NFPA 1006

Standard for Rescue Technician Professional Qualifications

2003 Edition

NFPA, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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Rescue Technician Professional Qualifications

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This edition of NFPA 1006, *Standard for Rescue Technician Professional Qualifications*, was prepared by the Technical Committee on Rescue Technician Professional Qualifications, released by the Technical Correlating Committee on Professional Qualifications, and acted on by NFPA at its November Association Technical Meeting held November 16–20, 2002, in Atlanta, GA. It was issued by the Standards Council on January 17, 2003, with an effective date of February 6, 2003, and supersedes all previous editions.

This edition of NFPA 1006 was approved as an American National Standard on January 17, 2003.

Origin and Development of NFPA 1006

In 1994, the NFPA Standards Council, after receipt of a request for the development of a standard for the professional qualifications of rescue technicians, approved the establishment of a technical committee on Rescue Technician Professional Qualifications under the Professional Qualifications project. The committee developed the first edition of NFPA 1006, *Standard for Rescue Technician Professional Qualifications*, which established general job performance requirements for a rescue technician as well as specific job performance requirements for special rescue operations. These performance requirements include rope rescue, surface water rescue, vehicle and machinery rescue, confined space rescue, structural collapse rescue, and trench rescue.

In the 2003 edition of NFPA 1006, all of the chapters were reviewed and changes were made to comply with the NFPA *Manual of Style*. Three new chapters were added to the document: Subterranean Rescue, Dive Rescue, and Wilderness Rescue.

In Memoriam, September 11, 2001

We pay tribute to the 343 members of FDNY who gave their lives to save civilian victims on September 11, 2001, at the World Trade Center. They are true American heroes in death, but they were also American heroes in life. We will keep them in our memory and in our hearts. They are the embodiment of courage, bravery, and dedication. May they rest in peace.

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These lists represent the membership at the time the Committees were balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the 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.

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

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, Annex I lists the complete title and edition of the source documents for both mandatory and nonmandatory extracts. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex I.

Chapter 1 Administration

1.1* Scope. This standard establishes the minimum job performance requirements necessary for fire service and other emergency response personnel who perform technical rescue operations.

1.2 Purpose. The purpose of this standard is to specify the minimum job performance requirements for service as a rescuer in an emergency response organization. It is not the intent of this standard to restrict any jurisdiction from exceeding these minimum requirements.

1.3* General.

1.3.1 Each performance objective shall be performed safely, competently, and in its entirety.

1.3.2 Job performance requirements need not be mastered in the order in which they appear. The authority having jurisdiction shall establish the instructional priority and the training program content to prepare individuals to meet the performance requirements of this standard.

1.3.3* It is incumbent on the authority having jurisdiction to determine which disciplines are required to achieve the desired types of service and to provide training or certification as necessary to satisfy the service needs.

1.3.4 Performance of each requirement shall be evaluated by individuals approved by the authority having jurisdiction. Evaluators shall be individuals who were not involved as instructors for the performance requirements being evaluated.

1.3.5 Wherever in this standard the terms *rules, regulations, procedures, supplies, apparatus,* and *equipment* are referred to, they shall imply that they are those available to or used by the authority having jurisdiction.

1.3.6 Performance of each requirement shall be in accordance with applicable NFPA standards and occupational health and safety regulations.

Chapter 2 Referenced Publications (Reserved)

Chapter 3 Definitions

3.1* General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not included, common usage of the terms shall apply.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.3 General Definitions.

3.3.1 Abrasion. The damaging effect on rope and other equipment caused by friction.

3.3.2 Access. See definition 3.3.27, Confined Space Approach.

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

3.3.3.1 ***High-Point Anchor.*** A point above the trench used for attachment of rescue systems.

3.3.4 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.

3.3.4.1* ***Multiple Point Anchor System.*** System configuration providing load distribution over more than one anchor point, either proportionally or disproportionally. There are basically two categories of multiple point anchor systems: load distributing and load sharing.

3.3.4.2* ***Single Point Anchor System.*** Anchor system relying on a single anchor point to sustain the entire load.

3.3.5 Ascent Device. An auxiliary equipment system component; a friction or mechanical device utilized alone or in combination to allow a person to ascend a fixed rope.

3.3.6 Atmospheric Monitoring. A method of evaluating the ambient atmosphere of a space, including but not limited to its oxygen content, flammability, and toxicity.

3.3.7* Attendant. A term used to describe a person who is qualified to be stationed outside one or more confined spaces, who monitors authorized entrants, and who performs specified duties.

3.3.8* Authorized Entrant. A term used to describe a U.S. federally regulated industrial worker designated to enter confined spaces who meets specified training requirements for each specific space he or she enters.

3.3.9* Basic First Aid Kit. Equipment or devices for managing infection exposure, airways, spinal immobilization, fracture immobilization, shock, and bleeding control.

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

3.3.11 Belayer. The rescuer who operates the belay system.

3.3.12 Belt. A system component; material configured as a device that fastens around the waist only and designated as a ladder belt, an escape belt, or a ladder/escape belt.

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

3.3.14 Beneficial System. Auxiliary-powered equipment in motor vehicles or machines that can enhance or facilitate rescues such as electric, pneumatic, or hydraulic seat positioners, door locks, window operating mechanisms, suspension systems, tilt steering wheels, convertible tops, or other devices or systems to facilitate the movement (extension, retraction, raising, lowering, conveyor control) of equipment or machinery.

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

3.3.16* Bombproof. A term used to refer to a single anchor point capable of sustaining the actual or potential forces exerted on the rope rescue system without possibility of failure.

3.3.17 Breach. An opening made in the wall, floor, or ceiling of a structure, based on construction type, that can be used for moving rescuers, equipment, or victims into or out of the structure.

3.3.18 Breaching Techniques. Methods that utilize breaking and cutting tools to create safe openings in masonry, concrete, and wood structures.

3.3.19 Buoyancy Control Device. Jacket or vest that contains an inflatable bladder for the purposes of controlling buoyancy.

3.3.20 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 that it could entrap, bury, or otherwise injure and immobilize a person.

3.3.21 Collapse Support Operations. Operations performed at the scene that include providing for rescuer comfort, scene lighting, scene management, and equipment readiness.

3.3.22 Collapse Type. Five general types of collapse include lean-to collapse, "V" shape collapse, pancake collapse, cantilever collapse, and A-frame collapse. *(See Annex B.)*

3.3.23 Collapse Zone. See definition 3.3.137, Rescue Area.

3.3.24 Community Resource List. A list that includes all private and public contact numbers that will provide the available community resources to mitigate a specified type or range of rescue incidents and hazardous conditions in the community. A form of agreement or contract negotiated prior to the potential incident with participating concerns will enhance reliability of the resources.

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

3.3.26* Confined Space. A space that is large enough and so configured that a person can enter and perform assigned work, that has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits), and that is not designed for continuous human occupancy.

3.3.27 Confined Space Approach. The means of approach to the entry opening of a confined space.

3.3.28 Confined Space Entry. Includes ensuing work activities in a confined space 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.

3.3.29 Confined Space Entry Opening. The port or opening used to enter a confined space.

3.3.30 Confined Space Entry Permit. A written or printed document established by an employer in applicable U.S. federally regulated industrial facilities for nonrescue entry into confined spaces, that authorizes specific employees to enter a confined space and contains specific information as required. *(See Annex C.)*

3.3.31* Confined Space Rescue Preplan. An informational document completed by rescue personnel pertaining to a specific space. The document should include but is not limited to information concerning hazard abatement requirements, access to the space, size and type of entry openings, internal configuration of the space, and a suggested action plan for rescue of persons injured within the space.

3.3.32 Confined Space Rescue Team. A combination of individuals trained and available to respond to confined space emergencies and perform rescues.

3.3.33 Confined Space Retrieval Equipment. See definition 3.3.143, Retrieval Equipment.

3.3.34* Confined Space Type. A classification of confined spaces that incorporates the size, configuration, and accessibility of an entry opening as well as the internal configuration/entanglement structures within the space.

3.3.35 Construction Grade Lumber. Lumber products that are readily available in sizes and lengths for general construction applications.

3.3.36* Construction Type. Based on major construction categories, these categories include, but are not limited to, wood frame, steel, unreinforced masonry (URM), tilt-up; precast, high-rise, and formed in place.

3.3.37 Cribbing. Short lengths of timber/composite materials, usually 101.60 mm × 101.60 mm (4 in. × 4 in.) and 457.20 mm × 609.60 mm (18 in. × 24 in.) long that are used in various configurations to stabilize loads in place or while load is moving.

3.3.38* Critical Angle. An internal angle in a system of 120 degrees or greater that results in an amplification of a force applied to the system.

3.3.39 Critical Incident Stress Debriefing (CISD). A postincident meeting designed to assist rescue personnel in dealing with psychological trauma as the result of an emergency.

3.3.40 Critique. A postincident analysis of the effectiveness of the rescue effort.

3.3.41 Cross Braces. 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.

3.3.42* Crush Syndrome. A condition in which muscle death occurs because of pressure applied by an external load (e.g., a vehicle, parts of a fallen building, a rock, or a squeeze in a tight hole).

3.3.43* Cut Sheet. A document that specifies the dimensions, slope, and other pertinent information regarding a particular excavation.

3.3.44 Cut Station. A functional area or sector that utilizes lumber, timber, and an assortment of hand and power tools to complete operational objectives for stabilizing or shoring at a rescue incident or training evolution.

3.3.45 Decontamination. The removal or neutralization of a hazardous material from equipment and/or personnel.

3.3.46 Descending a Line. A means of traveling down a fixed line using a descent control device.

3.3.47 Descent Control Device. An auxiliary equipment system component; a friction or mechanical device utilized with rope to control descent.

3.3.48 Disentanglement. The process of freeing a victim from entrapment.

3.3.49 Dive Profile. Plan for a dive, including the depth and duration of the dive, in order to determine the level of nitrogen in the bloodstream.

3.3.50* Dive Tables. Format utilized by divers, based upon various accepted studies, which calculate nitrogen levels and convert them to tabular data for determining a safe dive profile.

3.3.51 Divemaster. Dive professional demonstrating an advanced level of competency, charged with coordinating and leading divers.

3.3.52 Double Block and Bleed. The closure of a line, duct, or pipe by closing, locking, and tagging two valves in line and opening, locking, and tagging a drain or vent valve inline between the two closed valves.

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

3.3.54 Emergency. Any condition endangering or thought to be endangering life or property.

3.3.55 Emergency Medical Care. Prehospital care given to a victim of an accident or sudden illness.

3.3.56 Entrant. See definition 3.3.8, Authorized Entrant.

3.3.57 Entry. Includes ensuing work activities in the entry space 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. *(See also 3.3.28, Confined Space Entry.)*

3.3.58 Entry Opening. See definition 3.3.29, Confined Space Entry Opening.

3.3.59 Environmental Controls. See definition 3.3.21, Collapse Support Operations.

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

3.3.61* Extinguishing Devices. Devices used to suppress fire, including, but not limited to, CO_2 extinguishers, dry chemical extinguishers, hose lines, and fire-fighting foam.

3.3.62 Face(s) (also Wall, Side, or Belly). The vertical or inclined earth surface formed as a result of excavation work.

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

3.3.64 Fire Control Measures. Methods used to secure ignition sources at an incident scene that can include hoseline placement and utilization of chemical agents to suppress fire potential.

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

3.3.66 Flood Insurance Rate Maps. Maps produced by the National Flood Insurance Program, under the auspices of the Federal Emergency Management Agency (FEMA), that illustrate geographic areas that are subject to flooding.

3.3.67 Flotation Aids. Devices that provide supplemental flotation for persons in the water but do not meet U.S. Coast Guard performance criteria such as breaking strength of the thread used in sewing the device, the usable life of the flotation materials including compressibility factors, the colors and fading potential of certain dyes used in the fabrication of the device, and the strength and breaking force required for buckles and tie straps.

3.3.68* General Area. Sometimes called the "warm zone," an area surrounding the incident site (e.g., collapsed structure or trench) that has a size proportional to the size and nature of the incident.

3.3.69 Hardware. A type of auxiliary equipment that includes but is not limited to ascent devices, carabiners, descent control devices, pulleys, rings, and snap-links. [**1983:**1.3]

3.3.70 Harness. See definition 3.3.93, Life Safety Harness.

3.3.71 Hauling System. A rope system generally constructed from life safety rope, pulleys, and other rope rescue system components capable of lifting or moving a load across a given area.

3.3.72 Hazard Mitigation. Activities taken to isolate, eliminate, or reduce the degree of risk to life and property from hazards, either before, during, or after an incident.

3.3.73* Hazardous Atmosphere for Confined Space. Any atmosphere that can expose personnel to the risk of death, incapacitation, injury, acute illness, or impairment of the ability to self-rescue.

3.3.74 Hazardous Atmospheres. Any atmosphere that can expose personnel to the risk of death, incapacitation, injury, acute illness, or impairment of ability to self-rescue.

3.3.75 Hazardous Material. A substance (solid, liquid, or gas) that when released is capable of creating harm to people, the environment, and property.

3.3.76 Heavy Construction Type. Construction that utilizes masonry, steel, and concrete in various combinations, including tilt-up, steel frame with infill, concrete moment resisting frame, concrete shearwall, unreinforced masonry infill in concrete frame, and precast concrete. *(See Annex D.)*

3.3.77 Heavy Equipment. Typically, construction equipment that can include but is not limited to backhoes, trac hoes, grade-alls, and cranes.

3.3.78 Heavy Load. Any load over 3175.15 kg (7000 lb).

3.3.79 Heavy Structural Collapse. Collapse of heavy construction–type buildings that require special tools and training to gain access into the building.

3.3.80 High Angle. An environment in which the load is predominately supported by the rope rescue system.

3.3.81 Highline System. A system of using rope suspended between two points for movement of persons or equipment, including systems capable of movement between points of equal or unequal height.

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

3.3.83 Hydrology. Effect of water, its movement and mechanics, in relation to bodies of water.

3.3.84 Incident Management System. An organized system of roles, responsibilities, and standard operating procedures used to manage emergency operations, often referred to as incident command system (ICS).

3.3.85 Incident Termination. The procedure necessary to return the scene of an emergency to a state of safety following a rescue through elimination or isolation of hazards, so that rescue personnel and equipment can be removed from the scene and returned to a state of readiness.

3.3.86 Incline Plane. A lifting method that provides mechanical advantage by distributing the work required to lift a load over a distance along an incline rather than straight up and down.

3.3.87* Isolation. The process by which an area is rendered safe through mitigation of dangerous energy forms.

3.3.88* Isolation System. An arrangement of devices, including isolation 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, sand).

3.3.89 Job Performance Requirement. A statement that describes a specific job task, lists the items necessary to complete the task, and defines measurable or observable outcomes and evaluation areas for the specific task.

3.3.90* Knot. A fastening, including bights, bends, and hitches, made by tying together lengths of rope or webbing in a prescribed way.

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

3.3.92 Levers. Tools that have a relationship of load/fulcrum/force to create mechanical advantage and move a load.

3.3.93 Life Safety Harness. A system component; an arrangement of materials secured about the body used to support a person during fire service rescue.

3.3.94 Life Safety Rope. Rope dedicated solely for the purpose of supporting people during rescue, fire fighting, other emergency operations, or during training evolutions.

3.3.95 Lifting Tools. Hydraulic, pneumatic, mechanical, or manual tools that can lift heavy loads.

3.3.96 Light Frame Construction. Structures that have framework made out of wood or other lightweight materials. *(See Annex D.)*

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

3.3.98 Lip (Trench Lip). The area 2 ft horizontal and 2 ft vertical (0.61 m × 0.61 m) from the top edge of the trench face.

3.3.99 Lip Collapse. A collapse of the trench lip, usually subsequent to surcharge loading, impact damage from the excavating bucket, and/or inherent cohesive properties of the soil type.

3.3.100 Lip-In. See definition 3.3.99, Lip Collapse.

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

3.3.102 Load Stabilization. The process of preventing a load from shifting in any direction.

3.3.103 Load Test. A method of preloading a rope rescue system to ensure all components are set properly to sustain the expected load; generally performed by multiple personnel to exert force on the system at the load attachment point in the manner of function before life loading.

3.3.104 Locating Devices. Devices utilized to locate victims in rescue incidents and structural components, including but not limited to voice, seismic, video, K-9, and fiber optic.

3.3.105 Loop. An element of a knot created by forming a complete circle in a rope.

3.3.106 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).

3.3.107 Lowering System. A rope rescue system used to lower a load under control. Lowering systems should incorporate a mechanism to prevent the uncontrolled descent of the load during the lowering operation. This mechanism should reduce the need for excessive force to control the lower.

3.3.108 Maintenance Kits. Items required for maintenance and inspection that include, but are not limited to, the following: manufacturer product specifications; preventive maintenance checklists; periodic logbook records; inventory equipment lists; appropriate fluids, parts, and hardware; and testing instruments as required.

3.3.109 Marking Systems. Various systems used to mark hazards, victim location, and pertinent structural information. *(See Annex E.)*

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

3.3.111 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.

3.3.112 Mechanical Advantage System.

3.3.112.1 ***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).

3.3.112.2* ***Simple Rope Mechanical Advantage System.*** A rope mechanical advantage system containing a single rope and 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.

3.3.113 Member. A person performing the duties and responsibilities of an emergency response organization on a full-time or part-time basis, with or without compensation.

3.3.114 Mode of Transmission. The physical means of entry of a hazardous material into the human body, including inhalation, absorption, injection, and ingestion.

3.3.115 MSDS. Material safety data sheets.

3.3.116 Nonintersecting Trench. See 3.3.210.2.

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

3.3.118 Packaging. The process of securing a victim in a transfer device, with regard to existing and potential injuries or illness, so as to prevent further harm during movement.

3.3.119 Parbuckling. A technique for moving a load utilizing a simple 2:1 mechanical advantage system in which the load is placed inside a bight formed in a length of rope, webbing, tarpaulin, blanket, netting, and so forth that creates the mechanical advantage, rather than being attached to the outside of the bight with ancillary rope rescue hardware.

3.3.120 Permit-Required Confined Space. See definition 3.3.26, Confined Space.

3.3.121 Personal Escape. See definition 3.3.160, Self-Rescue.

3.3.122* Personal Flotation Device (PFD). A device manufactured in accordance with U.S. Coast Guard specifications that provides supplemental flotation for persons in the water.

3.3.123* Personal Protective Equipment (PPE). The equipment provided to shield or isolate a person from the chemical, physical, or thermal hazards that can be encountered at a specific rescue incident.

3.3.123.1* ***Water Rescue Personal Protective Equipment.*** Personal equipment required to protect rescuers from physical dangers posed by exposure to in-water hazards and also those hazards that are associated with the climate and the adjacent area.

3.3.124* Pneumatic Struts. Pneumatic or gas-filled tube and piston assemblies in vehicles or machinery.

3.3.125 Postbriefing. At the termination of an incident, after breakdown and cleanup has occurred, reviews the effectiveness of strategies, tactics, equipment, and personnel at an incident, as well as provides an opportunity to detect the presence of critical incident stress syndrome.

3.3.126 Prebriefing. At the beginning of an incident, after size-up information has been assessed, given to the rescue team to provide assignments, select and notify of strategy and tactics to be performed, and state the mission objective.

3.3.127 Pre-entry Medical Exam. A baseline medical evaluation of the rescue entrants performed immediately prior to a rescue entry.

3.3.128* Pre-incident Plan. A written document resulting from the gathering of general and detailed data to be used by responding personnel for determining resources and additions necessary to mitigate anticipated emergencies at a specific facility.

3.3.129* 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.

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

3.3.131* Rapid Intervention Crew/Company (RIC). A minimum of two fully equipped personnel on site, in a ready state, for immediate rescue of disoriented, injured, lost, or trapped rescue personnel.

3.3.132 Reach/Extension Device. Any device for water rescue that can be extended to a person in the water so that he or she can grasp it and be pulled to safety without physically contacting the rescuer.

3.3.133 Recovery. Nonemergency operations taken by responders to retrieve property or remains of victims.

3.3.134 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 bail-out block).

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

3.3.136 Requisite Equipment. Specific tools and equipment that are critical to performing a specific type of technical rescue.

3.3.137 Rescue Area. Sometimes called the "hot," "danger," or "collapse" zone, an area surrounding the incident site (e.g., collapsed structure or trench) that has a size proportional to the hazards that exist.

3.3.138 Rescue Attendant. See definition 3.3.7, Attendant.

3.3.139 Rescue Entrant. See definition 3.3.8, Authorized Entrant.

3.3.140 Rescue Service. The rescue team designated for confined space rescue by the AHJ.

3.3.141* Rescue Team. A combination of rescue-trained individuals who are equipped and available to respond to and perform technical rescues.

3.3.142 Rescue Technician. A person who is trained to perform or direct the technical rescue.

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

3.3.144 Rigging. The process of building a system to move or stabilize a load.

3.3.145 Rigging Systems. Systems used to move people or loads that can be configured with rope, wire rope, or cable and utilize different means, both mechanical and manual, to move the load.

3.3.146 Risk–Benefit Analysis. An assessment of the risk to rescuers versus the benefits that can be derived from their intended actions.

3.3.147 Rope. See definition 3.3.94, Life Safety Rope.

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

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

3.3.150 Safe Zone. In a trench, the area that projects 0.61 m (2 ft) in all directions around an installed cross brace or wale that is a component of an existing approved shoring system.

3.3.151 Safetied (Safety Knot). A securement of loose rope end issuing from a completed knot, usually fashioned by tying the loose end around another section of rope to form a knot. The means by which the loose end is prevented from slipping through the primary knot.

3.3.152 Scene Security. The means used to prevent or restrict entry to the scene of a rescue incident, either during or following the emergency.

3.3.153 Screw Jack. Shoring system component made of sections of threaded bar stock that are incorporated with lengths of pipe or wood.

3.3.154 SCUBA. Self-contained underwater breathing apparatus.

3.3.155 Search Functions. General area search, reconnaissance, victim location identification, and hazard identification or flagging.

3.3.156 Search Measures.

3.3.156.1* *Active Search Measures.* This phase of search measures includes those that are formalized and coordinated with other agencies.

3.3.156.2* *Passive Search Measures.* Search efforts that do not require active searching by the rescuers.

3.3.157 Search Parameters. The defined search area and scope.

3.3.158* Secondary Collapse. Causes or conditions that could contribute to a subsequent collapse in a building.

3.3.159 Security Measures. See definition 3.3.152, Scene Security.

3.3.160 Self-Rescue. Escaping or exiting a hazardous area under one's own power.

3.3.161 Sheeting or Sheathing. A component of a shoring system with a large surface area supported by the uprights and cross-bracing of the shoring system that is used to retain the earth in position when loose or running soils are encountered.

3.3.162 Sheeting and Shoring.

3.3.162.1 *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 0.61 m (2 ft) of shoring exists below the bottom of the strongback. [**1670:**1.3]

3.3.162.2 *Traditional Sheeting and Shoring.* The use of 1.22 m × 2.44 m (4 ft × 8 ft) sheet panels, with a strongback attachment, supplemented by a variety of conventional hydraulic, screw, and/or pneumatic shoring options.

3.3.163* Shield or Shield System. An engineered structure that is able to withstand the forces imposed on it by a cave-in and thereby protect persons within the structures.

3.3.164 Shore-Based Rescue. Any technique or procedure that provides a means for extracting a person from the water that does not require any member of the rescue team to leave the safety of the shore.

3.3.165 Shoring System. A system that supports unstable surfaces by placing a tension member between an unstable surface and base.

3.3.166 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.

3.3.167 Sides. See definition 3.3.62, Face.

3.3.168* Signaling Device. Any resource that provides a distinct and predictable display, noise, or sensation that can be used to communicate a predetermined message or to attract the attention of other persons as desired by the initiator of the signal.

3.3.169 Site Operations. The activities to be undertaken at a specific site to manage the rescue efforts.

3.3.170 Size-Up. The ongoing observation and evaluation of factors that are used to develop strategic goals and tactical objectives.

3.3.171 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; 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.

3.3.172 Slough-In. A type of collapse characterized by an interior portion of the trench wall spalling out and potentially leaving an overhanging ledge or void that needs to be filled.

3.3.173 Software. A flexible fabric component of rope rescue equipment.

3.3.174 Soldier Shoring or Skip Shoring. A shoring system that employs a series of uprights spaced at intervals with the exposed soil of the trench wall showing.

3.3.175 Span of Control. The maximum number of personnel or activities that can be effectively controlled by one individual (usually three to seven).

3.3.176 Specialized Equipment. Equipment that is unique to the rescue incident and made available.

3.3.177* Specialized Teams. Emergency response teams with specific skills and equipment that can be needed on the scene.

3.3.178 Spoil Pile (Spoil). A pile of excavated soil next to the excavation or trench.

3.3.179 Stabilization Points. Key points where stabilization devices can be installed on a vehicle or machine to keep the vehicle or object from moving during rescue operations.

3.3.180 Stabilization System. See definition 3.3.37, Cribbing.

3.3.181 Steel Cutting Tools. Hand tools, circular saw, exothermic torch, oxyacetylene torch, and plasma cutter.

3.3.182 Stiffbacks. See definition 3.3.214, Trench Upright.

3.3.183 Strongbacks. See definition 3.3.214, Trench Upright.

3.3.184 Structural Load Calculations. Load calculations based on the weight per cubic foot of construction materials such as concrete, steel, and wood.

3.3.185 Structural Support System. See definition 3.3.165, Shoring System.

3.3.186 Strut. The tensioned member placed between two opposing surfaces.

3.3.187 Subterranean Rescue. Extraction from any environment natural or manmade that exists below grade as an enclosed environment with limited means of access or egress, including caves, tunnels, and mines.

3.3.188 Superimposed Load. See definition 3.3.190, Surcharge Load.

3.3.189 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.

3.3.190 Surcharge Load. Any weight in the proximity of the trench that increases instability or the likelihood of secondary cave-in.

3.3.191 Surface. A base that is secure and conducive to supporting and stabilizing a vehicle or object.

3.3.192 Surface Encumbrance. A natural or manmade structural object adjacent to or in the immediate vicinity of an excavation or trench.

3.3.193 Surface Water Rescue. Rescue of a victim who is afloat on the surface of a body of water.

3.3.194 Swift Water. Water moving at a rate greater than 1 knot [1.85 km/hr (1.15 mph or 1.69 ft/sec)].

3.3.195* Swim. To propel oneself through water by means of purposeful body movements and positioning.

3.3.196* Swim Aids. Items of personal equipment that augment the individual rescuer's ability to propel through water.

3.3.197* System Safety Check. A method involving three components — physical or usual check, load test, and audible or visual confirmation — that evaluates the safe assembly of a rescue system.

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

3.3.199 Task. An essential step of a work operation required to complete the performance of a duty.

3.3.200 Team. See definition 3.3.32, Confined Space Rescue Team.

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

3.3.202 Throw Bag. A water rescue system that includes 15.24 m to 22.86 m (50 ft to 75 ft) of water rescue rope, an appropriately sized bag, and a closed-cell foam float.

3.3.203 Tidal Water. Ocean water or bodies of water that are connected to oceans that either experience a twice daily rise and fall of their surface caused by the gravitational pull of the moon or experience a corresponding ebb and flow of water in response to the tides. Due to the connection to the ocean, all tidal water has some degree of salinity, which nontidal water lacks.

3.3.204 Tide Tables. Schedule of predicted rise and fall of the surface of tidal waters above or below a mean water level at predictable times of each day of the year.

3.3.205 Toe. The point where the trench wall meets the floor of the trench.

3.3.206* Tool Kit. Equipment available to the rescuer as defined in this document.

3.3.207 Traffic Control. The direction or management of vehicle traffic such that scene safety is maintained and rescue operations can proceed without interruption.

3.3.208 Traffic Control Devices. Ancillary equipment/resources used at the rescue scene to facilitate traffic control such as flares, barricades, traffic cones, or barrier tape.

3.3.209 Transfer Device. Equipment used to package and allow removal of a victim from a specific rescue environment.

3.3.210* Trench (Trench Excavation). An excavation, narrow in relation to its length, made below the surface of the earth.

3.3.210.1* ***Intersecting Trench.*** A trench where multiple trench cuts or legs converge at a single point.

3.3.210.2 ***Nonintersecting Trench.*** A trench cut in a straight or nearly straight line with no crossing or converging trench legs or cuts.

3.3.211 Trench Box. See definition 3.3.163, Shield or Shield System.

3.3.212 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.

3.3.213 Trench Floor. The bottom of the trench.

3.3.214 Trench Upright. A vertical support member that spans the distance between the toe of the trench and the trench lip to collect and distribute the tension from the opposing wall over a large area.

3.3.215 Triage. The sorting of casualties at an emergency according to the nature and severity of their injuries.

3.3.216 Triage Tag. A tag used in the classification of casualties according to the nature and severity of their injuries.

3.3.217 Two-Person Load. 272 kg (600 lb).

3.3.218 Upright. See definition 3.3.214, Trench Upright.

3.3.219 Victim Management. The manner of treatment given to those requiring rescue assistance.

3.3.220 Victim Removal System. Those systems used to move a victim to a safe location.

3.3.221 Wales. Also called walers or stringers; horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of a shoring system or earth.

3.3.222 Water-Bound Victim. A victim that is in the water needing assistance.

3.3.223* Watercraft. Manned vessels that are propelled across the surface of a body of water by means of oars, paddles, water jets, propellers, towlines, or air cushions and are used to transport personnel and equipment while keeping their occupants out of the water.

3.3.224* Watercraft Conveyance. Devices intended for the purpose of transporting, moving, lifting, or lowering watercraft that may be required to be operated prior to and at the conclusion of every watercraft deployment.

3.3.225 Water Rescue Rope. Rope that floats, has adequate strength for anticipated use, is not weakened to the point of inadequacy for the task by saturation or immersion in water, and is of sufficient diameter to be gripped by bare wet hands.

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

3.3.227 Wedges and Shims. See definition 3.3.37, Cribbing.

Chapter 4 Rescue Technician

4.1* General Requirements. Because technical rescue is inherently dangerous and rescue technicians are frequently required to perform rigorous activities in adverse conditions, regional and national safety standards shall be included in agency policies and procedures. Rescue technicians shall complete all activities in the safest possible manner and shall follow national, federal, state, provincial, and local safety standards as they apply to the rescue technician.

4.2* Entrance Requirements. Before beginning training activities or engaging in rescue incidents, the following requirements shall be complied with:

(1) Age requirement established by the AHJ
(2) Medical requirements established by the AHJ
(3) Minimum physical fitness as required by the AHJ
(4) Emergency medical care performance capabilities for entry-level personnel developed and validated by the AHJ
(5) Minimum educational requirements established by the AHJ
(6) Minimum requirements for hazardous material incident and contact control training for entry-level personnel, validated by the AHJ

4.3* Minimum Requirements. For certification, the rescue technician shall perform all of the job performance requirements in Chapter 5 and all job performance requirements listed in at least one of the specialty areas (Chapters 6 through 14).

Chapter 5 Job Performance Requirements

5.1 General Requirements. The job performance requirements defined in Sections 5.2 through 5.5 shall be met prior to certification as a rescue technician.

5.2 Site Operations.

5.2.1 Identify the needed support resources, given a specific type of rescue incident, so that a resource cache is managed, scene lighting is provided for the tasks to be undertaken, environmental concerns are managed, personnel rehabilitation is facilitated, and the support operation facilitates rescue operational objectives.

(A) *Requisite Knowledge:* Equipment organization and tracking methods, lighting resource type(s), shelter and thermal control options, and rehab criteria.

(B) *Requisite Skills:* The ability to track equipment inventory, identify lighting resources and structures for shelter and thermal protection, select rehab areas, and manage personnel rotations.

5.2.2 Size up a rescue incident, given background information and applicable reference materials, so that the type of rescue is determined, the number of victims is identified, the last reported location of all victims is established, witnesses are identified and interviewed, resource needs are assessed, search parameters are identified, and information required to develop an incident action plan is obtained.

(A) *Requisite Knowledge:* Types of reference materials and their uses, availability and capability of the resources, elements of an action plan and related information, relationship of size-up to the incident management system, and information gathering techniques and how that information is used in the size-up process.

(B) *Requisite Skills:* The ability to read technical rescue reference materials, gather information, relay information, and use information gathering sources.

5.2.3 Manage incident hazards, given scene control barriers, personal protective equipment, requisite equipment, and available specialized resources, so that all hazards are identified, resource application fits the operational requirements, hazard isolation is considered, risks to rescuers and victims are minimized, and rescue time constraints are taken into account.

(A) *Requisite Knowledge:* Resource capabilities and limitations, types and nature of incident hazards, equipment types and their use, isolation terminology, methods, equipment and implementation, operational requirement concerns, common types of rescuer and victim risk, risk–benefit analysis methods and practices, and types of technical references.

(B) *Requisite Skills:* The ability to identify resource capabilities and limitations, identify incident hazards, assess victim viability (risk–benefit), utilize technical references, place scene control barriers, and operate control and mitigation equipment.

5.2.4 Manage resources in a rescue incident, given incident information, a means of communication, resources, tactical worksheets, personnel accountability protocol, applicable references, and standard operating procedures, so that references are utilized, personnel are accounted for, deployed resources achieve desired objectives, incident actions are documented, rescue efforts are coordinated, the command structure is established, task assignments are communicated and monitored, and actions are consistent with applicable regulations.

(A) *Requisite Knowledge:* Incident management system, tactical worksheet application and purposes, accountability protocols, resource types and deployment methods, documentation methods and requirements, availability, capabilities, and limitations of rescuers and other resources, communication problems and needs, communications requirements, methods, and means, types of tasks and assignment responsibilities, policies and procedures of the agency, and technical references related to the type of rescue incident.

(B) *Requisite Skills:* The ability to implement an incident management system, complete tactical worksheets, use reference materials, evaluate incident information, match resources to operational needs, operate communications equipment, manage incident communications, and communicate in a manner so that objectives are met.

5.2.5 Conduct a search, given hazard-specific personal protective equipment, equipment pertinent to search mission, an incident location, and victim investigative information, so that search parameters are established, victim profile is established, the entry and exit of all people either involved in the search or already within the search area are questioned and the information is updated and relayed to command, the personnel assignments match their expertise, all victims are located as quickly as possible, applicable technical rescue concerns are managed, risks to searchers are minimized, and all searchers are accounted for.

(A) *Requisite Knowledge:* Local policies and procedures and how to operate in the site-specific search environment.

(B) *Requisite Skills:* The ability to enter, maneuver in, and exit the search environment and provide for and perform self-escape/rescue.

5.2.6* Perform ground support operations for helicopter activities, given a rescue scenario/incident, helicopter, operational plans, personal protective equipment, requisite equipment, and available specialized resources, so that rescue personnel are aware of the operational characteristics of the aircraft and demonstrate operational proficiency in establishing and securing landing zones and communicating with aircraft personnel until the assignment is complete.

(A) *Requisite Knowledge:* Ground support operations relating to helicopter use and deployment, operation plans for helicopter service activities, type-specific personal protective equipment, aircraft familiarization and hazard areas specific to helicopter, scene control and landing zone requirements, aircraft safety systems, and communications protocols.

(B) *Requisite Skills:* The ability to provide ground support operations, review standard operating procedures for helicopter operations, use personal protective equipment, establish and control landing zones, and communicate with aircrews.

5.2.7 Terminate the incident, given isolation barriers and specialized teams and equipment so that all personnel are accounted for and removed from the scene, hazards are mitigated, further entry is denied, the victim is transported to the definitive care facility, rescue personnel are returned to a state of readiness, appropriate reporting and documentation of the incident is completed, and a critique and critical incident stress debriefing is conducted with rescue personnel.

(A) *Requisite Knowledge:* How to identify and mitigate a scene, forms for documentation, resources for critical incident stress debriefing, and local medical transportation protocol.

(B) *Requisite Skills:* The ability to provide scene security, complete reporting documentation of the incident, and apply local medical transportation protocol.

5.3 Victim Management.

5.3.1 Access a victim, given tool kits, personal protective equipment, and other equipment designed to allow physical approach to the victim, so that hazards are managed, the rescuer can approach the victim, the access point is determined, the means of access is maintained and stabilized, and an escape route is identified.

(A) *Requisite Knowledge:* Recognition of and methods to manage potential hazards within the rescue environment, methods and means to gain access, use of personal protective equipment and tool kit(s) used to gain access to the victim, and factors used to identify escape routes.

(B) *Requisite Skills:* The ability to manage hazards, use provided tools, use personal protective equipment, and choose safe entry and escape routes and techniques and tools (specific to the rescue environment) to make access to the victim.

5.3.2 Assess a victim, given personal protective equipment to include protection from airborne and bloodborne pathogens and a basic first aid kit, so that required resources can be identified and obtained, injuries are identified, risks to rescuers are minimized, victim viability is established, and treatment priorities are established.

(A) *Requisite Knowledge:* Victim assessment procedures, universal precautions for infectious disease, emergency medical

care, criteria related to mechanisms of injuries, issues relating to protocol, and types of resources and availability.

(B) *Requisite Skills:* The ability to use personal protective clothing, use personal protective equipment, follow established assessment procedures, relate mechanism of injury to assessment, and evaluate scene hazards.

5.3.3 Stabilize the victim, given a basic first aid kit, so that the victim's airway is established and maintained, ventilation is provided as required, circulation is maintained, severe bleeding is controlled, spinal immobilization precautions are taken, and the victim is treated for shock.

(A) *Requisite Knowledge:* Emergency medical care and uses for personal protective equipment.

(B) *Requisite Skills:* The ability to initiate emergency medical care and use personal protective equipment.

5.3.4 Triage victims, given triage tags and local protocol, so that rescue versus recovery factors are assessed, triage decisions reflect resource capabilities, severity of injuries is determined, and victim care and rescue priorities are established in accordance with local protocol.

(A) *Requisite Knowledge:* Types and systems of triage according to local protocol, resource availability, methods to determine injury severity, ways to manage resources, and prioritization requirements.

(B) *Requisite Skills:* The ability to use triage materials, techniques, and resources and to categorize victims properly.

5.3.5* Package an ill or injured victim, given a basic first aid kit and other specialized equipment, so that environmental conditions are assessed, illnesses or injuries are managed, and the potential for further injury is minimized.

(A) *Requisite Knowledge:* Effects of environmental conditions on packaging, emergency medical care, packaging equipment and methods, ways to minimize additional injuries, immobilization techniques, and application of victim personal protective equipment.

(B) *Requisite Skills:* The ability to select and apply packaging equipment, protect a victim, immobilize injuries, and apply personal protective equipment to a victim.

5.3.6 Move a victim in a low-angle environment, given victim transport equipment, litters, other specialized equipment, and victim removal systems specific to the rescue environment, so that the victim is moved without undue further injuries, risks to rescuers are minimized, the integrity of the victim's securement within the transfer device is established and maintained, the means of attachment to the rope rescue system is maintained, and the victim is removed from the hazard.

(A) *Requisite Knowledge:* Types of transport equipment and removal systems, selection factors with regard to specific rescue environments, methods to reduce and prevent further injuries, types of risks to rescuers, ways to establish and maintain victim securement, transport techniques, rope rigging applications and methods, and types of specialized equipment and their uses.

(B) *Requisite Skills:* The ability to secure a victim to transport equipment, assemble and operate environment-specific victim removal systems, and choose an incident-specific transport device.

5.3.7 Transfer a victim to emergency medical services (EMS), given local medical protocols, so that all pertinent information is passed from rescuer to EMS provider, and the victim can be transported to a medical care facility.

(A) *Requisite Knowledge:* Medical protocols for victim transfer, uses for checklists, triage tags or report forms utilized for this purpose by the AHJ, risks, laws and liabilities related to victim transfer, and information needs of the EMS provider.

(B) *Requisite Skills:* The ability to report victim condition and history to the EMS provider and to complete reports and checklists, and verbal communications skills.

5.4 Maintenance.

5.4.1* Inspect and maintain hazard-specific personal protective equipment, given clothing or equipment for the protection of the rescuers, including respiratory protection, cleaning and sanitation supplies, maintenance logs or records, and such tools and resources as are indicated by the manufacturer's guidelines for assembly or disassembly of components during repair or maintenance, so that damage, defects, and wear are identified and reported or repaired, equipment functions as designed, and preventive maintenance has been performed and documented consistent with the manufacturer's recommendations.

(A) *Requisite Knowledge:* Functions, construction, and operation of personal protective equipment; use of record-keeping systems of the AHJ; requirements and procedures for cleaning, sanitizing, and infectious disease control; use of provided assembly and disassembly tools; manufacturer and department recommendations; pre-use inspection procedures; and ways to determine operational readiness.

(B) *Requisite Skills:* The ability to identify wear and damage indicators for personal protective equipment; evaluate operational readiness of personal protective equipment; complete logs and records; use cleaning equipment, supplies, and reference materials; and select and use tools specific to the task.

5.4.2* Inspect and maintain rescue equipment, given maintenance logs and records, tools, and resources as indicated by the manufacturer's guidelines, an equipment replacement protocol, and organizational standard operating procedure, so that the operational status of equipment is verified and documented, all components are checked for operation, deficiencies are repaired or reported as indicated by standard operating procedure, and items subject to replacement protocol are correctly disposed of and changed.

(A) *Requisite Knowledge:* Functions and operations of rescue equipment, use of record-keeping systems, manufacturer and organizational care and maintenance requirements, selection and use of maintenance tools, replacement protocol and procedures, disposal methods, and organizational standard operating procedures.

(B) *Requisite Skills:* The ability to identify wear and damage indicators for rescue equipment, evaluate operation readiness of equipment, complete logs and records, and select and use maintenance tools.

5.5 Ropes/Rigging.

5.5.1 Tie knots, bends, and hitches, given ropes and webbing, so that the knots are dressed, recognizable, and back up as required.

(A) *Requisite Knowledge:* Knot efficiency, knot utilization, rope construction, and rope terminology.

(B) *Requisite Skills:* The ability to tie representative knots, bends, or hitches for the following purposes:

(1) End of line loop
(2) Midline loop
(3) Securing rope around desired objects
(4) Joining rope or webbing ends together
(5) Gripping rope

5.5.2 Construct a single-point anchor system, given life safety rope, edge protection, and other auxiliary rope rescue equipment, so that the chosen anchor system fits the incident needs, meets or exceeds the expected load, and does not interfere with rescue operations, the critical angle is not exceeded, an efficient anchor point is chosen, the need for redundant anchor points is assessed and used as required, the anchor system is inspected and loaded prior to being placed into service, and the integrity of the system is maintained throughout the operation.

(A) *Requisite Knowledge:* Application of knots, rigging principles, anchor selection criteria, system safety check procedures, rope construction, and rope rescue equipment applications and limitations.

(B) *Requisite Skills:* The ability to select rope and equipment; tie knots; rig systems; evaluate anchor points for required strength, location, and surface contour; and perform a system safety check.

5.5.3 Construct a simple rope mechanical advantage system, given life safety rope, carabiners, pulleys, rope grab devices, and auxiliary rope rescue equipment, so that the system constructed can accommodate the load, is efficient, and is connected to an anchor system and the load.

(A) *Requisite Knowledge:* Principles of mechanical advantage, capabilities and limitations of various simple rope mechanical advantage systems, application of knots, rigging principles, and system safety check procedures.

(B) *Requisite Skills:* The ability to select rope and equipment, tie knots, choose and rig systems, attach the mechanical advantage system to the anchor system and load, and perform a system safety check.

5.5.4 Direct a team in the operation of a simple rope mechanical advantage system, given rescue personnel, an established rope rescue system incorporating a simple rope mechanical advantage system, a load to be moved, and an anchor system, so that the movement is controlled, the load can be held in place when needed, operating methods do not stress the system to the point of failure, commands are used to direct the operation, and potential problems are identified, communicated, and managed.

(A) *Requisite Knowledge:* Principles of mechanical advantage, capabilities and limitations of various simple rope mechanical advantage systems, proper operation of simple rope mechanical advantage systems, personnel assignments, and operational commands.

(B) *Requisite Skills:* The ability to direct personnel effectively, use operational commands, analyze system efficiency, identify safety concerns, and perform system safety check.

5.5.5 Construct a lowering system, given an anchor system, life safety rope(s), descent control device, and auxiliary rope rescue equipment, so that the system can accommodate the load, is efficient, is capable of controlling the descent, is capable of holding the load in place or lowering with minimal effort over the required distance, and is connected to an anchor system and the load.

(A) *Requisite Knowledge:* Capabilities and limitations of various descent control devices, capabilities and limitations of various lowering systems, application of knots, rigging principles, and system safety check procedures.

(B) *Requisite Skills:* The ability to tie knots, perform rigging, attach to descent control device, anchor system, and load, and perform a system safety check.

5.5.6 Direct a lowering operation, given rescue personnel, an established lowering system, and a load to be moved, so that the movement is controlled, the load can be held in place when needed, operating methods do not stress the system to the point of failure, rope commands are used to direct the operation, and potential problems are identified, communicated, and managed.

(A) *Requisite Knowledge:* Application and use of descent control devices, capabilities and limitations of various lowering systems, operation of lowering systems, personnel assignments, and operational commands.

(B) *Requisite Skills:* The ability to direct personnel, use operational commands, analyze system efficiency, manage movement of the load, identify safety concerns, and perform a system safety check.

5.5.7 Construct a belay system, given life safety rope, anchor systems, personal protective equipment, and rope rescue equipment, so that the system is capable of arresting a fall, a fall will not result in system failure, the system is not loaded unless actuated, actuation of the system will not injure or render the belayer ineffective, the belayer is not rigged into the equipment components of the system, and the system is suitable to the site and is connected to an anchor system and the load.

(A) *Requisite Knowledge:* Principles of belay systems, capabilities and limitations of various belay devices, application of knots, rigging principles, and system safety check procedures.

(B) *Requisite Skills:* The ability to select a system, tie knots, perform rigging, attach to anchor system and load, don and use task-specific personal protective equipment, and perform a system safety check.

5.5.8 Operate a belay system during a lowering or raising operation, given an operating lowering or hauling system, a belay system, and a load, so that the belay line is not loaded during operation of the primary rope rescue system, the belay system is prepared for actuation at all times during the operation, the belayer is attentive at all times during the operation, the load's position is continually monitored, and the belayer moves rope through the belay device as designed.

(A) *Requisite Knowledge:* Application and use of belay devices, proper operation of belay systems in conjunction with normal lowering and hauling operations, and operational commands.

(B) *Requisite Skills:* The ability to tend a belay system as designed, tie approved knots, assess system effectiveness, properly attach a belay line to a belay device, don and use task-specific personal protective equipment, perform a system safety check, and manage and communicate belay system status effectively.

5.5.9 Belay a falling load, given a belay system and a dropped load, so that the belay line is not taut until the load is falling, the belay device is actuated when the load falls, the fall is arrested, the belayer utilizes the belay system as designed, and the belayer is not injured or rendered ineffective during actuation of the belay system.

(A) *Requisite Knowledge:* Application and use of belay devices, effective emergency operation of belay devices to arrest falls, personal protective equipment, and operating procedures.

(B) *Requisite Skills:* The ability to operate a belay system as designed, tie approved knots, use task-specific personal protective equipment, recognize and arrest a falling load, and communicate belay system actuation.

5.5.10 Conduct a system safety check, given a rope rescue system and rescue personnel, so that a physical/visual check of the system is made to ensure proper rigging, a load test is performed prior to life-loading the system, and verbal confirmation of these actions is announced and acknowledged before life-loading the rope rescue system.

(A) *Requisite Knowledge:* System safety check procedures, construction and operation of rope rescue systems and their individual components, personal protective equipment, equipment inspection criteria, signs of equipment damage, principles of rigging, and equipment replacement criteria.

(B) *Requisite Skills:* The ability to apply and use personal protective equipment, inspect rope rescue system components for damage, assess a rope rescue system for configuration, secure equipment components, inspect all rigging, and perform a system safety check.

Chapter 6 Rope Rescue

6.1 General Requirements. The job performance requirements defined in 6.1.1 through 6.1.10 shall be met prior to certification in rope rescue.

6.1.1 Construct a multiple-point anchor system, given life safety rope and other auxiliary rope rescue equipment, so that the chosen anchor system fits the incident needs, the system strength meets or exceeds the expected load and does not interfere with rescue operations, equipment is visually inspected prior to being put in service, the critical angle is not exceeded, the nearest anchor point that will support the load is chosen, the anchor system is system safety checked prior to being placed into service, the integrity of the system is maintained throughout the operation, and weight will be distributed between more than one anchor point.

(A)* *Requisite Knowledge:* Critical angles and effects and risks of exceeding the critical angle, safety issues in choosing anchor points, system safety check methods that allow for visual and physical assessment of system components, methods to evaluate the system during operations, integrity concerns, weight distribution issues and methods, knots and applications, selection and inspection criteria for hardware and software, formulas needed to calculate safety factors for load distribution, and the concepts of static loads versus dynamic loads.

(B) *Requisite Skills:* The ability to determine incident needs as related to choosing anchor systems, select effective knots, calculate expected loads, evaluate incident operations as related to interference concerns and set-up, choose anchor points, perform system safety check, and evaluate system components for compromised integrity.

6.1.2 Construct a compound rope mechanical advantage system, given a load, an anchor system, life safety rope, carabiners, pulleys, rope grab devices, and rope rescue equipment, so that the system constructed accommodates the load, reduces the force required to lift the load, operational interference is factored and minimized, the system is efficient, a system safety check is completed, and the system is connected to an anchor system and the load.

(A) *Requisite Knowledge:* Determination of incident needs as related to choosing compound rope systems, the elements of efficient design for compound rope systems, knot selection, methods for reducing excessive force to system components, evaluation of incident operations as related to interference concerns and set-up, rope commands, rigging principles, system safety check procedures, and methods of evaluating system components for compromised integrity.

(B) *Requisite Skills:* The ability to determine incident needs as related to choosing compound rope systems, select effective knots, calculate expected loads, evaluate incident operations as related to interference concerns and set-up, perform system safety check, and evaluate system components for compromised integrity.

6.1.3 Construct a fixed rope system, given an anchor system, life safety rope, and rope rescue equipment, so that the system constructed can accommodate the load, is efficient, and is connected to an anchor system and the load, and a system safety check is performed, and the results meet the incident requirements for descending or ascending operations.

(A) *Requisite Knowledge:* Knot selection, calculating expected loads, incident evaluation operations as related to interference concerns and set-up, rigging principles, system safety check procedures, and methods of evaluating system components for compromised integrity.

(B) *Requisite Skills:* The ability to select effective knots, calculate expected loads, use rigging principles, evaluate incident operations as related to interference concerns and set-up, perform system safety check, and evaluate system components for compromised integrity.

6.1.4 Direct the operation of a compound rope mechanical advantage system, given a rope rescue system incorporating a compound rope mechanical advantage system and a load to be moved, so that a system safety check is performed; the movement is controlled; the load can be held in place when needed; operating methods do not stress the system to the point of failure; operational commands are clearly communicated; and potential problems are identified, communicated, and managed.

(A) *Requisite Knowledge:* Methods to determine incident needs, types of interference concerns, rope commands, system safety check protocol, procedures for continued evaluation of system components for compromised integrity, common personnel assignments and duties, common and critical commands, methods for controlling a load's movement, system stress issues during operations, and management methods for common problems.

(B) *Requisite Skills:* The ability to determine incident needs, evaluate incident operations as related to interference concerns, complete a system safety check, continually evaluate sys-

tem components for compromised integrity, direct personnel effectively, communicate commands, analyze system efficiency, manage load movement, and identify concerns.

6.1.5 Complete an assignment while suspended from a rope rescue system, given a rope rescue system, an assignment, life-safety harnesses, litters, bridles, and specialized equipment necessary for the environment, so that risks to victims and rescuers are minimized, the means of attachment to the rope rescue system is secure, selected specialized equipment facilitates efficient rescuer movement, and specialized equipment does not unduly increase risks to rescuers or victims.

(A) *Requisite Knowledge:* Task-specific selection criteria for life-safety harnesses, personal protective equipment selection criteria, variations in litter design and intended purpose, rigging principles, techniques and practices for high-angle environments, and common hazards posed by improper maneuvering and harnessing.

(B) *Requisite Skills:* The ability to select and use rescuer harness and personal protective equipment for common environments, attach the life safety harness to the rope rescue system, maneuver around existing environment and system-specific obstacles, perform work while suspended from the rope rescue system, and evaluate surroundings for potential hazards.

6.1.6 Move a victim in a high-angle or vertical environment, given a rope rescue system, victim transfer devices, and specialized equipment necessary for the environment, so that risks to victims and rescuers are minimized, undesirable victim movement within the transfer device is minimized, the means of attachment to the rope rescue system is maintained, the victim is removed from the hazard, selected specialized equipment facilitates efficient victim movement, and the victim can be transported to the local EMS provider.

(A) *Requisite Knowledge:* Task-specific selection criteria for patient transfer devices, various carrying techniques, personal protective equipment selection criteria, design characteristics and intended purpose of various transfer devices, rigging principles, methods to minimize common environmental hazards and hazards created in high-angle environments.

(B) *Requisite Skills:* The ability to choose patient transfer devices, select and use personal protective equipment appropriate to the conditions, attach a transfer device to the rope rescue system, reduce hazards for rescuers and victims, and determine specialized equipment needs for victim movement.

6.1.7 Direct a team in the construction of a highline system, given rescue personnel, life safety rope, rope rescue equipment, and suitable anchor system capable of supporting the load, so that personnel assignments are made and clearly communicated, the system constructed can accommodate the load, tension applied within the system will not exceed the rated capacity of any of its component parts, system safety check is performed, movement on the system is efficient, and loads can be held in place or moved with minimal effort over the desired distance.

(A) *Requisite Knowledge:* Determination of incident needs as related to operation of highline systems, capabilities and limitations of various highline systems (including capacity ratings), incident site evaluation as related to interference concerns and obstacle negotiation, rigging principles, system safety check protocol, common personnel assignments and duties, common and critical operational commands, and common highline problems and ways to minimize these problems during construction.

(B) *Requisite Skills:* The ability to determine incident needs as related to construction of highline systems, evaluate an incident site as related to interference concerns and setup, identify the obstacles or voids to be negotiated with the highline, select a highline system for defined task, perform system safety checks, use rigging principles, and communicate with personnel effectively.

6.1.8 Direct a team in the operation of a highline system, given rescue personnel, an established highline system, a load to be moved, and personal protective equipment, so that the movement is controlled, the load is held in place when needed, operating methods do not stress the system to the point of failure, personnel assignments are made and tasks are communicated, and potential problems are identified, communicated, and managed.

(A) *Requisite Knowledge:* Ways to determine incident needs as related to the operation of highline systems, capabilities and limitations of various highline systems, incident site evaluation as related to interference concerns and obstacle negotiation, system safety check protocol, procedures to evaluate system components for compromised integrity, common personnel assignments and duties, common and critical operational commands, common highline problems and ways to minimize or manage those problems, and ways to increase the efficiency of load movement.

(B) *Requisite Skills:* The ability to determine incident needs, complete a system safety check, evaluate system components for compromised integrity, select personnel, communicate with personnel effectively, manage movement of the load, and evaluate for potential problems.

6.1.9 Ascend a fixed rope, given an anchored fixed rope system, a system to allow ascent of a fixed rope, a structure, a belay system, a life safety harness worn by the person ascending, and personal protective equipment, so that the person ascending is secured to the fixed rope in a manner that will not allow him or her to fall, the person ascending is attached to the rope by means of ascent control device(s) with at least two points of contact, injury to the person ascending is minimized, the person ascending can stop at any point on the fixed rope and rest suspended by his or her harness, the system will not be stressed to the point of failure, the person ascending can convert his or her ascending system to a descending system, and the system is suitable for the site and objective is reached.

(A) *Requisite Knowledge:* Task-specific selection criteria for life-safety harnesses and systems for ascending a fixed rope, personal protective equipment selection criteria, design and intended purpose of ascent control devices utilized, rigging principles, techniques for high-angle environments, converting ascending systems to descending systems, and common hazards posed by maneuvering and harnessing.

(B) *Requisite Skills:* The ability to select and use rescuer harness, a system for ascending a fixed rope, and personal protective equipment for common environments; attach the life safety harness to the rope rescue system; configure ascent control devices to form a system for ascending a fixed rope; make connections to the ascending system; maneuver around existing environment and system-specific obstacles; convert the ascending system to a descending system while suspended from the fixed rope; and evaluate surroundings for potential hazards.

6.1.10 Descend a fixed rope, given an anchored fixed-rope system, a system to allow descent of a fixed rope, a belay system, a life safety harness worn by the person descending, and personal protective equipment, so that the person descending is attached to the fixed rope in a manner that will not allow him or her to fall, the person descending is attached to the rope by means of a descent control device, the speed of descent is controlled, injury to the person descending is minimized, the person descending can stop at any point on the fixed rope and rest suspended by his or her harness, the system will not be stressed to the point of failure, and the system is suitable for the site and objective is reached.

(A) *Requisite Knowledge:* Task-specific selection criteria for life safety harnesses and systems for descending a fixed rope; personal protective equipment selection criteria; design, intended purpose, and operation of descent control devices utilized; safe rigging principles; techniques for high-angle environments; and common hazards posed by maneuvering and harnessing.

(B) *Requisite Skills:* The ability to select and use rescuer harness, a system for descending a fixed rope, and personal protective equipment for common environments; attach the life safety harness to the rope rescue system; make attachment of the descent control device to the rope and life safety harness; operate the descent control device; maneuver around existing environment and system-specific obstacles; and evaluate surroundings for potential hazards.

Chapter 7 Surface Water Rescue

7.1 General Requirements. The job performance requirements defined in 7.1.1 through 7.1.14 shall be met prior to certification in surface water rescue.

7.1.1* Develop a site survey for an existing water hazard, given historical data, specific personal protective equipment for conducting site inspections, flood insurance rate maps, tide tables, and meteorological projections, so that life safety hazards are anticipated, risk–benefit analysis is included, site inspections are completed, water conditions are projected, site-specific hazards are identified, routes of access and egress are identified, boat ramps (put-in and take-out points) are identified, and areas with high probability for victim location are determined.

(A) *Requisite Knowledge:* Requisite contents of a site survey; types, sources, and information provided by reference materials; hydrology and influence of hydrology on rescues; types of hazards associated with water rescue practices scenarios, inspections practices, and considerations techniques; risk–benefit analysis; identification of hazard-specific personal protective equipment; factors influencing access and egress routes; behavioral patterns of victims; and environmental conditions that influence victim location.

(B) *Requisite Skills:* The ability to interpret reference materials, evaluate site conditions, complete risk–benefit analysis, select and use necessary personal protective equipment for performing site inspections, anticipate rescue-specific personal protective equipment and specialized equipment needs, and predict victim behavior and movement.

7.1.2* Select water rescue personal protective equipment, given a surface water rescue assignment and assorted items of water rescue personal protective equipment, so that the rescuer will be protected from temperature extremes and blunt trauma, the rescuer will have flotation for tasks to be performed, swimming ability will be maximized during rescue activities, self-rescue needs have been evaluated and provided for, and a means of summoning help has been provided.

(A) *Requisite Knowledge:* Classes of personal flotation devices; selection criteria for in-water insulation garments, personal flotation devices, and water rescue helmets; personal escape techniques; applications for and capabilities of personal escape equipment; and equipment and procedures for signaling distress.

(B) *Requisite Skills:* The ability to select personal flotation devices, don and doff personal flotation devices, select water rescue helmets, don and doff water rescue helmets, select in-water insulating garments, don and doff in-water insulating garments, proficiency in emergency escape procedures, and proficiency in communicating distress signals.

7.1.3* Swim a designated water course, given a course that is representative of the bodies of water existing or anticipated within the geographic confines of the AHJ, water rescue personal protective equipment, and swimming aids as required, so that the specified objective is reached, all performance parameters are achieved, movement is controlled, hazards are continually assessed, distress signals are communicated and rapid intervention for the rescuer has been staged for deployment.

(A) *Requisite Knowledge:* Hydrology and specific hazards anticipated for representative water rescue environments (shoreline, in-water, and climatic), selection criteria for water rescue personal protective equipment and swim aids for anticipated water conditions and hazards, and swimming techniques for representative body of water.

(B) *Requisite Skills:* The ability to swim and float in different water conditions with and without flotation aids or swimming aids (as required), apply water survival skills, don and doff personal protective equipment, select and use swim aids, utilize communications systems, and evaluate water conditions to identify entry points and hazards.

7.1.4* Define search parameters for a water rescue incident given topographical maps of a search area, descriptions of all missing persons and incident history, hydrologic data including speed and direction of current or tides, so that areas with high probability of detection are differentiated from other areas, witnesses are interviewed, critical interview information is recorded, passive and active search tactics are implemented, personnel resources are considered and used, and search parameters are communicated.

(A) *Requisite Knowledge:* Topographical map components, hydrologic factors, methods to determine high probability of detection areas, critical interview questions and practices, methods to identify track traps, ways to identify spotter areas and purposes for spotters, personnel available and effects on parameter definition, the effect of search strategy defining the parameter, communication methods, and reporting requirements.

(B) *Requisite Skills:* The ability to read topographic maps, determine hydrology, conduct interviews, read and interpret passive search indicators, correlate personnel availability, define search strategy, and evaluate conditions used to define the search area.

7.1.5* Develop an action plan for a shore-based rescue of a single, water-bound victim, given an operational plan and a water rescue tool kit, so that all information is factored, risk–benefit analysis is conducted, protocols are followed, hazards are identified and minimized, personnel and equipment resources will not be exceeded, assignments are defined, consideration is given to evaluating changing conditions, and the selected strategy and tactics fit the conditions.

(A) *Requisite Knowledge:* Elements of an action plan; types of and information provided by reference materials and size-up; hydrology; types of hazards associated with water rescue practices, risk–benefit analysis, identification of hazard-specific personal protective equipment, factors influencing access and egress routes; behavioral patterns of victims; environmental conditions that influence victim location; safety, communications, and operational protocols; and resource capability and availability.

(B) *Requisite Skills:* The ability to interpret and correlate reference and size-up information; evaluate site conditions; complete risk–benefit analysis; apply safety, communications, and operational protocols; specify personal protective equipment requirements; and determine rescue personnel requirements.

7.1.6* Deploy a water rescue rope to a water-bound victim, given a water rescue rope in a throw bag and personal protective equipment, so that the deployed rope lands in the victim's hands, the rescue rope does not slip through the rescuer's hands, the victim is moved to the rescuer's shoreline, the victim is not pulled beneath the surface by rescuer efforts, the rescuer is not pulled into the water by the victim, and neither the rescuer nor the victim is tied to or entangled in the throw line.

(A) *Requisite Knowledge:* Types and capabilities of personal protective equipment, effects of hydrodynamic forces on rescuers and victims, hydrology and characteristics of water, behaviors of water-bound victims, water rescue rope-handling techniques, incident-specific hazard identification, criteria for selecting victim retrieval locations based on water environment and conditions, hazards and limitations of shore-based rescue, local policies/procedures for rescue team activation, and information on local water environments.

(B) *Requisite Skills:* The ability to select personal protective equipment specific to the water environment, don personal protective equipment, identify water hazards (i.e., upstream or downstream, current or tides), identify hazards directly related to the specific rescue, and demonstrate appropriate shore-based victim removal techniques.

7.1.7* Deploy a water rescue rope to a water-bound victim, given a coiled water rescue rope of 15.24 m to 22.86 m (50 ft to 75 ft) in length and personal protective equipment, so that the deployed rope lands in the victim's hands, the rescue rope does not slip through the rescuer's hands, the victim is moved to the rescuer's shoreline, the victim is not pulled beneath the surface by rescuer efforts, the rescuer is not pulled into the water by the victim, and neither the rescuer nor the victim is tied to or entangled in the throw line.

(A) *Requisite Knowledge:* Types and capabilities of personal protective equipment, effects of hydrodynamic forces on rescuers and victims, hydrology and characteristics of water, behaviors of water-bound victims, safe water rescue rope-handling techniques, incident-specific hazard identification, criteria for selecting victim retrieval locations based on water environment and conditions, hazards and limitations of shore-based rescue, local policies/procedures for rescue team activation, and information on local water environments.

(B) *Requisite Skills:* The ability to select personal protective equipment specific to the water environment, don personal protective equipment, identify water hazards (i.e., upstream or downstream, current or tides), identify hazards directly related to the specific rescue, and demonstrate appropriate shore-based victim removal techniques.

7.1.8 Deploy watercraft, given watercraft; support vehicles; watercraft conveyances; launch and recovery sites, docks, marinas or moorings; support personnel; and operational protocols; so that the watercraft is launched and recovered without damage or injury; trailers, conveyances, and support vehicles are utilized within the scope of their designed specifications; and the rescue effort is not delayed.

(A) *Requisite Knowledge:* Motor vehicle laws and operational protocols for support vehicles with watercraft conveyances, designed applications and limitations for support vehicles with watercraft conveyances during launch and recovery operations, location and routes of access to and egress from watercraft launch/recovery sites, support of vehicle operations, and launch/recovery protocols.

(B) *Requisite Skills:* The ability to support vehicle operations with and without trailers/conveyances, procedures for launching/recovering watercraft from the water, and operation of watercraft conveyances.

7.1.9* Negotiate a designated water course in a watercraft, given a watercraft that is available to the team, a course that is representative of the bodies of water existing or anticipated within the geographic confines of the AHJ, a range of assignments and water rescue personal protective equipment, so that the specified objectives are attained, all performance parameters are achieved, movement is controlled, hazards are continually assessed, launch does not proceed if the watercraft is not adequate or incapable of operating in the existing condition, distress signals are communicated, and rapid intervention for the watercraft crew has been staged for deployment.

(A) *Requisite Knowledge:* Limitations and uses of available watercraft, dynamics of moving water and its effects on watercraft handling, launch and docking procedures, conditional requirements for personal protective equipment, applications for motorized and nonmotorized craft, operating hazards as related to conditions, and crew assignments and duties.

(B) *Requisite Skills:* The ability to navigate watercraft with and without primary means of propulsion, evaluate conditions for launch, don water rescue personal protective equipment, utilize communications systems, apply procedures for broaching and righting watercraft, and apply procedures for casting and recovering personnel from watercraft.

7.1.10 As a member of a team, use a parbuckling technique to extricate an incapacitated water-bound victim from the water to a watercraft, given a water hazard that is representative of the bodies of water existing or anticipated within the geographic confines of the AHJ, a watercraft that is available to the team, nets, webbing, blankets, tarpaulins or ropes, a means of securement, and water rescue personal protective equipment, so that the watercraft is not broached, control of the watercraft is maintained, risks to victim and rescuers are minimized, and the victim is removed from the hazard.

(A) *Requisite Knowledge:* Limitations and uses of available watercraft, parbuckling (rollup) techniques, dynamics of moving water and its effects on watercraft handling, conditional requirements for personal protective equipment, and effects of extrication on watercraft handling and stability.

(B) *Requisite Skills:* The ability to construct a simple mechanical advantage and demonstrate lifting techniques.

7.1.11 Extricate an incapacitated water-bound victim from the water to the shore as a member of a team, given spinal stabilization devices, patient transfer devices, a water hazard that is representative of the bodies of water existing or anticipated within the geographic confines of the AHJ, and water rescue personal protective equipment, so that positive buoyancy for the victim and the rescuers is maintained, the victim's airway, respiratory efforts, and ventilatory support are not compromised, the victim's cervical spine is maintained in alignment, risks to victim and rescuers is minimized, and the victim is removed from the hazard.

(A) *Requisite Knowledge:* Effects of environmental conditions on spinal stabilization and transfer devices, emergency medical care, packaging equipment and methods, ways to minimize additional injuries, immobilization techniques, hydrology and specific hazards anticipated for specific water rescue environment, and selection procedures for water rescue personal protective equipment.

(B) *Requisite Skills:* The ability to secure a victim to spinal stabilization and transfer devices, stabilize a victim's spine manually while in the water, don and doff personal protective equipment, roll a victim from face-down to face-up position, and evaluate water conditions to select exit points and identify hazards.

7.1.12* Perform a swimming surface water rescue, given water rescue personal protective equipment, swim aids as required, flotation aids for victims, and reach/extension devices, so that victim contact is maintained, the rescuer maintains control of the victim, the rescuer and the victim reach safety at a predetermined area, and medical conditions and treatment options are considered.

(A) *Requisite Knowledge:* Hydrology and specific hazards anticipated for representative water rescue environment (shoreline, in-water, and climatic), victim behavior patterns, emergency countermeasures for combative victims, selection criteria for water rescue personal protective equipment, swim aids and flotation aids for anticipated water conditions, victim abilities and hazards, swimming techniques for representative bodies of water, and signs, symptoms, and treatment of aquatic medical emergencies.

(B) *Requisite Skills:* The ability to swim and float in different water conditions with and without flotation aids or swimming aids; apply water survival skills; manage combative water-bound victims; don and doff personal protective equipment; select and use personal protective equipment, flotation aids, and swim aids; utilize communications systems; select equipment and techniques for treatment of aquatic medical emergencies; and evaluate water conditions to identify entry points and hazards.

7.1.13 Direct a team in the operation of a highline system as a member of a team, given rescue personnel, an established highline system, a load to be moved, and personal protective equipment, so that the movement is controlled, the load is held in place when needed, operating methods do not stress the system to the point of failure, personnel assignments are made and tasks are communicated, operational commands are communicated to personnel, and potential problems are identified, communicated, and managed.

(A) *Requisite Knowledge:* Ways to determine incident needs as related to the operation of highline systems, capabilities and limitations of various highline systems, incident site evaluation as related to interference concerns and obstacle negotiation, system safety check protocol, procedures to evaluate system components for compromised integrity, common personnel assignments and duties, assignment considerations, common and critical operational commands, common highline problems and ways to minimize or manage them, and ways to increase the efficiency of load movement.

(B) *Requisite Skills:* The ability to determine incident needs, complete a system safety check, evaluate system components for compromised integrity, select personnel, communicate with personnel, manage movement of the load, and evaluate for potential problems.

7.1.14* Define applications for helicopter aquatic rescue operations within the area of responsibility for the AHJ, given a helicopter service, operational protocols, helicopter capabilities and limitations, rescue procedures, and risk factors influencing helicopter operations, so that air-to-ground communications are established and maintained, applications are within the capabilities and skill levels of the helicopter service, the applications facilitate victim extraction from water hazards that are representative of the bodies of water existing or anticipated within the geographic confines of the AHJ, air crew and ground personnel safety are not compromised, landing zones are designated and secured, and fire suppression resources are available at the landing zone.

(A) *Requisite Knowledge:* Local aircraft capabilities and limitations, landing zone requirements, hazards to aircraft, local protocols, procedures for operating around aircraft, dynamics of rescue options, crash survival principles, personal protective equipment limitations and selection criteria, and ancillary helicopter rescue equipment.

(B) *Requisite Skills:* The ability to determine applicability of air operations, establish and control landing zones, assess fire protection needs, communicate with air crews, identify hazards, rig aircraft for anticipated rescue procedures, apply crash survival procedures, and select and use personal protective equipment.

Chapter 8 Vehicle and Machinery Rescue

8.1 General Requirements. The job performance requirements defined in 8.1.1 through 8.1.10 shall be met prior to certification in vehicle and machinery rescue.

8.1.1 Plan for a vehicle/machinery incident, given agency guidelines, planning forms, a vehicle/machinery incident or simulation, so that a standard approach is used during training and operational scenarios, emergency situation hazards are identified, isolation methods and scene security measures are considered, fire suppression and safety measures are identified, vehicle/machinery stabilization needs are evaluated, and resource needs are identified and documented for future use.

(A) *Requisite Knowledge:* Operational protocols, specific planning forms, types of vehicles and machinery common to the AHJ boundaries, vehicles/machinery hazards, incident support operations and resources, vehicle/machinery anatomy, and fire suppression and safety measures.

(B) *Requisite Skills:* The ability to apply operational protocols, select specific planning forms based on the types of vehicle/machinery, identify and evaluate various types of vehicle/machinery within the AHJ boundaries, request support and resources, identify vehicle/machinery anatomy, and determine the required fire suppression and safety measures.

8.1.2* Establish "scene" safety zones, given scene security barriers, incident location, incident information, and personal protective equipment, so that action hot, warm, and cold safety zones are designated, zone perimeters are consistent with incident requirements, perimeter markings can be recognized and understood by others, zone boundaries are communicated to incident command, and only authorized personnel are allowed access to the rescue scene.

(A) *Requisite Knowledge:* Use and selection of personal protective equipment, traffic control flow and concepts, types of control devices and tools, types of existing and potential hazards, methods of hazard mitigation, organizational standard operating procedure, and types of zones and staffing requirements.

(B) *Requisite Skills:* The ability to select and use personal protective equipment, apply traffic control concepts, position traffic control devices, identify and mitigate existing or potential hazards, and apply zone identification and personal safety techniques.

8.1.3* Establish fire protection, given an extrication incident and fire control support, so that fire and explosion potential is managed and fire hazards and rescue objectives are communicated to the fire support team.

(A) *Requisite Knowledge:* Types of fire and explosion hazards, incident management system, types of extinguishing devices, agency policies and procedures, types of flammable and combustible substances and types of ignition sources, and extinguishment or control options.

(B) *Requisite Skills:* The ability to identify fire and explosion hazards, operate within the incident management system, use extinguishing devices, apply fire control strategies, and manage ignition potential.

8.1.4* Stabilize a vehicle or machine, given a basic extrication tool kit and personal protective equipment, so that the vehicle or machinery is prevented from moving during the rescue operations; entry, exit, and tool placement points are not compromised; anticipated rescue activities will not compromise vehicle or machinery stability; selected stabilization points are structurally sound; stabilization equipment can be monitored; and the risk to rescuers is minimized.

(A) *Requisite Knowledge:* Types of stabilization devices, mechanism of vehicle and machinery movement, types of stabilization points, types of stabilization surfaces, AHJ policies and procedures, and types of vehicle and machinery construction components as they apply to stabilization.

(B) *Requisite Skills:* The ability to apply and operate stabilization devices.

8.1.5* Isolate potentially harmful energy sources, given basic extrication tool kit and personal protective equipment, so that all hazards are identified, systems are managed, beneficial system use is evaluated, and hazards to rescue personnel and victims are minimized.

(A) *Requisite Knowledge:* Types and uses of personal protective equipment, types of energy sources, system isolation methods, specialized system features, tools for disabling hazards, and policies and procedures of the AHJ.

(B) *Requisite Skills:* The ability to select and use task- and incident-specific personal protective equipment, identify hazards, operate beneficial systems in support of tactical objectives, and operate tools and devices for securing and disabling hazards.

8.1.6 Determine the vehicle access and egress points, given the structural and damage characteristics and potential victim location(s), so that victim location(s) is identified; entry and exit points for victims, rescuers, and equipment are designated; flow of personnel, victim, and equipment is identified; existing entry points are used; time constraints are factored; selected entry/egress points do not compromise vehicle stability; chosen points can be protected; equipment and victim stabilization is initiated; and AHJ safety and emergency procedures are enforced.

(A) *Requisite Knowledge:* Vehicle construction/features, entry and exit points, routes and hazards operating systems, AHJ standard operating procedure, and emergency evacuation/safety signals.

(B) *Requisite Skills:* The ability to identify entry and exit points and probable victim locations and assess and evaluate impact of vehicle stability on the victim.

8.1.7 Create access and egress openings for rescue, given basic extrication tool kit, specialized tools and equipment, personal protective equipment, and an assignment, so that the movement of rescuers and equipment complements victim care and removal, an emergency escape route is provided, the technique chosen is expedient, victim and rescuer protection is afforded, and vehicle stability is maintained.

(A) *Requisite Knowledge:* Vehicle construction and features, electrical, mechanical, hydraulic, pneumatic, and alternative entry and exit equipment, points and routes of ingress and egress, techniques and hazards, agency policies and procedures, and emergency evacuation and safety signals.

(B) *Requisite Skills:* The ability to identify vehicle construction features, select and operate tools and equipment, apply tactics and strategy based on assignment, apply victim care and stabilization devices, perform hazard control based on techniques selected, and demonstrate safety procedures and emergency evacuation signals.

8.1.8 Disentangle victim(s), given an extrication incident, a basic extrication tool kit, personal protective equipment, and specialized equipment, so that undue victim injury is prevented, victim protection is provided, and stabilization is maintained.

(A) *Requisite Knowledge:* Tool selection and application, stabilization systems, protection methods, disentanglement points and techniques, and dynamics of disentanglement.

(B) *Requisite Skills:* The ability to operate disentanglement tools, initiate protective measures, identify and eliminate points of entrapment, and maintain incident stability and scene safety.

8.1.9 As a member of a team, remove a packaged victim to a designated safe area given a victim transfer device, designated egress route, and personal protective equipment, so that the team effort is coordinated, the designated egress route is used, the victim is removed without compromising victim packaging, undue injury is prevented, and stabilization is maintained.

(A) *Requisite Knowledge:* Patient handling techniques; incident management system; types of immobilization, packaging, and transfer devices; types of immobilization techniques; and uses of immobilization devices.

(B) *Requisite Skills:* Use of immobilization, packaging, and transfer devices for specific situations, immobilization techniques, application of medical protocols and safety features to immobilize, package, and transfer and all lifting techniques of the patient.

8.1.10* Terminate a vehicle/machinery incident, given personal protective equipment specific to the incident, isolation barriers, extrication tool kit, so that rescuers and bystanders are protected during termination operations; the party responsible for the operation, maintenance, or removal of the affected vehicle/machinery is notified of any modification or damage created during the extrication process; scene control is transferred to a responsible party; potential or existing hazards are communicated to that responsible party; and command is terminated.

Chapter 9 Confined Space Rescue

9.1 General Requirements. The job performance requirements defined in 9.1.1 through 9.1.9 shall be met prior to certification in confined space rescue.

9.1.1 Preplan a confined space incident, given applicable guidelines and regulations and a preplan form, so that a standard approach is used during a confined space rescue emergency, hazards are recognized and documented, isolation methods are identified and documented, all accesses to the location of the entry opening are identified and documented, all types of entry openings are identified and documented, and internal configurations and special resource needs are documented for future rescuer use.

(A) *Requisite Knowledge:* Operational protocols, specific preplan forms, types of hazards common to jurisdictional boundaries, hazards that should and must be identified on preplans, isolation methods and issues related to preplanning, issues and constraints relating to the types of confined space openings, internal configuration special resource needs of a confined space, and applicable legal issues.

(B) *Requisite Skills:* The ability to select a specific preplan form; draft or draw a sketch of confined spaces; complete supplied forms; identify and evaluate various configurations of confined spaces, access points, entry openings, isolation procedures, and energy control locations; recognize general and site-specific hazards; document all data; and apply all regulatory compliance references.

9.1.2* Assess the incident, given a preplan of the space or size-up information, information from technical resources, monitoring equipment, and personal protective equipment required to perform the assessment, so that general area and space-specific hazards are identified, bystanders and victims are interviewed, immediate and ongoing monitoring of the space is performed, the victims' conditions and location are determined, a risk–benefit analysis is performed, methods of ingress and egress for rescuer and victims are identified, rescue systems for victim removal are determined, and an emergency means of retrieval for rescue entrants is established.

(A) *Requisite Knowledge:* Use of preplans, size-up, and interviewing techniques; types of personal protective equipment; monitoring equipment protocols, rescue and retrieval systems; permit programs; types of and uses for available resources; risk–benefit analysis methods; common hazards and their influence on the assessment; methods to identify egress from and ingress into the space; and processes to identify size, type, and configuration of the opening(s) and internal configuration of the space.

(B) *Requisite Skills:* The ability to select and interpret preplan and size-up information, conduct interviews, choose and utilize personal protective equipment, operate monitoring equipment, identify hazard mitigation options, identify probable victim location, perform risk–benefit analysis, recognize characteristics and hazards of confined spaces, and evaluate specific rescue systems for entry and retrieval of rescuers and victims during confined space incidents.

9.1.3* Conduct monitoring of the environment, given monitoring equipment reference material, personal protective equipment, accurately calibrated detection and monitoring equipment, and size-up information, so that a representative sample of the space is obtained, accurate readings are made, readings are documented, and effects of ventilation in determining atmospheric conditions and the conditions of the space have been determined for exposures to existing or potential environmental hazards.

(A) *Requisite Knowledge:* Capabilities and limitations of detection and monitoring equipment, ways to confirm calibration, defining confined space configuration as it applies to obtaining a representative sample of space, basic physical properties of contaminants, and how to determine contents of a confined space.

(B) *Requisite Skills:* The ability to use and confirm calibration of detection and monitoring equipment and acquire representative sample of space.

9.1.4 Control hazards, given personal protective equipment and a confined space tool kit, so that the rescue area is established; access to the incident scene is controlled; rescuers are protected from exposure to hazardous materials and atmospheres, all forms of harmful energy releases, and physical hazards; and victims are protected from further harm.

(A) *Requisite Knowledge:* Proper personal protective equipment; safety protocols; monitoring equipment and procedures; ventilation equipment and procedures; incident hazards; types of hazardous materials exposure risks; forms, sources, and control of harmful energy and physical hazards in the confined space.

(B) *Requisite Skills:* The ability to utilize personal protective equipment, place scene control barriers, operate atmospheric monitoring equipment, isolate dangerous forms of energy, and mitigate physical and atmospheric hazards.

9.1.5 Prepare for entry into the confined space, given a confined space and a confined space rescue tool kit, so that victim communication is established when possible, continuous atmospheric monitoring is initiated, rescuer readiness is veri-

fied, rescuers' limitations are identified and evaluated, rescuers unsuitable to entry operations are reassigned and replaced, route and methods of entry are determined, and rescuer evacuation is planned.

(A) *Requisite Knowledge:* Effects of hazardous atmospheres on victims and rescuers, types and operation of required hazard-specific monitoring equipment, organization protocol for medical and psychological evaluation related to entry, methods of entry into confined space in accordance with operational protocols, and rescuer evaluation methods.

(B) *Requisite Skills:* The ability to operate monitoring equipment, perform rescuer pre-entry medical exam, evaluate rescuer capabilities and limitations, identify victim communication needs, evaluate for point and route of entry, and select evacuation methods.

9.1.6 Enter a confined space, given personal protective equipment; safety, communication, and operational protocols; and a confined space rescue tool kit, so that the victim is contacted, controlled entry is established and maintained, atmosphere is continuously monitored, the victim's mental and physical condition is further assessed, patient care is initiated, the patient is packaged to restrictions of the space, and patient removal can be initiated.

(A) *Requisite Knowledge:* Principles of operation for atmospheric monitoring equipment; methods for patient care in confined spaces; safety, communication, medical, and operational protocols; and controlled entry and egress procedures for confined spaces.

(B) *Requisite Skills:* The ability to use and apply personal protective equipment and rescue-related systems and equipment; implement safety, communication, and operational protocols; use medical protocols to determine treatment priorities; use medical equipment specific to confined space victim needs; and reassess and confirm mode of operation.

9.1.7* Package the victim for removal from a confined space, given a confined space rescue tool kit, so that damage to the rescue/retrieval equipment is prevented, the victim is given the smallest possible profile, and further harm to the victim is minimized.

(A) *Requisite Knowledge:* Spinal management techniques, victim packaging techniques, how to use low-profile packaging devices and equipment, methods to reduce or avoid damage to equipment, and the similarities and differences between packaging for confined spaces and other types of rescue.

(B) *Requisite Skills:* The ability to immobilize a victim's spine; package victims in harnesses, low-profile devices, and litters; recognize and perform basic management of various traumatic injuries and medical conditions; support respiratory efforts; and perform cardiopulmonary resuscitation as required based on the environment.

9.1.8 Remove all entrants from a confined space, given personal protective equipment, rope and related rescue and retrieval systems, personnel to operate rescue and retrieval systems, and a confined space rescue tool kit, so that internal obstacles and hazards are negotiated, all persons are extricated from a space in the selected transfer device, the victim and rescuers are decontaminated as necessary, and the victim is delivered to the emergency medical services (EMS) provider.

(A) *Requisite Knowledge:* Personnel and equipment resource lists, specific personal protective equipment, types of confined spaces and their internal obstacles and hazards, rescue and retrieval systems and equipment, operational protocols, medical protocols, EMS providers, and decontamination procedures.

(B) *Requisite Skills:* The ability to select and use personal protective equipment, select and operate rescue and retrieval systems used for victim removal, utilize medical equipment, and use equipment and procedures for decontamination.

9.1.9 Terminate the confined space incident, given isolation barriers, documentation forms, and a confined space rescue tool kit, so that all personnel are accounted for and removed from the space, injuries are avoided, further entry into the space is denied, and the scene is secure.

(A) *Requisite Knowledge:* Methods to secure a scene, forms for documentation, tools for securing space access points, accountability protocols, and methods for denying further entry.

(B) *Requisite Skills:* The ability to apply regulations as needed, use tools, complete reporting documentation of the incident, and apply protocols.

Chapter 10 Structural Collapse Rescue

10.1 General Requirements. The job performance requirements defined in 10.1.1 through 10.1.16 shall be met prior to certification in structural collapse rescue.

10.1.1* Conduct a size-up of a collapsed structure, given an incident and specific incident information, so that existing and potential conditions within the structure and the immediate periphery are evaluated, needed resources are defined, hazards are identified, construction and occupancy types are determined, collapse type is identified if possible, the need for rescue is assessed, a scene security perimeter is established, and the size-up is conducted within the scope of the incident management system.

(A) *Requisite Knowledge:* Identification of construction types, characteristics, and probable occupant locations; methods to assess rescue needs; expected behavior of each construction type in a structural collapse incident; causes and associated effects of structural collapses; types and capabilities of resources; general hazards associated with structural collapse and size-up; and procedures for implementing site control and scene management.

(B) *Requisite Skills:* The ability to categorize construction types, evaluate structural stability and hazards, and implement resource and security (scene management) protocols.

10.1.2 Determine potential victim locations, given size-up information, a structural collapse tool kit, the type of construction and occupancy, time of day, and collapse pattern, so that search areas are established and victims can be located.

(A) *Requisite Knowledge:* Capabilities and limitation of search instruments and resources, types of building construction, occupancy classifications, collapse patterns, victim behavior, and potential areas of survivability.

(B) *Requisite Skills:* The ability to use size-up information, occupancy classification information, and search devices, and assess and categorize type of collapse.

10.1.3 Develop a collapse rescue incident action plan, given size-up information and a collapsed structure, so that initial size-up information is utilized, an incident management system is incorporated, existing and potential conditions within the structure and the immediate periphery are included, specialized resource needs are identified, work perimeters are determined, collapse type/category and associated hazards are identified, construction and occupancy types are determined, incident objectives are established, and scene security measures are addressed.

(A) *Requisite Knowledge:* Incident-specific size-up information, incident management system components, dynamics of incident conditions and peripheral areas, incident-specific resources in a given geographical area, construction and occupancy types, scene security requirements, personnel needs and limitations, and rescue scene operational priorities.

(B) *Requisite Skills:* The ability to utilize size-up information, implement an incident management system, monitor changing conditions specific to the incident, identify potential specialized resources, determine construction and occupancy types, identify specific incident security requirements, and create written documentation.

10.1.4 Implement a collapse rescue incident action plan, given an action plan and a collapsed structure, so that pertinent information is used, an incident management system is established and implemented, monitoring of dynamic conditions internally and externally is established, specialized resources are requested, hazards are mitigated, victim rescue and extraction techniques are consistent with collapse and construction type, and perimeter security measures are established.

(A) *Requisite Knowledge:* Components of an action plan specific to collapse incidents, incident management systems, dynamics of incident conditions and peripheral areas, identification of specialized resource lists, hazard identification, rescue and extrication techniques consistent with each collapse and construction type, perimeter security measures, and personnel needs and limitations.

(B) *Requisite Skills:* The ability to implement the components of an action plan in a collapse incident, implement an incident management system, initiate hazard mitigation objectives, request specialized resources, initiate rescue objectives, and demonstrate perimeter security measures.

10.1.5 Search a collapsed structure, given personal protective equipment, the structural collapse tool kit, an assignment, operational protocols, and size-up information, so that all victim locations and potential hazards are identified, marked, and reported; protocols are followed; the mode of operation can be determined; and rescuer safety is maintained.

(A) *Requisite Knowledge:* Concepts and operation of the incident management system as applied to the search function, application of specialty tools and locating devices, application of recognized marking systems, voice sounding techniques, potential victim locations as related to the type of structure and occupancy, building construction, collapse types and their influence on the search function, operational protocols, and various hazards and their recognition.

(B) *Requisite Skills:* The ability to implement an incident management system, apply search techniques, use marking systems, identify and mitigate hazards, and select and use victim locating devices.

10.1.6* Stabilize a collapsed light-frame structure as a member of a team, given size-up information, a specific pattern of collapse, a basic structural collapse tool kit, and an assignment, so that strategies to effectively minimize the movement of structural components are identified and implemented; hazard warning systems are established and understood by participating personnel; incident-specific personal protective equipment is identified, provided, and utilized; physical hazards are identified; confinement, containment, and avoidance measures are discussed; and a rapid intervention team is established and staged.

(A) *Requisite Knowledge:* Identification and proper care of personal protective equipment; structural load calculations for shoring system requirements; shoring systems for stabilization; specific hazards associated with light-frame structural collapse; strategic planning for collapse incidents; communications and safety protocols; atmospheric monitoring equipment needs; identification, characteristics, expected behavior, type, causes, and associated effects of light-frame structural collapses; and recognition of, potential for, and signs of impending secondary collapse.

(B) *Requisite Skills:* The ability to select and construct shoring systems for collapses in light-frame structures, use personal protective equipment, perform structural load calculations, determine resource needs, select and operate basic and specialized tools and equipment, implement communications and safety protocols, and mitigate specific hazards associated with shoring tasks.

10.1.7* Stabilize a collapsed heavy construction-type structure as a member of a team, given size-up information, hazard-specific personal protective equipment, an assignment, a specific pattern of collapse, a basic structural collapse tool kit, specialized equipment necessary to complete the task, and engineering resources if needed, so that hazard warning systems are established and understanding by team members is verified, all unstable structural components that can impact the work and egress routes are identified, alternative egress routes are established when possible, expert resource needs are determined and communicated to command, load estimates are calculated for support system requirements, all shoring systems meet or exceed load-bearing demands, shoring systems are monitored continuously for integrity, safety protocols are followed, Rapid Intervention Crew (RIC) are established and staged to aid search and rescue personnel in the event of entrapment, an accountability system is established, atmospheric monitoring is ongoing, and progress is communicated as required.

(A) *Requisite Knowledge:* Identification and proper care of personal protective equipment, structural load calculations for shoring system requirements, shoring systems for stabilization, specific hazards associated with heavy structural collapse, hazard warning systems, specialized resource and equipment needs, communications and rescuer safety protocols, atmospheric monitoring equipment needs, identification of construction types, characteristics and expected behavior of each type in a structural collapse incident, causes and associated effects of structural collapses, and recognition of potential for and signs of impending secondary collapse.

(B) *Requisite Skills:* The ability to select and construct shoring systems for heavy construction-type collapses, use personal protective equipment, perform structural load calculations, determine resource needs, select and operate basic and spe-

cialized tools and equipment, implement communications and rescuer safety protocol, and mitigate specific hazards associated with shoring tasks.

10.1.8 Implement collapse support operations at a rescue incident, given an assignment and available resources, so that scene lighting is adequate for the tasks to be undertaken, environmental concerns are managed, personnel rehabilitation is facilitated, and the support operations facilitate rescue operational objectives.

(A) *Requisite Knowledge:* Resource management protocols, principles for establishing lighting, environmental control methods, and rescuer rehabilitation protocols.

(B) *Requisite Skills:* The ability to manage resources, set up lights, initiate environmental controls, and set up rehabilitation for rescuers.

10.1.9 Release a victim from entrapment by components of a collapsed structure, given personal protective equipment and resources for breaching, breaking, lifting, prying, shoring, and/or otherwise moving or penetrating the offending structural component, so that hazards to rescue personnel and victims are minimized, considerations are given to crush syndrome, techniques enhance patient survivability, tasks are accomplished within projected time frames, and techniques do not compromise the integrity of the existing structure or structural support systems.

(A) *Requisite Knowledge:* Identification, utilization, and proper care of personal protective equipment; general hazards associated with each type of structural collapse; methods of evaluating structural integrity; crush syndrome protocols; identification of construction types and collapse characteristics; causes and associated effects of structural collapses; potential signs of impending secondary collapse; selection and application of rescue tools and resources; and risk–benefit assessment techniques for extrication methods and time constraints.

(B) *Requisite Skills:* The ability to select, use, and care for personal protective equipment, operate rescue tools and stabilization systems, recognize crush syndrome indicators, and complete risk–benefit assessments for selected methods of rescue and time constraints.

10.1.10* Remove a victim from a collapse incident, given a disentangled victim, a basic first aid kit, and victim packaging resources, so that basic life functions are supported as required, victim is evaluated for signs of crush syndrome, advanced life support is called if needed, methods and packaging devices selected are compatible with intended routes of transfer, universal precautions are employed to protect personnel from bloodborne pathogens, and extraction times meet time constraints for medical management.

(A) *Requisite Knowledge:* Identification, utilization, and proper care of personal protective equipment resources for structural collapse incidents; general hazards associated with structural collapse; identification of construction types; characteristics and expected behavior of each type in a structural collapse incident; causes and associated effects of structural collapses; recognition of potential for and signs of impending secondary collapse; characteristic mechanisms of injury and basic life support; and patient packaging principles.

(B) *Requisite Skills:* Selection, use, and care of personal protective equipment, basic pre-hospital care of soft-tissue injuries, fracture stabilization, airway maintenance techniques, and cardiopulmonary resuscitation; selection and use of patient packaging equipment.

10.1.11* Lift a heavy load as a team member, given a structural collapse tool kit and a load to be lifted, so that the load is lifted, control and stabilization are maintained before, during, and after the lift, and access can be gained.

(A) *Requisite Knowledge:* Applications of levers; classes of levers; principles of leverage, gravity, and load balance; resistance force; mechanics of load stabilization; mechanics of load lifting; application of pneumatic, hydraulic, mechanical, and manual lifting tools; how to calculate the weight of the load; safety protocols; and stabilization systems.

(B) *Requisite Skills:* The ability to evaluate and estimate the weight of the load, the operations of lifting tools, the application of a lever, and the application of load stabilization systems.

10.1.12* Move a heavy load as a team member, given a structural collapse tool kit, so that the load is moved the required distance to gain access and so that control is constantly maintained.

(A) *Requisite Knowledge:* Applications of rigging systems, applications of levers, classes of levers, inclined planes, gravity and load balance, friction, mechanics of load stabilization and load lifting, capabilities and limitations of lifting tools, how to calculate the weight of the load, and safety protocols.

(B) *Requisite Skills:* The ability to evaluate and estimate the weight of the load, operate required tools, construct and use levers, incline planes, utilize rigging systems, and stabilize the load.

10.1.13 Breach structural components, given an assignment, personal protective equipment, various types of construction materials, and a structural collapse tool kit, so that the opening supports the rescue objectives, the necessary tools are selected, structural stability is maintained, and the methods utilized are safe and efficient.

(A) *Requisite Knowledge:* Effective breaching techniques; types of building construction and characteristics of materials used in each; the selection, capabilities, and limitations of tools; safety protocols for breaching operations; calculation of weight; and anticipation of material movement during breaching and stabilization techniques.

(B) *Requisite Skills:* Select and use breaching tools, implement breaching techniques based on building construction type, use personal protective equipment, and apply stabilization where required.

10.1.14 Cut through structural steel, given a structural collapse tool kit, personal protective equipment, and an assignment, so that the steel is efficiently cut, the victim and rescuer are protected, fire control measures are in place, and the objective is accomplished.

(A) *Requisite Knowledge:* Safety considerations; the selection, capabilities, and limitations of steel cutting tools; cutting tool applications; types of potential and actual hazards and mitigation techniques; and characteristics of steel used in building construction.

(B) *Requisite Skills:* The ability to assess tool needs, use cutting tools, implement necessary extinguishment techniques, mitigate hazards, and stabilize heavy loads.

10.1.15* Construct cribbing systems, given an assignment, personal protective equipment, a structural collapse tool kit, various lengths and dimensions of construction-grade lumber, wedges, and shims, so that the cribbing system will safely support the load, the system is stable, and the assignment is completed.

(A) *Requisite Knowledge:* Different types of cribbing systems and their construction methods, limitations of construction lumber, load calculations, principles of and applications for cribbing, and safety protocols.

(B) *Requisite Skills:* The ability to select and construct cribbing systems, evaluate the structural integrity of the system, determine stability, and calculate loads.

10.1.16 Coordinate the use of heavy equipment, given personal protective equipment, means of communication, equipment and operator, and an assignment, so that common communications are established, equipment usage supports the operational objective, hazards are avoided, and rescuer and operator safety protocols are followed.

(A) *Requisite Knowledge:* Types of heavy equipment, capabilities, application and hazards of heavy equipment and rigging, safety protocols, and types and methods of communication.

(B) *Requisite Skills:* The ability to use hand signals and radio equipment, recognize hazards, assess for operator and rescuer safety, and use personal protective equipment.

Chapter 11 Trench Rescue

11.1 General Requirements. The job performance requirements defined in 11.1.1 through 11.1.12 shall be met prior to certification in trench rescue.

11.1.1 Conduct a size-up of a collapsed trench, given an incident and background information and applicable reference material, so that the size-up is conducted within the scope of the incident management system; the existing and potential conditions are evaluated within the trench and the rescue area; general hazards are identified; a witness or "competent person" is secured; the probability of victim existence, number, condition, and location is determined; potential for rapid, nonentry rescues or victim self-rescue is recognized; needed personnel, supply, and equipment resources are evaluated; and utility involvement and location are determined. *(See Annex F.)*

(A) *Requisite Knowledge:* Methods to distinguish soil types, collapse mechanics, and other contributing factors such as severe environmental conditions and other general hazards; need to immediately secure "competent person" or witness; signs and evidence of victim involvement, number, and location; jurisdictional and community resource lists and agreements; effects and hazards of collapse and rescue efforts on utilities at the incident site; personnel training level and availability; risk–benefit analysis; protocols; incident management system; and all applicable regulations, laws, and standards.

(B) *Requisite Skills:* The ability to measure dimensions of trench, categorize soil, identify type and degree of collapse, and determine severe environmental conditions with implications for secondary collapse and victim survivability; demonstrate interview techniques; implement protocols and resource acquisition agreements; implement public works utility notification, response, and location procedures; perform a risk–benefit analysis for determining self-rescue, rescue, or recovery mode; implement an incident management system for span of control; and apply governing regulations, laws, and standards.

11.1.2* Implement a trench emergency action plan, given size-up information and a trench incident, so that initial size-up information is utilized; prebriefing is given to rescuers; documentation is ongoing; the collapse zone is established; a risk–benefit analysis is conducted; rapid, nonentry rescues or victim self-rescues are performed; the rescue area and general area is made safe; strategy and tactics are confirmed and initiated for existing and potential conditions; rapid intervention team and operational tasks are assigned; other hazards are mitigated; rescue resources are staged; and a protective system is being utilized.

(A) *Requisite Knowledge:* Size-up information and documentation; need to brief rescuers; areas that could be affected by collapse; variables to factor risk–benefit analysis; criteria for rapid, nonentry rescues; methods to control hazards in the general area; options for strategy and tactical approach by factoring time frame, risk–benefit, approved shoring techniques, and personnel and equipment available; incident management system; rescue personnel and equipment cache staging; and options for victim isolation and/or protective systems.

(B) *Requisite Skills:* The ability to use and document tactical worksheets; disseminate information; understand mechanics and extent of collapse effects; perform risk–benefit analysis; execute rapid, nonentry rescues; mitigate hazards by isolation, removal, or control; choose strategy and tactics that will enhance successful outcome; use incident management system and resource staging; and apply choice of isolation and/or protective system promptly to surround victim.

11.1.3* Implement support operations at trench emergencies, given an assignment equipment and other resources, so that a resource cache is managed, scene lighting is provided for the tasks to be undertaken, environmental concerns are managed, a cut station is established, supplemental power is provided for all equipment, atmospheric monitoring and ventilation are implemented, personnel rehab is facilitated, operations proceed without interruption, extrication methods are in place, and the support operations facilitate rescue operational objectives.

(A) *Requisite Knowledge:* Equipment organization and tracking methods, lighting resources, dewatering methods, shelter and thermal control options, basic carpentry methods, hand and power tool applications, atmospheric monitoring protocol, rehab criteria, and extrication and removal equipment options.

(B) *Requisite Skills:* The ability to track equipment inventory, provide power, use lighting, choose and deploy dewatering techniques, acquire or construct structures for shelter and thermal protection, select rehab areas and personnel rotations, operate atmospheric monitoring and ventilation equipment, and perform patient packaging and removal.

11.1.4* Construct load stabilization systems, given an assignment, personal protective equipment, and a trench tool kit, so that the stabilization system will support the load safely, the system is stable, and the assignment is completed.

(A) *Requisite Knowledge:* Different types of stabilization systems and their construction methods, limitations of the system,

load calculations, principles of and applications for stabilization systems, and safety considerations.

(B) *Requisite Skills:* The ability to select and construct stabilization systems, evaluate structural integrity of the system, determine stability, and calculate loads.

11.1.5* Lift a load, given a trench tool kit, so that the load is lifted the required distance to gain access, settling or dropping of the load is prevented, control and stabilization are maintained before, during, and after the lift, and operational objectives are attained.

(A) *Requisite Knowledge:* Applications of levers, classes of levers, principles of leverage, gravity and load balance, resistance force, mechanics and types of load stabilization, mechanics of load lifting, application of pneumatic, hydraulic, mechanical, and manual lifting tools, how to calculate the weight of the load, and safety protocols.

(B) *Requisite Skills:* The ability to evaluate and estimate the weight of the load, the proper operations of the tools, operation of a lever, and application of load stabilization systems.

11.1.6* Coordinate the use of heavy equipment, given personal protective equipment, means of communication, equipment and operator, and an assignment, so that operator capabilities and limitations for task are evaluated, common communications are maintained, equipment usage supports the operational objectives, and hazards are avoided.

(A) *Requisite Knowledge:* Types of heavy equipment, capabilities, application and hazards of heavy equipment and rigging, operator training, types of communication, and methods to establish communications.

(B) *Requisite Skills:* The ability to use hand signals, use radio equipment, recognize hazards, assess operator for skill and calm demeanor, assess heavy equipment for precision of movement and maintenance, monitor rescuer and victim safety, and use personal protective equipment.

11.1.7* Support a nonintersecting trench as a member of a team, given size-up information, an action plan, a trench tool kit, and an assignment, so that strategies to minimize the further movement of soil are implemented effectively, trench walls, lip, and spoil pile are monitored continuously, rescue entry team(s) remain in a safe zone, any slough-in and wall shears are mitigated, emergency procedures and warning systems are established and understood by participating personnel, incident-specific personal protective equipment is utilized, physical hazards are identified and managed, victim and rescuer protection is maximized, victim extrication methods are considered, and a rapid intervention team is staged.

(A) *Requisite Knowledge:* Shoring and shielding, tabulated data, strategies and tactics, protocols on making the general area safe, criteria for a safe zone within the trench, types of collapses and techniques to stabilize, emergency procedures, selection of personal protective equipment, and consideration of selected stabilization tactics on extrication and victim safety.

(B) *Requisite Skills:* The ability to interpret tabulated data information and tables, place shoring and shielding systems, use protocols, choose methods to stabilize, use personal protective equipment, anticipate extrication logistics, and create systems in trenches 2.44 m (8 ft) deep.

11.1.8* Support an intersecting trench as a member of a team, given size-up information and action plan, a trench tool kit, and an assignment, so that strategies to minimize the further movement of soil are implemented effectively, trench walls, lip, and spoil pile are monitored continuously, rescue entry team(s) in the trench remain in a safe zone, any slough-in and wall shears are mitigated, emergency procedures and warning systems are established and understood by participating personnel, incident-specific personal protective equipment is utilized, physical hazards are identified and managed, victim protection is maximized, victim extrication methods are considered, and a rapid intervention team is staged.

(A) *Requisite Knowledge:* Shoring and shielding, tabulated data, strategies and tactics, types of intersecting trenches and techniques to stabilize, protocols on making the general area safe, criteria for safe zones in the trench, types of collapses and techniques to stabilize, emergency procedures, selection of personal protective equipment, and consideration of selected stabilization tactics on extrication and victim safety.

(B) *Requisite Skills:* The ability to interpret tabulated data information and tables, place shoring and shielding systems, identify type of intersecting trench, use trench rescue protocols, select types of collapse and methods to stabilize, identify hazards in a trench, use personal protective equipment, and anticipate extrication logistics.

11.1.9* Install supplemental sheeting and shoring for each 0.61 m (2 ft) of depth dug below an existing approved shoring system, given size-up information, an action plan, and a trench tool kit, so that the movement of soil is minimized effectively, initial trench support strategies are facilitated, rescue entry team safe zones are maintained, excavation of entrapping soil is continued, victim protection is maximized, victim extrication methods are considered, and a rapid intervention team is staged.

(A) *Requisite Knowledge:* Shoring and shielding, tabulated data, strategies and tactics, methods and techniques to install supplemental sheeting and shoring, protocols on making the general area safe, criteria for safe zones in the trench, types of collapses and techniques to stabilize, emergency procedures, selection of personal protective equipment, and consideration of selected stabilization tactics on extrication and victim safety.

(B) *Requisite Skills:* The ability to interpret tabulated data information and tables, place shoring and shielding systems, identify supplemental sheeting and shoring, use all trench rescue protocols, select types of collapse and methods to stabilize, identify exposure to hazards within the trench relative to existing safe zones, select and use personal protective equipment, and anticipate extrication logistics.

11.1.10* Release a victim from entrapment by components of a collapsed trench, given personal protective equipment, a trench rescue tool kit, and specialized equipment, so that hazards to rescue personnel and victims are minimized, considerations are given to crush syndrome and other injuries, techniques are used to enhance patient survivability, tasks are accomplished within projected time frames, and techniques do not compromise the integrity of the existing trench shoring system.

(A) *Requisite Knowledge:* Identification, utilization, and proper care of personal equipment; general hazards associated with each type of trench collapse; methods of evaluating shoring

systems and trench wall stability; crush syndrome protocols; identification of collapse characteristics; causes and associated effects of trench collapse; potential signs of subsequent collapse; selection and application of rescue tools and resources; risk–benefit assessment techniques for extrication methods; and time restraints.

(B) *Requisite Skills:* The ability to select, use, and care for personal protective equipment, operate rescue tools and stabilization systems, identify crush syndrome clinical settings, and complete risk–benefit assessments for selected methods of rescue and time restraints.

11.1.11* Remove a victim from a trench, given a disentangled victim, a basic first aid kit, and victim packaging resources, so that basic life functions are supported as required, the victim is evaluated for signs of crush syndrome, methods and packaging devices selected are compatible with intended routes of transfer, universal precautions are employed to protect personnel from bloodborne pathogens, and extraction times meet time constraints for medical management.

(A) *Requisite Knowledge:* Medical protocols, available medical resources, transfer methods and time needed to execute, universal precautions protocol, rope rescue systems, high-point anchor options, and patient ladder raise removal techniques.

(B) *Requisite Skills:* The ability to select and use personal protective equipment, provide basic medical care and immobilization techniques, identify the need for advanced life support and crush syndrome management, and use a removal system that matches logistical and medical management time-frame concerns.

11.1.12* Terminate a trench emergency incident, given personal protective equipment and removal of victim(s), so that all rescue equipment is removed from the trench, sheeting and shoring are removed in the reverse order of their placement, emergency protocols and safe zones in the trench are adhered to, rescue personnel are removed from the trench, the last supporting shores are pulled free with ropes, equipment is cleaned and serviced, reports are completed, and a postbriefing is performed.

(A) *Requisite Knowledge:* Selection of personal protective equipment, equipment used and location, shoring and shielding tactics and order of placement, shoring removal protocols, criteria for a "safe zone" within the trench, personnel accountability, emergency procedures, manufacturer's recommended care and maintenance procedures, and briefing protocols.

(B) *Requisite Skills:* The ability to use personal protective equipment, remove equipment and protective systems, use trench safety protocols, clean and service equipment, and perform an incident debriefing.

Chapter 12 Subterranean Rescue

12.1 General Requirements. The job performance requirements defined in 12.1.1 through 12.1.12 shall be met prior to certification in subterranean rescue.

12.1.1* Plan for subterranean rescue operations given resources, subterranean environments within the boundaries of the AHJ, so that the locations, known hazards, and all known entrances are documented.

(A) *Requisite Knowledge:* Location of subterranean spaces, hazards involving subterranean environments, resource requirements, and terminology.

(B) *Requisite Skills:* The ability to recognize subterranean entrances and hazards of the subterranean environment.

12.1.2* Assess the incident, given size-up information, site maps, charts, diagrams, blueprints, forms, information from technical resources and on-site personnel, monitoring equipment, and personal protective equipment necessary to perform the assessment, so that general area and site-specific hazards are identified, known witnesses are interviewed, the total number and potential locations of victims is determined, a risk–benefit analysis is performed, ventilation requirements are determined, entry and egress are identified, and specialized resource needs are identified.

(A) *Requisite Knowledge:* Subterranean hazards, specialized resource requirements, information sources, search guidelines, risk–benefit analysis, ventilation requirements, means of controlled entry and egress of subterranean spaces, and terminology.

(B) *Requisite Skills:* The ability to interpret size-up information, conduct interviews, choose and utilize personal protective equipment, identify hazard mitigation options, identify potential victim locations, and recognize characteristics and hazards of natural and manmade subterranean spaces.

12.1.3* Conduct atmospheric monitoring of the subterranean environment, given personal protective equipment, atmospheric monitoring equipment, reference material, so that atmospheric readings are continually assessed, readings are documented, and changes and readings are tracked.

(A) *Requisite Knowledge:* Capabilities and limitations of monitoring equipment, calibration methods, atmospheric hazards associated with subterranean spaces and underground construction, personal protective equipment required for subterranean rescue, and the use of reference material specific to subterranean rescue.

(B) *Requisite Skills:* The ability to use and calibrate atmospheric monitoring equipment, interpret resource information, and choose and utilize personal protective equipment.

12.1.4 Size-up a subterranean rescue incident, given maps, charts, diagrams, and blueprints, so that search parameters, routes, and equipment are determined, rescuers are briefed and assigned routes to follow, and time estimates are anticipated.

(A) *Requisite Knowledge:* Applicable document symbols, search techniques for subterranean rescues, skills and abilities of rescuers, time parameters for rescuers to move within the subterranean environment, transport equipment dimensions and specifications, and rigging requirements of subterranean environments.

(B) *Requisite Skills:* The ability to interpret maps, charts, diagrams, and blueprints, and to assign duties and tasks to rescuers.

12.1.5* Develop a subterranean rescue incident action plan, given an incident and size-up information, so that size-up information and the incident management system is utilized, safety requirements and communication needs are addressed, existing and potential conditions in the subterranean space are identified, and incident objectives are established and followed.

(A) *Requisite Knowledge:* Incident-specific size-up information, incident management systems, safety planning, communication resources, subterranean hazards and work conditions, and specialized resources for subterranean rescue.

(B) *Requisite Skills:* The ability to use size-up assessment information, implement an incident management system, identify special resource needs, create written documentation, and develop safety and communications plans.

12.1.6* Establish subterranean space ventilation, given size-up information, technical resource information, and worker or witness information, so that ventilation needs are determined, required airflow is established and maintained, required air changes are accomplished, and atmospheric hazards are monitored and controlled.

(A) *Requisite Knowledge:* Airflow criteria for subterranean rescue, potential subterranean space configurations, types of ventilation equipment, and hazards present in specific spaces posing problems for successful rescue.

(B) *Requisite Skills:* The ability to set up and operate ventilation equipment, establish required airflow based on subterranean configuration, and initiate monitoring and hazard control measures specific to ventilation.

12.1.7* Coordinate the use of specialized resources, given personal protective equipment, communications equipment, size-up information, specialized resources, and an incident action plan, so that specialized resources are considered with respect to the incident management system, specialized resource usage supports incident objectives, hazards are identified, avoided, monitored, or controlled, and rescuer and resource safety is maintained.

(A) *Requisite Knowledge:* Specialized resources specific to subterranean rescue, Incident Management System (IMS), use of incident action plans, communications methods, and subterranean rescue hazards.

(B) *Requisite Skills:* The ability to coordinate resources, implement IMS components, utilize incident action plans, operate communications equipment, and interpret size-up information.

12.1.8 Control hazards, given personal protective equipment, subterranean rescue tool kit, and size-up information, so that hazards in the rescue area are identified; atmospheric hazards, physical hazards, and energy sources are controlled; a rescue perimeter is established; and victims and rescuers are protected.

(A) *Requisite Knowledge:* Subterranean gases, potential sources of energy and physical hazards, lighting requirements, hazard mitigation techniques, lockout/tag-out procedures specific to a subterranean space, ventilation needs, and scene-marking methods.

(B) *Requisite Skills:* The ability to establish a perimeter, apply lockout/tag-out methods where needed, operate air-monitoring equipment in IDLH conditions, and operate lighting equipment.

12.1.9* Prepare for entry into a subterranean space, given technical information on the space, size-up information, subterranean classification, space site map, and a subterranean space rescue tool kit, so that specific personal protective equipment is selected and used, specific routes for rescue are identified, accountability is maintained, a back-up rescue team is ready and standing by, entry team readiness is confirmed, communication systems are in place, continuous atmospheric monitoring capabilities are used, lighting is assured, and safe ingress and egress control points are maintained and monitored.

(A) *Requisite Knowledge:* Use of technical and size-up information, knowledge of subterranean rescue personal protective equipment, subterranean classifications, mapping and routing systems, accountability systems, rescue team requirements, communications methods, atmospheric monitoring requirements, lighting methods, and subterranean ingress and egress control points.

(B) *Requisite Skills:* The ability to choose and use personal protective equipment, follow identified rescue routes, interpret information sources, utilize accountability systems, operate communication systems, utilize monitoring equipment, and utilize lighting equipment.

12.1.10* Enter a subterranean space for rescue as a member of a team, given personal protective equipment, rope and related access equipment (if applicable to the given environment), established routes, subterranean rescue tool kit, size-up information, subterranean space classification, technical resource information on the subterranean space, and subterranean map, so that identified routes are followed, specific subterranean environmental obstacles are negotiated, the victims are located, patient respiratory protection is initiated, disentanglement is accomplished, atmospheric monitoring is maintained, hazard assessment continues, and collapse potential is assessed.

(A) *Requisite Knowledge:* Use of technical and size-up information, construction and use of rope or other systems for access as applicable to a given environment, methods for following identified routes, classifications of subterranean spaces, respiratory protection options, atmospheric monitoring considerations, and hazard assessment methods.

(B) *Requisite Skills:* The ability to interpret information sources, assess hazards, construct and use rope or other systems for access if applicable to the environment entered, apply personal protective equipment, interpret symbols, locate and use identified routes for rescue, surface and subterranean movement, and operate monitoring equipment.

12.1.11* Package the victim for removal from a subterranean space, given a subterranean tool kit and patient transfer devices, so that damage to rescue equipment is prevented, the victim is given the best profile for removal, and further harm to the victim is minimized.

(A) *Requisite Knowledge:* Spinal management techniques, victim packaging techniques, use of low-profile packaging devices and equipment, methods to reduce or avoid damage to equipment, and the similarities and differences between packaging for subterranean space and other types of rescue.

(B) *Requisite Skills:* The ability to immobilize a victim's spine; package victims in harnesses, low-profile devices, and litters; recognize and perform basic management of various traumatic injuries and medical conditions; support respiratory efforts; and perform cardiopulmonary resuscitation as required based on the environment.

12.1.12 Remove all victims, entrants, and equipment from a subterranean space, given personal protective equipment, rope and related rescue equipment, personnel to operate rescue systems, and a subterranean rescue tool kit, so that internal obstacles and hazards are negotiated, all persons are extricated

from the area in the selected transfer device, the victim and rescuers are decontaminated as necessary, and the victim is delivered to the emergency medical services (EMS) provider.

(A) *Requisite Knowledge:* Personnel and equipment resource lists, specific personal protective equipment, subterranean classifications and their typical internal obstacles and hazards, rescue systems and equipment (including applicable rope rescue systems for lowering, raising, and/or traversing a given area), operations protocols, medical protocols, EMS providers, and decontamination procedures as applicable.

(B) *Requisite Skills:* The ability to select and use personal protective equipment, select and operate rescue systems (including applicable rope rescue systems for lowering, raising, and/or traversing a given area) used for victim disentanglement and removal, utilize medical equipment, and use equipment and procedures for decontamination as required.

Chapter 13 Dive Rescue

13.1* General Requirements. The job performance requirements defined in 13.1.1 through 13.1.14 shall be met prior to certification in dive rescue. In addition, candidates shall possess accepted advanced open water SCUBA certification from a nationally recognized agency. At the entry level, and for any specialties utilized by an organization at the technician level, the AHJ shall ensure provision of certification in that specialty by a nationally recognized certifying agency. The curriculum for such certification shall be oriented toward the needs and operational requirements of public safety diving as defined herein.

13.1.1 Develop a dive profile/plan, given pre-dive checklist so that elements of the plan, risk–benefit, hazard-specific equipment, access/egress routes, environmental conditions, type of search to be performed, review of signals, and surface pressures are defined.

(A) *Requisite Knowledge:* Use of references, use of dive tables, searcher limitations, incident management systems resource capabilities, search technique and theory, SCUBA limitations/abilities, float/refloat theory.

(B) *Requisite Skills:* The ability to use dive tables, develop plan, implement incident management, read and interpret maps, interview witnesses, translate information given into a search plan, use communications equipment, define search parameters, and determine hydrology, critical interview questions, spotter placement, and strategies.

13.1.2* Select and use personal protective equipment, given a sub-surface mission and personal protective and life-support equipment, so that rescuer is protected from temperature extremes, proper buoyancy is maintained, AHJ protocols are complied with, swimming ability is maximized, routine and emergency communications are established between components of the team, self-rescue needs have been evaluated and provided for, and pre-dive safety checks have been conducted.

(A) *Requisite Knowledge:* Manufacturer's recommendations, standard operating procedures, basic signals and communications techniques, selection criteria of insulating garments, buoyancy characteristics, personal escape techniques, applications for and capabilities of personal escape equipment, hazard assessment, and AHJ protocols for equipment positioning.

(B) *Requisite Skills:* The ability to use personal protective equipment according to the manufacturer's directions, proficiency in emergency escape procedures, proficiency in communications, don and doff equipment in an expedient manner, and use pre-dive checklists.

13.1.3* Demonstrate fundamental watermanship skills, given safety equipment, props, and confined water body, so that basic skills are demonstrated in a controlled environment, performance parameters are achieved, and problems may be identified prior to work in high-stress environment.

(A) *Requisite Knowledge:* Basic forward stroke swimming theory (surface skills).

(B) *Requisite Skills:* Basic swimming skills, including the ability to swim and float in different water conditions with and without flotation aids or swimming aids (as required), and apply water survival skills.

13.1.4* Negotiate a SCUBA water course, given a SCUBA-dive designated course, safety equipment, props, and confined water body, so that skills are demonstrated in a controlled environment, performance parameters are achieved, hazards are continually assessed, proper buoyancy control is maintained, and emergency procedures are demonstrated.

(A) *Requisite Knowledge:* Basic SCUBA theory (subsurface skills).

(B) *Requisite Skills:* Basic SCUBA skills, including the ability to maneuver using SCUBA in different water conditions including limited visibility, and apply water survival skills.

13.1.5 Supervise, coordinate, and lead dive teams during operations, given incident checklists, dive checklists, maps, topographic surveys, charts, and pre-dive/post-dive medical evaluation checklist, so that teams are managed, personnel are supervised, hazards are assessed and identified, safety and health of team is ensured, qualifications/abilities of divers are verified, pre-dive briefing is conducted, and post-dive medical evaluation and briefing is performed.

(A) *Requisite Knowledge:* "Divemaster" level knowledge; knowledge of supervisory practices, dive tables, emergency procedures, communications procedures, local protocols, and pre-dive safety checks.

(B) *Requisite Skills:* The ability to use SCUBA, dive tables, emergency procedures, communication procedures, and leadership/management skills.

13.1.6* Assist a surfaced diver in distress, given safety equipment, personal protective equipment, water hazard, and a tired, entrapped, or stressed diver, so that the diver is rescued or assisted, and the victim is extricated from environment.

(A) *Requisite Knowledge:* Techniques for approach and assistance of surfaced victims or divers, buoyancy control techniques, disentanglement procedures, and communication procedures.

(B) *Requisite Skills:* The ability to use personal protective equipment, flotation devices, techniques for rescue or assistance, swimming techniques using SCUBA gear, and panicked diver evasion techniques.

13.1.7* Assist a submerged diver in distress, given safety equipment, personal protective equipment, and an entrapped, tired, or distressed diver, so that the diver is rescued or assisted, and the victim is extricated from environment.

(A) *Requisite Knowledge:* Techniques for approach and assistance of victims, buoyancy control techniques, out-of-air emergency procedures, use of secondary air systems, procedures for disentanglement, and communications procedures.

(B) *Requisite Skills:* The ability to use personal protective equipment, techniques for rescue or assistance, buoyancy control devices, and regulators, weight belt removal, and emergency ascents.

13.1.8* Demonstrate procedures for underwater self-rescue, given safety equipment, a pool or controlled water environment, SCUBA equipment, and props, so that hazards are recognized, emergency procedures are performed, diver self-extricates from situation, and problems may be identified prior to work in a high-stress environment.

(A) *Requisite Knowledge:* Basic SCUBA emergency procedures for applicable environments and emergency medical treatment protocols for oxygen toxicity, bends, decompression injuries, and other dive-related injuries and illnesses.

(B) *Requisite Skills:* The ability to implement loss of communications procedures; regulator loss, failure, or out-of-air procedures; disentanglement and self-extrication procedures; severed or entangled umbilical or tag line procedures; equipment loss or failure procedures; and emergency treatment of injured divers.

13.1.9 Perform searches appropriate to the environment/nature of the water body and procedures for effective underwater communications, given search parameters for a subsurface rescue incident, hydrologic data (including speed and direction of current or tides), descriptions of missing persons and incident history, checklists, safety diver tasks, knots used, conditions affecting overlap, pattern selection, water body representative of the AHJ, and safety and SCUBA equipment, so that areas with high probability of detection are differentiated from other areas, witnesses are interviewed, critical interview information is recorded, personnel resources are considered, search parameters are communicated, search is performed, and object is found.

(A) *Requisite Knowledge:* Search theory, environmental considerations, and procedures/protocols; hydrologic factors, methods to determine high probabilities of detection areas, and critical interview questions and practices.

(B) *Requisite Skills:* The ability to negotiate a body of water, use rope or items in search, implement procedures for effective underwater communications, and communicate.

13.1.10* Control an underwater site as a potential crime scene and generate an accurate record of possible evidence and its environment, given paper and pencil, evidence tube or container, marker float, GPS, and last seen point, so that items are secured, possible evidence is preserved by taking notes on, documenting, making sketches of, photographing, or retrieving evidence, chain of custody and evidentiary nature is maintained, and information is passed to law enforcement.

(A) *Requisite Knowledge:* Understand and maintain the "chain of evidence," camera operations, scent article handling and preservation, clue awareness, and specific scene situation considerations (i.e., wreckage, dead bodies, injury, evidence).

(B) *Requisite Skills:* Interview skills of corroborating witnesses, basic drawing skills.

13.1.11* Define procedures for use of watercraft for dive operations, given watercraft used by the AHJ, so that watercraft pre-deployment checks are completed, watercraft launch or recovery is achieved as stipulated by AHJ operational protocols, divers are deployed and recovered, both on-board and dive rescue operations conform with watercraft operational protocols and capabilities, communications are clear and concise, and the candidate is familiar with watercraft nomenclature, operational protocols, design limitations, and launch/recovery site issues.

(A) *Requisite Knowledge:* Entry/exit procedures, communications techniques, and boat diving operation techniques.

(B) *Requisite Skills:* The ability to implement entry/exit procedures and communications with watercraft crew and use emergency/safety equipment.

13.1.12* Define procedures and applications for use of aircraft for dive operations, given aircraft used by the AHJ, protocols and procedures, air-to-ground communication, extraction issues, and safety procedures, so that aircraft pre-deployment checks are completed, divers are deployed and recovered, both on-board and dive rescue operations conform with aircraft operational protocols and capabilities, communications are clear and concise, and the candidate is familiar with aircraft nomenclature, operational protocols, and design limitations.

(A) *Requisite Knowledge:* Entry/exit procedures, communications techniques, and aircraft operation techniques.

(B) *Requisite Skills:* The ability to implement entry/exit procedures and communications with aircraft crew and use emergency/safety equipment.

13.1.13* Remove incapacitated victim from water to the operating deck of a watercraft, using techniques selected by the AHJ (parbuckling, etc.), given lifting and removal equipment and procedures selected by the AHJ, spinal immobilization techniques and equipment, personal protective equipment, and watercraft used by the AHJ, so that scene safety protocols are adhered to, limitations and design of watercraft are evaluated, techniques utilize simple mechanical advantage when lifting, watercraft maneuvering enhances victim and diver recovery operations, and patient injuries and welfare are not compromised by removal techniques.

(A) *Requisite Knowledge:* Medical treatment protocols, simple mechanical advantage, access points of boats.

(B) *Requisite Skills:* Utilize medical treatment protocols, maintain positive buoyancy, maintain airway, c-spine.

13.1.14 Remove incapacitated victim from water to the shore or a dock, using techniques selected by the AHJ (parbuckling, etc.), given lifting and removal equipment and procedures selected by the AHJ, spinal immobilization techniques and equipment, personal protective equipment, and representative shores or docks found in the jurisdiction, so that scene safety protocols are adhered to, victim is removed to a predetermined area, techniques utilize simple mechanical advantage when lifting, and patient injuries and welfare are not compromised by removal techniques.

(A) *Requisite Knowledge:* Medical treatment protocols, simple mechanical advantage, access points, site selection criteria.

(B) *Requisite Skills:* Utilize medical treatment protocols, maintain positive buoyancy, maintain airway, c-spine.

Chapter 14 Wilderness Rescue

14.1 General Requirements. The job performance requirements defined in 14.1.1 through 14.1.11 shall be met prior to certification in wilderness rescue.

14.1.1 Plan a wilderness rescue incident, given available maps and resources so that hazards are identified and documented, all accesses to the locations are identified and documented, and special resource needs are documented for future use.

(A) *Requisite Knowledge:* Operational protocols, specific pre-plan forms, types of hazards common to jurisdictional boundaries, and hazards that must be identified on plans.

(B) *Requisite Skills:* The ability to select a specific pre-plan form, draft or draw a sketch of wilderness area, complete supplied forms, recognize general and specific hazards, and document all data.

14.1.2 Interview witness(es), given witness recording forms, so that available information as to the location, habits, mental and physical condition, clothing, and appearance of the victim can be determined, subject profile can be established, victim's last known location is identified, and search areas can be prioritized.

(A) *Requisite Knowledge:* Interviewing techniques, interviewing forms, and lost-person behavior.

(B) *Requisite Skills:* The ability to apply interviewing techniques and determine lost-person behavior profile.

14.1.3* Collect and document evidence to determine victim's potential location, given various pieces of evidence and collection and documentation equipment, so that the scene (area) is thoroughly searched and evidence is protected, documented, cataloged, and collected.

(A) *Requisite Knowledge:* How to maintain the chain of evidence, scene search procedures, evidence protection methods, documentation and catalog methods, and evidence collection procedures.

(B) *Requisite Skills:* The ability to operate photography equipment, utilize standard evidence collection tools, and collecting, documenting, and cataloging procedures.

14.1.4* Develop profile(s) for the victim(s), given victim information and collected evidence, so that a search plan can be developed and implemented.

(A) *Requisite Knowledge:* Interviewing techniques, evidence collection, and weather conditions.

(B) *Requisite Skills:* The ability to interpret evidence, conduct victim analysis, and evaluate present and predicted weather conditions.

14.1.5* Operate in a wilderness environment, given personal protective equipment, food and water, and a wilderness tool box, so that the rescuer can function in the wilderness environment for a prolonged period of time.

(A) *Requisite Knowledge:* Potential weather conditions, terrain conditions, and wilderness survival.

(B) *Requisite Skills:* The ability to implement wilderness navigation, orienteering, and wilderness survival techniques.

14.1.6 Navigate in the wilderness to a specified location, given navigation equipment, topographical maps of the area to be navigated, and communication equipment, so that the specified location is identified and reached, search patterns are conducted, teams are guided to the desired location, and all clues relative to the location of the search victim are identified and communicated back to the command post.

(A) *Requisite Knowledge:* Search patterns, navigation equipment, map reading, map types and systems, and use of communication equipment.

(B) *Requisite Skills:* The ability to read maps, use navigation equipment, measure a distance in varied terrain, and navigate accurately around obstacles.

14.1.7 Locate a victim in a wilderness environment, given a starting location, area to be searched, navigation equipment, topographical maps, and communication equipment, so that the victim's location can be determined.

(A) *Requisite Knowledge:* Man-tracking skills, search patterns, communication skills, passive and active search, sign cutting, jump tracking, and attraction methods.

(B) *Requisite Skills:* The ability to implement man tracking, search patterns, communication techniques, passive and active search, sign cutting, and jump tracking, use a tracking stick, and communicate track to others using track ID form.

14.1.8 Treat a victim's injuries and medical condition(s), given a wilderness first aid tool kit, so that additional complications to the victim will be prevented or minimized.

(A) *Requisite Knowledge:* Basic life support for the wilderness environment.

(B) *Requisite Skills:* The ability to provide basic life support in a wilderness environment.

14.1.9* Manage a victim in a wilderness environment, given a victim and basic and advanced life support kits, so that the basic and advanced life support medical care of the victim is managed during transport and the potential for further injury is minimized.

(A) *Requisite Knowledge:* Medical care in a wilderness environment.

(B) *Requisite Skills:* The ability to provide medical care and advanced life support in a wilderness environment.

14.1.10* Package a victim for wilderness transport, given victim packaging materials and victim transport devices, so that additional complications to the victim will be prevented or minimized.

(A) *Requisite Knowledge:* Basic life support and patient packaging for the wilderness environment.

(B) *Requisite Skills:* The ability to apply basic life support and patient packaging for the wilderness environment.

14.1.11 Move the victim(s) and the entry team(s) from the wilderness environment, given personal protective equipment and wilderness rescue tool kit, so that existing mechanical egress equipment is utilized by trained rescue personnel and removal is completed.

(A) *Requisite Knowledge:* Terrain hazards, wilderness rescue personal protective equipment, applicable rope rigging and rescue systems, and mechanical access and egress systems.

(B) *Requisite Skills:* The ability to assess hazards, use personal protective equipment, construct and utilize applicable rope rigging and rescue systems, and use mechanical access and egress systems.

Annex A Explanatory Material

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

A.1.1 The committee intends the document to provide the minimum standard for professional rescuers. The committee is aware that, in order to meet the requirements of this standard, considerable resources might have to be applied to meet equipment and training needs. The committee is aware that these resources might not be available to many small community fire services, industrial sites, and other volunteer operations. The committee does not intend to imply that rescue operations at various levels cannot be undertaken by these organizations, only that this standard applies to those services charged to provide technical rescue at the technician level.

A.1.3 Table A.1.3 provides an overview of general duties.

Table A.1.3 General Duties Table

Site Operations	Patient Management	Maintenance	Rope/Rigging
Size-up	Access	Tools and equipment	Tie knots
Establish IMS	Triage victims	Vehicle	Construct anchor systems
Mitigate hazards	Stabilize	Communications	Construct simple mechanical advantage
Search location	Package	Personal protective equipment	Operate simple mechanical advantage system
	Extricate		Construct lowering systems
	Transfer		Operate lowering systems

A.1.3.3 The purpose of the matrix in Table A.1.3.3 is to help the authority having jurisdiction assess chapter requirements depending on specific rescue disciplines needed in their area.

A.3.1 Definitions of action verbs used within this document are based upon the first definition of the word found in *Webster's Third New International Dictionary of the English Language.*

A.3.2.1 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.

Table A.1.3.3 Rescue Technician Matrix

Discipline	Chapter Correlation
High/Low Angle	6
Surface Water	7
Vehicle and Machinery	8
Confined Space	9
Building Collapse	10
Trench	11
Tunnel	12
Dive	13
Wilderness Search and Rescue	14
Cave/Mines	12
Tower	6
Urban	6, 9, 10
Industrial	6, 8, 9
Farm	6, 8, 9
Fireground (Rapid Intervention)	6, 10
Elevator and Escalator	6, 8, 9
Silo	6, 8, 9
Elevated Train/Subway	6, 8, 9, 12
Wells/Cisterns	6, 9
Utility Vaults/Switching Station	6, 9
Scaffolding Collapse	6, 10
Trams/Gondola/Ski Lift	6, 8
Elevated Crane	6, 8
Shipboard	6, 8, 9
Bridges	6, 7
Winery Tanks	9
Aircraft	8
Train/Light Rail	8
Swiftwater	7, 13
Surf	7, 13
Ice	7, 13

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, 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.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.4.1 Multiple Point Anchor System. The subcategories of these systems can be further defined as follows:

(1) Load distributing anchor systems (also referred to as self-equalizing or self-adjusting) are anchor systems established from two or more anchor points that:
   (a) Maintain near-equal loading on the anchor points despite direction changes on the mail line rope
   (b) Re-establish equal loading on remaining anchor points if any one of them fails; The system should be configured so as to limit the resulting drop that occurs as the result of an anchor point failure.

(2) Load sharing anchor systems are established from two or more anchor points that distribute the load among the anchor points somewhat proportionately but will not adjust the direction changes on the main line rope. The system should be configured so as to limit the resulting drop that occurs as the result of an anchor point failure.

A.3.3.4.2 Single Point Anchor System. Figure A.3.3.4.2 illustrates such a system.

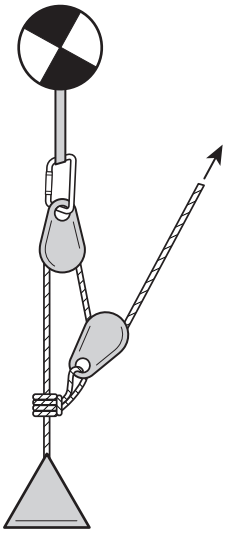


FIGURE A.3.3.4.2 Compound A 3:1 System (Z-Rig)

A.3.3.7 Attendant. An attendant does all of the following:

(1) Remains outside the confined space during entry operations until relieved by another attendant
(2) Summons rescue and other needed resources as soon as he or she determines that authorized entrants might need assistance to escape from confined space hazards
(3) Performs nonentry rescues as specified by the rescue procedure listed on the permit

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.3.3.8 Authorized Entrant. The authorized entrant meets the following training requirements:

(1) *Hazard Recognition.* Including recognition of the signs and symptoms of exposure to a hazardous material or atmosphere within the space, understanding of consequences of exposure, and the mode of transmission for the hazard (injection, ingestion, inhalation, or absorption)
(2) *Communications.* 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
(3) *Personal Protective Equipment.* Including all personal protective equipment appropriate for the confined space and proper training and documentation of training in its use
(4) *Self-Rescue.* The method by which the entrant will escape from the space should an emergency occur; this includes self-actuated methods (such as climbing a ladder or crawling through a horizontal manway opening) as well as those externally applied and operated (such as a hauling system attached to the entrant and operated by the rescue team).

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.3.3.9 Basic First Aid Kit. See Table A.3.3.9.

Table A.3.3.9 Basic First Aid Kit

General Category	Specific Information
Assorted bandages	Cravats, ace, self-adhering of various sizes
Assorted dressings	Occlusive, sterile pads, and rolls of various sizes
Assorted splints	Air, vacuum, wire, rigid, soft, traction
Bag valve mask resuscitators	
BP cuff and stethoscope	Adult and pediatric
Cervical collars	Full set adult and pediatric
Oxygen with flow regulator and air adjuncts	D size with 1-25 mmG flow
Portable suction	
Additional items determined by the AHJ	

A.3.3.10 Belay. This may 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.3.3.16 Bombproof. This term generally refers to an anchor point so structurally significant that failure of this component is likely to cause structural collapse. Examples of bombproof anchor points include large structural steel I-beams and large structural reinforced concrete columns.

A.3.3.26 Confined Space. A confined space also 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 a potential to contain a hazardous atmosphere
(3) Contains a material that has the potential for engulfing an entrant
(4) 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
(5) Contains any other recognized serious safety or health hazard (including fall, environmental, and equipment hazards)

For purposes of this standard, this definition excludes mines and caves or other natural formations that must be addressed by other specialized training and equipment.

A.3.3.31 Confined Space Rescue Preplan. See Figure A.3.3.31.

A.3.3.34 Confined Space Type. Figure A.3.3.34 shows predefined types 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 simulated rescue practice 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 (i.e., congested or noncongested).

A.3.3.36 Construction Type. 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 lightframe, heavy wall, heavy floor, and precast concrete construction. These four categories usually comprise the majority of structures affected by a collapse.

A.3.3.38 Critical Angle. See Figure A.3.3.38.

A.3.3.42 Crush Syndrome. This muscle death can lead to myoglobinuria, renal failure, muscle loss, and contractions.

A.3.3.43 Cut Sheet. The cut sheet is utilized by an excavating crew to assist them in completing a job. Usually the competent person or job supervisor will have this document in his or her possession.

A.3.3.50 Dive Tables. Figure A.3.3.50 is an illustration of a Recreational Dive Planner.

A.3.3.61 Extinguishing Devices. Many extinguishing mediums can be ineffective if used inappropriately to combat fires involving incompatible materials. The proper extinguishing medium should be appropriately matched to the class of fire. For instance, use of the wrong type of foam can be completely ineffective based on the type of material being extinguished. The foam should be matched to the specific incident (e.g., polar solvents, nonpolar solvents, pressurized fire, nonpressurized fire).

A.3.3.68 General Area. Within the general area, access by people, heavy machinery, and vehicles is limited and strictly controlled.

A.3.3.73 Hazardous Atmosphere for Confined Space. Hazardous atmosphere can result from one or more of the following:

(1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL).
(2) Airborne combustible dust at a concentration that meets or exceeds its LFL, which can be estimated by observing the density of the concentration. In general, if the concentration of dust obscures vision at a distance of 1.5 m (5 ft) or less, it might be within its flammable range.
(3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent.
(4) Atmospheric concentration of any hazardous substance that could result in exposure to personnel in excess of its dose or permissible exposure limit (PEL).
(5) Any other atmospheric condition that is immediately dangerous to life or health (IDLH).

A.3.3.87 Isolation. Some methods of isolation include blanking or blinding of pipes, misaligning or removing sections of pipe lines or ducts, a double block and bleed system, lockout or tagout of all sources of energy, or blocking or disconnecting all mechanical linkages.

A.3.3.88 Isolation System. 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.3.3.90 Knot. A knot will maintain its integrity. Although more accurately classified as "ties," the term *knot* is commonly used to refer to knots, bends, and hitches.

A.3.3.112.2 Simple Rope Mechanical Advantage System. Figure A.3.3.112.2 illustrates such a system.

A.3.3.122 Personal Flotation Device (PFD). PFDs are classified by performance criteria into five types with specific limitations on where and under what circumstances each type can be used.

A.3.3.123 Personal Protective Equipment (PPE). Personal protective equipment includes both personal protective clothing and respiratory protection specific to a particular rescue discipline. Adequate personal protective equipment should appropriately protect the respiratory system, skin, eyes, face, hands, feet, head, body, and hearing.

A.3.3.123.1 Water Rescue Personal Protective Equipment. At a minimum, consideration should be given to mobility, flotation, and thermal protection. Rescuers should also evaluate potential for blunt head trauma, entanglement in lines and vegetation, exposure to chemical, biological, and etiological contaminants, the need for an auxiliary emergency air supply, and a means of summoning help when in distress.

A.3.3.124 Pneumatic Struts. Also refers to devices (which contain potentially hazardous stored energy) mounted on vehicles or machinery to stabilize or hold open doors or hatches.

A.3.3.128 Pre-incident Plan. A site-specific preplan can also provide useful information for consideration during size-up, including, but not limited to, the following:

(1) Rescue team notification
(2) Acceptable entry conditions for rescue
(3) Hazard analysis
(4) Risk analysis of hazards
(5) Site map
(6) Hazard abatement (including control zones, ventilation, lockout/tag-out procedures, etc.)
(7) Use of buddy system (when applicable)
(8) Communications (site, rescue attendant to rescue entrant, etc.)
(9) Command post
(10) Incident management organizational chart
(11) Standard operating guidelines
(12) Safe work practices
(13) Medical assistance
(14) Pre-entry safety briefings
(15) Pre- and post-entry physicals (if indicated)

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 Summon 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): _____
- Backup 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.3.3.31 Confined Space Rescue Preplan.

CS TYPE 1 / 1E — elevated
Portal size: Less than 0.61 m (24 in.)
Configuration: Round /oval
Accessibility: Horizontal entry (vertical portal)

CS TYPE 2 / 2E — elevated
Portal size: 0.61 m (24 in.) or larger
Configuration: Round /oval
Accessibility: Horizontal entry (vertical portal)

CS TYPE 3 / 3E — elevated
Portal size: Less than 0.61 m (24 in.)
Configuration: Square /rectangle
Accessibility: Horizontal entry (vertical portal)

CS TYPE 4 / 4E — elevated
Portal size: 0.61 m (24 in.) or larger
Configuration: Square /rectangle
Accessibility: Horizontal entry (vertical portal)

***CS TYPE 5 / 5E** — elevated
Portal size: Less than 0.61 m (24 in.)
Configuration: Round /oval
Accessibility: Vertical top entry (horizontal portal)

***CS TYPE 6 / 6E** — elevated
Portal size: 0.61 m (24 in.) or larger
Configuration: Round /oval
Accessibility: Vertical top entry (horizontal portal)

***CS TYPE 7 / 7E** — elevated
Portal size: Less than 0.61 m (24 in.)
Configuration: Square /rectangle
Accessibility: Vertical top entry (horizontal portal)

***CS TYPE 8 / 8E** — elevated
Portal size: 0.61 m (24 in.) or larger
Configuration: Square /rectangle
Accessibility: Vertical top entry (horizontal portal)

CS TYPE 9 / 9E — elevated
Portal size: Less than 0.61 m (24 in.)
Configuration: Round /oval
Accessibility: Vertical bottom entry (horizontal portal)

CS TYPE 10 / 10E — elevated
Portal size: 0.61 m (24 in.) or larger
Configuration: Round /oval
Accessibility: Vertical bottom entry (horizontal portal)

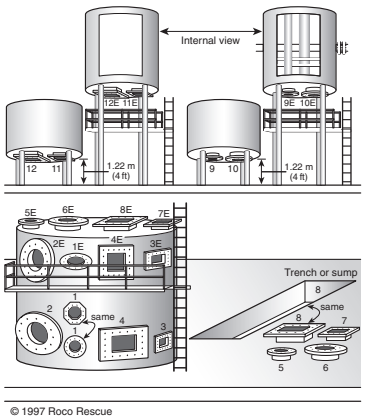
CS TYPE 11 / 11E — elevated
Portal size: Less than 0.61 m (24 in.)
Configuration: Square /rectangle
Accessibility: Vertical bottom entry (horizontal portal)

CS TYPE 12 / 12E — elevated
Portal size: 0.61 m (24 in.) or larger
Configuration: Square /rectangle
Accessibility: Vertical bottom entry (horizontal portal)

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

Definitions:

1. 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.
2. Elevated Portal — Bottom of passageway is 1.22 m (4 ft) or higher from ground level.
3. Horizontal Entry — Access passageway is entered traveling parallel to ground level through a vertical portal.
4. Manway or Portal — An internal or external opening large enough for a person to pass through.
5. Rectangular/Square Portal — A four-sided opening with four right angles. Opening size is determined by measuring the shortest side of the opening.
6. Round/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.
7. Vertical Entry — Access passageway is entered traveling perpendicular to ground level through a horizontal portal.



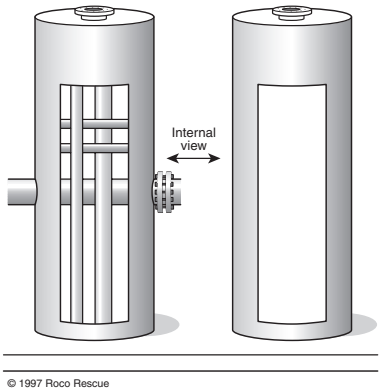


FIGURE A.3.3.34 Confined Space Types.

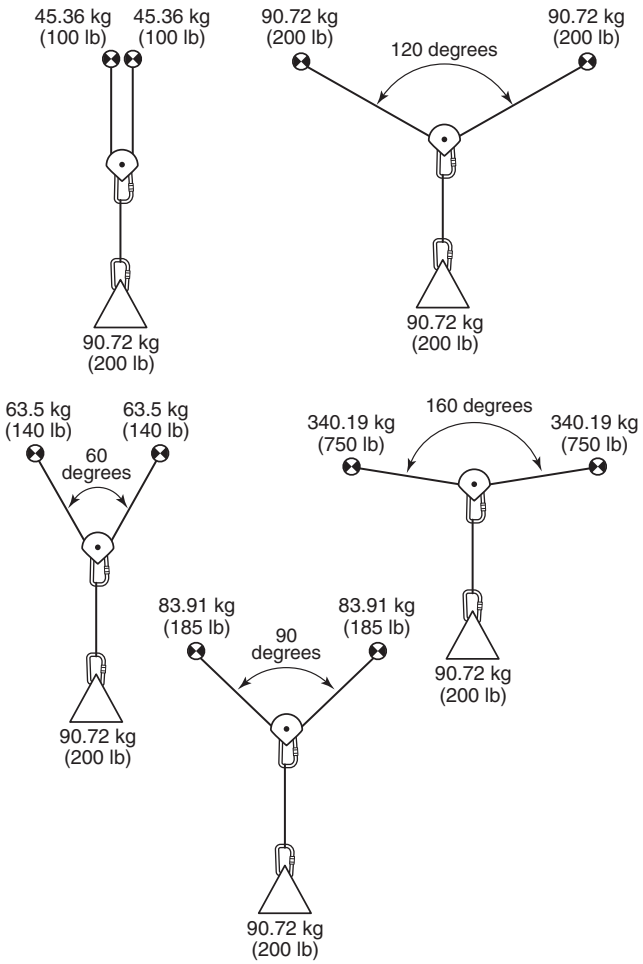


FIGURE A.3.3.38 The Effect of Angle Forces on Anchors and Lines: Critical Angles.

Guidelines for initial response planning within the quantity and capability of available personnel and equipment should include, but is not limited to, the following:

(1) Response objectives for confined space emergencies
(2) Nonentry rescue options
(3) Entry-type rescue options
(4) Whether rescuer and equipment capabilities are appropriate for available rescue options
(5) Needs analysis and procedures for providing emergency decontamination to victims suspected of being contaminated with a hazardous material

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

(1) Scene control, including control zones and communication
(2) Incident management system consistent with the organization's standard operating procedure
(3) Nonentry retrieval
(4) Qualifying entry-type rescues
(5) Emergency decontamination as needed
(6) Technical-level rescue service assistance

A.3.3.129 Protective System. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

A.3.3.131 Rapid Intervention Crew/Company (RIC). Fire departments respond to many incidents that present a high risk to fire fighter safety. Departments in compliance with OSHA 29 CFR 1910.134, "Respiratory Protection Regulations," must have a minimum of two persons on scene fully equipped when members are operating in an IDLH or potentially IDLH atmosphere. The primary purpose is the rescue of injured, lost, or trapped fire fighters. Departments utilizing an incident management system in accordance with NFPA 1561, *Standard on Emergency Services Incident Management System*, or 29 CFR 1910.120, "Regulation on Hazardous Waste," along with a personnel accountability system have incorporated the RIC into their management system. Many departments have redefined their response plans to include the dispatch of an additional company (engine, rescue, or truck) to respond to incidents and stand by as the RIC. Incident commanders can assign additional RICs based on the size and complexity of the incident scene. This OSHA rule is also included as part of special operations incidents in NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program [see sample standard operating procedures (SOP)]*, for RICs.

In some departments, an RIC can also be known as a Rapid Intervention Team.

A.3.3.135 Registered Licensed Professional Engineer. However, a 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.3.3.141 Rescue Team. The number of persons required for an effective team is dependent upon variables such as the task(s) to be completed, the abilities of the individual team members, and the individuals' ability to work together efficiently. Although many recommendations exist as to an "ideal" minimum number of team members, this should be based on the circumstances surrounding the incident and the logistics involved. NFPA 1670, *Standard on Operations and Training for Technical Rescue Incidents*, recognizes the need for minimum staffing levels for certain technical rescue incidents and contains guidelines to that effect.

A.3.3.143 Retrieval Equipment (Retrieval System). 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 or existing structural systems. A nonentry retrieval can simply involve operating the crank on a winch/tripod system where anchors and protection systems are already in place.

These systems are required wherever 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.

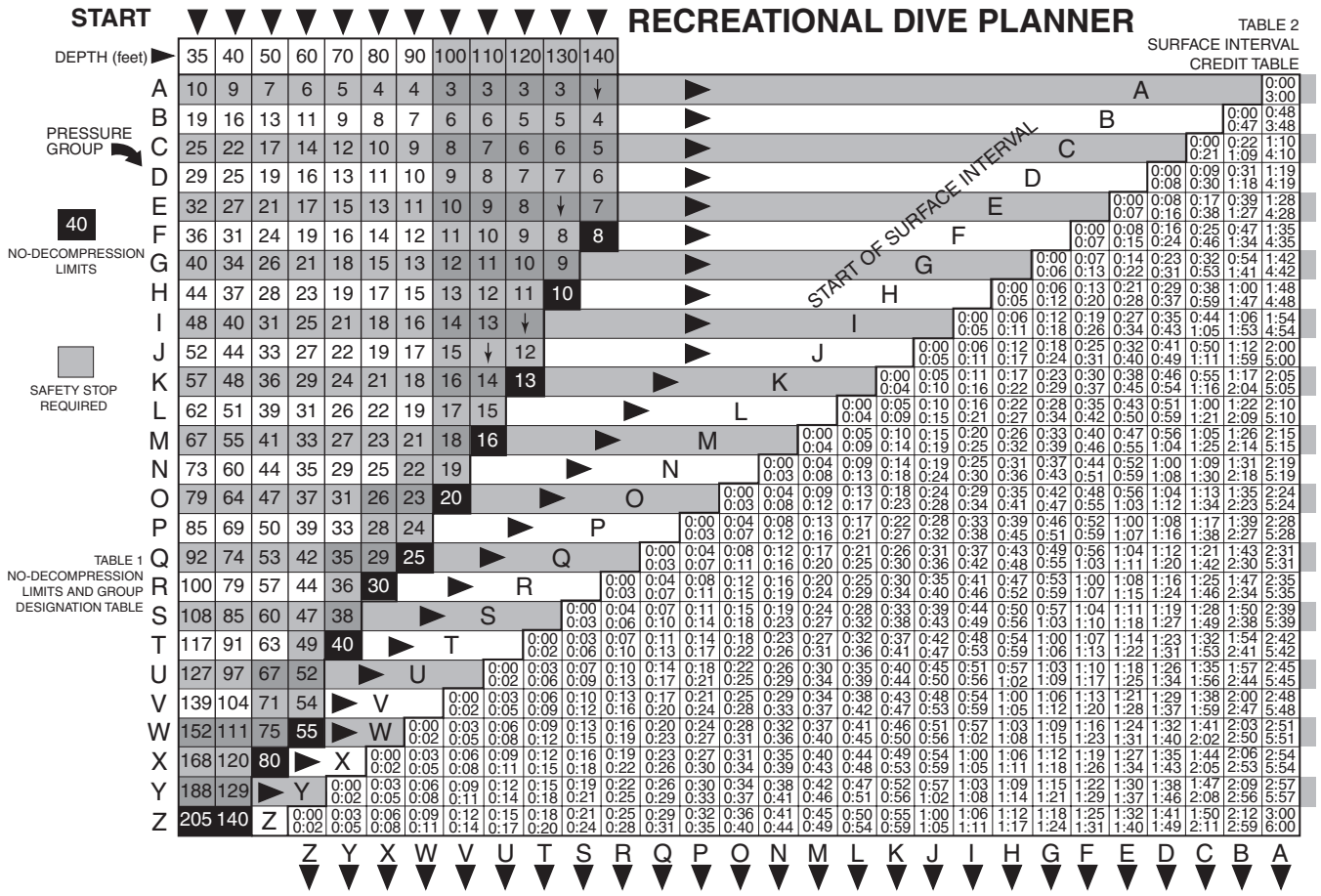


FIGURE A.3.3.50 Dive Table.

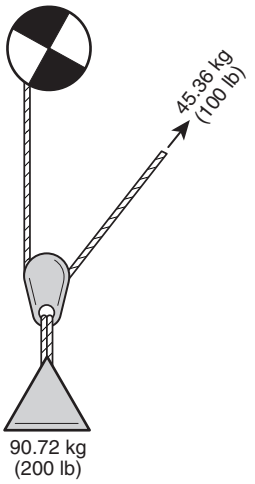


FIGURE A.3.3.112.2 Simple A 2:1 System.

A.3.3.156.1 Active Search Measures. Of primary and immediate importance is locating the point last seen (PLS) of the missing subject. Sometimes, the reporting person (RP) will have no direct knowledge of what happened. For example, the RP can be a family member reporting a group of canoeists overdue at a takeout. At other times, the RP will have witnessed a river accident such as a raft overturning or a fisherman being swept away, and will be able to give a description of the victims and a fairly exact PLS. RPs should be interrogated for all information they might have about the victim, to include physical description, clothing, destination, experience, time the incident occurred, and any other details that might help the search (e.g., the type of shoes to aid trackers).

A.3.3.156.2 Passive Search Measures. The searches at this point are detailed, formal searches, not hasty ones. It is better to have small, trained groups of searchers thoroughly search an area repeatedly than to search with large groups of untrained people, since these frequently trample more evidence than they find. As the search progresses, the incident commander should debrief team leaders frequently and revise the search plan as necessary.

A.3.3.158 Secondary Collapse. Indications of potential for secondary collapse include the following:

(1) Leaning walls
(2) Smoke or water seeping through joints
(3) Unusual sounds (e.g., creaking, groaning)
(4) Recurring aftershocks
(5) Sagging floor or roof assemblies
(6) Missing, strained, or damaged points of connection of structural elements

(7) Excessive loading of structural elements
(8) Sliding plaster and airborne dust
(9) Separating walls
(10) Lack of water runoff
(11) Racked or twisted structure
(12) Building vibration

A.3.3.163 Shield or Shield System. Shields can be permanent structures or can be designed to be portable. They can be either manufactured or job-built. Shields used in trenches are usually referred to as *trench boxes* or *trench shields*.

A.3.3.168 Signaling Device. Examples of signaling devices include, but are not restricted to, flares, strobe lights, mirrors, brightly colored (air) panels, flags, light-emitting devices, smoke pyrotechnics, air horns, and whistles.

A.3.3.177 Specialized Teams. These teams can include, but are not limited to, hazardous materials teams, fire suppression teams, and medical teams.

A.3.3.195 Swim. For the purposes of this standard, any purposeful body positioning in water that a rescuer demonstrates that facilitates movement to a desired objective is construed as swimming.

A.3.3.196 Swim Aids. Examples include, but are not restricted to, webbed gloves, swim fins, boogie boards, and surf boards.

A.3.3.197 System Safety Check. Personnel should review all system components carefully to ensure proper assembly. Personnel should preload the system in a safe manner (e.g., standing away from edges while preloading). A signal is issued by the person performing the system safety check to confirm the completion of the first two steps. The signal should address other rescuers utilizing the system and should be acknowledged by one or more of them.

A.3.3.198 Tabulated Data. Also, the term is applied to six tables found in Appendix C of 29 CFR 1926, Subpart P.

A.3.3.206 Tool Kit. Several specialized tool kits have been established based on the specific technical rescue discipline. The lists of kits in Annex G is intended to supply a listing of equipment needed at specific incidents. It is not intended to limit organizations from expanding their equipment or capabilities.

A.3.3.210 Trench (Trench Excavation). In general, the depth of a trench is greater than the width, but the width, measured at the bottom, is no greater than 4.57 m (15 ft). 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 4.57 m (15 ft) or less, the excavation is also considered a trench.

A.3.3.210.1 Intersecting Trench. Common configurations are "L," "X," and "T."

A.3.3.223 Watercraft. Examples include basic paddle boats, powered inflatable boats (I.R.B.), rigid hulled craft, hovercraft, air boats, and one- and two-person water jet–driven (personal) watercraft.

A.3.3.224 Watercraft Conveyance. Examples include trailers, pickup trucks, forklifts, and davits.

A.4.1 All technical rescue activities should be carried out in the safest possible manner, including the consideration that all risks taken are to the benefit of the operation. Technical rescue skills require a high degree of physical activity, coordination, and operational planning and a strong knowledge of all applicable protocols. It is for this reason that entrance requirements are outlined in Section 4.2 and clarified in A.4.2.

A.4.2 The following list elaborates these requirements.

(1) *Age Requirements.* The AHJ is empowered to set minimum and maximum age requirements. Due to the fact that technical rescue requires a level of maturity inherent to the rescue environment, it is recommended that the minimum age required to begin training as a rescue technician be set at 18 years. However, some fire and rescue organizations have set requirements to allow participation by individuals under the age of 18.
(2) *Medical Requirements.* The AHJ is empowered to establish medical requirements for initiation of training and continued participation as a rescue technician. It is recommended that the authority having jurisdiction adopt NFPA 1582, *Standard on Medical Requirements for Fire Fighters and Information for Fire Department Physicians*, in whole or in part as part of their own standard development process.
(3) *Minimum Physical Fitness.* Technical rescue operations involve activities that pose great physical and mental challenges. Technical rescue is an inherently demanding activity requiring the technician to perform challenging physical activities in a high-stress environment.
(4) *Emergency Medical Care Training.* Prior to beginning training as a rescue technician, a minimum medical training requirement should be met. Rescue technicians should be trained at minimum to the level of emergency medical technician–basic as described in the National Standard Curriculum issued by the United States Department of Transportation (DOT), National Highway Transportation Safety Authority. (DOT recommends all emergency responders be trained to the EMT–paramedic level.) Requirements for EMT–basic are as follows:
    (a) Responds to emergency calls to provide efficient and immediate care to the critically ill and injured and transports patients to a medical facility. After receiving a call from the dispatcher, drives an ambulance to an address or location using the most expedient route, depending on traffic and weather conditions. Observes traffic ordinances and regulations concerning emergency vehicle operation.
    (b) Upon arrival at the scene of a crash or illness, parks the ambulance on a safe location to avoid additional injury. Prior to initiating patient care, the EMT–basic will also size-up the scene to determine that the scene is safe, the mechanism of injury or nature of illness, and the total number of patients and to request additional help as necessary. In the absence of law enforcement, creates a safe traffic environment, such as the placement of road flares, removal of debris, and redirection of traffic for the protection of the injured and those assisting in the care of injured patients.
    (c) Determines the nature and extent of the illness or injury and establishes priority for required emergency care. Based on assessment findings, renders emergency medical care to adult, infant, and child, medical and trauma patients. Duties include, but are not limited to, opening and maintaining an airway, ventilating patients, and cardiopulmonary resuscitation, including the use of automatic external defibrillators. Provides prehospital emergency medical care of simple and multiple system trauma such as controlling hemorrhage, treatment of shock (hypoperfusion), bandaging wounds, and immobilization of painful, swollen,

deformed extremities. Medical duties include assisting in childbirth, management of respiratory, cardiac, diabetic, allergic, behavioral, and environmental emergencies and suspected poisonings. Searches for medical identification emblem as clue in providing emergency care. Provides additional care upon assessment of the patient and obtaining of historical information. These interventions include assisting patients with prescribed medications, including sublingual nitroglycerin, epinephrine auto-injectors, and hand-held aerosol inhalers. The EMT–basic will also be responsible for administration of oxygen, oral glucose, and activated charcoal.

(d) Reassures patients and bystanders by working in a confident, efficient manner.

(e) Avoids mishandling and undue haste while working expeditiously to accomplish the task.

(f) Where a patient must be extricated from entrapment, assesses the extent of injury, gives all possible emergency care and protection to the entrapped patient, and uses the prescribed techniques and appliances for safely removing the patient. If needed, radios the dispatcher for additional help and special rescue and/or utility services. Provides simple rescue service if a specialized unit has not accompanied the ambulance. After extraction, provides additional care in triaging the injured in accordance with standard emergency procedures.

(g) Complies with regulations on the handling of the deceased, notifies authorities, and arranges for the protection of property and evidence at the scene.

(h) Lifts the stretcher [must be able to lift and carry 57 kg (125 lb)], places it in the ambulance and sees that the patient and stretcher are secured, and continues emergency medical care.

(i) From the knowledge of the condition of the patient, the extent of injuries, and the relative locations and staffing of emergency hospital facilities, determines the most appropriate facility to which the patient will be transported, unless otherwise directed by the medical director. Reports directly to the emergency department or communications center the nature and extent of injuries, the number being transported, and the destination to ensure prompt medical care on arrival. Identifies assessment findings that can require communications with medical direction for advice and notification that special professional services and assistance be immediately available upon arrival at the medical facility.

(j) Assists in carrying patient out of ambulance and into the receiving facility.

(k) Reports orally and in writing observations and emergency medical care of the patient at the emergency scene and in transit to the receiving facility staff for the purposes of records and diagnostics. Upon request, provides assistance to the receiving facility staff.

(5) *Educational Requirements.* Because rescue technicians can be required to read and comprehend standards and procedures, prepare written reports, and diagram and understand principles of mechanical advantage, structural engineering, and other related disciplines, it is recommended that the rescue technician be at minimum a high school graduate.

(6) *Training.* People having the potential for encountering hazardous materials on an incident scene should be trained to recognize the hazard and implement exposure and control methods.

A.4.3 To obtain certification as a professional rescuer in any discipline, a person must first meet a series of core requirements that the committee considers universal to technical rescue activities. Those core requirements should be met before certification, but it is not required that all core studies be completed before obtaining certification in a specific discipline.

A.5.2.6 It is the intent of this section that rescue technicians be familiar with the types of aircraft or helicopter services available to assist in their area, including operational standard operating procedure, equipment carried on the aircraft, safety and on-board aircraft systems and hazards associated with type-specific aircraft, and the ability to communicate via an established radio system with aircrews to complete a task or assignment (e.g., air medical evacuation or search). It is also expected that rescue technicians be aware of and provide for fire suppression in the event of an aircraft mishap while on location. *(See Figure A.5.2.6.)*

A.5.3.5 The rescue technician should maintain life without doing any more harm to the victim when possible, given the following:

(1) Tools for complete spinal immobilization (e.g., cervical immobilization device, long spine board, C-collar, Reeves Sleeve)
(2) A hard or soft evacuation device (e.g., SKED stretcher, Stokes basket)
(3) A vertical harness
(4) A low-angle harness (e.g., web harness or hard/soft transportation device)
(5) Carabiners
(6) Medical equipment for a level of skill care from basic to advanced life support
(7) Some form of head protection for the victim's eyes and head (e.g., helmet, litter shield for victim's head)
(8) A harness
(9) An accessory cord
(10) Ascending equipment
(11) Etriers
(12) Rope so the victim can be effectively transported to the ground or air ambulance without further physical harm to the victim
(13) A vertical or low-angle harness, either constructed or premade, to be properly attached to the raising or lowering system and the backup safety to be attached as well, for evacuation of the victim

Victim packaging should be performed according to the following considerations:

(1) Victim airway is maintained during evacuation at all times.
(2) Victim extremities are secured so that they will not fall out of a hard or soft evacuation device and are secured to such device for evacuation in heads-up or heads-down position.
(3) The attendant is secured to the raising or lowering system with the victim, using rope rescue equipment.
(4) The attendant is secured to a backup safety in case of main system failure.
(5) The rope used can maintain the load capacity so that it does not fail or let go of the load.

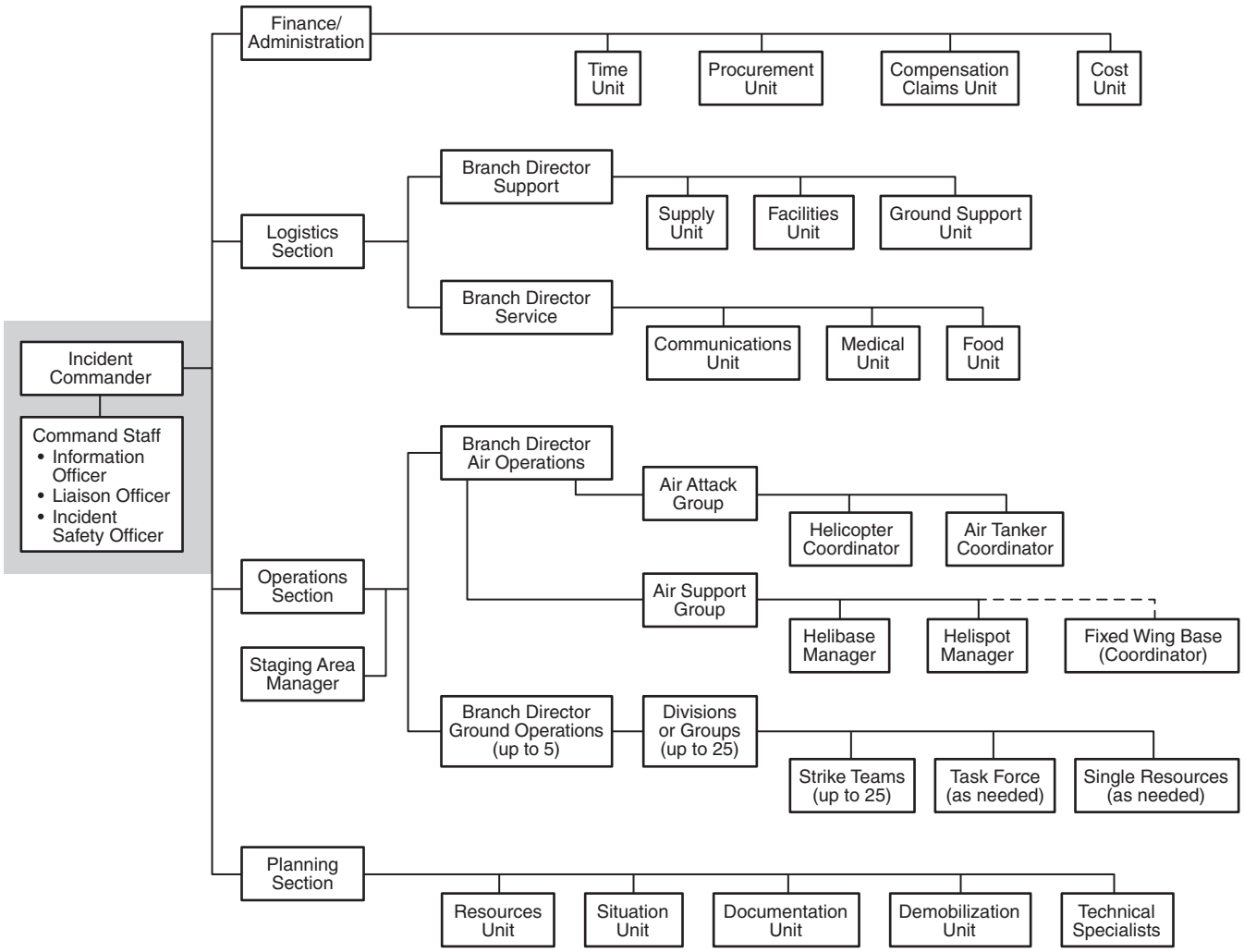


FIGURE A.5.2.6 Sample Incident Management System Organizational Chart.

(6) Oxygen bottles.
(7) IVs and monitors are secured to the victim in the evacuation device.
(8) Injured body parts are stabilized, protected, and secured during evacuation.
(9) The victim can be turned on his or her side in the evacuation device for airway maintenance purposes while continuing to maintain full spinal immobilization.
(10) The victim's airway is established and maintained.
(11) Breathing is adequate.
(12) Circulation is maintained and any other potential life-threatening medical conditions are managed.
(13) The victim is protected from further injury during transport and placed on proper immobilization devices.
(14) The victim can be placed on and secured to proper transport devices.
(15) No further injury occurs to the victim.
(16) No injury occurs to the rescuer.
(17) The victim can be moved in a continual motion away from the hazard.
(18) All information is passed from the rescuer to EMS providers.
(19) Equipment is retrieved.
(20) The victim can be transported to an appropriate medical facility.

Requisite knowledge for victim packaging includes, but is not limited to, the following:

(1) Emergency care provider (EMT–basic as minimum certification level is recommended)
(2) Good understanding of the mechanics of injury to victims, thereby dictating medical needs
(3) Use of all spinal immobilization devices and hard or soft evacuation devices used in high- or low-angle rescues, employed in the area of operation, including those used by units that can be called upon to support the operation
(4) Proficient knot-tying knowledge
(5) Securing victim and medical equipment into hard or soft evacuation devices
(6) Construction of high- or low-angle harness or premade harnesses and securing said equipment to the evacuation device
(7) Securing and allowing attendant operations in the raising and lowering device being employed

Requisite skills for victim packaging include, but are not limited to, the following:

(1) Use medical devices consistent with the rescuer's level of training to establish and maintain the victim's airway
(2) Treat life-threatening conditions using the medical equipment available within the rescuer's level of training and within the constraints that are presented by the rescue environment
(3) Apply spinal immobilization devices
(4) Package victim in a head-up or head-down attitude in a soft or hard evacuation device consistent with the method of transport
(5) Tie a harness using webbing and/or utilize commercial harnesses designed for high- or low-angle rescue work
(6) Attach harness to system
(7) Secure all medical devices required for continued patient care (e.g., IVs, oxygen supply) into the evacuation device so that said equipment will continue to operate effectively
(8) Secure the attendant to the system
(9) Deliver pertinent information to the EMS provider upon delivery of victim/completed rescue
(10) Clean and check all equipment and put back into service

A.5.4.1 Rescue technicians should limit their activities in this section to field-level maintenance only. Field-level maintenance generally describes those procedures performed on a given piece of equipment that does not require disassembly, repair, or component replacement except where provided for in manufacturers' user instructions. Where it is recognized that many agencies perform their own maintenance and repair of equipment based on manufacturers' technical training, this capability is beyond that of the rescue technician and not addressed within the scope of this standard.

A.5.4.2 Rescue equipment should be inspected and maintained in accordance with manufacturers' recommendations and that inspection and maintenance recorded in an appropriate record-keeping system. Rescue technicians should be capable of establishing a schedule of inspection and maintenance requirements for all rescue-specific equipment in their inventory to ensure operational readiness and have these activities documented in an appropriate manner as determined by the AHJ.

A.6.1.1(A) For the purposes of this document, the term *static loads* relates to forces applied within a system when the load is not moving. The term *dynamic loads* is intended to address those forces created by moving loads as well as those caused by the sudden cessation of that movement (shock loads).

A.7.1.1 Water environments can include, but are not limited to, swiftwater, still water, ice covered water, and tidal water. Rescuers should demonstrate the requisite knowledge of each water environment anticipated within the geographical confines of the AHJ and their associated tactical and safety considerations as part of this competency.

A.7.1.2 Temperature extremes include both hypo- and hyperthermia. Personal protective equipment users must be aware of the potential for either condition to develop and strategies for avoidance and recognition. Adequate flotation is dependent upon the mode of operation. As an example, for surface rescue positive buoyancy is desired, whereas for underwater operations, neutral buoyancy should be maintained. Proper fit of personal protective equipment is determined by the manufacturers' specifications and related documentation; the primary intent is that the safety and efficiency of the rescuer is not impaired or the garments' capabilities exceeded.

The AHJ should utilize personal protective equipment appropriate to the conditions present in its response area, as well as based on the scope of its operations. In considering personal protective equipment selection, the following factors should be addressed:

(1) Flotation (buoyancy)
(2) Insulation from cold water exposure
(3) Protection from physical hazards (e.g., abrasion, cuts, tears, punctures)
(4) Visibility
(5) Garment form, fit, and mobility
(6) Limited chemical and biological protection (e.g., from bloodborne pathogens). Reference FEMA document FA 136, *Protective Clothing and Equipment for Emergency Responders for Urban Search and Rescue Missions*
(7) Provision of "low-profile" helmets (i.e., helmets without a brim on the back) utilized in the water rescue environment to avoid possible cervical spine hyperextension or hyperflexion injuries, as well as provide protection from blunt force trauma

A.7.1.3 Many programs exist to evaluate a minimum swim capability through a designated water course. These programs range from recreational to swiftwater applications. The AHJ should devise or adopt a minimum swim capability based on the response area needs.

A.7.1.4 *Active Search Measures.* Of primary and immediate importance is locating the point last seen (PLS) of the missing subject. Sometimes the reporting person (RP) will have no direct knowledge of what happened. For example, the RP may be a family member reporting a group of canoeists overdue at a takeout. At other times the RP will have witnessed a river accident such as a raft overturning or a fisherman being swept away, and will be able to give a description of the victims, and a fairly exact PLS. RPs should be interrogated for all information they might have about the victim, to include physical description, clothing, destination, experience, time the incident occurred, and any other details that might help the search (e.g., the type of shoes to aid the trackers).

Passive Search Measures. The searches at this point are detailed, formal searches, not hasty ones. It is better to have small, trained groups of searchers thoroughly search an area repeatedly than to search with large groups of untrained people, since these frequently trample more evidence than they find. As the search progresses, the incident commander should debrief team leaders frequently and revise the search plan as necessary.

A.7.1.5 Water conditions and temperature will be assessed and the appropriate levels of protection identified by the AHJ based on its response area and conditions present. Classes of personal flotation devices are identified by the AHJ and applicable regulatory agencies [e.g., U.S. Coast Guard, International Maritime Organization (IMO)].

Emergency disentanglement procedures and equipment are identified, specified, and defined by the AHJ and should be based on the AHJ's identified scope of operation and conditions and hazards likely to be encountered in its response area.

A.7.1.6 Both throw rope deployments should be conducted sequentially, to the same victim, within a span of approximately 40 seconds to a victim 12.19 m (40 ft) away from the rescuer.

A.7.1.7 See A.7.1.6.

A.7.1.9 It is the intent of the committee that the watercraft operator be required to perform a range of skills that demonstrate the operator's ability to control the craft in challenging or adverse conditions, to recover from a loss of power or primary means of propulsion, to right an overturned craft, to cast and recover rescuers and victims, to dock with fixed points and other watercraft, and to tow a disabled watercraft to safety. The specific evolutions required to demonstrate this level of proficiency should be defined by the AHJ.

All personnel (including the operator) should be competent in the use of self-rescue practices and procedures applicable to the scope of operation, including, but not limited to, drownproofing, swiftwater self-rescue, current considerations (rip current, etc.), and basic swimming skills as identified by the AHJ.

These requirements should be applied in the same manner that apparatus operators must meet specific knowledge and skill requirements based on the type of apparatus being operated *(see NFPA 1002, Standard for Fire Apparatus Driver/Operator Professional Qualifications).*

A.7.1.12 Swimming surface water rescue is the most hazardous form of all water rescues for the individual rescuer. In addition to exposure to the hazards imposed by the aquatic environment, the rescuer can also be confronted with a panicking, combative victim who can require physical restraint during the rescue so that all appropriate survival skills can be utilized. For these reasons, only strong swimmers should attempt to complete this standard. Many programs exist to evaluate a minimum swim capability through a designated water course. These programs range from recreational to swiftwater applications. The AHJ should devise or adopt a minimum swim capability based on the response area needs.

A.7.1.14 While helicopters are not universally available to water rescuers and there are many restrictions on the use of aircraft for rescue, they are nonetheless frequently "drafted" for improvised rescues during times of crisis. Therefore, water rescue teams and the supporting helicopter services should plan for the use of helicopters that can be called upon during these crises to identify capabilities and limitations of the team and the helicopter service, to train in those procedures that all parties agree are within their collective skill levels and for which they are equipped, and to draft protocols that will define exactly what procedures the helicopter service will be called upon to perform and the criteria for that decision.

A.8.1.2 The intent of this section is to establish working zones in, around, or near a working incident. It is expected that the established zones function with AHJ incident management systems currently in place.

Traffic control concepts include utilizing devices and resources such as law enforcement, fire services personnel, auxiliary police, cones, flares, lane markings, and flashlights to direct, restrict, or stop work as necessary to the movement of vehicular traffic in, around, or near a working incident, in order to protect victims and rescuers. The term *traffic control* also implies the control of pedestrians, rescuers, emergency vehicles, and equipment traffic.

A.8.1.3 The intent of this section is to provide fire control measures and teams at the scene of working rescue incidents. These teams should be in the ready position with a charged hose line of at least 38-mm (1½-in.) diameter or greater (no booster lines) to function as a rapid intervention and extinguishment team. This section implies having an independent water source (i.e., attack pumper), with sufficient extinguishment agent on board to mitigate any unforeseen fires or explosions. Further, it is the intent of this section to have the rapid intervention personnel standing by in donned, self-contained breathing apparatus but not necessarily hooked up/into breathing air. This state of readiness should be maintained until the incident management structure authorizes de-escalation in accordance with AHJ procedures.

A.8.1.4 The five directional movements to be considered during the stabilization process are defined as follows:

(1) *Horizontal movement.* Vehicle moves forward or rearward on its longitudinal axis or moves horizontally along its lateral axis.
(2) *Vertical movement.* Vehicle moves up and down in relation to the ground while moving along its vertical axis.
(3) *Roll movement.* Vehicle rocks side to side while rotating about on its longitudinal axis and remaining horizontal in orientation.
(4) *Pitch movement.* Vehicle moves up and down about its lateral axis, causing the vehicle's front and rear portions to move left/right in relation to their original position.
(5) *Yaw movement.* Vehicle twists or turns about its vertical axis, causing the vehicle's front and rear portions to move left or right in relation to their original position.

A.8.1.5 It is the intent that rescue technicians control hazards by de-energizing where possible vehicle systems that pose hazards to rescuers or victims. These systems can include components such as electrical, fuel, chemical, and pneumatic systems, including fuel pumps, air bags (passive restraint devices), alternative fuel systems, and air suspension systems. Care should be taken in controlling hazards not to eliminate the potential use by rescuers of beneficial systems, such as seat adjustment or positioning controls, restraint retractors, or other powered devices that would enable more efficient operations.

A.8.1.10 It is the intent of the committee that specific attention be given to maintaining scene safety and security during termination activities due to the high frequency of responder injuries during this operational phase. Hazards present at the conclusion of an event must be communicated to the party responsible for the scene, including damage or modification to equipment or vehicles due to the extrication process, and responsibility for scene control transferred to them. Consideration should also be given to preserving the integrity of the scene for investigation by AHJs.

A.9.1.2 Printed information resources can include, but are not limited to, entry permits, MSDS, and site plans or drawings. The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Scope, magnitude, and nature of the incident
(2) Location, number, and condition of victims
(3) Risk versus benefit analysis (body recovery versus rescue)
(4) Access to the scene
(5) Environmental factors
(6) Available and necessary resources
(7) Establishment of a control perimeter

It is the intent of the committee that safety and operational protocols include some form of checklist or "permit" for rescue teams operating at a confined space emergency. These checklists should be used to confirm completion of procedures necessary to allow safe entry into a confined space to

perform rescue. Hazards can include, but are not limited to, the following:

(1) Atmospheric hazards
(2) Chemical hazards
(3) Temperature extremes
(4) Engulfment and entrapment
(5) Any other recognized safety or health hazard

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

(1) 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
(2) 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, "Regulation on Hazardous Waste"
(3) Recognition of the need for a confined space rescue service or additional resources when nonentry retrieval is not possible
(4) Notification of the designated rescue service and other resources necessary for initiation of confined space rescue
(5) The recognition of hazardous atmospheres or materials through visual assessment and information received from on-site personnel

Specific procedures for mitigating hazards at confined space rescue can include, but are not limited to, consideration of the following:

(1) Personal protective equipment
(2) Fall protection
(3) Harnesses
(4) Lockout/tag-out procedures
(5) Hazard assessment
(6) Scene assessment

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

(1) Identification of the important industrial documentation, where available, useful in hazard assessment; this includes entry permits, lockout/tag-out procedures and checklists, and hot work permits.
(2) Selection of all applicable information necessary for emergency responders from an MSDS
(3) Selection of the proper personal protective equipment for the hazard as per NFPA 472, *Standard for Professional Competence of Responders to Hazardous Materials Incidents*, and 29 CFR 1910.120, "Regulation on Hazardous Waste"

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:

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

The assessment at this level should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Hazards such as engulfment potential, environmental factors (chemical, atmospheric, temperature, etc.), harmful forms of energy (electrical, mechanical, movement due to gravity, hydraulic, etc.), and configuration hazards (diverging walls, entrapment, obstructions, trip/fall hazards, etc.)
(2) Risk versus benefit analysis (body recovery versus rescue)
(3) Available and necessary additional resources
(4) Establishment of control zones
(5) Magnitude of the hazard and isolation procedures
(6) Effectiveness of the nonentry or qualifying entry-type rescue
(7) Overall safety of rescue operations
(8) Level of rescue response (appropriate for the type of rescue being attempted)
(9) Current and projected status of the planned response
(10) Personnel accountability

The AHJ should address the possibility of members of the organization having physical and/or psychological disorders that can impair their ability to perform rescue in confined spaces (e.g., physical disabilities, fear of heights, fear of enclosed spaces). Roles, functions, and responsibilities for these team positions should be consistent with the organization's standard operating guidelines for confined space rescue.

Some methods of isolation include blanking or blinding of pipes *(see Figure A.9.1.2)*; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tag-out of all sources of energy; or blocking or disconnecting all mechanical linkages.

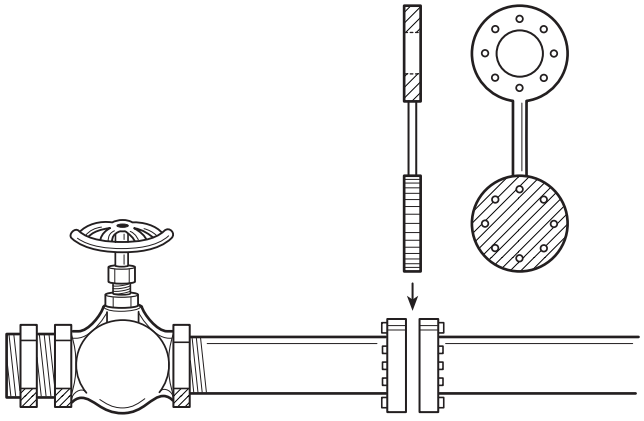


FIGURE A.9.1.2 Blanking or Blinding.

A.9.1.3 Acceptable entry conditions for confined spaces are as follows.

(1) Acceptable limits for oxygen concentration in air should be within 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.
(2) 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.

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

The confined space rescue technician 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:

(1) Identification of the hazards found within confined spaces and an understanding of how those hazards influence victim viability and rescue/recovery operations
(2) Selection and use of monitoring equipment to assess the following hazards:
    (a) Oxygen-deficient atmospheres
    (b) Oxygen-enriched atmospheres
    (c) Flammable environments
    (d) Toxic exposures
    (e) Radioactive exposures
    (f) Corrosive exposures

The confined space rescue technician should understand 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 can 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

Skills relating to use of such equipment 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.

Limitations of detection and monitoring equipment refers to the extent to which the equipment can provide specific readings and how external factors influence the instrument readings and reliability. For example, the following factors should be considered:

(1) Temperature extremes
(2) Cross-sensitivity
(3) Calibration
(4) Power
(5) Time of sampling period
(6) Location of sample
(7) Condition of instrument sensors

Utilization and evaluation of reference terms and resources should 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) IDLH
(8) MSDS
(9) Reference manuals
(10) Computerized reference databases
(11) Technical information centers
(12) Technical information specialists and monitoring equipment

A *Confined Space Rescue On-Scene Prioritized Action Plan* is a plan used to mitigate the incident.

(1) *Priority 1: Make the scene safe*
    (a) Hazard assessment: Approach to the space and entrance into the space
    (b) Hazard mitigation: Control or remove the hazard
    (c) De-energize and protect the sources of electricity, fluids, hydraulics, and so forth
(2) *Priority 2: Victim contact by primary responder*
    (a) Establish victim location
    (b) Primary medical survey (ABCs)
    (c) Determine mode of injury
    (d) Begin psychological first aid
    (e) Determine feasibility of safe retrieval and retrieve if possible
(3) *Priority 3: Size-up*
    (a) Information gathering
    (b) Resource identification
    (c) Primary responder report
    (d) Brainstorm strategy: risk/reward
    (e) Incident management system (IMS)
    (f) Team member assignments
(4) *Priority 4: Preparation*
    (a) Rescuer personal protective equipment
    (b) Anchoring and rigging rescue equipment
    (c) Authorized entrant review
(5) *Priority 5: Access patient*
    (a) Designate access team leader: each group of two or more must have a team leader
    (b) Utilize rescuer retrieval (high-point)
    (c) Designate backup personnel
(6) *Priority 6: Stabilize and package patient*
    (a) First aid to life-threatening injuries
    (b) Secure packaging for rescue transport
(7) *Priority 7: Evacuate*
    (a) Move victim to a safe location
    (b) Provide medical report to EMS
    (c) Remove rescuers
    (d) Emergency retrievals
(8) *Priority 8: Response termination*
    (a) Pickup and inventory gear
    (b) Decontamination (if necessary)
    (c) Rebuild gear packages for the next call
    (d) Field evaluation of rescuer mental state

A.9.1.7 Packaging devices that can be used in confined spaces include, but are not limited to, the following:

(1) Full spine immobilization devices
(2) Short spine immobilization devices
(3) Cervical spine immobilization devices
(4) Litters
(5) Prefabricated full-body harnesses
(6) Tied full-body harnesses
(7) Wrist loops (wristlets)

A.10.1.1 The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Scope and magnitude of the incident
(2) Risk–benefit analysis
(3) Number and size of structures affected
(4) Integrity and stability of structures affected
(5) Occupancy types (e.g., residential, mercantile)
(6) Number of known and potential victims
(7) Access to the scene
(8) Environmental factors
(9) Available and necessary resources

A.10.1.6 Application of the methods and materials necessary to shore windows, doors, floors/roofs, and walls in a light-frame structure should include vertical "dead shores" and basic Raker shores.

A.10.1.7 Application of the methods, materials, and devices necessary to shore windows, doors, floors or roofs, and walls in a heavy construction-type structure should include usage of the Ellis clamp systems, Ellis post screw jacks, pneumatic shores, Lace post shoring systems, horizontal shores, and cross-tied Raker shores (single, double, and triple diagonal).

A.10.1.10 Utilization of the victim transfer devices authorized by the AHJ should include horizontal and vertical applications, proper patient securing methods, and rigging attachments.

A.10.1.11 When lifting a load by utilizing basic hand tools (prybars), jacks, and airbags available in the tools kit, the load should also be stabilized during the lifting operation using a recognized cribbing stabilization system so that movement of the load is controlled throughout the lift.

A.10.1.12 The load should be moved a distance of 6.10 m (20 ft) utilizing pipes as rollers. This process includes maintaining constant control of the load and its direction of travel and application of any necessary rigging to complete the task.

A.10.1.15 Cribbing systems should consist of the following five basic configurations of cribbing, shown in Figure A.10.1.15: 0.61-m × 0.61-m (2-ft × 2-ft) crosstie, 0.91-m × 0.91-m (3-ft × 3-ft) crosstie, platform crosstie, triangle crosstie, and modified crosstie.

Included in this section are knowledge of the advantages, disadvantages, and limitations of each type of system.

A.11.1.2 A prebriefing should include, but is not limited to, information regarding the following:

(1) Tactical assignments with explicit instructions
(2) General hazards and safety instructions
(3) Communications protocols, procedures, and details
(4) Anticipated environmental concerns
(5) Time frames for operations
(6) Emergency procedures
(7) Specific equipment needs

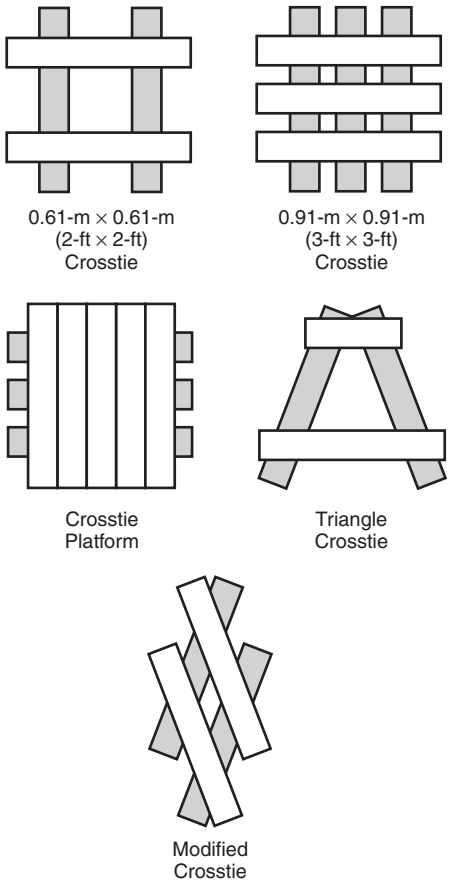


FIGURE A.10.1.15 Five Basic Configurations of Cribbing.

(8) Debriefing procedures
(9) Anticipated logistical needs

Documentation for entry operations, as a minimum, should include the following:

(1) Development of some type of representation of incident management system command structure
(2) Time of incident
(3) Total time of operation
(4) Environmental conditions
(5) Location of victim
(6) Creation of a tactical checklist that includes entry times, exit times, personal accountability reports, atmospheric readings, rehabilitation information, injuries sustained, and incident number

Rapid, nonentry rescues can include placing a ladder to allow a victim to perform a self-rescue or to allow noninjured workers already in the trench to remove a victim. The ladder can be dropped in quickly at the end(s) of the trench by first responders before ground pads are placed. See also *Rapid, nonentry rescues* in Annex F.

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

(1) Placing ground pads around the lip of the trench to minimize the effect of rescuers' weight on secondary collapse potential

(2) Controlling or limiting traffic and sources of vibration in the area including shutting down all vehicles and equipment
(3) Controlling or limiting access to the area by unnecessary personnel
(4) Identifying general hazards, affected utilities, and isolating, removing, and/or reducing their impact; also refer to *General hazards* in Annex F, for more detailed information on general and other hazard types
(5) Controlling of the utilities in and around a trench or excavation emergency to ensure the safety of responding personnel and victims; the AHJ should have available to rescuers or local public works employees 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:
   (a) Electrical services (primary and secondary)
   (b) Gas, propane, fuel oil, or other alternative energy sources (primary systems)
   (c) Water/steam
   (d) Sanitary systems
   (e) Communications
   (f) Secondary service systems (such as compressed, medical, or industrial gases)

An RIC, as specified in Section 8.5 of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, should consist of rescuers at or above the capability level at which the incident is operating.

A.11.1.3 Support operations can include, but are not limited to, the following functional sectors in the incident management system:

(1) *Ventilation sector.* Monitors and ventilates personnel
(2) *Extrication sector.* Prepares for extrication methods and tactics
(3) *EMS sector.* Plans for ongoing patient care, transfer, and transport in coordination with the incident commander and receiving hospital
(4) *Support sector.* Can handle lighting, power, and environmental management
(5) *Cut station.* Handles construction and fabrication of shoring materials

A.11.1.4 Cribbing systems in the trench rescue environment have a multitude of applications. Such applications can include, but are not limited to, the following:

(1) Stabilizing or securing a heavy load
(2) Providing a base for lifting entrapping loads (heavy reinforced concrete pipes or boulders) from within the trench or from the top of the trench
(3) Maintaining lift by cribbing under the load as it is lifted

Examples of available curricula that outline various lifting and rigging principle areas are as follows:

(1) Rescue Systems 1
(2) Rescue Systems 2
(3) FEMA Rescue Specialist

Lifting and stabilization topics that are detailed include the following:

(1) Gravity and mechanics, general principles
(2) Load stabilization utilizing mechanical principles
(3) Using power with an advantage (classes of levers, inclined planes, hydraulic or pneumatic presses, etc.)
(4) Overcoming friction
(5) Estimating load weights
(6) Mechanics of lifting
(7) Lifting and rigging

A.11.1.5 See A.11.1.4.

A.11.1.6 Deciding the mode of operation (rescue vs. recovery) and conducting a risk–benefit analysis should guide you in the selection of strategy in the possible use of heavy equipment. Strong consideration must be given to the great surcharge loads and vibration created by using heavy equipment in the area of the collapse and the ultimate effect these factors have on the continued safety and condition of the victim and rescuers at the incident. It is strongly recommended to use heavy equipment only in support or recovery operations. Where possible, the job site supervisor or another competent excavating professional should be kept at the command post to assist in problem solving. Ultimately, however, the decision to utilize heavy equipment at a trench collapse incident should be made on a case-by-case basis. Operational support tasks for heavy equipment can include:

(1) Placing a trench box or isolation system
(2) Excavating around an existing protective reinforced or engineered structure for access
(3) Sloping, benching operations in recovery operations, or where an existing trench collapse, due to running, saturated, or extremely unstable soil conditions, cannot be safely shored or protected
(4) Lifting or moving a heavy load, where other options are not feasible
(5) Utilization as a high-point anchor for rope rescue systems (carefully monitored)

The suitability of the operator to complete a rescue operational objective is based, subjectively at times, on his or her experience, training, recommendation by peers, familiarity to rescuers, and a calm, professional demeanor in an often emotionally charged situation. The incident commander should maintain control of the scene.

A.11.1.7 It is the intent of the committee to define the outcomes desired for each job performance requirement. The methods and equipment used to reach that outcome, in this case the shoring of a "nonintersecting" trench, should be those that best suit the particular needs and resource availability of the AHJ.

The term *tabulated data* usually refers to the six tables found in Appendix C of 29 CFR 1926, Subpart P. Tabulated data can also be in other written form where the protective system and its installation has been engineered and approved by a registered professional engineer.

When considering stabilization tactics, it is critical to recognize logistical needs in terms of space required to remove the victim(s) from the trench. A forest of wales and struts placed without regard to the location of the victim can demonstrate technical abilities but will do nothing for victim survival. The survivability time-frame, depth and width of the trench, soil conditions, and type of injuries sustained are only a few examples of the variables that need to be addressed. This process will involve thinking ahead and looking at all options available to shore in an approved manner, in acceptable time frames, while placed in locations that will enhance ease and safety of victim(s) removal.

A.11.1.8 Different types of intersecting trenches can include an "L," "T," or "X" configuration. In most cases, a trench is

backfilled as the intended installation continues. There are times, however, when an exposure to an unprotected intersecting trench will present itself. Protecting the victim and quickly stabilizing the inside corners are priorities in this type of trench collapse. Use of a shield system or trench box located on site and rated for the trench in question can be a "quick and dirty" way to protect the victim if a competent heavy equipment operator is present. Where shoring with timber, hydraulics, or pneumatic struts, it is recommended that both sides of an inside corner are stabilized simultaneously to prevent the possible "blow out" of the unsupported corner. Shoring the inside corners and the unopposed floating panels necessitates additional skills, equipment, and training. In any case, the shoring of intersecting trenches should be done in a well-thought-out manner with an awareness of the particular vulnerability to collapse of an inside corner.

A.11.1.9 Lateral pressures and potential for collapse increase as the depth of the trench increases. For that reason, supplemental shoring that extends below the initial sheeting and shoring is most critical to the stability of the entire system. The dirt should be excavated over a wide enough area to uncover the victim completely while allowing enough room for placing supplemental shoring and facilitating safety, treatment, and removal. This approach will maintain the integrity of the protective system and provide competent patient management.

A.11.1.10 Trench rescue by nature is a time-consuming endeavor. The time can be minimized by careful planning and sectorization of the tasks that need to be performed simultaneously. The rescuers in the trench should identify the tools needed to disentangle the victim. These tools can be limited to shovels to remove entrapping soil or can include exothermic torches, air bags, and cribbing, depending on the nature of the entrapment. There should be rescuers assigned topside to assemble, prepare, and deploy whatever resources are necessary to complete disentanglement (i.e., extrication sector). Any unwarranted delay can severely affect the survivability of the victim. In addition, an EMS sector should be assigned so that information on victim injuries and stabilization equipment can be processed and so that treatment can be initiated and maintained. The treatment of crush syndrome must begin *before* the victim is released from the offending compressive weight or the victim will quickly succumb to the effects of the toxins released into the bloodstream.

A.11.1.11 It is imperative that the route of transfer be identified and the ambulance to the nearest hospital or trauma center be positioned to transport as soon as a victim is removed. An advanced life support–equipped and staffed medical unit is the preferred level of care and transport. The receiving hospital should already be aware of the condition of the patient and the estimated time of arrival. The rescuers should always be cognizant of the hazards and utilize universal precautions in the rescue area.

A.11.1.12 Termination is often the most dangerous portion of a rescue operation. The victim has been removed and transported, the tension and adrenaline has subsided, and it is a setting for potential catastrophe. Rescuers must maintain their attentiveness and safety policies until all equipment and shoring material is removed from the trench. The trench entrants must be vigilant about staying within the "safe zone" while removing struts in the reverse order that they were placed. They must leave the trench completely before pulling the last shores out with ropes. Arrangements should be made to have physical barriers placed to minimize further opportunities for an accident and to turn control of the incident site over to the AHJ or jobsite contractor. Equipment should be cleaned thoroughly and maintained to the manufacturers' recommendations. Damage and lost equipment should be documented as such, and reports should be completed for record-keeping and review. And, finally, the rescue team should have a postbriefing to discuss effectiveness of strategies, tactics, equipment, and personnel. Signs of critical incident stress syndrome should be monitored and addressed.

A.12.1.1 Technical information and information to gather for size-up related to tunnel rescues include the following:

(1) Tunnel configuration
(2) Tunnel construction
(3) Power sources underground
(4) Means of access and egress
(5) Operation machinery
(6) Groundwater problems
(7) Pumping operations
(8) Shoring and stabilization methods
(9) Hazard control methods
(10) Ventilation controls

A.12.1.2 Considerations should be given for the need to manage a prolonged subterranean rescue operation in a primitive setting. Considerations may include relief crews, rehabilitation of rescuers, and provisions for waste management during long-term operations.

A.12.1.3 Atmosphere monitoring will include the use of multi-gas detectors. The common tunnel gases that must be analyzed include oxygen levels, hydrogen, methane, nitrogen, carbon monoxide, acetylene, hydrogen sulfide, sulfur dioxide, oxides of nitrogen, and hydrocarbons. Anemometers are used to measure airflow to determine competency of the ventilation system. (See A.9.1.3 for further information related to atmospheric hazard detection.)

A.12.1.5 Assessment information used to formulate the incident action plan will include:

(1) Scope, magnitude, and nature of the incident
(2) Location, number, and condition of victims
(3) Rescue versus recovery decision
(4) Access and egress points for the tunnel
(5) Environmental factors
(6) Resource requirements and availability
(7) Hazards and hazard control requirements
(8) Availability of accurate information

Incident action plans include measurable strategic objectives, tactical assignments to accomplish strategic goals, benchmarks plans, safety plans, communications plans, and alternative tactical consideration. The use of outside specialized resources such as engineers, tunnel rescue experts, and tunnel construction companies should be incorporated into the incident action plan.

A.12.1.6 Ventilation systems at micro-tunnel construction sites may be as simple as small positive pressure fans; however, large tunneling projects will have extensive built-in ventilation systems designed to deliver specific airflow requirements based on the size and complexity of the site. Rescuers may be able to augment positive pressure blowers at smaller micro-tunneling with their own positive pressure fans. However, at large tunneling projects, rescuers will need to check with the appropriate on-site construction personnel to assess built-in

ventilation systems, their capabilities, and if they are effectively functioning.

Built-in ventilation system components will include surface fans, vent lines, and, in some cases, scavenger fans. Ventilation system design may be positive pressure, negative pressure, or a combination system. Rescue personnel will be required to measure airflow in the tunnels where they must operate using anemometers to ensure proper airflow.

A.12.1.7 Tunnel hazard mitigation will often require rescuers to utilize the services of outside resources, such as tunnel construction companies, to assist with stabilization of roof and face areas. On-site personnel will need to be consulted to confirm locations of energy sources for lockout/tag-out activities. Size-up information will identify the presence of atmospheric hazards and/or explosives hazards that must be controlled through proper personal protective equipment utilization, monitoring and ventilation, and avoidance where appropriate.

Specialized resources that may be used at a tunnel rescue include construction company personnel who have pertinent information on the construction operation and can identify hazards, construction features, hazards control techniques, and layout of the tunnel. Tunnel construction companies and engineers will be utilized where appropriate to assist with stabilization of a tunnel environment. This may include determining the need for shoring or other stabilization techniques and the installation of tunnel liner plates, timber shoring systems, roof bolting, or other stabilization methods.

Rescuers must make sure that outside resources operate within the incident command system, are supervised effectively, and clearly understand the hazards and incident action plan. Competent full-time communications must be in place between rescuers and the outside resources that are utilized.

A.12.1.9 Accountability systems should meet the requirements of NFPA 1561, *Standard on Emergency Services Incident Management System*, and 29 CFR 1926.800 and will require the rescue team to maintain the tracking board to identify personnel as they enter and exit the tunnel.

The backup rescue entry team will consist of a team of six rescuers that are trained and fully equipped to perform a tunnel rescue. The team will be available and standing by on the outside of the tunnel, ready to assist the primary entry team if needed.

Tunnel rescue entry teams should be checked by a team safety representative to ensure that proper personal protective equipment is in place and utilized, respiratory protection equipment is fully functional, communications systems are ready, and that the team is properly equipped and physically and emotionally prepared to perform the rescue task. A preentry checklist can be used to assist with this task.

Communications systems should include a primary and backup communications capability. These systems, which may include radio systems, hard-wired systems, and phone systems, must be intrinsically safe.

Lighting systems should include redundant systems that are intrinsically safe and/or explosion proof. These systems may include helmet lanterns, helmet lights, handheld flashlights, and area lighting systems.

Access to an egress from shafts and tunnels may include built-in ladder systems, portable ladders, powered man-lifts, rope and rigging systems, and powered conveyor or train systems. The rescue team must assess entry and egress options and determine the best access points for entry into the tunnel.

Examples of methods used to identify routes include, but are not limited to, flagging tape, reflective strips, reflective buttons, light sticks, and arrows.

A.12.1.10 The term *team* includes, but is not limited to, a component within the command structure such as communications, equipment, medical, and transportation.

Mines and tunnels are typically classified as gaseous, potentially gaseous, or nongaseous per 29 CFR 1926.800. However, with regard to entry into any subterranean environment, the following hazards should be considered:

(1) Isolation of dangerous forms of energy including, but not limited to, electrical, mechanical, pneumatic, and hydraulic
(2) Water hazards; techniques for movement through hazards such as holes, swiftwater, currents, and waterfalls should be developed and used where applicable. This may include wading and crawling in various depths of water while wearing and carrying rescue equipment and materials creating negative buoyancy and swimming while wearing cave rescue clothing. It is also important to consider the potential for rapid intrusion of water due to weather or other conditions.
(3) Collapse hazards; some subterranean environments may be structurally unstable. Shoring skills may be required to stabilize interior surfaces.
(4) Interior configuration, which may present a significant difference in height, constricted passageways, or slippery surfaces
(5) Any other hazards, including biological, chemical, animal and insect infestation, and atmospheric hazards

A.12.1.11 The rescue team should be prepared to supply respiratory protection for victims incapacitated or trapped at tunnel incidents. This may be accomplished by bringing in an additional breathing apparatus for the victims or supplying breathing air through an airline if distances from the tunnel opening to the victims allow. Rescuers must prepare and maintain air supply for victims they can access that will be trapped for an extended period of time.

Structural stabilization inside tunnels will require the use of outside specialized resources such as tunnel construction companies, engineers, shoring resources, or a coordinated effort with rescuers. An understanding of the use of tunnel liner plates, roof bolting, and formwork installation by experienced tunnel construction employees is important to the success of this type of rescue. Engineers who are experienced with tunnel construction should be consulted to determine the safety of operation in a tunnel after a collapse, and to determine the shoring/stabilization requirements to make the rescue area safe.

Disentanglement activities at the tunnel rescue may involve entrapment by machinery inside the tunnel, collapse of the tunnel, or collapse of shoring materials. Extrication methods will include standard extrication procedures required as outlined in the vehicle and machinery chapter of the document for machinery entrapments. Stabilization of the tunnel roof and walls may be required as rescuers progress toward an entrapment due to a cave-in.

The type of shoring and stabilization will typically be beyond the capability of most rescue teams and will require the assistance of specialized resources such as certified mine rescue teams, engineers, and tunnel construction companies. Some tunnel collapse incidents that are deemed recovery operations may require the use of heavy equipment for excavation purposes.

A.13.1 The committee is of the opinion that Advanced Open Water certification provided by most nationally recognized certifying agencies (agencies associated with the Recreational SCUBA Training Council) build an acceptable foundation for the basic SCUBA skills required for Dive Rescue Technician. These courses do not, however, offer all of the skills required to meet these standards, and further training and experience in special hazards expected to be encountered in the AHJ's territory should be sought. Examples of nationally recognized certifying agencies include PADI, NAUI, YMCA, SSI, and DRI. Candidates should have experience diving in various environments by taking additional specialties. Examples of specialties include ice, current, hazardous materials, dry suit, and lifting operations.

Candidates should demonstrate leadership skills similar to that of a "Divemaster" as defined by the Recreational SCUBA Training Council. The Dive Rescue Technician should have documented substantial dive experience in varied environments and have the ability to supervise and lead others. These personnel should also be able to employ checklists to identify pre- and post-dive needs.

A.13.1.2 Examples of personal protective equipment utilized in dive rescue are buoyancy control devices, masks, fins, snorkels, regulator sets (including first and second stages), redundant air systems, consoles (with submersible pressure gauge, depth gauge, dive timer), thermal protection, and lighting systems. Figure A.13.1.2 is an illustration of a dive safety checklist.

A.13.1.3 The understanding of the committee is that candidates for this specialty shall have obtained prior SCUBA certification and, as a result, have met basic watermanship requirements. The committee's opinion is that candidates should have the ability to swim a designated watercourse similar to the conditions that will be encountered in the AHJ's territory in order to determine the candidate's ability to perform self-rescue. We recommend that the skills involved in this test be more strenuous than what is expected for civilians to perform for enrolling in an Open Water SCUBA course.

An example of a Divemaster-level watercourse for watermanship would be a concurrent 365.76 m (400-yard) swim, 15-minute water tread or "drownproofing," 731.52 m (800-yard) swim using mask, fins, and snorkel, and a 91.44 m (100-yard) inert diver tow. At no point shall the diver utilize flotation aids to assist in the swim. The inert diver is not permitted to assist in propulsion, but the task is not to be a "rescue" skill.

A.13.1.4 The committee's intent is that skills should be performed in a controlled situation replicating the worst conditions expected to be encountered in the AHJ's territory. The intent is to determine the candidate's ability to perform assigned tasks and to effect self-rescue. The skills involved in this test should be *at least* as strenuous as what is expected for civilians to demonstrate for Divemaster certification *(see Figure A.13.1.4)*.

A.13.1.6 The committee intends that this JPR should measure the rescue technician's ability to assist (or rescue) other divers, including his/her buddy, on the surface. Surfaced divers, because of the nature of their injuries or the equipment they are using, may require specialized assistance.

A.13.1.7 The committee intends that this JPR should measure the rescue technician's ability to assist (or rescue) other divers, including his/her buddy, at depth. Because of the nature of their injuries or the equipment they are using, some divers may require specialized assistance. Rescue divers must be cognizant of buoyancy and barotrauma issues in relation to the ascent of the diver they are trying to assist.

A.13.1.8 The committee recommends the diver perform these skills in a blacked out mask to test ability to perform in a low-visibility environment. The reason this is being done in a pool or confined water environment is so that the student can be observed for problems prior to being exposed to the actual low-visibility environment. These skills involve locating and utilizing personal emergency equipment (not limited to cutting devices, secondary air system, communications equipment, etc.) positioned according to AHJ protocols.

A.13.1.10 Drowned victims may be treated as potential homicides until proven otherwise. Therefore, the search area should be treated as a potential crime scene and appropriate evidence secured and documented *(see Figure A.13.1.10)* according to AHJ protocol.

A.13.1.11 The committee's intent is for the candidate to know what procedures are used when using watercraft in their jurisdiction, or at least basic watercraft deployment and/or recovery technique, even if the AHJ does not have its own watercraft. This includes the diver's role on the boat, nomenclature, and use of emergency/safety equipment (e.g., fire extinguishers, flares, flotation devices, etc.). The committee understands that not all dive teams have boats and not all boat operators are knowledgeable about deploying divers. In this case, the technician should be able to act as a liaison between the team and the boat operator.

A.13.1.12 The committee's intent is to have the candidate at least know what procedures should be used when using aircraft in their jurisdiction, even if the AHJ does not have its own aircraft. This includes use of on-board emergency equipment and emergency escape procedures.

A.13.1.13 Removal of victim from water to a watercraft requires special skills. The committee is aware not all jurisdictions have boats, but the technician should know how to utilize this equipment.

A.14.1.3 It is the intent of the committee that the wilderness rescuer be able to generate an accurate record of collected evidence and its environment by taking notes, making sketches, photographing evidence, and retrieving the evidence; given various articles of evidence, evidence collection equipment, and the last known location of the victim; so that scent articles of a lost subject are retrieved and preserved for use by a canine search team, notes are taken documenting placement of clues and the position of people or bodies and pertinent facts surrounding the scene, the scene and clues are photographed, photographs show three sides of any one pertinent object, photographs possess an indication of scale, photographs indicate the time and date they were taken, a sketch of the scene is created in conjunction with photographs of pertinent objects depicting their position relative to each other, corroborating witnesses are properly interviewed to attain information on what they saw and heard at the scene, interviews with corroborating witnesses are recorded properly so that the witness(es) may be contacted later and their role and what was seen and heard established in writing.

A.14.1.4 It is the intent of the committee that wilderness rescue technicians recognize the need to document and preserve evidence especially at the potential scene of a crime. Knowledge and skills include: Understand and maintain the "chain of evidence," camera operations, scent article handling and preservation, clue awareness, interview skills of corroborating witnesses, basic drawing skills, specific scene situation considerations (e.g., crash, injury, and dead body(s) evidence).

PRE-DIVE SAFETY CHECKLIST

Position	Name
Incident commander	
Safety officer	
Rescue group supervisor	
Line tender	
Diver	
Safety diver	

Buddy Checklist

- ❑ Buddy equipment check
- ❑ Hand signals
- ❑ Lost buddy/communications procedure
- ❑ Emergency ascent procedure
- ❑ Line signals
- ❑ Procedure for diver in need of assistance

Conditions

- ❑ Weather _____
- ❑ Surface _____
- ❑ Current _____
- ❑ Visibility _____
- ❑ Water temp. _____
- ❑ Thermocline _____
- ❑ Surf _____
- ❑ High tide _____
- ❑ Low tide _____

Safety Procedures

- ❑ Max. depth _____
- ❑ Max. bottom time _____
- ❑ Min. PSI to surfacing _____
- ❑ Direction _____
- ❑ Compass heading _____

Search

- ❑ **RESCUE VS. RECOVERY**
- ❑ Search pattern _____
- ❑ Review procedure for found object

Equipment Recommendations

- ❑ Tank size _____
- ❑ Suit _____
- ❑ Hood & gloves _____
- ❑ Mask/fins/snorkel/booties
- ❑ Weight belt
- ❑ BCD
- ❑ Regulator & alternate
- ❑ Depth gauge & pressure gauge
- ❑ Compass
- ❑ Comm. device _____
- ❑ 2 cutting devices _____
- ❑ Other equipment: _____
- ❑ _____
- ❑ _____

Back-Up Diver Information

- ❑ Has recommended equipment
- ❑ Weight _____
- ❑ Pressure group start _____
- ❑ PSI start _____
- ❑ Safety diver ready _____
- ❑ PSI ending _____
- ❑ Pressure group ending _____

Primary Diver Information

- ❑ Has recommended equipment
- ❑ Weight _____
- ❑ Pressure group start _____
- ❑ PSI start _____
- ❑ Time on air _____
- ❑ PSI ending _____
- ❑ Pressure group ending _____

FIGURE A.13.1.2 Dive Safety Checklist.

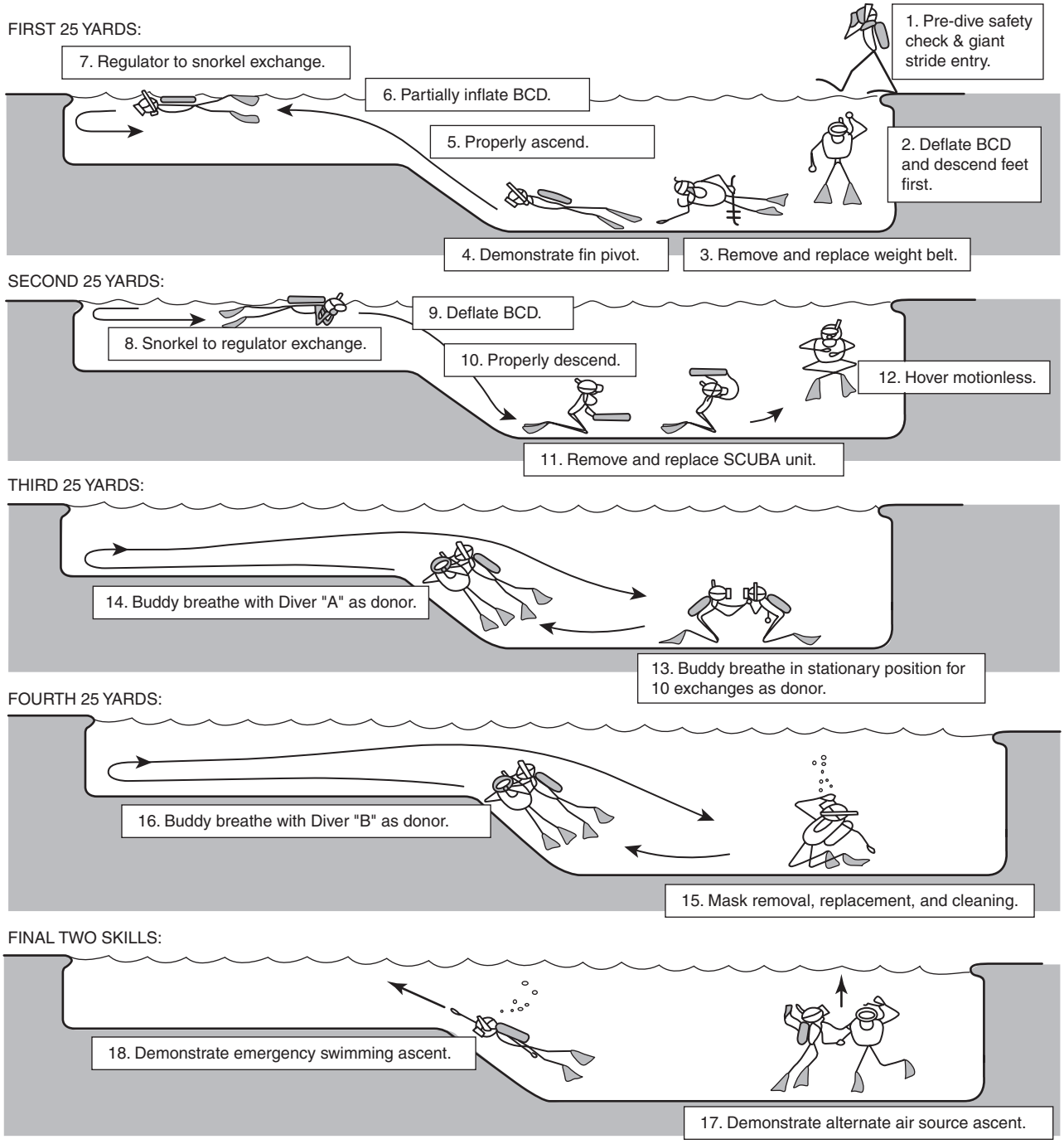


FIGURE A.13.1.4 Example of Divemaster Level Watercourse for Watermanship.

DIVE SITE DIAGRAM

Incident location:

GPS coordinates: **Lat:** **Long:**

Closest access:

Type of access:

Conditions	**Witness name and phone**
❑ Weather _____ ❑ Surface _____ ❑ Current _____ ❑ Visibility _____ ❑ Water temp. _____ ❑ Thermocline _____ ❑ Surf _____ ❑ High tide _____ ❑ Low tide _____	❑ **1** _____ ❑ **2** _____ ❑ **3** _____ ❑ **4** _____

Scene diagram

Number indicates witness location.
Letter indicates evidence location.

Block = _____ m (ft)

FIGURE A.13.1.10 Dive Site Diagram.

A.14.1.5 It is the intent of the committee that the rescue technician have enough survival equipment, food, water, and other necessary materials to operate independently for three days in the wilderness environment. Wilderness skills and knowledge would include the ability to construct improvised shelter, preparation of supplied food, purification of drinking water, utilization of established primary and emergency communications mediums, selection and use of layered clothing, and application of land navigation resources.

A.14.1.9 It is the intent of the committee that a person working in a wilderness environment will be able to manage the long-term medical care of a victim, with *long-term* meaning the time it takes to remove the victim from the wilderness environment and deliver him or her to a medical facility (possibly ranging from 1 hour to 5 days or longer depending on the environment). The wilderness technician should have at least a thorough knowledge of basic life support, and advanced life support training is recommended so that IV fluids and other advance life support measures can be utilized.

A.14.1.10 Packaging materials may include spinal care devices, thermal barrier, vapor barrier, and splints. Victim transport devices may include rigid basket-type litters and flexible wrap-around litters.

Annex B Collapse Types

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Collapse patterns and potential victim locations include the following:

(1) *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 B.1(a).

(2) *"V" Shape.* 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 B.1(b).

(3) *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 B.1(c).

(4) *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 B.1(d).

(5) *A-Frame.* An A-frame collapse 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 these interior partitions. Other victims will be located in the debris near both exterior walls. See Figure B.1(e).

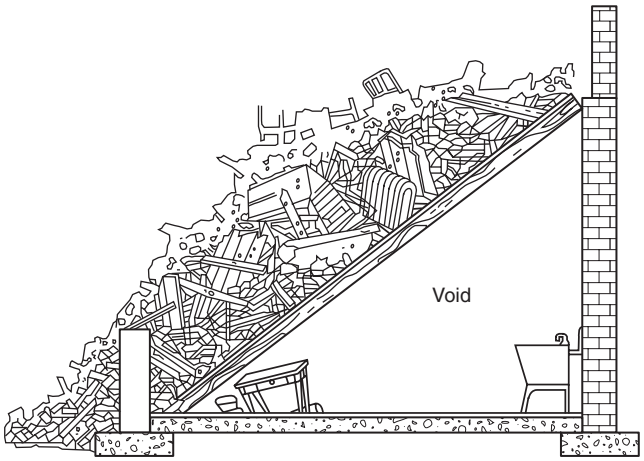


FIGURE B.1(a) Lean-To Floor Collapse. ***(Courtesy of U.S. Department of Civil Defense)***

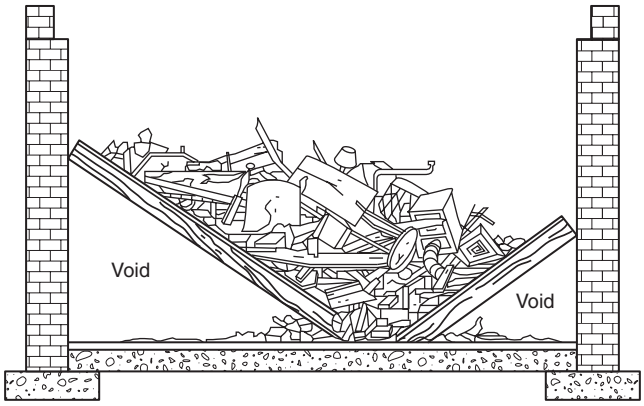


FIGURE B.1(b) V-Shape Floor Collapse. ***(Courtesy of U.S. Department of Civil Defense)***

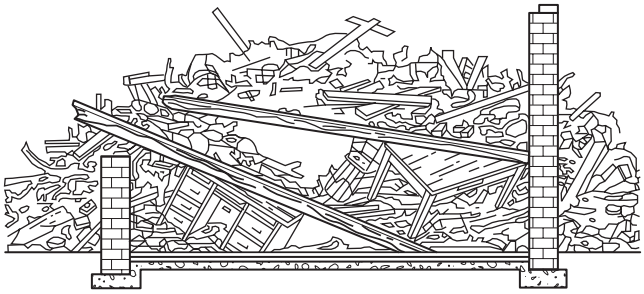


FIGURE B.1(c) Pancake Floor Collapse. ***(Courtesy of U.S. Department of Civil Defense)***

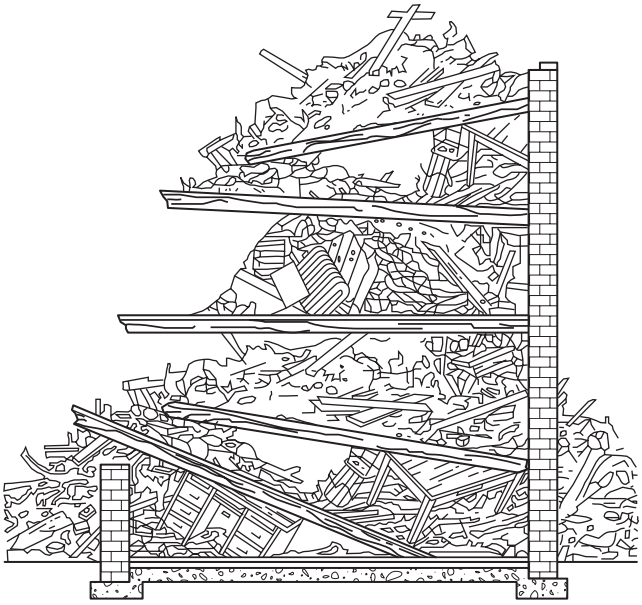


FIGURE B.1(d) Cantilever Floor Collapse. ***(Courtesy of U.S. Department of Civil Defense)***

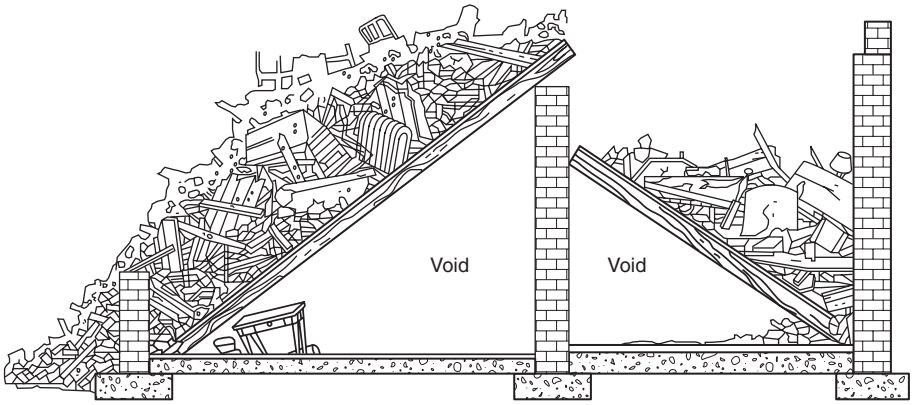


FIGURE B.1(e) A-Frame Floor Collapse.

Annex C Confined Space Entry Permit

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

C.1 In certain industries, U.S. federal law does not require a permit system even though spaces can be present meeting the characteristics of confined spaces as defined within this standard. In these cases, as well as cases of unauthorized or nonregulated entry into confined spaces, a permit might not be available for reference by the rescue team. The space must be assessed completely before entry can be made safely. 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. See Figure C.1(a) through Figure C.1(d).

ENTRY PERMIT

Address: _____

RP name: _____ Title: _____

RP or Witness Account of Incident: _____

_____

If no witness, what clues are available at the site: _____

_____

Space type: Tank: _____ Pipe: _____ Silo: _____ Evacuation: _____

Confined Space Permit obtained? ❑ Yes ❑ No

Product involved: _____

Product hazards: LEL _____ % TLV _____ ppm IDLH _____ ppm

Explosive? ❑ Yes ❑ No

Establishment of zones? ❑ Yes ❑ No Isolation of area: _____ hr(s)

Lockout completed: _____ hr(s)

Number of victims: _____ Time victims trapped: _____ (24-hr clock)

Victim status: _____

_____

Victim #	Age	Name	Medical HX
1.			
2.			
3.			
4.			

Victim #	Location	Priority
1.		1 2 3 4
2.		1 2 3 4
3.		1 2 3 4
4.		1 2 3 4

Communications established with victims? ❑ Yes ❑ No

FIGURE C.1(a) Example of an Entry Permit Form.

Access points	Location	Entry accessible		Ventilation point	
1.	_____	Yes	No	Yes	No
2.	_____	Yes	No	Yes	No
3.	_____	Yes	No	Yes	No
4.	_____	Yes	No	Yes	No

Is there an adequate number of trained personnel on the scene to perform the tasks associated with the rescue? (minimum of eight required) ❑ Yes ❑ No

Is the proper equipment present at the scene to complete the operation?

	Yes	No
Atmosphere monitoring equipment	❑	❑
Explosion-proof lighting	❑	❑
Explosion-proof communications	❑	❑
Supplied-air breathing apparatus or remote aid	❑	❑
Cascade system	❑	❑
Victim removal systems/equipment	❑	❑
Ventilation equipment with CFM OF 4,000–5,000 and necessary duct work	❑	❑

Request for haz mat and/or rescue units: _____ hr(s)

Diagram of confined space (including entry and egress locations):

FIGURE C.1(a) ***Continued***

CONFINED SPACE ENTRY TEAM CHECKLIST

Entry Team member's name: _____

Filled out by: _____

- ❑ Confined space atmosphere evaluated
- ❑ Medical checkout by ALS unit
- ❑ Jump suit donned
- ❑ 2.2 cylinders on remote air topped off
- ❑ Escape bottle topped off
- ❑ Remote air tested and operational
- ❑ Communications check
- ❑ Life line attached
- ❑ Atmosphere monitors attached and on
- ❑ Helmet on
- ❑ Gloves on

ENTRY TEAM MEDICAL CHECKLIST

Entry time: _____ BP _____ / _____ Pulse _____ Resp _____ Skin _____

Notes: _____

_____

Exit time: _____ BP _____/ _____ Pulse _____ Resp _____ Skin _____

Notes: _____

_____

FIGURE C.1(b) Entry Team Medical Checklist.

ATMOSPHERE MONITORING LOG

Unit	Time	LEL	O_2	Action
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____

FIGURE C.1(c) Atmosphere Monitoring Log.

AGREEMENT TO PROVIDE RESCUE RESPONSE

This is to confirm that (*rescue service*) has agreed to provide permit-required confined space rescue response to (*employer's facility*) – hereafter referred to as (*employer*).

(*Employer*) understands that in order for (*rescue service*) to provide such response, (*employer*) is required and agrees to:

1) Inform (*rescue service*) of the hazards and/or potential hazards present in the confined spaces.
2) Provide access prior to entry to all permit spaces from which (*rescue service*) may be required to perform rescue.
3) Provide MSDS for each substance to which there may be potential exposure in the confined space.
4) Notify (*rescue service*) prior to commencing entry and verify that (*rescue service*) is available to respond. (It is recommended that the rescue service require the employer to fax a copy of the entry permit to the rescue service prior to entry.)
5) Evacuate all confined spaces after entry has begun if notified by (*rescue service*) that (*rescue service*) is not available to respond.
6) (*Rescue service*) has the full authority to make the determination whether entry will be made for rescue given the current existing conditions.

(*Rescue service*) agrees to:

1) Perform rescue preplans of all confined spaces for which (*rescue service*) is responsible for rescue response prior to entry.
2) Provide a list of rescue equipment needed for each entry into such spaces for listing on the permit as required.
3) Notify (*employer*) immediately if the rescue service becomes unavailable for immediate response for any reason.

Name	*Name*
Employer	*Rescue Service*
Date	*Date*

Note: At this point the rescue service should address any additional considerations for response. For example, if the rescue service is a municipal service, the service should address anticipated difficulties in response, such as being unavailable due to response to accident, fires, etc., which may result in extended periods of unavailability. Also consider language qualifying the extent of availability. This would include such things as stating that response cannot be guaranteed due to, for instance, two separate instances occurring simultaneously when there is only one response unit/team. Although the rescue service would be responsible under this agreement for notifying the host employer when the service is no longer available due to another response, it is possible that the incidents can occur simultaneously, in which case neither employer would have been notified. Also consider language agreeing to how such a response decision will be handled, i.e., triage, closest response, etc.

FIGURE C.1(d) Agreement to Provide Rescue Response.

Annex D Structural Types

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

D.1 Table D.1 and Figure D.1(a) through Figure D.1(n) can be used to clarify material on structural types found in the body of the document. (Table D.1 is from NFPA 1670, *Standard on Operations and Training for Technical Rescue Incidents*.)

Table D.1 Combinations of Materials in Structural Types (after ATC, 1987)

Structural Type Identifier	General Description
W	Wood buildings of all types
S1	Steel moment-resisting frames
S2	Braced steel frames
S3	Light metal buildings
S4	Steel frames with cast-in-place concrete shearwalls
C1	Concrete moment-resisting frames
C2	Concrete shearwall buildings
C3/C5	Concrete or steel frame buildings with unreinforced masonry in-fill walls
TU	Tilt-up buildings
PC2	Precast concrete frame buildings
RM	Reinforced masonry
URM	Unreinforced masonry

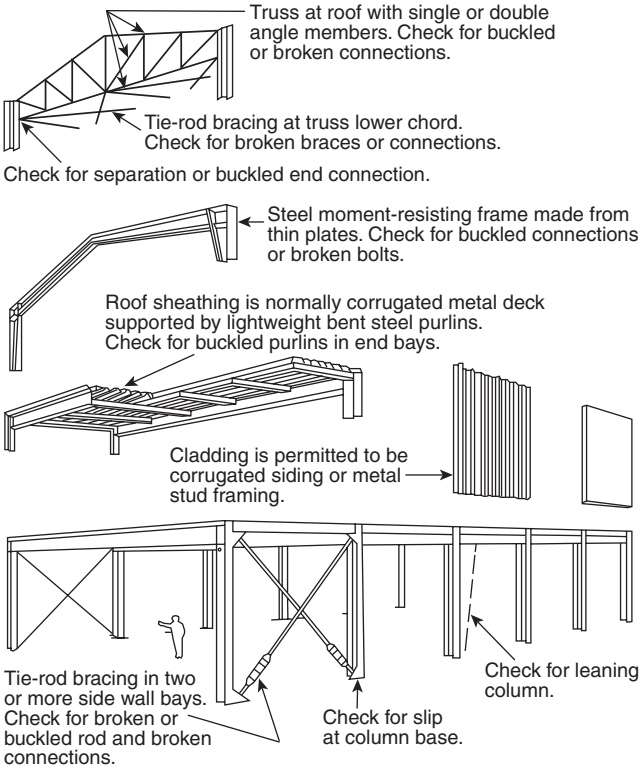


FIGURE D.1(a) Light Metal Buildings.

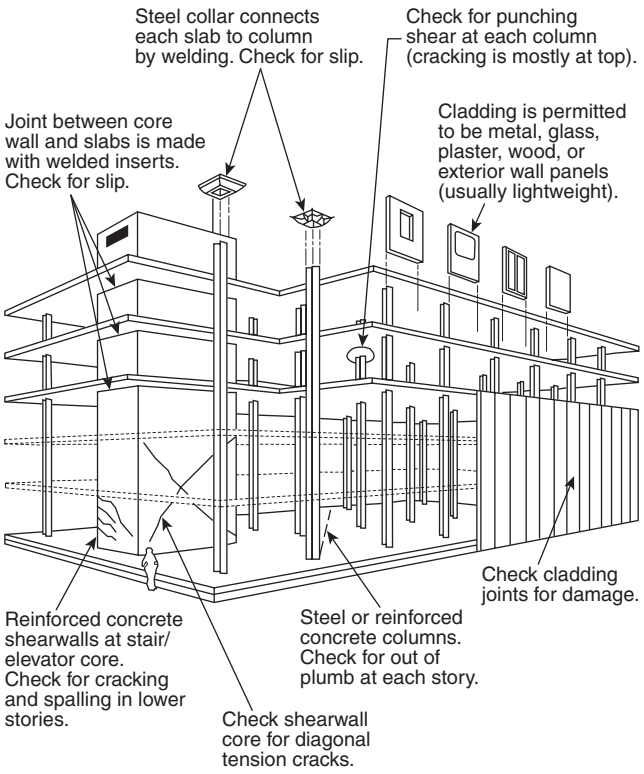


FIGURE D.1(b) Post-Tensioned Lift Slab Building.

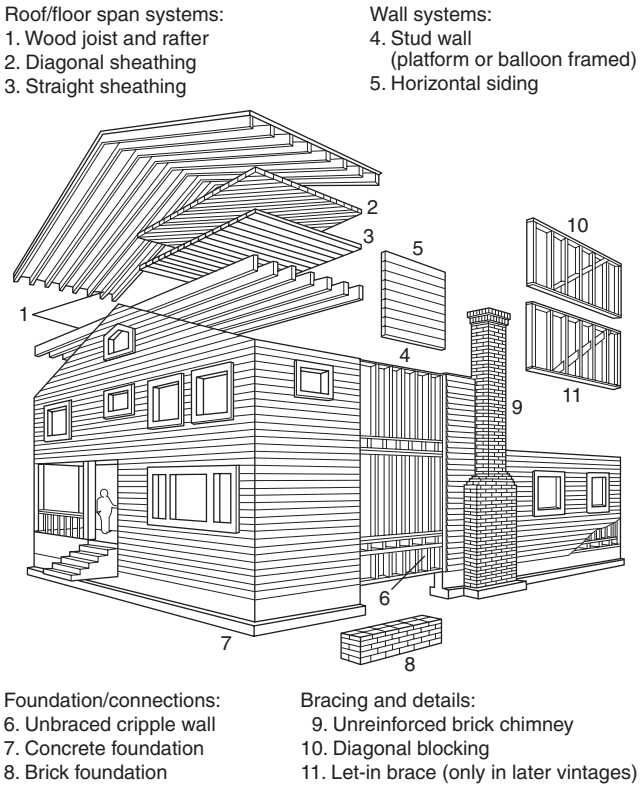


FIGURE D.1(c) Wood Stud Frame Construction.

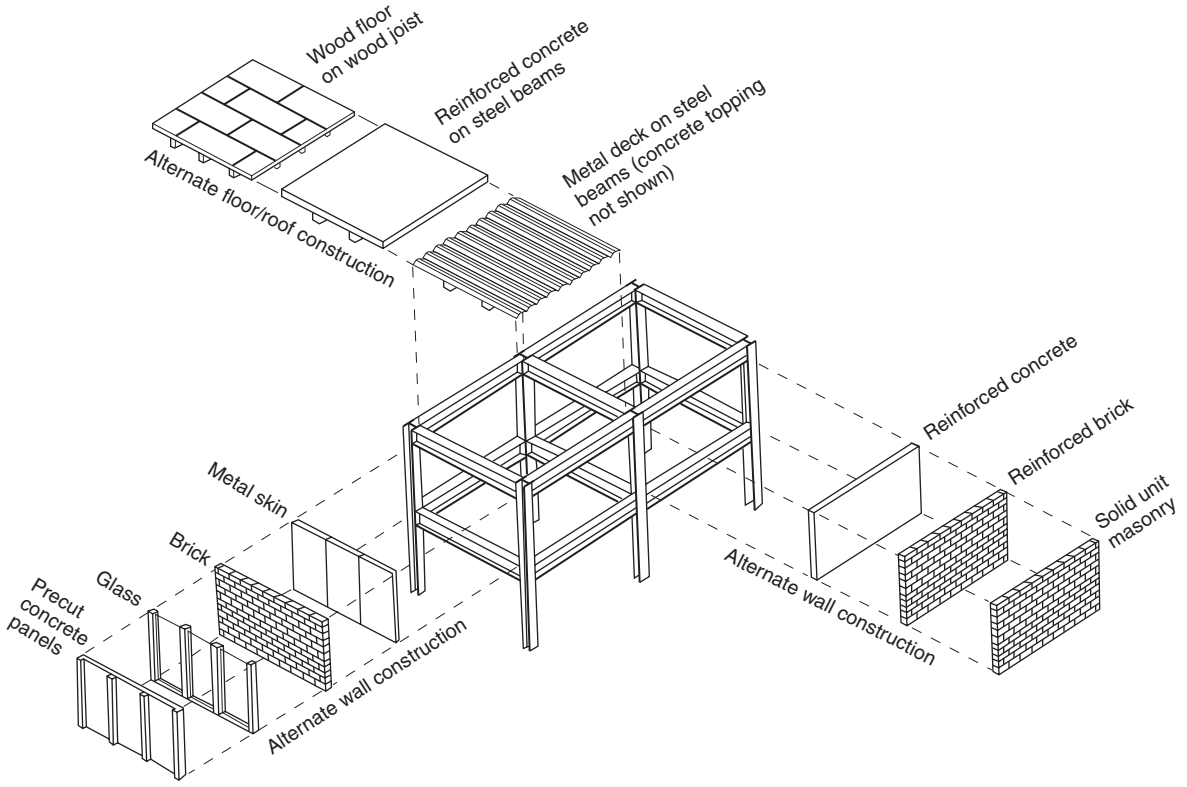


FIGURE D.1(d) Steel Moment-Resisting Frame.

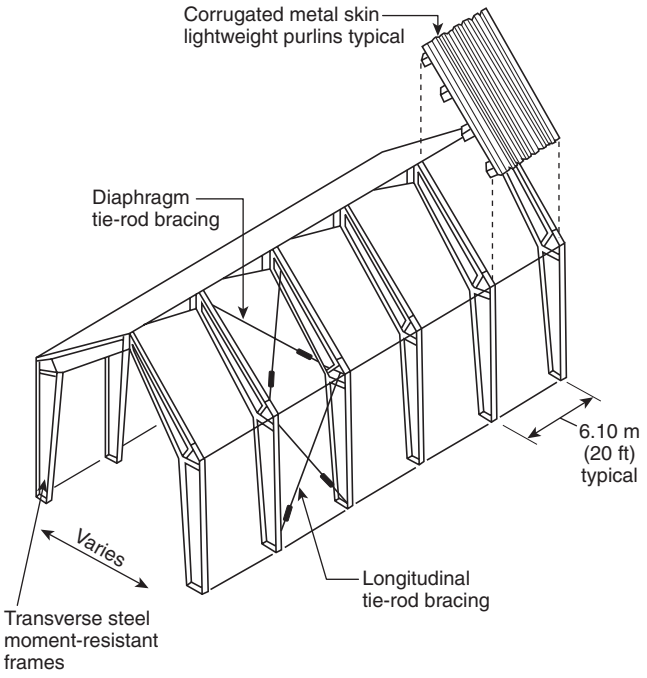


FIGURE D.1(e) Light Metal Construction.

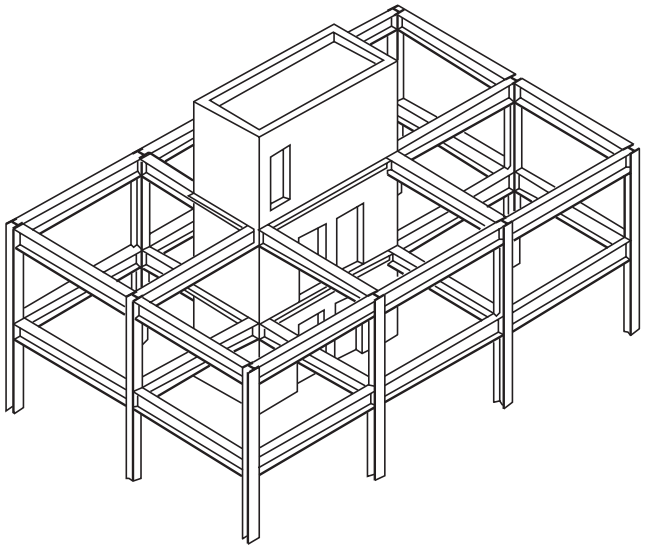
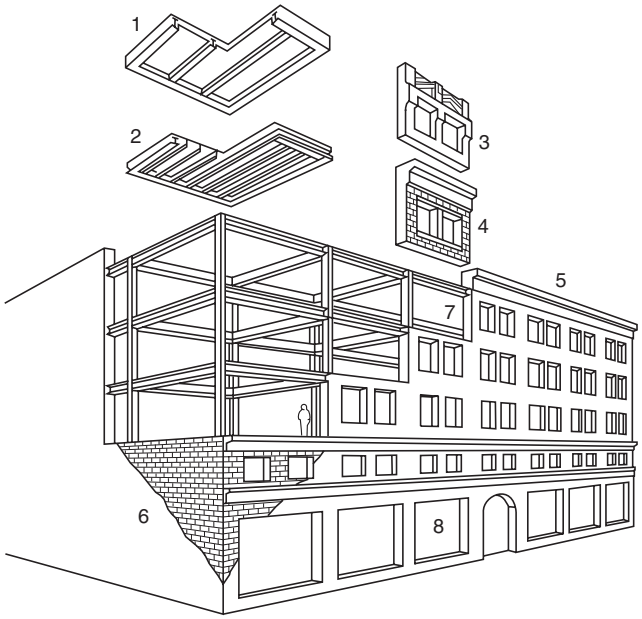


FIGURE D.1(f) Steel Frame with Shearwall.

Roof/floor span systems:
1. Steel framing with concrete cover
2. Wood floor joist and diaphragm (diagonal and straight)

Wall systems:
3. Non-load-bearing concrete wall
4. Non-load-bearing unreinforced masonry cover wall



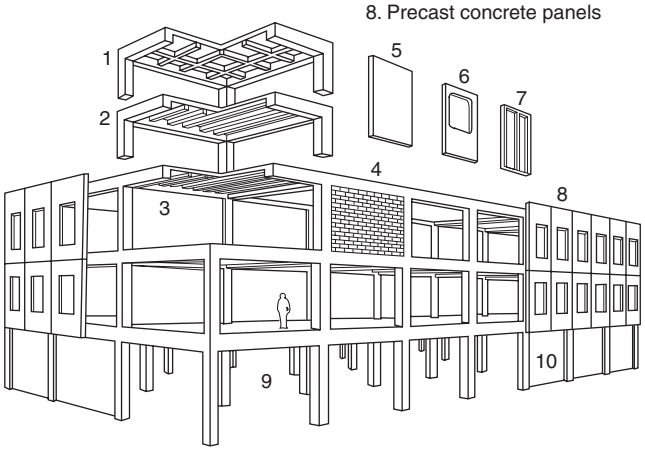
Details:
5. Unreinforced and unbraced parapet and cornice
6. Solid party walls

Openings and wall penetrations:
7. Window-penetrated front facade
8. Large openings of street-level shops

FIGURE D.1(g) Steel Frame with Unreinforced Masonry (URM) In-Fill.

Roof/floor diaphragms:
1. Concrete waffle slab
2. Concrete joist and slab
3. Steel decking with concrete topping

Curtain wall/nonstructural infill:
4. Masonry infill walls
5. Stone panels
6. Metal skin panels
7. Glass panels
8. Precast concrete panels



Structural system:
9. Distributed concrete frame

Details:
10. Typical tall first floor (soft story)

FIGURE D.1(h) Concrete Moment-Resisting Frame.

Roof/floor span systems:
1. Heavy timber rafter roof
2. Concrete joist and slab
3. Concrete flat slab

Wall system:
4. Interior and exterior concrete beating walls
5. Large window penetrations of school and hospital buildings

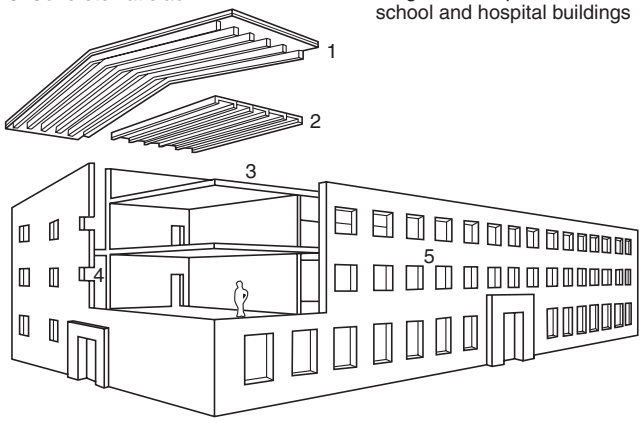
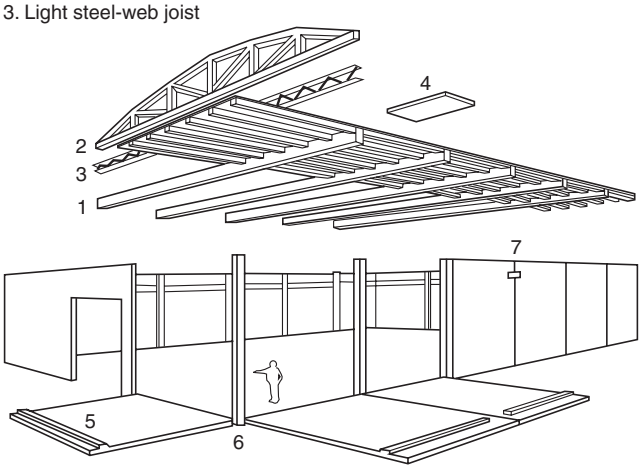


FIGURE D.1(i) Concrete Shearwall.

Roof/floor span systems:
1. Glue laminated beam and joist
2. Wood truss
3. Light steel-web joist

Roof/floor diaphragms:
4. Plywood sheathing



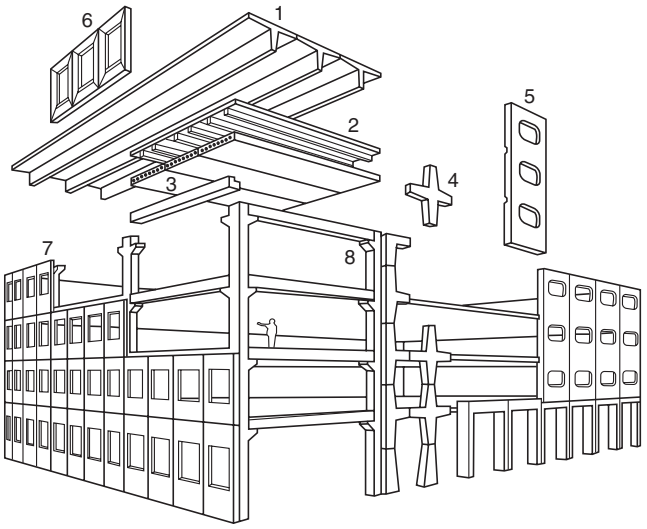
Details:
5. Anchor-bolted wooden ledger for roof/floor support

Wall systems:
6. Cast-in-place columns — square, T-shape, and H-shape
7. Welded steel plate-type panel connection

FIGURE D.1(j) Tilt-Up Construction Typical of the Western United States. (Tilt-up construction in the eastern United States can incorporate a steel frame.)

Roof/floor span systems:
1. Structural concrete T sections
2. Structural double T sections
3. Hollow-core concrete slab

Wall systems:
4. Load-bearing frame components (cross)
5. Multistory load-bearing panels



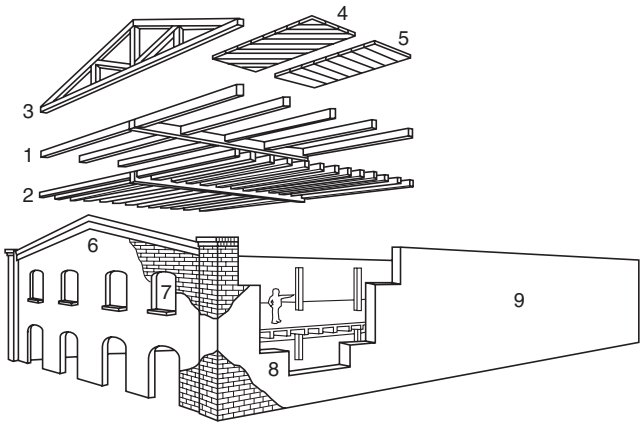
Curtain wall system:
6. Precast concrete panels
7. Metal, glass, or stone panels

Structural system:
8. Precast column and beams

FIGURE D.1(k) Precast Concrete Frame.

Roof/floor span systems:
1. Wood post and beam (heavy timber)
2. Wood post, beam, and joist (mill construction)
3. Wood truss-pitch and curve

Roof/floor diaphragms:
4. Diagonal sheathing
5. Straight sheathing



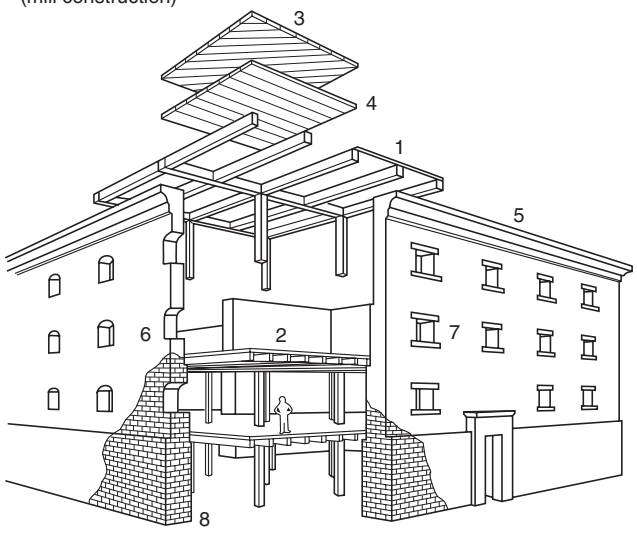
Details:
6. Typical unbraced parapet and cornice
7. Flat arch window openings

Wall systems:
8. Bearing wall — four or more wythes of brick
9. Typical long solid party wall

FIGURE D.1(l) Unreinforced Masonry Bearing Wall.

Roof/floor span systems:
1. Wood post and beam (heavy timber)
2. Wood post, beam, and joist (mill construction)

Roof/floor diaphragms:
3. Diagonal sheathing
4. Straight sheathing



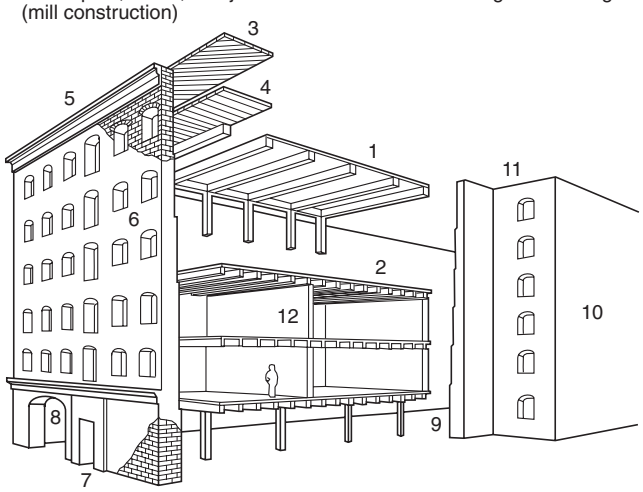
Details:
5. Typical unbraced parapet and cornice
6. Flat arch window openings
7. Small window penetrations (if building is originally a warehouse)

Wall systems:
8. Bearing wall — four to eight wythes of brick

FIGURE D.1(m) Unreinforced Masonry Bearing Wall.

Roof/floor span systems:
1. Wood post and beam (heavy timber)
2. Wood post, beam, and joist (mill construction)

Roof/floor diaphragms:
3. Diagonal sheathing
4. Straight sheathing



Details:
5. Typical unbraced parapet and cornice
6. Flat arch window openings
7. Typical penetrated facade of residential buildings
8. Large openings of ground-floor shops

Wall systems:
9. Bearing wall — four to eight wythes of brick
10. Typical long solid party wall
11. Light/ventilation wells in residential building
12. Nonstructural wood stud partition walls

FIGURE D.1(n) Unreinforced Masonry Bearing Wall.

D.2 Light Frame Construction. 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.

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.

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.

D.3 Heavy Construction.

D.3.1 Heavy Wall Construction. 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.

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.

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.

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.

D.3.2 Heavy Floor Construction. 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 posttensioned 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.

The reinforcing steel, along with the varying thicknesses of concrete structural slab and girder supports utilized in this construction assembly, poses significant concerns with respect to breaching and void penetration.

The loss of reinforcement capability and the integrity of structural loading capacity of the floor and wall assemblies creates significant safety and operational considerations during collapse operations.

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 pans or structural metal floor decks and also might include precast and posttensioned concrete plank systems. These concrete/metal pan floor assemblies are supported by the structural steel framing system.

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.

Multiple assembly or component failures might be present in a collapse situation where isolated or multiple collapse conditions or collapse configurations exist.

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.3.3 Precast Construction. 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.

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.

These structures rely on single or multipoint connections for floor and wall enclosure assembly and are a safety and operational concern during collapse operations.

Examples of this type of construction include commercial, mercantile, office, and multiuse or multifunction structures, including parking structures and large occupancy facilities.

Annex E Marking Systems

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

E.1 Structure and 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 and 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 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.

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 E.1(a) illustrates the search marking system.

An "X" measuring 0.61 m × 0.61 m (2 ft × 2 ft) 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 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. See Figure E.1(a).

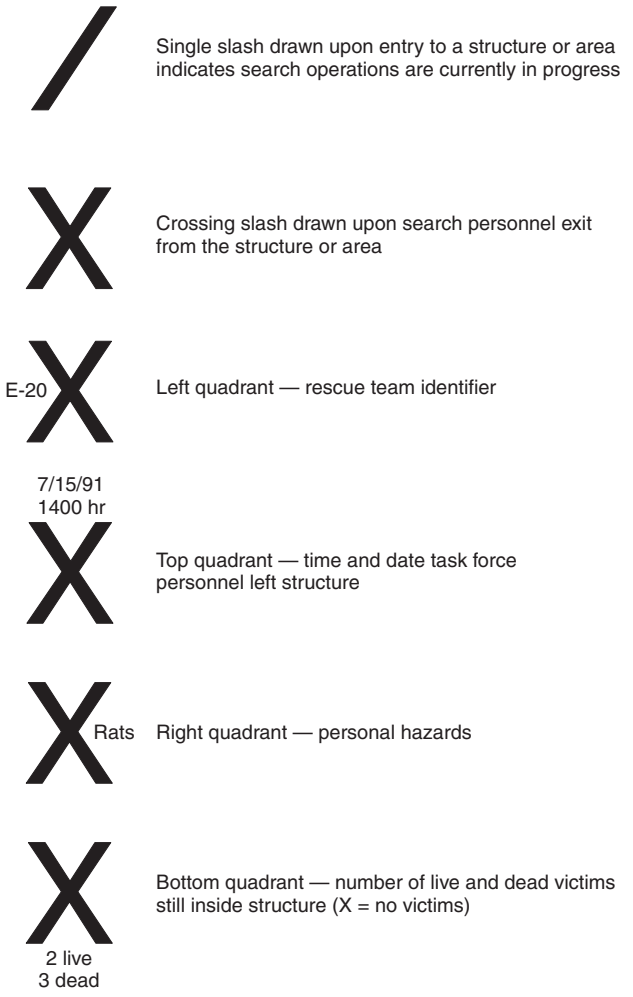


FIGURE E.1(a) FEMA Task Force Search and Rescue Marking System.

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 0.61 m × 0.61 m (2 ft × 2 ft) square box on the building adjacent to the most accessible point of entry.

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 might need shoring, bracing, or removal of hazards in spite of the fact that some areas might be safe. Two diagonal lines in the box (an "X") indicate that the building is not safe for search and rescue operations and might 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. See Figure E.1(b).

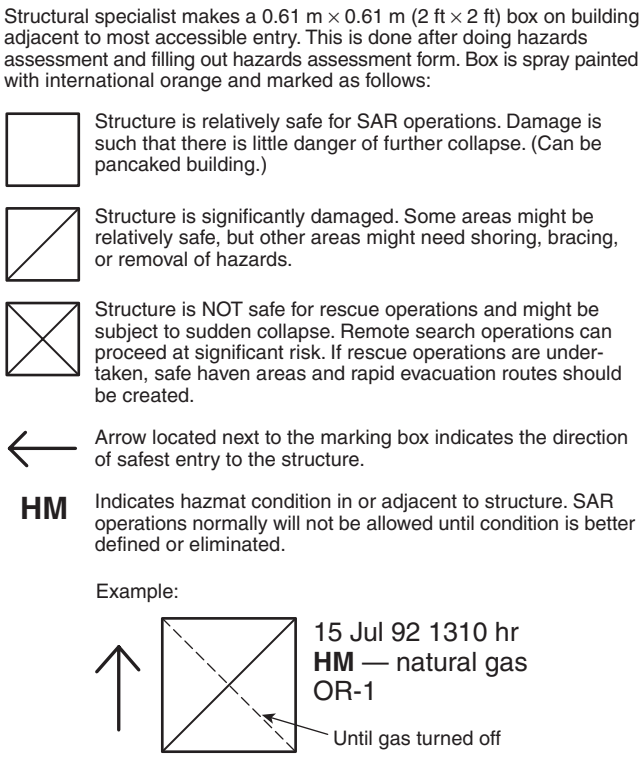


FIGURE E.1(b) Task Force Building Marking System (Structure/Hazard Evaluation).

FEMA Task Force Structure Marking System (Structure Identification within a Geographic 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.

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