[See Figure A-5-3.3(i).]

Operational procedures for response implementation should include, but are not limited to, the following:

(a) Scene control procedures including control zones and communication
(b) Incident management system consistent with the organization's standard operating procedure
(c) Nonentry retrieval
(d) Qualifying entry-type rescues
(e) Emergency decontamination as needed
(f) Technical-level rescue service assistance

A-5-3.3(j) Organizations at the operations level are expected to safely apply lowering and raising systems (rope or nonrope based) as appropriate during confined space emergencies. These applications can involve the use of rope rescue systems in the high-angle environment to both lower rescuers into and remove rescuers and victims from confined spaces. The determination of what systems are most appropriate to accomplish these tasks should be dictated by the circumstances surrounding the incident.

A-5-4.2(a) The size-up/assessment at this level should include, but not be limited to, the initial and continuous evaluation of the following:

(a) Available/necessary additional resources
(b) Hazard isolation and control requirements.

A-5-4.2(b) Procedures should be consistent with local, state, and federal guidelines such as those found in 29 *CFR* 1910.120, *U.S. Federal OSHA Standard on Hazardous Waste Operations and Emergency Response* (HAZWOPER).

A-5-4.2(c) Planning response for entry-type rescues with hazards should consider the following issues:

(a) Options for entry-type confined space rescues beyond the capability of operations-level personnel

(b) Selection, use, maintenance, and training relative to personal protective clothing and equipment provided by the AHJ for operating in and around confined space emergencies

(c) Determination of response objectives based on circumstances of the confined space emergency. The response objective can involve any one of the following:

Confined Space Rescue Preplan

Date:

Space Designation: *(unit / vessel name and ID number)*	**Space Location:**
Staging Area:	
Space Category: ❑ Category I — Rescue Available (RA) ❑ Category II — Rescue Stand-by (RS)	**Space Type (1–12):** _____ Elevated: Y N Congested Y N

Means to Summons Rescue Service:
❑ Phone ❑ Pager ❑ Radio ❑ Audible signal ❑ Intercom ❑ Other _____

Method of Rescue: ❑ *Confirm that attendant has been trained in emergency response procedures.*

❑ External (retrieval):	❑ Internal: _____ (congested: _____)
❑ Hauling system required	❑ Victim-lowering system required / lowering area: _____
❑ Anchorage: overhead: _____	Pre-rigging required? ❑ Yes ❑ No

Anchorage: ❑ Beam ❑ Welded steel handrail ❑ Support strut ❑ Other: _____
❑ Stairwell ❑ Anchored steel pipe ❑ Support column

Suggested CSR Preplanned Technique: CSR#_____ (1–5)

Rescue Equipment Requirements: *(Indicate quantity needed)*

	Hauling systems		Carabiners		Pulleys
	Ascenders		Prusiks		Shock absorbers
	Anchor straps		Webbing		Rigging bags

Rescue Ropes Needed: *(Indicate quantity needed)*

	Main line(s)		Hauling systems		Lowering line(s)
	Safety line(s)		Line-transfer system(s)		

Medical and Packaging Equipment Needed: *(Indicate quantity needed)*

	Spinal immobilization device:		Stretcher device:
	C-collar:		Medical kit:

Additional PPE: *(See permit / MSDS)*

Designation of Rescue Personnel: *(Last name, first initial)*
- First responder(s): _____
- Team leader: _____
- Safety line(s): _____
- Back-up rescuer: _____
- Rigger: _____
- Attendant: _____
- Air watch: _____

Space Description:

Sketch or Diagram of Space: *(Use back of page if needed)*

Entry supervisor:	Phone:	Date:
Report completed by:		

Figure A-5-3.3(i) Confined space rescue preplan.

1. Victim rescue
2. Victim recovery
3. Remote extrication
4. Nonintervention

(d) Verification of the need for emergency decontamination

(e) Development of a plan of action, including safety considerations, consistent with the organization's standard operating guidelines, for entry-type confined space rescue. Components of a typical action plan might include the following:

1. Site assessment
2. Confined space assessment
3. Resource organization and accountability (IMS)
4. Perimeters and control zones
5. Hazard evaluation
6. A comprehensive risk/benefit analysis that evaluates the viability of the victim
7. Personal protective equipment
8. Chemical protective clothing
9. Specialized rescue equipment
10. Rescue/recovery objectives
11. On-scene work assignments
12. Communications procedures
13. Emergency decontamination procedures (victim)
14. Decontamination procedures (rescuers)
15. On-scene safety and health procedures including personnel health monitoring, on-scene rehabilitation, emergency medical care procedures, and the designation of a safety officer
16. Scene termination procedures

(f) Implementation of the planned response to successfully rescue or recover victims from confined spaces by completing the following tasks:

1. Perform the duties of an assigned position within the local incident management system (IMS)
2. Perform entry-type rescues from confined spaces
3. Perform support functions for entry-type rescues from confined spaces
4. Don, safely operate, and doff appropriate personal protective clothing including, but not limited to, liquid splash protection and vapor protective clothing, which might be required when operating around the scene of confined space emergencies involving hazardous materials

(g) Development of procedures that include required equipment and safety precautions for the following entry-type confined space rescues:

1. Vertical rescue
2. Horizontal rescue
3. Suspended victim rescue
4. Entrapped or engulfed victim (collapse, particulate matter, etc.)

A-5-4.2(d) See 5-4.2(c).

A-6-1.1 It is the intent of this provision that the AHJ, as part of the hazard analysis and risk assessment, identify the types of vehicles and machinery within their response area. These types can include, but are not limited to, cars, trucks, buses, trains, mass transit systems, aircraft, watercraft, agriculture implements, industrial/construction machinery, and elevators/escalators. The AHJ should develop procedures and provide training to personnel that is commensurate with the potential for rescue situations involving the above-mentioned vehicles and machinery.

A-6-1.2 In all types of vehicle and machinery rescue incidents, the potential exists for extenuating circumstances that would require expertise beyond the normal capability of the organization to safely operate. Examples of these situations can include, but are not limited to, complex and/or unusual machinery, unusual vehicles, unusual locations of either machinery or vehicles, multiple complicating hazards (e.g., water, chemicals, and extreme height), failure of essential equipment, or severe environmental conditions (e.g., snow and rain). These conditions should be evaluated during the initial risk assessment and on an incident-by-incident basis.

A-6-2.2(a) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(a) Scope and magnitude of the incident

(b) Risk/benefit analysis (body recovery versus rescue)

(c) Number/size of vehicles and/or machines affected

(d) Integrity and stability of vehicles and/or machines affected

(e) Number of known/potential victims

(f) Access to the scene

(g) Hazards such as disrupted or exposed utilities, standing or flowing water, mechanical, hazardous materials, electrical, and explosives

(h) Exposure to traffic

(i) Environmental factors

(j) Available/necessary resources

A-6-2.2(b) See A-2-2.5.

A-6-2.2(c) The emergency response system includes, but is not limited to, operations- and technician-level personnel, as well as local, state, and federal resources.

A-6-2.2(d) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A-6-2.2(e) General hazards associated with rescue operations at vehicle and/or machinery rescue incidents can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members.

(a) *Utilities.* Control of the utilities in and around a vehicle and/or machinery rescue incident is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services in order to provide a safe environment in which to operate and to ensure the safety of victims. The following utilities should be considered when providing training:

1. Electrical services (primary and secondary)
2. Gas, propane, fuel oil, or other alternative energy sources (primary systems)

3. Water
4. Sanitary systems
5. Communications
6. Secondary service systems (such as compressed, medical, or industrial gases)

(b) *Hazardous Materials.* Vehicle and/or machinery rescue incidents might include various materials that, when released during an incident, could pose a hazard to victims and responders. The AHJ should provide members with training in the recognition of potential hazardous material releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials in order to conduct operations safely and effectively.

(c) *Personal Hazards.* At the site of any vehicle and/or machinery rescue incident, there are many dangers that pose personal injury hazards to the responders. The AHJ should train members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards in order to help ensure their safety. Every member should be made aware of hazards such as trips, falls, blows, cuts, abrasions, punctures, impalement, and so forth.

(d) *Movement of Vehicle(s) and/or Machinery.* Uncontrolled movement of vehicle(s) and/or machinery components can cause extremely hazardous and potentially fatal situations. Responding personnel should be familiar with and trained in techniques for stabilizing and removing the potential for movement of vehicle(s) and/or machinery components.

(e) *Release of High-Pressure Systems.* Vehicles and machinery often include high-pressure systems (e.g., hydraulic, pneumatic) that can fail without warning. Such failure can cause extremely hazardous conditions, injury, and death of victims and responders. The AHJ should provide members with training in the recognition of potential high-pressure system hazards, the determination of an existing hazard, and the methods used to contain, confine, or divert such hazards in order to conduct operations safely and effectively.

(f) *Other Hazards.* There are numerous other hazards associated with vehicle and/or machinery rescue incidents. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide members with training and awareness of these other hazards in order to perform rescue operations safely and effectively.

A-6-3.3(b) The rescue area is that area immediately surrounding [within a 20-ft (6.10 m), or so, radius] the vehicle and/or machinery. Making the rescue area safe includes, but is not limited to, the following actions; however, specific actions should be based on the vehicle/machinery type and specific situation.

(a) Establishing operational zones (i.e., hot, warm, cold) and site security
(b) Utilizing specific techniques and tools (including cribbing, chocks, and wedges) to stabilize the vehicle
(c) Utilizing specific techniques and tools (i.e., lockout and tagout) to isolate the involved equipment
(d) Making the rescue area (i.e., hot zone) safe for entry
(e) Safely undertaking disentanglement and/or extrication operations using hand tools
(f) Ventilating the rescue area and monitoring its atmosphere when necessary
(g) Supporting any unbroken utilities
(h) Providing protective equipment for any victims, if possible, when necessary
(i) Prohibiting entry into an unsafe vehicle and/or machinery rescue area
(j) Preventing the touching or operating of equipment or machinery involved until its safety has been established

A-6-3.3(g) In order to perform a safe disentanglement and/or extrication operation, the AHJ should provide training on the following topics:

(a) Types of passenger restraint systems
(b) Frame and construction features of vehicles
(c) Types of suspension systems in vehicles
(d) Types and classification of impacts
(e) Categories of mechanical injury
(f) Various stabilization techniques
(g) Center of gravity and its relationship to rollover
(h) Use of cribbing and chocks
(i) Building a crib box
(j) Types and examples of levers for mechanical advantage
(k) Proper and effective use of hand tools including a hammer, pry bar, hack saw, glass punch, Halligan, knife/belt cutter, cable cutter, and come-a-long
(l) Disentanglement through primary access points
(m) Patient packaging prior to removal from a vehicle and/or machine
(n) Protection of the victim during extrication and/or disentanglement operations

A-6-3.3(h) These procedures refer to the mitigation and management of the hazards identified in A-6-2.2(e).

A-6-4.2(a) In order to perform a safe disentanglement and/or extrication operation from large/heavy vehicles and/or machines, the AHJ shall provide training on the following topics:

(a) Frame and construction features of heavy/large vehicles and machinery
(b) Use and components of a rescue chain assembly
(c) Pneumatic high-, medium-, and low-pressure lifting bags
(d) Use, care, and maintenance of wire rope and its associated equipment
(e) Large and heavy object weight estimation
(f) Steps necessary to lift and/or move large objects
(g) Use of cribbing and chocks with large and heavy objects
(h) Use of commercial heavy wreckers and recovery services to assist at incidents involving large transportation vehicles
(i) Use, care, and maintenance of both manual and power winches
(j) Types and examples of lifting devices that use mechanical advantage principles
(k) Proper and effective use of power tools including hydraulic, pneumatic, and electrical spreading, cutting, lifting, and ram-type tools
(l) Disentanglement through both primary and secondary access points through the use of available power tools
(m) Protection of the victim during this type of extrication and/or disentanglement operations
(n) Lockout/tagout of machinery
(o) Identification and use of various sling configurations

A-6-4.2(b) "Unusual" situations include, but are not limited to, extrication and/or disentanglement operations at inci-

dents involving cars on their tops, cars on their sides, and cars on top of other cars, trucks, and large commercial vehicles.

"Advanced stabilization" includes techniques using chains, cables, jack devices, and cribbing/shoring to stabilize vehicles of any size.

A-6-4.2(c) Power tools (e.g., air bags, hydraulic spreaders and rams, hand tools, and power tools) and training necessary to remove, cut, and move components displaced at a vehicle and/or machinery rescue incident should be provided.

"Specialized rescue equipment" can include, but is not limited to, hydraulic, pneumatic, and electrical spreading, cutting, lifting, and ram-type tools immediately available and in use by the organization.

A-7-1.2 In all types of water incidents, the potential exists for extenuating circumstances that would require expertise beyond the normal capability of the organization to safely operate. Examples of these situations include, but are not limited to, depth, current, water movement, water temperature extremes, or severe environmental conditions (e.g., snow and rain). These conditions should be evaluated during the initial risk assessment and on an incident-by-incident basis.

A-7-2.2(a) The assessment phase includes size-up *[see A-7-2.2(b)]* as well as an evaluation of the subject's condition and the subject's ability to assist in his or her own rescue.

Consideration should be given to the need for dive rescue early in the size-up/assessment phase. The best intended surface rescue can eventually require dive capability.

A-7-2.2(b) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(a) Scope, magnitude, and nature of the incident
(b) Location and number of victims
(c) Risk/benefit analysis
(d) Separation, isolation, security, and interviewing of witnesses
(e) Hazards such as disrupted or exposed utilities, standing or flowing water, mechanical, hazmat, and explosives
(f) Access to the scene
(g) Environmental factors
(h) Resource assessment, internal and external
(i) Rescue verses recovery

A-7-2.2(c) See A-2-2.5.

A-7-2.2(d) The emergency response system includes, but is not limited to, operations- and technician-level personnel, as well as local, state, and federal resources.

A-7-2.2(e) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A-7-2.2(f) General hazards associated with water search and rescue operations can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members.

(a) *Utilities.* Control of the utilities in and around a water incident is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services in order to provide a safe environment in which to operate and to ensure the safety of victims. The following utilities should be considered when providing training:

1. Electrical services (primary and secondary)
2. Gas, propane, fuel oil, or other alternative energy sources (primary systems)
3. Water/steam
4. Sanitary systems
5. Communications
6. Secondary service systems (such as compressed, medical, or industrial gases)

(b) *Hazardous Materials.* Water incident sites might include various materials unique to a site that, when released during a rescue, could pose a hazard to victims and responders. The AHJ should provide members with training in the recognition of potential hazardous material releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials in order to conduct operations safely and effectively.

(c) *Personal Hazards.* At the site of any water incident, there are many dangers that pose personal injury hazards to the responders. The AHJ should train members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards in order to help ensure their safety. Every member should be made aware of hazards such as trips, falls, blows, punctures, impalement, and so forth.

(d) *Confined Space.* Some water incident sites necessitate a confined space rescue. Responding personnel should be familiar with and trained in confined space rescue requirements and techniques. The AHJ should determine the applicable laws and standards related to confined space rescue and should provide training to members in confined space rescue.

(e) *Hazards That Are Immediately Dangerous to Life and Health.* These hazards include swift water with currents exceeding that which a person or watercraft can safely and effectively operate.

(f) *Other Hazards.* There are numerous other hazards associated with water rescues. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide members with training and awareness of these other hazards in order to perform rescue operations safely and effectively.

(g) *General Area.* The general area around a water incident site is the entire area around a rescue site. Any member operating within the vicinity of the water's edge can accidentally enter the hazard zone. PPE should be utilized accordingly. Making the general area safe includes, but is not necessarily limited to, the following:

1. Controlling/limiting access to the area by unnecessary personnel
2. Identifying hazards and removing and/or reducing their impact
3. Utilizing personal flotation devices (PFDs) and other PPE

A-7-3.3 Certain jurisdictions might not need to achieve operational capability in one or more specialties. The organization should have the option of selecting those specialties relevant to needs identified in the risk assessment and hazard analysis.

A-7-3.4 Further requirements of PPE are included in 2-4.2 of this standard. This requirement applies to all the described disciplines.

A-7-3.4(c) It is important to note that fire-related PPE such as fire helmets and boots are not typically appropriate for water rescue work and in some cases actually pose a hazard.

A-7-3.5(a) These procedures include, but are not limited to, assuring the wearing of proper PPE, procedural checklists, site security (keep bystanders back), reviewing the operational plan (and one's place in the plan), reviewing communications procedures (rescuer to tender, tender to shore, rescuer to rescuer), reviewing emergency procedures, proper attire for the potential weather, reviewing procedures for equipment handling, and assuring proper rest and attitude for the operation.

Water rescue requires a combination of knowledge, skills, abilities, physical fitness, and judgement to expect positive outcomes. These things are to be gained through a combination of training and experience.

A-7-3.5(b) Hazards to both victim and rescuer include, but are not limited to, the following:

(a) Holes
(b) Strainers
(c) Hydraulics
(d) Low head dams
(e) Debris
(f) Cold water
(g) Currents
(h) Undercuts
(i) Backwash
(j) Outwash
(k) Contamination
(l) Obstructions
(m) Turbidity

A-7-3.5(d) Mechanisms of entrapment include, but are not limited to, the following:

(a) Undercuts
(b) Underwater hazards
(c) Strainers
(d) Hydraulics

A-7-3.5(e) It is important for the organization to have the capability to continuously evaluate the effectiveness of the chosen plan of action. If the initial plan is not working, or requires modification to ensure safety or effectiveness, the plan should be changed. The potential for "tunnel vision" (a narrow focus excluding important influences) should be considered by those running the operation.

A-7-3.5(f) Shore-based rescues include, but are not limited to, reaching to a victim, throwing something to a victim (e.g., rope, buoy), and talking a victim into self-rescue.

Many readily available items found on shore can be used to reach to a victim in the water while not exposing the rescuer to undue risk. Important aspects of reaching techniques include body position and reaching device selection (i.e., anything that can be used to extend a rescuer's reach).

Many items (e.g., throw bag, PFD, ring buoy, manufactured floatation or rope-throwing devices) found on shore can be thrown to a victim and used either as flotation or to pull the victim to shore.

A-7-3.5(g) The accurate use of throw bags takes practice and knowledge of proper body position, throwing technique, rope retrieval technique, and target selection (e.g., upstream in moving water, slightly beyond the victim).

A-7-3.5(h) Members of organizations at the operations level should have the ability to assist other rescue personnel with the construction of rope rescue systems. Skills involved in supplying this assistance include, but are not limited to, equipment identification, knot-tying capability, and limited knowledge of how the applicable rope rescue equipment should be used.

A-7-3.5(j) Procedures for survival swimming and self-rescue are important because a rescuer might find him- or herself unintentionally in the water. These procedures should include, but are not limited to, the ability to float and swim with and without floatation, the ability to conserve body heat while immersed in water (heat escape lessening position), the ability to use one's clothing for floatation, and the ability to remove one's self from the water by climbing into a boat, exiting at shore, or exiting from a pool's edge.

A-7-3.5(k) Environmental conditions like weather and temperature play an important role in a rescuer's safety and comfort. Cold temperatures can lead to hypothermia and/or local cold injuries that can seriously impair a rescuer's ability to think and act. Wetness, through perspiration or from the environment, can substantially increase the speed at which a rescuer becomes affected by cold. Therefore, thermal protection from the elements is essential for safe operations in cold and wet environments.

It is also very important to note that all environments can lead to heat stress as well. For example, much of the apparel designed for rescue operations serves to protect the rescuer from heat loss and wet by being waterproof and insulating its wearer from the ambient environment. Unfortunately, a side effect of such garments is the serious impairment of the body's most effective means of thermal regulation: the evaporation of perspiration from the skin. In all environments and conditions, rescuers wearing proper PPE will require great attention to the substantial potential for thermal stress (e.g., overheating). Pre-operation physical exams, appropriate hydration/nutrition, and monitored rehabilitation are essential for safe operations and healthy personnel.

A-7-3.5(m) The regular use of an approved form for the collection and transfer of this information is recommended.

A-7-3.5(n) Boat-based operations include, but are not limited to, the capability to perform surface support operations from within a boat while in surf, on the water, or on ice (whichever is applicable).

A-7-3.5(p) Accessible victims are those who can be retrieved without the rescuer having to venture out onto the ice or into the water.

A-7-3.6(a) Hazards associated with dive operations include, but are not limited to, the following:

(a) Barotrauma (decompression sickness, nitrogen narcosis, oxygen toxicity, etc.)
(b) Drowning
(c) Hyperventilation, hypercarbia, and other respiratory problems
(d) Anxiety reactions
(e) Fatigue and exhaustion
(f) Dehydration (electrolyte imbalances)
(g) Heat stress (i.e., heat exhaustion, stroke, and cramps)
(h) The combination of prescription medication or smoking and diving

(i) Pre-existing medical conditions or injuries
(j) Hypothermia

A-7-3.6(b) Surface support personnel are called upon to assist technicians in preparing to dive, dress, and equip divers; provide search pattern control and direction; monitor divers' time, depth, dive profile, and air supply; and provide a communication link to the surface via electronic communication equipment or manual rope pull signals.

A-7-3.6(d) Surface support personnel should be capable of recognizing, maintaining, and operating all surface support equipment used by the organization.

A-7-3.6(g) Unusual or extreme environmental conditions can require very specialized dive and/or surface support training specific to the situation(s) encountered. *(See A-7-4.7.1 for some specialty examples.)*

A-7-3.7(a) Hazards associated with ice rescue include, but are not limited to, the following:

(a) Hypothermia
(b) Localized cold injuries (i.e., frostbite, frostnip)
(c) Thermal burns from heating devices

A-7-3.7(b) Rescuers should be able to recognize and describe the implication of the following ice and water characteristics:

(a) New (frazil) ice
(b) Candle ice
(c) Old (rotten) ice
(d) Clear (hard) ice
(e) Milk ice
(f) The depth of ice and how it relates to carrying capacity
(g) Water currents and how they relate to ice thickness
(h) Obstacles and how they relate to current and ice formation
(i) Salt water and ice formation (i.e., sea ice)

A-7-3.7(c) Surface support personnel should be capable of recognizing, maintaining, and operating all surface support equipment used by the organization.

A-7-3.7(e) One component of hypothermia that should be emphasized to cold weather rescuers is the effects of cold weather/water on a victim's ability to help themselves, respond to instructions from rescuers, or assist in his or her rescue.

A-7-3.8(a) Surf hazards include, but are not limited to, the following:

(a) Riptides
(b) Undertows
(c) Currents
(d) Tides
(e) Obstructions
(f) Debris
(g) Cold water
(h) Contamination

A-7-3.8(d) See A-7-3.5(j).

A-7-3.9.2(a) The ability to assess moving water is important for safe operations. Examples of water characteristics and features that should be identifiable include eddies, downstream/upstream "V"s, standing waves, laminar/helical flows, confluence, cushion/pillows, and swift water classifications.

A-7-3.9.2(c) A tag line is a line stretched across a river and brought to the level of a stationary victim. A floating tag line has a floatation device attached to the line to keep the rope on the surface of the water and to provide something for the victim to grasp. A snag line is a variation of the tag line that is weighted to reach an object beneath the surface of the water. A tension diagonal, or zip line, is a line positioned at an angle greater than 45 degrees diagonal to the water's flow and just above the surface of moving water, anchored at both ends and tensioned tightly. This type of taut, diagonal line can be used in a variety of ways as an operational rescue tool.

A-7-3.9.2(d) Swift water self-rescue involves all capabilities discussed in A-7-3.5(j) as well as the capability to swim in current while defending against obstacles that are likely to be encountered.

A common technique used to safely swim in moving water is to swim face up with the feet downstream while using the hands to maneuver (swim). When obstacles such as rocks are encountered the feet can be used to push off. If strainers are encountered that cannot be circumnavigated, the swimmer should make every attempt to swim over (never under or through) them while maneuvering toward a safe shore.

Additional hazards can be found in A-7-3.5(b).

A-7-4.6(c) Boat-assisted operations involve the actual performance of rescue techniques through the use of one or more boats. *[See also A-7-3.5(n).]*

A-7-4.6(d) "Go" techniques include, but are not limited to, the following:

(a) Shallow water crossing
(b) In-water contact rescues with or without floating rescue devices, including rescue tubes, boards, and so forth
(c) Rescuer combat techniques (i.e., blocks/escapes) when conducting in-water contact rescues
(d) The use of specialized PPE (i.e., rescue release personal flotation devices) and other specialized equipment and techniques utilized by the AHJ
(e) Advanced rope rescue techniques including the use of high lines
(f) Other "go" techniques and more advanced options utilized by the AHJ

A-7-4.7.1 Examples of specialty training include dry suit use, full face or light helmet use, underwater communications equipment, deep diving, night/limited visibility, current, polluted water, team operations, leadership, lifting equipment, cave/cavern diving, tidal diving, surface supply diving, ice diving, and underwater tools. Organizations at the technician level can gain knowledge, skills, and abilities necessary to extend their capabilities at a controlled training situation.

Additional areas that might need to be addressed include scene surveys, drowning accidents, operational planning, effective search patterns, electronic equipment (e.g., sonar, underwater video), safety procedures, handling of outside influences, rescue/recovery techniques and procedures, incident management system (IMS), critical incident stress debriefing (CISD), and risk/benefit.

Nationally recognized agencies include, but are not limited to, the following:

(a) PADI (Professional Association of Dive Instructors)
(b) SSI (SCUBA Schools International)
(c) NAUI (National Association of Underwater Instructors)
(d) YMCA (Young Men's Christian Association)

(e) PDIC (Professional Diving Instructor's Corporation)
(f) DRI (Dive Rescue International)
(g) NASDS (National Association of SCUBA Diving Schools)
(h) MDEA (Multinational Diving Educators Association)
(i) IDEA (International Diving Educators Association)
(j) LACUI (Los Angeles County Underwater Instructors)

A-7-4.7.3(a) Training in skin and SCUBA diving should include, but not be limited to, the information conveyed in a nationally recognized skin/SCUBA diving program.

A-7-4.7.3(c) Safe use of dive tables means precise use of nationally recognized dive tables specified for the type of dive operation undertaken.

A-7-4.7.3(h) The treatment of dive-related injuries and maladies is often beyond the capability of standard basic life support (BLS) providers. Therefore, the AHJ should assure that procedures are in place during any dive to provide appropriate emergency medical care for the treatment of dive-related injuries. This can include the training of selected personnel as dive medics (a specialized emergency medical training program) or establishing a standard operating procedure (SOP) to address the situation.

A-7-4.7.3(j) Effective underwater communication refers to the capability to communicate between divers and from a diver to the surface. Such communications can be achieved through the use of rope signals, a hard-wired communications system, a wireless communications system, or whatever system is in use by the organization.

A-7-4.8(a) Self-rescue on ice includes, but is not limited to, the following capabilities:

(a) Roll, crawl, or swim away from an ice hole
(b) Utilize any personal ice rescue equipment used by the organization such as ice awls, crampons, and so forth
(c) Practical methods of weight distribution

A-8-1.2 In all types of wilderness rescue incidents, the potential exists for extenuating circumstances that would require expertise beyond the normal capability of the organization to safely operate. Examples of these situations include lowering and raising operations requiring significant obstacle negotiation, descending or ascending operations from extreme heights, or severe environmental conditions (e.g., snow, rain, altitude). These conditions should be evaluated during the initial risk assessment and on an incident-by-incident basis.

A-8-2.3(a) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(a) Scope and magnitude of the incident including whether it is a search, rescue, or body recovery
(b) Assessment of time required
(c) Assessment of manpower needs
(d) Specific environmental factors involved
(e) Integrity and stability of the environment involved
(f) Number of known/potential victims
(g) Weather (current and forecast)
(h) Urgency (based on the type of known/potential victims)
(i) Available/necessary resources

A-8-2.3(b) The emergency response system includes, but is not limited to, operations- and technician-level personnel, as well as local, state, and federal resources.

A-8-2.3(c) Training should address the process of achieving and maintaining control of the site and the perimeter. This might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A-8-2.3(d) General hazards associated with search and rescue operations in the wilderness can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards and, in order to help ensure their safety, assure members have the ability to recognize potential hazards that they can encounter.

(a) *Personal Hazards.* In the wilderness environment, there are many dangers that pose personal injury and physiological hazards to the responders. Personnel should be made aware of hazards including, but not limited to, blisters, scrapes, scratches, falls, blows, bruises, dehydration, and so forth.

(b) *Environmental Hazards.* Depending on the specific environment, there are many dangers that pose hazards to the responders. Personnel should be made aware of hazards including, but not limited to, insect bites and stings, poisonous plants, exposure injuries (cold and heat), snow blindness, altitude illness, lightning, sunburn, dangerous wildlife, and so forth.

(c) *Terrain Hazards.* Specific features in an environment can pose hazards to responders. Personnel should be made aware of hazards including, but not limited to, cliffs, avalanches, standing water (e.g., ponds, lakes), flat ice (e.g., ponds, lakes), moving water (e.,g., rivers, streams), caves, mines, wells, high winds, snow (blowing and fallen), coastal white water surf, and so forth.

(d) *Man-Made Hazards.* Humans, whether intentionally or accidentally, can also cause unsafe conditions in the wilderness. Personnel should be made aware of hazards including, but not limited to, booby-trapped stills and labs (covert ethanol and drug production), hazardous materials dumps, trained attack dogs (drug labs), and so forth.

A-8-2.3(f) Conventional emergency response PPE and equipment (especially fire-related equipment) is often inappropriate for use in a wilderness setting. For instance, fire helmets and boots can increase one's potential for injury in the wilderness.

Conventional emergency response skills such as using a sphygmomanometer and using an ambulance cot have very little application in the wilderness. Therefore, such skills and equipment will require modification to achieve the rescuer's desired goals in the wilderness.

A-8-2.3(g) Documents for the collection and recording of information can include the following:

(a) Information regarding the lost person or persons
(b) Information needed to determine search urgency
(c) Information required by the AHJ
(d) Information required by the incident management system (IMS)
(e) Information required to identify a subject's track (i.e., footprint)
(f) Information for development of search strategy

A-8-2.3(h) Isolation includes keeping the reporting party handy for interviewers and isolated from media and the incident operations, as well as isolated from one another, in the case of multiple reporting parties.

A-8-3.2 In some cases, where minimum exposure to wilderness hazards exists, it can be appropriate for the AHJ to establish SOPs that permit operations-level personnel to conduct certain rescues without supervision of technician-level personnel.

A-8-3.3(a) Resources can include but are not limited to the following:

(a) Search dogs
(b) Trackers
(c) Aircraft
(d) Ground/air search specialists
(e) Rope rescue specialists
(f) Water search and rescue specialists
(g) Trench rescue specialists
(h) Vehicle/machinery rescue specialists
(i) Collapsed building search and/or rescue specialists
(j) Emergency incident management (overhead) teams
(k) Avalanche rescue specialists
(l) Cave rescue specialists
(m) Mine rescue specialists
(n) Other technical search and/or rescue providers and managers

A-8-3.3(b) The AHJ shall establish wilderness medical care protocols.

A-8-3.3(c) Body management refers to the skills and knowledge involved in maintaining personal nutrition, hydration, rest, and other physiological requirements of the human body.

A-8-3.3(e) Personal support equipment should include that which is necessary to address the following needs, or potential needs, of a rescuer in a wilderness setting:

(a) Personal medical (first aid) supplies
(b) Additional clothing appropriate for anticipated environment/weather
(c) Fluids and food appropriate for mission duration
(d) Personal safety and comfort gear (e.g., flashlight, sunglasses, sunscreen)
(e) Navigation (e.g., compass, map)
(f) General marking and documentation tools (e.g., flagging tape, paper/pencil)
(g) Improvisational tools (e.g., wire, twine, leaf bag, safety pin)
(h) Emergency shelter, bivouac, and/or body protection
(i) Emergency communications (e.g., whistle, radio, flare)
(j) Pack for contents (e.g., belt pack, ruck sack)

A-8-3.3(f) The AHJ should establish procedures for negotiating and/or avoiding conditions and hazards specific to the wilderness environments and terrains in which rescuers can become involved. It is likely that some conditions and/or situations will exceed the capability of the organization. In such situations, additional, more experienced, specialized, or highly trained resources should be procured. *(See also 8-1.2 and A-8-1.2.)*

Skills involved in supporting and participating in a search should include, but not be limited to, the following:

(a) Hasty, efficient, and thorough search techniques
(b) Principles of confinement and segmentation of the search area
(c) Principles and importance of clue awareness
(d) Basic search probability theory application and terminology
(e) Principles of lost person behavior
(f) Procedures for serving as an air observer (e.g., searching from an aircraft)
(g) Procedures for handling, processing, and documenting evidence

A-8-3.3(k) Skills involved in supporting and participating in a search should include, but not be limited to, the following:

(a) Hasty, efficient, and thorough search techniques
(b) Principles of confinement and segmentation of the search area
(c) Principles and importance of clue awareness
(d) Basic search probability theory application and terminology
(e) Principles of lost person behavior
(f) Procedures for serving as an air observer (e.g., searching from an aircraft)
(g) Procedures for handling, processing, and documenting evidence

A-8-3.3(o) The ability to discern limitations in accessing and/or evacuating should be based on the following:

(a) Individual and team expertise
(b) Qualified personnel available
(c) Ability to communicate from the patient scene
(d) Anticipated manpower and time

A-8-4.4(c) Members of an organization at the technician level should be adept and experienced at every skill required of subordinate personnel. Technician-level organizations should have the capability to address any potential operation that falls within their jurisdiction. To accomplish this, members of these organizations should be personally adept at wilderness skills, travel, and operations in the wilderness setting.

A-8-4.4(d) Such an operational plan should be based on the hazard analysis and risk assessment performed according to Section 2-2 of this standard, available resources, environmental influences and conditions, and the urgency of the situation. Specifically with regard to a search, the implemented plan should involve proper search management techniques including, but not necessarily limited to, the following:

(a) Determining the urgency of the search
(b) Developing a lost subject profile
(c) Establishing and segmenting the search area properly
(d) Conducting an appropriate investigation and interviews
(e) Applying the concept of search probability theory
(f) Designing, developing, and establishing appropriate search strategy and tactics
(g) Establishing and managing appropriate base camp
(h) Briefing and debriefing of operational personnel properly and thoroughly
(i) Considering suspension of the search when appropriate
(j) Demobilizing personnel and facilities
(k) Documenting the incident properly

A-9-1.2 In all types of trench and excavation rescue incidents, the potential exists for extenuating circumstances that would require expertise beyond the normal capability of the organization to safely operate. Examples of these situations include, but are not limited to, very deep trenches, unusually shaped excavations, multiple complications (e.g., deep excavation and fluid soil), involvement of hazardous/toxic substances, completely buried subjects, or severe environmental conditions (e.g., snow and rain). These conditions should be evaluated during the initial risk assessment and on an incident-by-incident basis.

A-9-2.2(a) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(a) Scope, magnitude, and nature of the incident
(b) Location and number of victims
(c) Risk versus benefit analysis (body recovery versus rescue)
(d) Exposure to traffic and sources of vibration
(e) Hazards such as disrupted or exposed utilities, standing or flowing water, secondary collapse, mechanical, hazmat, and explosives
(f) Trench/excavation dimensions
(g) Access to the scene
(h) Environmental factors
(i) Available/necessary resources

A-9-2.2(b) See A-3-2.2(b).

A-9-2.2(c) The emergency response system includes, but is not limited to, operations- and technician-level personnel, as well as local, state, and federal resources.

A-9-2.2(d) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A-9-2.2(e) General hazards associated with search and rescue operations at trench and excavation collapses can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members.

(a) *Utilities.* Control of the utilities in and around a trench or excavation emergency is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services in order to provide a safe environment in which to operate and to ensure the safety of victims. The following utilities should be considered when providing training:

1. Electrical services (primary and secondary)
2. Gas, propane, fuel oil, or other alternative energy sources (primary systems)
3. Water/steam
4. Sanitary systems
5. Communications
6. Secondary service systems (such as compressed, medical, or industrial gases)

(b) *Hazardous Materials.* Excavations might include various materials unique to a site that, when released during a collapse, could pose a hazard to victims and responders. The AHJ should provide members with training in the recognition of potential hazardous material releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials in order to conduct operations safely and effectively.

(c) *Personal Hazards.* At the site of any trench or excavation collapse, there are many dangers that pose personal injury hazards to the responders. The AHJ should train members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards in order to help ensure their safety. Every member should be made aware of hazards such as trips, falls, blows, punctures, impalement, and so forth.

(d) *Confined Space.* All trench and many excavation collapses necessitate a confined space rescue. Responding personnel should be familiar with and trained in confined space rescue requirements and techniques. The AHJ should determine the applicable laws and standards related to confined space rescue and should provide training to members in confined space rescue.

(e) *Other Hazards.* There are numerous other hazards associated with trench and excavation collapses. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide members with training and awareness of these other hazards in order to perform rescue operations safely and effectively.

The "general area" around a trench or excavation emergency is the entire area within 300 ft (91.44 m) (or more, as established by the incident commander). Making the general area safe includes, but is not necessarily limited to, the following:

(a) Controlling/limiting traffic and sources of vibration in the area including shutting down all vehicles and equipment
(b) Controlling/limiting access to the area by unnecessary personnel
(c) Identifying hazards and removing and/or reducing their impact

A-9-2.2(f) The types of collapse normally encountered at an excavation or trench incident include the following:

(a) Spoil pile collapse — where the excavated earth piled on the side of the trench slides into the trench
(b) Shear wall collapse — where one side of the trench shears away from the wall of the trench
(c) Slough collapse — where a below-grade section collapses, leaving the potential for the collapse of an overhanging ledge

The reasons and indicators of initial and secondary collapse of trenches and excavations are usually related to one or more of the following site characteristics:

(a) Unprotected trench (lack of protection systems)
(b) Static loads
(c) Standing water or water seeping into trench
(d) Intersecting trenches
(e) Vibrations (from vehicles, nearby roads, airports, etc.)
(f) Previously disturbed soil
(g) Exterior cracking of trench walls

A-9-2.2(g) Rapid, nonentry rescues include placing a ladder to allow a victim to perform a self-rescue or allowing noninjured persons in the trench to remove a victim.

A-9-2.2(h) As a rule of thumb, a cubic foot of soil weighs 100 pounds and a cubic yard of soil weighs 1.5 tons.

The weight and movement of soil alone can cause crush injuries, and the characteristics of the soil (e.g., wet, hard, sandy) will dictate how the soil will entrap (e.g., flow around, drown) a victim.

A-9-3.1 Severe environmental conditions include operations involving frozen soil, running soil (e.g., gravel, sand, liquid), severe weather (e.g., heavy rain, wind, or flooding), or night (dark) operations.

Supplemental sheeting and shoring includes operations that involve the use of commercial sheeting/shoring systems and/or isolation devices, or cutting and placement of sheeting and shoring when greater than 2 ft (.61 m) of shoring exists below the bottom of the strongback. Supplemental sheeting and shoring requires additional training beyond that of traditional sheeting and shoring. Traditional sheeting and shoring involves the use of 4 ft × 8 ft (1.22 m × 2.44 m) sheet panels with a strongback attachment supplemented by a variety of

conventional shoring options such as hydraulic, pneumatic, and/or screw shores.

Commercial sheeting/shoring systems and devices include trench boxes, sheet piles, plate steel, and the like. Isolation devices include concrete pipes, concrete vaults, steel pipe, or anything that serves to separate the victim(s) from the surrounding soil.

A-9-3.3(b) Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning should be provided to ensure the stability of such structures for the protection of employees.

Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees should not be permitted except when one of the following occurs:

(a) A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure.
(b) The excavation is in stable rock.
(c) A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity.
(d) A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

Sidewalks, pavements, and appurtenant structure should not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

A-9-3.3(c) Procedures to identify probable victim locations include the following:

(a) Visualization of the victim
(b) Presence of drink cups or food containers, work tools, laser targets, buckets, grade poles, grease and brush, engineers hubs, or anything that can indicate the victim's last probable physical location
(c) Information from bystanders
(d) End of pipe string
(e) Sounds in pipes
(f) "Cat" or tire tracks

A-9-3.3(d) The rescue area is that area immediately surrounding the trench and/or excavation site. Making the rescue area safe includes, but is not limited to, the following actions; however specific actions should be based on both the type of collapse and the soil type.

(a) Utilizing sheeting and shoring to stabilize trench/excavation walls
(b) Making the trench/excavation safe for entry
(c) Safely undertaking disentanglement operations in the trench/excavation
(d) Placing ground pads at the lip of the trench/excavation
(e) Ventilating the trench and monitoring its atmosphere
(f) Dewatering
(g) Supporting any unbroken utilities
(h) Providing a helmet and goggles for a victim, if possible
(i) Prohibiting entry into an unsafe trench/excavation
(j) Preventing the touching or operating of heavy equipment until its safety has been established

The term *tabulated data* usually refers to the six tables found in Appendix C of 29 *CFR* 1926, Subpart P.

Traditional sheeting and shoring should not be used in situations that exceed the tabulated data for timber trench shoring presented in 29 *CFR* 1926, Subpart P. Also, these systems should not be used where they would be submerged in water.

A-9-3.3(e) In many parts of the United States, a one-call underground utility location service is available to contractors and residents who are preparing to excavate. By making one telephone call (usually a toll free number), excavators can learn the location of all underground utility installations in the area of the planned excavation. This service quickly notifies all possible utility providers in the area who, in turn, either indicate that there is no utility in the area or have someone go to the site to mark the utilities. Such a service can be invaluable to emergency responders at the site of a trench or excavation emergency incident.

Where no one-call system exists, all utility companies who might have underground equipment at or near the excavation site must be notified so they can have a representative respond to mark underground utility locations.

A-9-3.3(f) The following is excerpted from 29 *CFR* 1926.651, "Specific Excavation Requirements," and specifies soil types.

> "Cemented soil" means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.
>
> "Cohesive soil" means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sideslopes, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay, and organic clay.
>
> "Dry soil" means soil that does not exhibit visible signs of moisture content.
>
> "Fissured" means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.
>
> "Granular soil" means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.
>
> "Layered system" means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.
>
> "Moist soil" means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.
>
> "Plastic" means a property of a soil that allows the soil to be deformed or molded without cracking or appreciable volume change.
>
> "Saturated soil" means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper

use of instruments such as a pocket penetrometer or sheer vane.

"Soil classification system" means, for the purpose of this subpart, a method of categorizing soil and rock deposits in a hierarchy of stable rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the characteristics of the deposits and the environmental conditions of exposure.

"Stable rock" means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

"Submerged soil" means soil that is underwater or is free-seeping.

"Type A" means cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are clay, silty clay, sandy clay, clay loam, and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if one of the following conditions exists:

(a) The soil is fissured.
(b) The soil is subject to vibration from heavy traffic, pile driving, or similar effects.
(c) The soil has been previously disturbed.
(d) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater.
(e) The material is subject to other factors that would require it to be classified as a less stable material.

"Type B" means one or more of the following:

(a) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa)
(b) Granular cohesionless soils including angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and, in some cases, silty clay loam and sandy clay loam
(c) Previously disturbed soils except those that would otherwise be classed as Type C soil
(d) Soil that meets the unconfined compressive strength or cementation requirements for Type A but is fissured or subject to vibration
(e) Dry rock that is not stable
(f) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B

"Type C" means one or more of the following:

(a) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less
(b) Granular soils including gravel, sand, and loamy sand
(c) Submerged soil or soil from which water is freely seeping
(d) Submerged rock that is not stable
(e) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper

"Unconfined compressive strength" means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

"Wet soil" means soil that contains significantly more moisture than moist soil but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

The classification of soil should be made based on the results of at least one visual and at least one manual analysis. Such analyses should be conducted by a competent person using tests described in Appendix A (Soil Classification) of 29 *CFR* 1926, Subpart P, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials or the U.S. Department of Agriculture textural classification system.

The visual and manual analyses, such as those specified in Appendix A (Soil Classification) of 29 *CFR* 1926, Subpart P, should be designed and conducted to provide sufficient quantitative and qualitative information as might be necessary to identify properly the properties, factors, and conditions affecting the classification of the soil.

A-9-3.3(j) A ladder or engineered ramp can be required for entry or egress from a trench. For instance, 29 *CFR* 1926.651(c)(1)(v) requires, "A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet or more in depth so as to require no more than 25 feet of lateral travel for employees."

A-9-3.3(k) The pre-entry briefing should include, but not be limited to, information regarding the following:

(a) Tactical assignments with explicit instructions
(b) General hazards and safety instructions
(c) Communications protocols, procedures, and details
(d) Anticipated environmental concerns
(e) Time frames for operations
(f) Emergency procedures
(g) Specific equipment needs
(h) Debriefing procedures
(i) Anticipated logistical needs

A-9-3.3(l) Documentation for entry operations, as a minimum, should include the following:

(a) Development of some type of representation of IMS command structure
(b) Time of incident
(c) Total time of operation
(d) Environmental conditions
(e) Location of victim
(f) Creation of a tactical checklist that includes entry times, exit times, personal accountability reports, atmospheric readings, rehabilitation information, injuries sustained, and incident number

A-9-3.3(m) Rapid intervention team (RIT) members should be at or above the capability level at which the incident is operating.