NFPA 1006
Standard for Rescue Technician Professional Qualifications

2000 Edition

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

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Standard for

Rescue Technician Professional Qualifications

2000 Edition

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 the National Fire Protection Association, Inc., at its November Meeting held November 14–17, 1999, in New Orleans, LA. It was issued by the Standards Council on January 14, 2000, with an effective date of February 11, 2000.

This edition of NFPA 1006 was approved as an American National Standard on February 11, 2000.

Origin and Development of NFPA 1006

In 1994, the NFPA Standards Council, after a 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 this first edition of NFPA 1006, *Standard for Rescue Technician Professional Qualifications*, which establishes general job performance requirements for a rescue technician as well as specific job performance requirements for special rescue operations. These include rope rescue, surface water rescue, vehicle and machinery rescue, confined space rescue, structural collapse rescue, and trench rescue.

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

Committee Scope: This Committee shall have primary responsibility for the management of the NFPA Professional Qualifications Project and documents related to professional qualifications for fire service, public safety, and related personnel.

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

Committee Scope: This committee shall have the primary responsibility for documents on the professional qualifications for fire service and related personnel who will perform rescue operations.

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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 Appendix A.

Information on referenced publications can be found in Appendix E.

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 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.

1-3.4 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.

1-3.5 Performance of each requirement shall be in accordance with applicable NFPA standards and occupational health and safety regulations.

1-4* Definitions.

1-4.1 Abrasion. The damaging effect on rope and other equipment caused by friction.

1-4.2 Access. See definition 1-4.32, Confined Space Approach.

1-4.3 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.

1-4.4 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.

1-4.4.1* Anchor System, Multiple Point. 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.

1-4.4.2* Anchor System, Single Point. Anchor system relying on a single anchor point to sustain the entire load.

1-4.5* Approved. Acceptable to the authority having jurisdiction.

1-4.6 Ascending, Line. A means of safely traveling up a fixed line with the use of one or more ascent devices.

1-4.7 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.

1-4.8 Atmospheric Monitoring. A method of evaluating the ambient atmosphere of a space, including but not limited to its oxygen content, flammability, and toxicity.

1-4.9* Attendant. A term used to describe a U.S. federally regulated industrial worker qualified to be stationed outside one or more confined spaces who monitors authorized entrants and who performs specified duties.

1-4.10* Authority Having Jurisdiction. The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

1-4.11* 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.

1-4.12* Basic First Aid Kit. Equipment or devices for managing infection exposure, airways, spinal immobilization, fracture immobilization, shock, and bleeding control.

1-4.13 Belay. The method by which a potential fall distance is controlled to minimize damage to equipment and/or injury to a live load, 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.

1-4.14 Belayer. The rescuer who operates the belay system.

1-4.15 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.

1-4.16 Belt, Escape. A belt that is certified as compliant with the applicable requirements of this standard and is intended for use only by the wearer as an emergency self-rescue device.

1-4.17 Belt, Ladder. A belt that is certified as compliant with the applicable requirements of this standard and is intended for use as a positioning device for a person on a ladder.

1-4.18 Belt, Ladder/Escape. A belt that is certified as compliant with the applicable requirements of this standard for both a ladder belt and an escape belt, and that is intended for use both as a positioning device for a person on a ladder and for use only by the wearer as an emergency self-rescue device.

1-4.19 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.

1-4.20 Bend. A knot that joins two ropes or webbing pieces together.

1-4.21 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, conveyer control) of equipment or machinery.

1-4.22 Bight. The open loop in a rope or piece of webbing formed when it is doubled back on itself.

1-4.23* 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.

1-4.24 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.

1-4.25 Breaching Techniques. Methods that utilize breaking and cutting tools to create safe openings in masonry, concrete, and wood structures.

1-4.26 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 failing or sliding, in sufficient quantity that it could entrap, bury, or otherwise injure and immobilize a person.

1-4.27 Collapse.

1-4.27.1 Collapse Support Operations. Operations performed at the scene that include providing for rescuer comfort, scene lighting, scene management, equipment readiness.

1-4.27.2* Collapse Type. Five general types of collapse include lean-to collapse, "V" shape collapse, pancake collapse, cantilever collapse, and A-frame collapse.

1-4.27.3 Collapse Zone. See definition 1-4.142, Rescue Area.

1-4.28 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.

1-4.29 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.

1-4.30 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).

1-4.31* Confined Space. A space that is large enough and so configured that a person can enter and perform assigned work, has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits), and is not designed for continuous human occupancy.

1-4.31.1 Confined Space, Elevated. A confined space with an entry opening located more than 4 ft above ground level.

1-4.31.2 Confined Space, Nonelevated. A confined space whose entry opening is at or near ground level.

1-4.32 Confined Space Approach. The means of approach to the entry opening of a confined space.

1-4.33 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.

1-4.34 Confined Space Entry Opening. The port or opening used to enter a confined space.

1-4.35* 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.

1-4.36* 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.

1-4.37 Confined Space Rescue Team. A combination of individuals trained and available to respond to confined space emergencies and perform rescues.

1-4.38 Confined Space Retrieval Equipment. See definition 1-4.149, Retrieval Equipment.

1-4.39 Confined Space Tool Kit. See definition 1-4.214.2, Tool Kit, Confined Space.

1-4.40* 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.

1-4.41 Construction Grade Lumber. Lumber products that are readily available in sizes and lengths for general construction applications.

1-4.42* 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.

1-4.43 Cribbing. Short lengths of timber, usually 4 in. × 4 in. (101.60 mm × 101.60 mm) and 18 in. to 24 in. (457.20 mm to 609.60 mm) long, which are used in various configurations to stabilize loads in place or while the load is moving. Cribbing can be combined and/or cut to form *wedges* (inclined-shaped) or *chocks* (stair-step shaped).

1-4.44* Critical Angle. Any internal angle in a rope rescue system of 120 degrees or greater that results in an amplification of a force applied to the system.

1-4.45 Critical Incident Stress Debriefing (CISD). A postincident meeting designed to assist rescue personnel in dealing with psychological trauma as the result of an emergency.

1-4.46 Critique. A postincident analysis of the effectiveness of the rescue effort.

1-4.47 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.

1-4.48* 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).

1-4.49* Cut Sheet. A document that specifies the dimensions, slope, and other pertinent information regarding a particular excavation.

1-4.50 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.

1-4.51 Decontamination. The removal or neutralization of a hazardous material from equipment and/or personnel.

1-4.52 Descending a Line. A means of traveling down a fixed line using a descent control device.

1-4.53 Descent Control Device. An auxiliary equipment system component; a friction or mechanical device utilized with rope to control descent.

1-4.54 Disentangle. The process of freeing a victim from entrapment.

1-4.55 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.

1-4.56 Edge Protection. A means of protecting software components within a rope rescue system from the potentially harmful effects of exposed sharp or abrasive edges.

1-4.57 Elevated Confined Space. See definition 1-4.31.1, Confined Space, Elevated.

1-4.58 Emergency. Any condition endangering or thought to be endangering life or property.

1-4.59 Emergency Medical Care. Prehospital care given to a victim of an accident or sudden illness.

1-4.60 Entrant. See definition 1-4.11, Authorized Entrant.

1-4.61 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.

1-4.62 Entry Opening. See definition 1-4.34, Confined Space Entry Opening.

1-4.63 Environmental Controls. See definition 1-4.27.1, Collapse Support Operations.

1-4.64 Excavation. Any man-made cut, cavity, trench, or depression in an earth surface, formed by the earth removal.

1-4.65* Extinguishing Devices. Devices used to suppress fire, including but not limited to CO_2 extinguishers, dry chemical extinguishers, hose lines, and fire-fighting foam.

1-4.66 Face(s) (also Wall, Side, or Belly). The vertical or inclined earth surface formed as a result of excavation work.

1-4.67 Failure. The breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

1-4.68 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.

1-4.69 Fixed Line System. A rope rescue system consisting of a nonmoving rope attached to an anchor system.

1-4.70 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.

1-4.71 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.

1-4.72* 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.

1-4.73 Hardware. See definition 1-4.145.1, Rescue Equipment, Auxiliary Rope.

1-4.74 Harness. See definition 1-4.98, Life Safety Harness.

1-4.75 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.

1-4.76 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.

1-4.77 Hazardous Atmosphere. Any atmosphere that exposes personnel to the risk of death, incapacitation, injury, acute illness, or impairment of the ability to self-rescue.

1-4.77.1* 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.

1-4.78 Hazardous Material. A substance (solid, liquid, or gas) that when released is capable of creating harm to people, the environment, and property.

1-4.79* 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.

1-4.80 Heavy Equipment. Typically, construction equipment that can include but is not limited to backhoes, trac hoes, grade-alls, and cranes.

1-4.81 Heavy Load. Any load over 7000 lb (3175.15 kg).

1-4.82 Heavy Structural Collapse. Collapse of heavy construction–type buildings that require special tools and training to gain access into the building.

1-4.83 High Angle. An environment in which the load is predominately supported by the rope rescue system.

1-4.84 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.

1-4.85 High-Point Anchor. A point above the trench used for attachment of rescue systems.

1-4.86 Hitch. A knot that attaches to or wraps around an object, and when the object is removed, the knot will fall apart.

1-4.87 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).

1-4.88 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.

1-4.89 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.

1-4.90* Intersecting Trench. A trench where multiple trench cuts or legs converge at a single point.

1-4.91* Isolation. The process by which an area is rendered safe through mitigation of dangerous energy forms.

1-4.92* 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).

1-4.93 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.

1-4.94 Knot. A fastening, including bights, bends, and hitches, made by tying together lengths of rope or webbing in a prescribed way.

1-4.95 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.

1-4.96 Laser Target. A square or rectangular plastic device used in conjunction with a laser instrument to set the line and grade of pipe.

1-4.97 Levers. Tools that have a relationship of load/fulcrum/force to create mechanical advantage and move a load.

1-4.98 Life Safety Harness. A system component; an arrangement of materials secured about the body used to support a person during fire service rescue.

1-4.99 Life Safety Rope. A safety rope designed to support one- and two-person loads.

1-4.100 Lifting Tools. Hydraulic, pneumatic, mechanical, or manual tools that can lift heavy loads.

1-4.101* Light Frame Construction. Structures that have framework made out of wood or other lightweight materials.

1-4.102 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.

1-4.103 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.

1-4.104 Lip-In. See definition 1-4.103, Lip Collapse.

1-4.105* 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.

1-4.106 Litter. A transfer device designed to support a victim during movement.

1-4.107 Load Stabilization. See definition 1-4.143, Cribbing.

1-4.108 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.

1-4.109 Locating Devices. Devices utilized to locate victims in various collapse types and structural components, including but not limited to voice, seismic, video, K-9, and fiber-optic.

1-4.110 Loop. An element of a knot created by forming a complete circle in a rope.

1-4.111 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).

1-4.112 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.

1-4.113 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.

1-4.114* Marking Systems. Various systems used to mark hazards, victim location, and pertinent structural information.

1-4.115 Maximum Working Load. Weight supported by the life safety rope and system components that must not be exceeded.

1-4.116 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.

1-4.117 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.

1-4.118 Mode of Transmission. The physical means of entry of a hazardous material into the human body, including inhalation, absorption, injection, and ingestion.

1-4.119 MSDS. Material safety data sheets.

1-4.120 Nonelevated Confined Space. See definition 1-4.31.2, Confined Space, Nonelevated.

1-4.121 Nonintersecting Trench. See definition 1-4.219.1, Trench, Nonintersecting.

1-4.122 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.

1-4.123 One-Person Load. 300 lb (136 kg).

1-4.124 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.

1-4.125 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.

1-4.126* Passive Search Measures. Search efforts that do not require active searching by the rescuers.

1-4.127 Permit-Required Confined Space. See definition 1-4.31, Confined Space.

1-4.128 Personal Escape. See definition 1-4.165, Self-Rescue.

1-4.129 Personal Flotation Device (PFD). A device manufactured in accordance with U.S. Coast Guard specifications that provides supplemental flotation for persons in the water. PFDs are classified by performance criteria into five types with specific limitations on where and under what circumstances each type can be used.

1-4.130 Personal Protective Equipment (PPE). Consists of full personal protective clothing, plus equipment specific to the various rescue disciplines. Personal protective equipment is provided to protect or isolate personnel from the chemical, physical, and/or thermal hazards that can be encountered at a rescue incident. Personal protective equipment can address respiratory system, skin, head, eyes, face, hands, feet, body, and ear protection.

1-4.131 Pneumatic Strut. Pneumatic pistons (in assorted adjustable lengths) that are used in shoring systems to prevent further collapse.

1-4.132 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.

1-4.133 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.

1-4.134 Pre-entry Medical Exam. A baseline medical evaluation of the rescue entrants performed immediately prior to a rescue entry.

1-4.135* 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.

1-4.136* 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.

1-4.137* Rapid Intervention Crew/Company (RIC). A minimum of two fully equipped personnel on site, in a ready state, for immediate rescue of injured or trapped fire fighters. In some departments they can also be known as a Rapid Intervention Team.

1-4.138 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.

1-4.139 Recovery. Nonemergency operations taken by responders to retrieve property or the remains of victims.

1-4.140* Registered Licensed Professional Engineer. A person who is registered as a professional engineer in the state where the work is to be performed.

1-4.141 Requisite Equipment. Specific tools and equipment that are critical to performing a specific type of technical rescue.

1-4.142 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.

1-4.143 Rescue Attendant. See definition 1-4.9, Attendant.

1-4.144 Rescue Entrant. See definition 1-4.11, Authorized Entrant.

1-4.145 Rescue Equipment. See Appendix B.

1-4.145.1 Rescue Equipment, Auxiliary Rope. System components, other than life-safety rope and harnesses, that are load-bearing accessories designed to be utilized for rescue, including but not limited to ascending devices, carabiners, descent control devices, rope grab devices, and snap-links.

1-4.146 Rescue Service. The rescue team designated for confined space rescue by the authority having jurisdiction.

1-4.147* Rescue Team. A combination of rescue-trained individuals who are equipped and available to respond to and perform technical rescues.

1-4.148 Rescue Technician. A person who is trained to perform or direct the technical rescue.

1-4.149* Retrieval Equipment (or Retrieval System). Combinations of rescue equipment used for nonentry (external) rescue of persons from confined spaces.

1-4.150 Rigging. The process of building a system to move or stabilize a load.

1-4.151 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.

1-4.152 Risk–Benefit Analysis. An assessment of the risk to rescuers versus the benefits that can be derived from their intended actions.

1-4.153 Rope. See definition 1-4.99, Life Safety Rope.

1-4.154 Rope Rescue Equipment. Components used to build rope rescue systems, including life safety rope, life safety harnesses, and auxiliary rope rescue equipment.

1-4.155 Rope Rescue System. A system comprised of rope rescue equipment and an appropriate anchor system intended for use in the rescue of a subject.

1-4.156 Safe Zone. In a trench, the area that projects 2 ft (0.61 m) in all directions around an installed cross brace or wale that is a component of an existing approved shoring system.

1-4.157 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.

1-4.158 Scene Security. The means used to prevent or restrict entry to the scene of a rescue incident, either during or following the emergency.

1-4.159 Screw Jack. Shoring system component made of sections of threaded bar stock that are incorporated with lengths of pipe or wood.

1-4.160 Search Function. General area or building search, reconnaissance, victim location identification, and hazard identification or flagging.

1-4.161* Search Measures, Active. This phase of search measures include those that are formalized and coordinated with other agencies.

1-4.162 Search Parameters. The defined search area and scope.

1-4.163* Secondary Collapse. Causes or conditions that could contribute to a subsequent collapse in a building.

1-4.164 Security Measures. See definition 1-4.158, Scene Security.

1-4.165 Self-Rescue. Escaping or exiting a hazardous area under one's own power.

1-4.166 Shall. Indicates a mandatory requirement.

1-4.167 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.

1-4.168* 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.

1-4.169 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.

1-4.170 Shoring System. A system that supports unstable surfaces by placing a tension member between an unstable surface and base.

1-4.171 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.

1-4.172 Should. Indicates a recommendation or that which is advised but not required.

1-4.173 Sides. See definition 1-4.66, Face.

1-4.174* 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 attention of other persons as desired by the initiator of the signal.

1-4.175* 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.

1-4.176 Site Operations. The activities to be undertaken at a specific site to manage the rescue efforts.

1-4.177 Size-Up. The ongoing observation and evaluation of factors that are used to develop strategic goals and tactical objectives.

1-4.178 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.

1-4.179 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.

1-4.180 Software. A flexible fabric component of rope rescue equipment.

1-4.181 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.

1-4.182 Span of Control. The maximum number of personnel or activities that can be effectively controlled by one individual (usually three to seven).

1-4.183 Specialized Equipment. Equipment that is unique to the rescue incident and made available.

1-4.184* Specialized Teams. Emergency response teams with specific skills and equipment that can be needed on the scene.

1-4.185 Spoil Pile (or spoil). A pile of excavated soil next to the excavation or trench.

1-4.186 Stabilization Points. Key points on a motor vehicle or machine used to keep the vehicle or object from moving during rescue operations.

1-4.187 Stabilization System. See definition 1-4.43, Cribbing.

1-4.188 Steel Cutting Tools. Hand tools, circular saw, exothermic torch, oxyacetylene torch, and plasma cutter.

1-4.189 Stiffbacks. See definition 1-4.224, Trench Upright.

1-4.190 Strongbacks. See definition 1-4.224, Trench Upright.

1-4.191 Structural Collapse Tool Kit. See definition 1-4.214.3, Tool Kit, Structural Collapse.

1-4.192 Structural Load Calculations. Load calculations based on the weight per cubic foot of construction materials such as concrete, steel, and wood.

1-4.193 Structural Support System. See definition 1-4.170, Shoring System.

1-4.194 Strut. The tensioned member placed between two opposing surfaces.

1-4.195 Superimposed Load. See definition 1-4.198, Surcharge Load.

1-4.196 Supplemental Sheeting and Shoring. Additional sheeting and shoring installed as the level of the trench floor is excavated past an existing safe zone.

1-4.197 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.

1-4.198 Surcharge Load. Any weight in the proximity of the trench that increases instability or the likelihood of secondary cave-in.

1-4.199 Surface. A base that is secure and conducive to supporting and stabilizing a vehicle or object.

1-4.200 Surface Encumbrance. A natural or manmade structural object adjacent to or in the immediate vicinity of an excavation or trench.

1-4.201 Surface Water Rescue. Rescue of a victim who is afloat on the surface of a body of water.

1-4.202 Swift Water. Water moving at a rate greater than 1 knot [1.15 mph or 1.66 ft/sec (1.85 km/hr)].

1-4.203* Swim. To propel oneself through water by means of purposeful body movements and positioning.

1-4.204* Swim Aids. Items of personal equipment that augment the individual rescuer's ability to propel through water.

1-4.205* 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.

1-4.206* Tabulated Data. Any set of site-specific design data used by a professional engineer to design a protective system at a particular location.

1-4.207 Task. An essential step of a work operation required to complete the performance of a duty.

1-4.208 Team. See definition 1-4.37, Confined Space Rescue Team.

1-4.209 Technical Rescue. The application of special knowledge, skills, and equipment to safely resolve unique or complex rescue situations.

1-4.210 Throw Bag. A water rescue system that includes 50 ft to 75 ft (15.24 m to 22.86 m) of water rescue rope, an appropriately sized bag, and a closed-cell foam float.

1-4.211 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 that nontidal water lacks.

1-4.212 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.

1-4.213 Toe. The point where the trench wall meets the floor of the trench.

1-4.214* Tool Kit. Equipment available to the rescuer as defined in this document.

1-4.214.1 Tool Kit, Basic Extrication. A generic set of equipment items needed to operate at most extrications.

1-4.214.2 Tool Kit, Confined Space. Equipment required to perform certain confined space entry and rescue procedures.

1-4.214.3 Tool Kit, Structural Collapse. See Appendix B.

1-4.214.4 Tool Kit, Trench Rescue. See Appendix B.

1-4.214.5 Tool Kit, Water Rescue. Includes, but is not limited to, throw bags, line throwing device(s), assorted rescue rope and hardware, approved life safety harnesses, fixed and portable communication devices, swim aids, reach/extension devices, victim packaging devices, sufficient quantities of water rescue personal protective equipment for team members and victims, and appropriate navigational instruments for the area.

1-4.215 Traditional Sheeting and Shoring. The use of 4 ft by 8 ft (1.219 m by 2.438 m) sheet panels, with a strongback attachment, supplemented by a variety of conventional hydraulic, screw, and/or pneumatic shoring options.

1-4.216 Traffic Control. The direction or management of motor vehicle traffic such that scene safety is maintained and rescue operations can proceed without interruption.

1-4.217 Traffic Control Devices. Ancillary equipment/resources used at the rescue scene to facilitate traffic control such as flares, barricades, traffic cones, or barrier tape.

1-4.218 Transfer Device. Equipment used to package and allow safe removal of a victim from a specific rescue environment.

1-4.219* Trench (Trench Excavation). A excavation, narrow in relation to its length, made below the surface of the earth.

1-4.219.1 Trench, Nonintersecting. A trench cut in a straight or nearly straight line with no crossing or converging trench legs or cuts.

1-4.220 Trench Box. See definition 1-4.168, Shield.

1-4.221 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.

1-4.222 Trench Floor. The bottom of the trench.

1-4.223 Trench Rescue Tool Kit. See definition 1-4.214.4, Tool Kit, Trench Rescue.

1-4.224 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.

1-4.225 Triage. The sorting of casualties at an emergency according to the nature and severity of their injuries.

1-4.226 Triage Tag. A tag used in the classification of casualties according to the nature and severity of their injuries.

1-4.227 Two-Person Load. 600 lb (272 kg).

1-4.228 Upright. See definition 1-4.224, Trench Upright.

1-4.229 Victim Management. The manner of treatment given to those requiring rescue assistance.

1-4.230 Victim Removal System. Those systems used to move a victim to a safe location.

1-4.231 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.

1-4.232 Water-Bound Victim. A victim that is in the water needing assistance.

1-4.233* 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.

1-4.234* 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.

1-4.235* 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.

1-4.236 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.

1-4.237 Water Rescue Tool Kit. See definition 1-4.214.5, Tool Kit, Water Rescue.

1-4.238 Wedges and Shims. See definition 1-4.43, Cribbing.

Chapter 2 Rescue Technician

2-1* 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.

2-2* Entrance Requirements. Before beginning training activities or engaging in rescue incidents the following requirements shall be complied with:

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

2-3* Minimum Requirements. For certification, the rescue technician shall perform all of the job performance requirements in Chapter 3 and all job performance requirements listed in at least one of the specialty areas (Chapters 4 through 9).

Chapter 3 Job Performance Requirements

3-1 General Requirements. The job performance requirements defined in Sections 3-2 through 3-5 shall be met prior to certification as a rescue technician.

3-2 Site Operations.

3-2.1 Identify the needed support resources, given a specific type of rescue incident, so that a resource cache is managed, scene lighting is adequate 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 and availability, 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.

3-2.2 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.

3-2.3 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.

3-2.4 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 correctly 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 clearly 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, typical 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 clear and concise manner so that objectives are met.

3-2.5 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 per-

sonnel 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.

3-2.6* 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 familiar with 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.

3-2.7 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 eliminated or controlled, further entry is denied, the victim is transported to the appropriate care facility, the scene is rendered safe, 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 secure 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.

3-3 Victim Management.

3-3.1 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 secured, 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 appropriate 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.

3-3.2 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, considerations 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.

3-3.3 Stabilize the victim, given a basic first aid kit, so that the victim's airway is established and maintained, ventilation is adequate, 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.

3-3.4 Triage victims, given triage tags and local protocol, so that rescue versus recovery factors are considered, 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.

3-3.5* Package an ill or injured victim, given a basic first aid kit and other specialized equipment if available, so that environmental conditions are considered, 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.

3-3.6 Move a victim in a low-angle environment, given victim transport equipment, litters, other specialized equipment if available, and victim removal systems appropriate to the specific 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 secure, 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 common 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.

3-3.7 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 authority having jurisdiction, 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.

3-4 Maintenance.

3-4.1* 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 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 as needed, 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 authority having jurisdiction; 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 appropriate to the task.

3-4.2* 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.

3-5 Ropes/Rigging.

3-5.1 Tie knots, bends and hitches, given ropes and webbing, so that the knots are properly dressed, recognizable, and safetied as required.

(a) *Requisite Knowledge:* Knot efficiency, proper knot utilization, rope construction, rope terminology, and methods of safety.

(b) *Requisite Skills:* 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

3-5.2 Construct a single-point anchor system, given life safety rope, edge protection, and other auxiliary rope rescue equipment if available, 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, a safe and 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, safe 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 desired strength, location, and surface contour; and perform a system safety check.

3-5.3 Construct a simple rope mechanical advantage system, given life safety rope, carabiners, pulleys, rope grab devices, and auxiliary rope rescue equipment if available, 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, safe 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.

3-5.4 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, appropriate commands are used to direct the operation, and potential problems are readily 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:* Direct personnel effectively, use operational commands, analyze system efficiency, identify safety concerns, and perform system safety check.

3-5.5 Construct a lowering system, given an anchor system, life safety rope(s), descent control device, and auxiliary rope rescue equipment if available, so that the system can accommodate the load, is efficient, is capable of safely controlling the descent, is capable of holding the load in place or lowering with minimal effort over the desired 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, safe rigging principles, and system safety check procedures.

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

3-5.6 Direct a lowering operation, given appropriate 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 readily identified, communicated, and managed.

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

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

3-5.7 Construct a belay system, given life safety rope, anchor systems, personal protective equipment, and auxiliary rope rescue equipment if available, 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, safe 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.

3-5.8 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.

3-5.9 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 rapidly react to a falling load, and communicate belay system actuation.

3-5.10 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, proper personal protective equipment, equipment inspection criteria, signs of equipment damage, principles of safe 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 improper configuration, secure equipment components, inspect all rigging, and perform a system safety check.

Chapter 4 Rope Rescue

4-1 General Requirements. The job performance requirements defined in 4-1.1 through 4-1.10 shall be met prior to certification in rope rescue.

4-1.1 Construct a multiple-point anchor system, given life safety rope and other auxiliary rope rescue equipment where available, 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 safe anchor points are 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 distributions 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.

4-1.2 Construct a compound rope mechanical advantage system, given a load, an anchor system, life safety rope, carabiners, pulleys, rope grab devices, and auxiliary rope rescue equipment if available, so that the system constructed can accommodate 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, safe 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.

4-1.3 Construct a fixed rope system, given an anchor system, life safety rope, and auxiliary rope rescue equipment if available, so that the system constructed can accommodate the load, is efficient, and is connected to an anchor system and the load 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, safe 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 safe rigging principles, evaluate incident operations as related to interference concerns and set-up, perform system safety check, and evaluate system components for compromised integrity.

4-1.4 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 readily 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 properly 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 system components for compromised integrity, direct personnel effectively, communicate commands, analyze for system efficiency, manage load movement, and identify safety concerns.

4-1.5 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, safe rigging principles, considerations and practices for high-angle environments, and common hazards posed by improper maneuvering and harnessing.

(b) *Requisite Skills:* The ability to select and use proper 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.

4-1.6 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 secure, 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, safe rigging principles, types of methods to minimize common environmental hazards and hazards created by improper practices, and considerations and practices for 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.

4-1.7 Direct a team in the construction of a highline system, given rescue personnel; life safety rope; auxiliary rope rescue equipment, where available, minimally rated for two-person loads; and suitable anchor systems, 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, safe 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 an appropriate highline system for defined task, perform system safety checks, use safe rigging principles, and communicate with personnel effectively.

4-1.8 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 clearly communicated, operational commands are distinctly communicated to personnel, and potential problems are readily 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, 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.

4-1.9 Ascend a fixed rope, given a properly 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 secured 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 their ascending system to a descending system, and the system is suitable for the site and will facilitate reaching the desired objective.

(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, considerations and practices for high-angle environments, converting ascending systems to descending systems, and common hazards posed by improper maneuvering and harnessing.

(b) *Requisite Skills:* The ability to select and use proper 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.

4-1.10 Descend a fixed rope, given a properly 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 secured to the fixed rope in a manner that will not allow him or her to fall, the person descending is secured 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 will facilitate reaching the desired objective.

(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 proper operation of descent control devices utilized; safe rigging principles; considerations and practices for high-angle environments; and common hazards posed by improper maneuvering and harnessing.

(b) *Requisite Skills:* The ability to select and use proper 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 proper 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 5 Surface Water Rescue

5-1 General Requirements. The job performance requirements defined in 5-1.1 through 5-1.15 shall be met prior to certification in surface water rescue.

5-1.1* Develop a site survey for an existing water hazard, given historical data, specific personal protective equipment for conducting site inspections, flood insurance rate maps if applicable, tide tables if applicable, 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, inspection practices, and considerations; 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.

5-1.2* Select proper 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 adequate 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:* Selection of personal flotation devices, donning and doffing personal flotation devices, selection of water rescue helmets, donning and doffing water rescue helmets, selection of in-water insulating garments, donning and doffing of in-water insulating garments, proficiency in emergency escape procedures, and proficiency in communicating distress signals.

5-1.3* 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 authority having jurisdiction, 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.

5-1.4* 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 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 parameters definition, the effect of search strategy defining the parameter, communication methods, and reporting requirements.

(b) *Requisite Skills:* Read topographic maps, determine hydrology, conduct interviews, read and mark track traps, and correlate personnel availability, search strategy, and conditions to the parameter definition.

5-1.5* Develop an action plan for a shore-based rescue of a single, water-bound victim, given an operational plan where available, an incident, size-up information, protocols, rescue personnel, resource information, and a water rescue tool kit, so that all available 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 for 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.

5-1.6* 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, 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, demonstrate proficiency in deploying water rescue rope from throw bags, and demonstrate appropriate shore-based victim removal techniques.

5-1.7* Deploy a water rescue rope to a water-bound victim, given a coiled water rescue rope of 50 ft to 75 ft (15.240 m to 22.860 m) 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, demonstrate proficiency in deploying water rescue rope from throw bags, and demonstrate appropriate shore-based victim removal techniques.

5-1.8 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.

5-1.9* 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 authority having jurisdiction, 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 for the conditions, 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.

5-1.10 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 authority having jurisdiction, 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 is 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 system, anchor mechanical advantage systems in watercraft, and demonstrate proper lifting techniques.

5-1.11 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 authority having jurisdiction, 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.

5-1.12* 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, 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.

5-1.13 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 authority having jurisdiction, 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 the victim and rescuers are 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 hazards anticipated for the specific water-rescue environment, and selection procedures for water rescue personal protective equipment.

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

5-1.14 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 clearly communicated, operational commands are distinctly communicated to personnel, and potential problems are readily 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 effectively, manage movement of the load, and evaluate for potential problems.

5-1.15* Define applications for helicopter aquatic rescue operations within the area of responsibility for the authority having jurisdiction, 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 safe victim(s) extraction from water hazards that are representative of the bodies of water existing or anticipated within the geographic confines of the authority having jurisdiction, 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 6 Vehicle and Machinery Rescue

6-1 General Requirements. The job performance requirements defined in 6-1.1 through 6-1.8 shall be met prior to certification in vehicle and machinery rescue.

6-1.1* 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:* Selection and use of personal protective equipment, application of traffic control concepts, positioning of traffic control devices, identification and mitigation of existing or potential hazards, application of zone identification, and personnel safety techniques.

6-1.2* 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, authority having jurisdiction 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.

6-1.3 Determine the vehicle access and egress points, given the structural and damage characteristics and potential victim location(s), so that victim location(s) are considered; entry and exit points for victims, rescuers, and equipment are designated; flow of personnel, victim, and equipment is considered; existing entry points are used; time constraints are factored; selected entry/egress points do not compromise vehicle stability; chosen points can be made safe; equipment and victim stability is considered; and AHJ safety and emergency procedures are enforced.

(a) *Requisite Knowledge:* Vehicle construction/features, entry and exit points, routes and hazards operating systems, authority having jurisdiction 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.

6-1.4 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 orderly 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.

6-1.5* 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 considered, 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 authority having jurisdiction.

(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.

6-1.6* 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.

6-1.7 Disentangle victim(s), given an extrication incident, a basic extrication tool kit, personal protective equipment, and specialized equipment, so that undue victim injury is avoided, 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.

6-1.8 As a member of a team, remove a packaged victim to a 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 avoided, and stabilization is maintained.

(a) *Requisite Knowledge:* Patient handling techniques, incident management system, types of immobilization, packaging and transfer devices, types of immobilization techniques, uses of immobilization devices, organizational protocols, lifting and moving techniques, and safety.

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

Chapter 7 Confined Space Rescue

7-1 General Requirements. The job performance requirements defined in 7-1.1 through 7-1.9 shall be met prior to certification in confined space rescue.

7-1.1 Preplan a confined space incident, given applicable guidelines and regulations and a preplan form, so that a safe, 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, considerations 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.

7-1.2* Assess the incident, given a preplan of the space or size-up information, information from technical resources, monitoring equipment, and personal protective equipment necessary to perform the assessment, so that general area and space-specific hazards can be identified, bystanders and victims are interviewed, immediate and ongoing monitoring of the space is performed, the victims' conditions and location can be determined, a risk–benefit analysis can be 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 can be established.

(a) *Requisite Knowledge:* Use of preplans, size-up, and interviewing techniques; types of personal protective equipment; monitoring equipment protocols, rescue and retrieval systems; the impact of 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 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.

7-1.3* Conduct monitoring of the environment, given monitoring equipment reference material, personal protective equipment, properly 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.

7-1.4 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.

7-1.5 Prepare for entry into the confined space, given a confined space and a confined space rescue tool kit, so that patient communication is established when possible, continuous atmospheric monitoring is initiated, rescuer readiness is verified, rescuers' limitations are identified and considered, rescuers unsuitable to entry operations are reassigned and replaced, route and methods of entry are determined, and rescuer evacuation is considered.

(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, determine rescuer suitability, relate limitations to operational needs, identify victim communication needs, evaluate for point and route of entry, and select evacuation methods.

7-1.6 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, safe entry is established and maintained, atmosphere is continuously monitored, the victim's mental and physical condition can be 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 safe 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.

7-1.7* 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 if appropriate to the environment.

7-1.8 Remove all entrants from a confined space, given personal protective equipment, rope and related rescue and retrieval systems, personnel to safely operate rescue and

retrieval systems, and a confined space rescue tool kit, so that internal obstacles and hazards are negotiated, all persons can be extricated from a space safely in the selected transfer device, the victim and rescuers can be decontaminated as necessary, and the victim can be 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.

7-1.9 Secure the confined space access during termination, 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 rendered safe.

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

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

Chapter 8 Structural Collapse Rescue

8-1 General Requirements. The job performance requirements defined in 8-1.1 through 8-1.16 shall be met prior to certification in structural collapse rescue.

8-1.1* Conduct a size-up of a collapsed structure, given an incident and available 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.

8-1.2 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, use occupancy classification information, use search devices, and assess and categorize type of collapse.

8-1.3 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.

8-1.4 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.

8-1.5 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.

8-1.6* 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.

8-1.7* 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 Teams (RITs) 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 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 specialized tools and equipment, implement communications and safety protocol, and mitigate specific hazards associated with shoring tasks.

8-1.8 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 practices and procedures.

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

8-1.9 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.

8-1.10* 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.

8-1.11* 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 in a safe manner, 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 considerations; and stabilization systems.

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

8-1.12* 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 considerations.

(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.

8-1.13 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 proper 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 considerations 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, apply safe practices, select and use personal protective equipment, and apply stabilization where required.

8-1.14 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.

8-1.15* 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 considerations.

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

8-1.16 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 is maintained.

(a) *Requisite Knowledge:* Types of heavy equipment, capabilities, application and hazards of heavy equipment and rigging, safety considerations, types of communication, and methods to establish common communications.

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

Chapter 9 Trench Rescue

9-1 General Requirements. The job performance requirements defined in 9-1.1 through 9-1.12 shall be met prior to certification in trench rescue.

9-1.1* 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 is determined.

(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.

9-1.2* 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(s) 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.

9-1.3* Implement support operations at trench emergencies, given an assignment and available resources, so that a resource cache is managed, scene lighting is adequate 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 type and availability, de-watering 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, apply efficient use of lighting resources, 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.

9-1.4* 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 application 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.

9-1.5* Lift a heavy load as a team member, 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 zones and considerations.

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

9-1.6* Coordinate the use of heavy equipment, given personal protective equipment, means of communication, equipment and operator, and an assignment, so that operator suitability for task is considered, common communications are maintained, equipment usage supports the operational objectives, hazards are avoided, and life safety is maintained.

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

9-1.7* 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, 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 8 ft (2.438 m) deep.

9-1.8* 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.

9-1.9* Install supplemental sheeting and shoring for each 2 ft (0.61 m) 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, 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.

9-1.10* 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.

9-1.11* 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 timeframe concerns.

9-1.12* 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 a postincident brief.

Appendix A Explanatory Material

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

A-1-1 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-1-4 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-1-4.4.1 Anchor System, Multiple Point. The subcategories of these systems can be further defined as follows.

(a) Load distributing anchor systems (also referred to as self-equalizing or self-adjusting) are anchor systems established from two or more anchor points that:

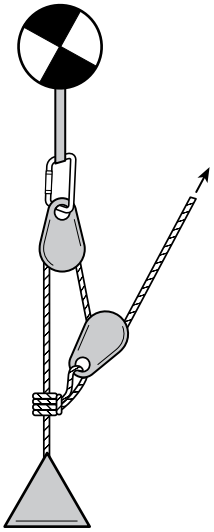
(1) Maintain near-equal loading on the anchor points despite direction changes on the mail line rope
(2) Re-establish equal loading on remaining anchor points if any one of them fails. The system should be configured so as to limit the resulting drop that occurs as the result of an anchor point failure.

(b) 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-1-4.4.2 Anchor System, Single Point. Figure A-1-4.4.2 illustrates such a system.

A-1-4.5 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.

FIGURE A-1-4.4.2 Compound A 3:1 system (Z-Rig).



A-1-4.9 Attendant. An attendant performs 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 the attendant 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-1-4.10 Authority Having Jurisdiction. The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A-1-4.11 Authorized Entrant. The authorized entrant meets the following training requirements.

(a) *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).

(b) *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.

(c) *Personal Protective Equipment.* Including all personal protective equipment appropriate for the confined space and proper training and documentation of training in its use.

(d) *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-1-4.12 Basic First Aid Kit. See Table A-1-4.12.

Table A-1-4.12 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-1-4.23 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-1-4.27.2 Collapse Type. Collapse patterns and potential victim locations include the following.

(a) *Lean-To.* A lean-to is formed when one or more of the supporting walls or floor joists breaks or separates at one end, causing one end of the floor(s) to rest on the lower floor(s) or collapse debris. Potential areas where victims might be located are under the suspended floor and on top of the floor at the lowest level. See Figure A-1-4.27.2(a).

(b) *V.* A "V" is formed when heavy loads cause the floor(s) to collapse near the center. Potential areas where victims might be located are under the two suspended floor pieces and on top of the floor in the middle of the V. See Figure A-1-4.27.2(b).

(c) *Pancake.* A pancake is formed when the bearing wall(s) or column(s) fails completely and an upper floor(s) drops onto a lower floor(s), causing it to collapse in a similar manner. Potential areas where victims might be located are under the floors and in voids formed by building contents and debris wedged between the floors. See Figure A-1-4.27.2(c).

(d) *Cantilever.* A cantilever is formed when one end of the floor(s) hangs free because one or more walls have failed and the other end of the floor(s) is still attached to the wall(s). Potential areas where victims might be located are on top of or under the floors. See Figure A-1-4.27.2(d).

(e) *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 A-1-4.27.2(e).

FIGURE A-1-4.27.2(a) Lean-to floor collapse. (Courtesy of U.S. Department of Civil Defense)

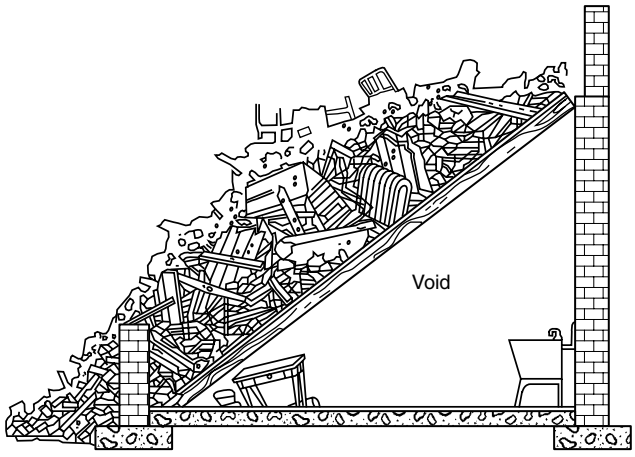


FIGURE A-1-4.27.2(b) V-shape floor collapse. (Courtesy of U.S. Department of Civil Defense)

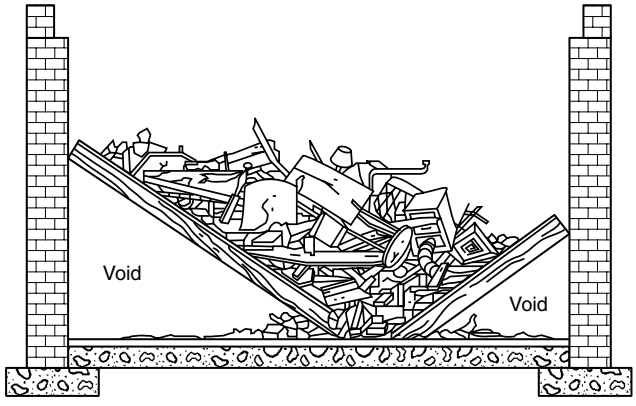


FIGURE A-1-4.27.2(c) Pancake floor collapse. (Courtesy of U.S. Department of Civil Defense)

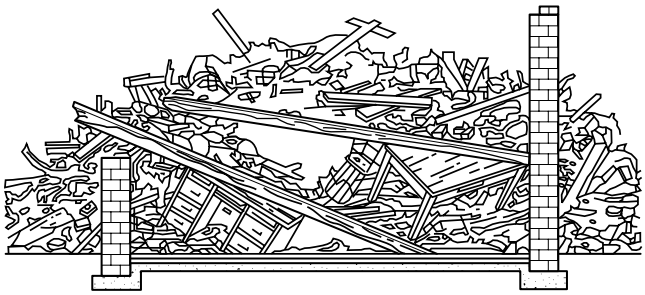


FIGURE A-1-4.27.2(d) Cantilever floor collapse. (Courtesy of U.S. Department of Civil Defense)

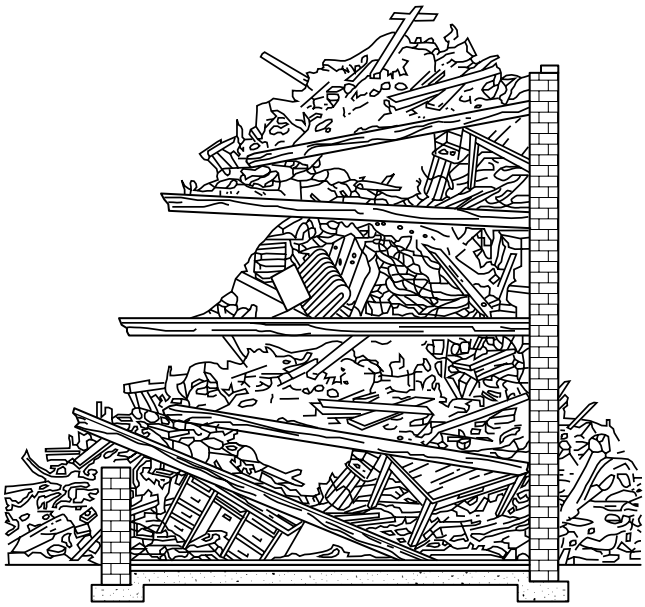
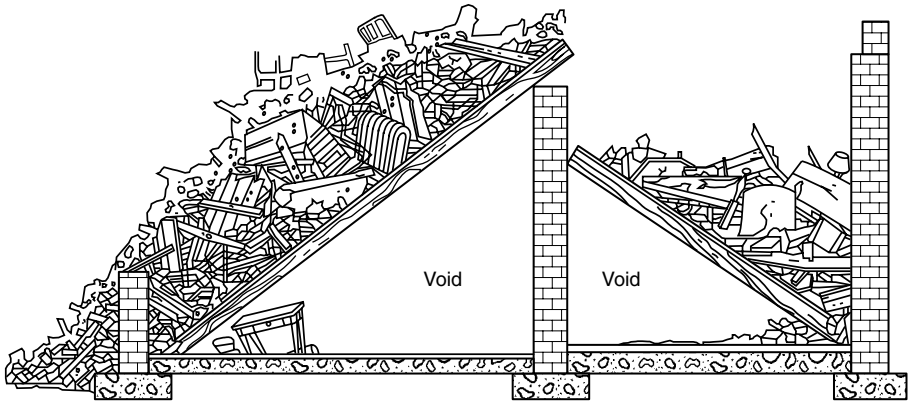


FIGURE A-1-4.27.2(e) A-frame floor collapse.



A-1-4.31 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-1-4.35 Confined Space Entry Permit. 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 Figures A-1-4.35(a) through A-1-4.35(d).

FIGURE A-1-4.35(a) Example of an entry permit form.

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 A-1-4.35(a) *(continued)*

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 A-1-4.35(b) Entry team medical checklist.

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 A-1-4.35(c) Atmosphere monitoring log.

Atmosphere Monitoring Log

Unit	Time	LEL	O_2	Action
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
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_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____
_____	_____ hrs	_____ %	_____ %	_____

FIGURE A-1-4.35(d) Agreement to provide rescue response.

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.

A-1-4.36 Confined Space Rescue Preplan. See Figure A-1-4.36.

A-1-4.40 Confined Space Type. Figure A-1-4.40 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).

FIGURE A-1-4.36 Confined space rescue preplan.

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-1-4.40 Confined space types.

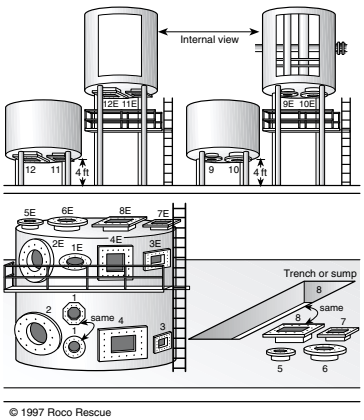
CS TYPE 1 / 1E — elevated Portal size: Less than 24 in. Configuration: Round / oval Accessibility: Horizontal entry (vertical portal)	**CS TYPE 2 / 2E** — elevated Portal size: 24 in. or larger Configuration: Round / oval Accessibility: Horizontal entry (vertical portal)
CS TYPE 3 / 3E — elevated Portal size: Less than 24 in. Configuration: Square / rectangle Accessibility: Horizontal entry (vertical portal)	**CS TYPE 4 / 4E** — elevated Portal size: 24 in. or larger Configuration: Square / rectangle Accessibility: Horizontal entry (vertical portal)
***CS TYPE 5 / 5E** — elevated Portal size: Less than 24 in. Configuration: Round / oval Accessibility: Vertical top entry (horizontal portal)	***CS TYPE 6 / 6E** — elevated Portal size: 24 in. or larger Configuration: Round / oval Accessibility: Vertical top entry (horizontal portal)
***CS TYPE 7 / 7E** — elevated Portal size: Less than 24 in. Configuration: Square / rectangle Accessibility: Vertical top entry (horizontal portal)	***CS TYPE 8 / 8E** — elevated Portal size: 24 in. or larger Configuration: Square / rectangle Accessibility: Vertical top entry (horizontal portal)
CS TYPE 9 / 9E — elevated Portal size: Less than 24 in. Configuration: Round / oval Accessibility: Vertical bottom entry (horizontal portal)	**CS TYPE 10 / 10E** — elevated Portal size: 24 in. or larger Configuration: Round / oval Accessibility: Vertical bottom entry (horizontal portal)
CS TYPE 11 / 11E — elevated Portal size: Less than 24 in. Configuration: Square / rectangle Accessibility: Vertical bottom entry (horizontal portal)	**CS TYPE 12 / 12E** — elevated Portal size: 24 in. or larger Configuration: Square / rectangle Accessibility: Vertical bottom entry (horizontal portal)

NOTE: For SI units, 24 in. = 610 mm.

**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 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.



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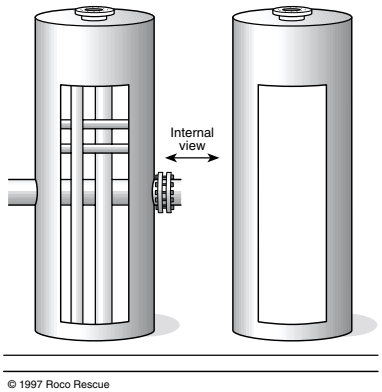

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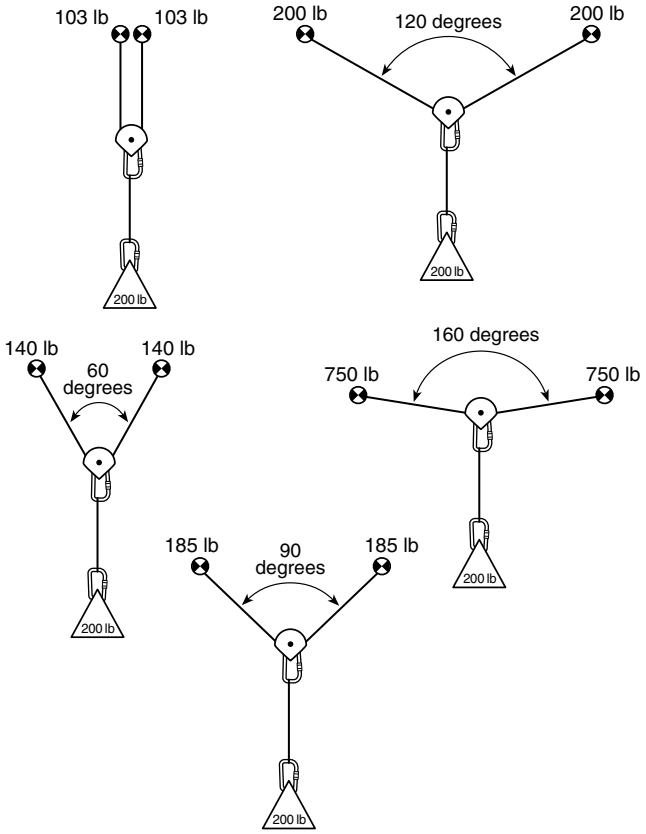
A-1-4.42 Construction Type. The construction categories, types, and occupancy usage of various structures might necessitate the utilization of a variety of different techniques and material. The four construction categories that the rescuer most likely will encounter in collapse situations are lightframe, heavy wall, heavy floor, and precast concrete construction. These four categories usually comprise the majority of structures affected by a collapse.

A-1-4.44 Critical Angle. See Figure A-1-4.44.

FIGURE A-1-4.44 The effect of angle forces on anchors and lines: critical angles.



A-1-4.48 Crush Syndrome. This muscle death can lead to myoglobinuria, renal failure, muscle loss, and contractions.

A-1-4.49 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-1-4.65 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-1-4.72 General Area. Within the general area, access by people, heavy machinery, and vehicles is limited and strictly controlled.

A-1-4.77.1 Hazardous Atmosphere for Confined Space. Hazardous atmosphere can result from one or more of the following:

(a) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL).

(b) Airborne combustible dust at a concentration that meets or exceeds its LFL, which can be estimated by observing the density of the concentration. In general, if the concentration of dust obscures vision at a distance of 5 ft (1.5 m) or less, it might be within its flammable range.

(c) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent.

(d) Atmospheric concentration of any hazardous substance that could result in exposure to personnel in excess of its dose or permissible exposure limit (PEL).

(e) Any other atmospheric condition that is immediately dangerous to life or health (IDLH).

A-1-4.79 Heavy Construction Type. See Appendix D.

A-1-4.90 Intersecting Trench. Common configurations are "L," "X," and "T."

A-1-4.91 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 tag-out of all sources of energy, or blocking or disconnecting all mechanical linkages.

A-1-4.92 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-1-4.101 Light Frame Construction. See Appendix D.

A-1-4.105 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-1-4.114 Marking Systems. 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 authority having jurisdiction at any structural collapse event. This information not only should be used to identify operational priorities but also should be forwarded to the

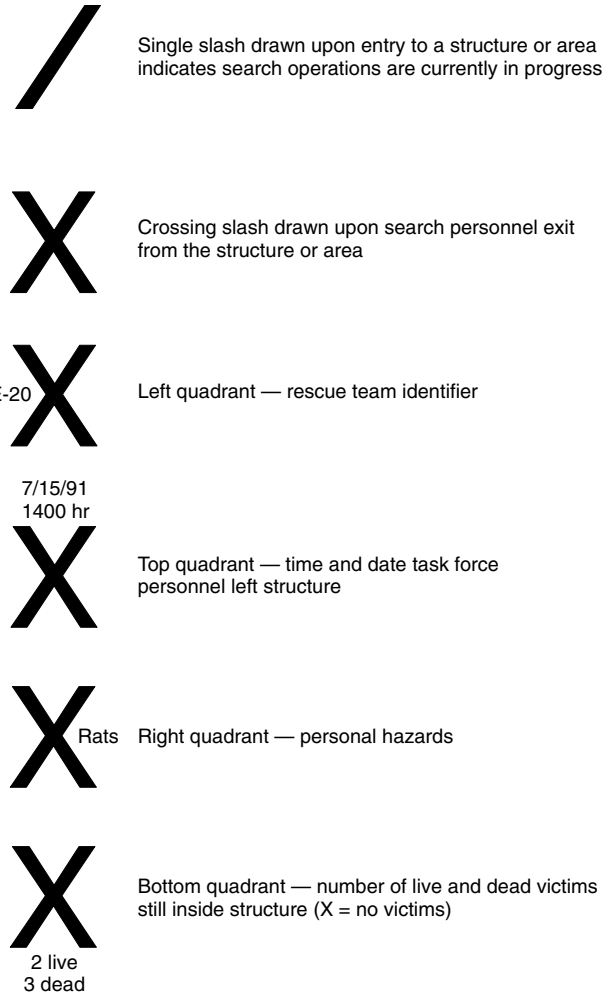
incident commander to assist in the overall assessment of the event.

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 A-1-4.114(a) illustrates the search marking system.

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

In addition, search personnel should mark the exact location of a victim(s) with orange spray paint. Surveyor's tape can be used as a flag to identify the appropriate area in conjunction with the spray paint. To reduce needless duplication of search efforts, markings should be made at each point of entry or separate area of the structure. Where updated information 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 A-1-4.114(a).

FIGURE A-1-4.114(a) FEMA task force search and rescue marking system.

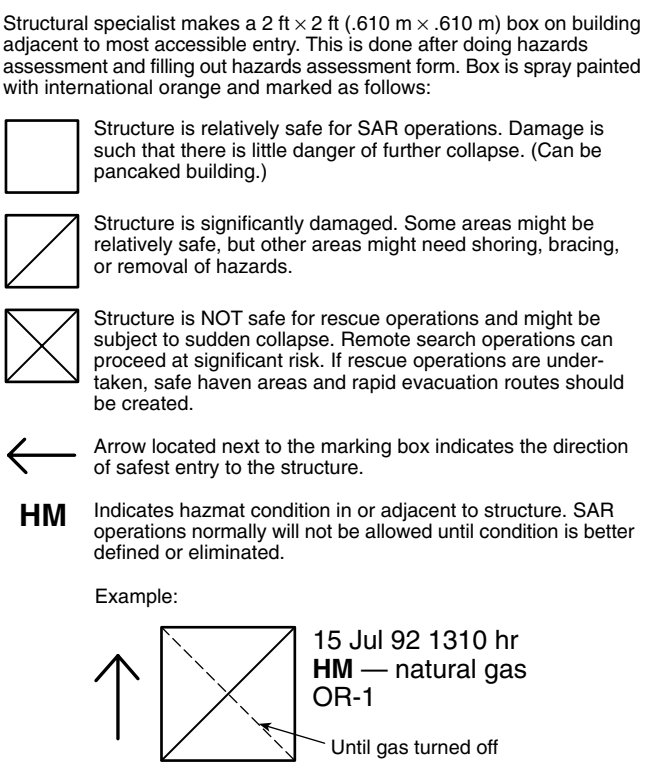


FEMA Task Force Building Marking System (Structure/Hazard Evaluation). This system is designed to identify specific hazards associated with any collapsed structure. Personnel should be cognizant of the nationally accepted marking system and should be proficient in the use of the system. See *FEMA US&R 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 2 ft × 2 ft (0.61 m × 0.61 m) 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 A-1-4.114(b).

FIGURE A-1-4.114(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 authority having jurisdiction 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 building number. Such identification is not always possible due to postdisaster conditions. See *FEMA US&R Response System,* Appendix D, "Structure Triage, Assessment & Marking System."

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

It is imperative that personnel clearly identify each structure within a geographic area. This identification will assist both in the specific ongoing search and rescue effort and the long-term, postdisaster identification of the site. See Figures A-1-4.114(c) and A-1-4.114(d).

FIGURE A-1-4.114(c) Task force marking system for structure identification within a geographic area.

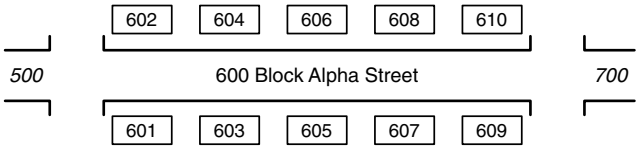
An important duty of a structure triage team is to differentiate buildings clearly in groupings such as by block(s) or jurisdictional areas/sectors. This geographic (area/sector) identification of buildings should be consolidated at the command post and used to deploy search and rescue personnel and/or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

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

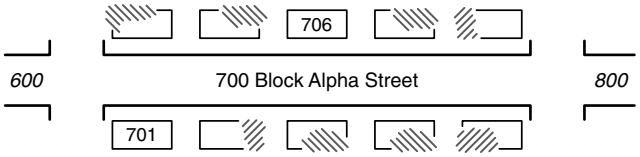
It is important to identify each separate structure clearly within a geographic area when information is being disseminated to other operational entities. The primary method of identification should be the existing street name, hundred block, and building number. Obviously, such identification is not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

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

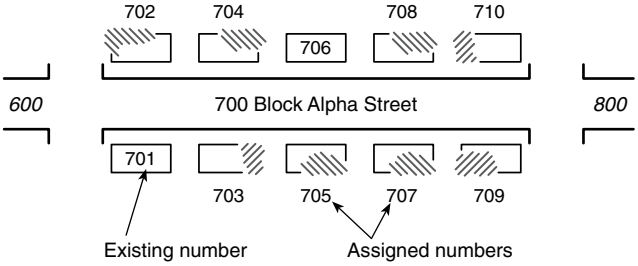
1. Each structure should be identified by existing street name and building number.



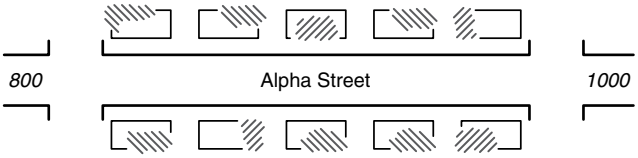
2. If some previously existing numbers have been obliterated, an attempt should be made to re-establish the numbering system based upon one or more structures that still display an existing number.



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



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



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

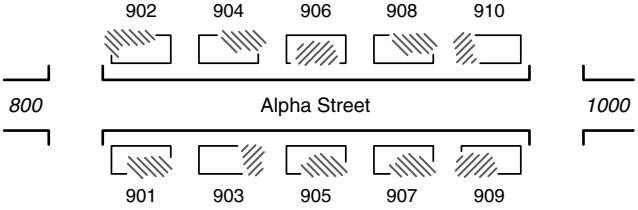
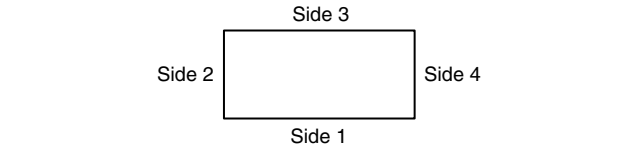


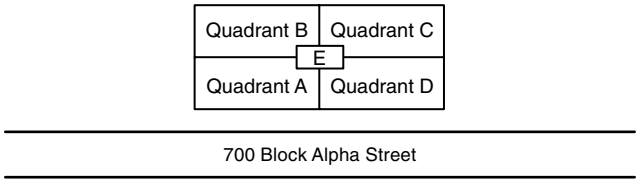
FIGURE A-1-4.114(d) Task force structure marking and system structure identification within a geographic area — single structure.

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

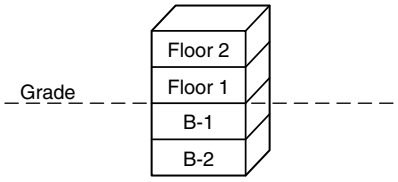
1. The address side of the structure is defined as Side 1. Other sides of the structure are assigned numerically in a clockwise manner from Side 1.



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



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



A-1-4.126 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-1-4.135 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)

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-1-4.136 Protective System. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

A-1-4.137 Rapid Intervention Crew/Company. 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 Immediately Dangerous to Life or Health (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 rapid intervention crew 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 rapid intervention crew. 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 rapid intervention crews.

A-1-4.140 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 "manufac-

tured protective systems" or "tabulated data" to be used in the construction of protective systems.

A-1-4.147 Rescue Team. The number of persons required for an effective team is dependant 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-1-4.149 Retrieval Equipment (or 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.

A-1-4.161 Search Measures, Active. 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 reporting person 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-1-4.163 Secondary Collapse. Indications of potential for secondary collapse include the following:

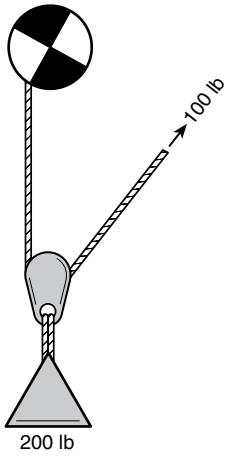
(1) Leaning walls
(2) Smoke or water seeping through joints
(3) Unusual sounds (e.g., creaking, groaning)
(4) Recurring aftershocks
(5) Sagging floor or roof assemblies
(6) Missing, strained, or damaged points of connection of structural elements
(7) Excessive loading of structural elements
(8) Sliding plaster and airborne dust
(9) Separating walls
(10) Lack of water runoff
(11) Racked or twisted structure
(12) Building vibration

A-1-4.168 Shield or Shield System. Shields can be permanent structures or can be designed to be portable. Shields can be either manufactured or job-built. Shields used in trenches are usually referred to as *trench boxes* or *trench shields*.

A-1-4.174 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-1-4.175 Simple Rope Mechanical Advantage System. Figure A-1-4.175 illustrates such a system.

FIGURE A-1-4.175 Simple A 2:1 system.



A-1-4.184 Specialized Teams. These teams can include but are not limited to hazardous materials teams, fire suppression teams, and medical teams.

A-1-4.203 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-1-4.204 Swim Aids. Examples include but are not restricted to webbed gloves, swim fins, boogie boards, and surf boards.

A-1-4.205 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-1-4.206 Tabulated Data. Also, the term is applied to six tables found in Appendix C of OSHA 29 *CFR* 1926, Subpart P.

A-1-4.214 Tool Kit. Several specialized tool kits have been established based on the specific technical rescue discipline. The kits listed are intended to supply a listing of equipment needed at specific incidents and are not intended to limit organizations from expanding their equipment or capabilities. *(See Appendix B.)*

A-1-4.219 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 15 ft (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 ft (4.6 m) or less, the excavation is also considered a trench.

A-1-4.233 Watercraft. Examples include basic paddle boats, powered inflatable boats (I.R.B.), rigid hulled craft, hovercraft,

air boats, one- and two-person water jet–driven (personal) watercraft.

A-1-4.234 Watercraft Conveyance. Examples include trailers, pickup trucks, forklifts, and davits.

A-1-4.235 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-2-1 *General Requirements.* 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 2-2 and clarified in A-2-2.

A-2-2 *Entrance Requirements.* The following list elaborates these requirements.

(a) *Age Requirements.* The authority having jurisdiction is empowered to set minimum and maximum age requirements. However, some fire and rescue organizations have set requirements to allow for participation by individuals under the age of 18. 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.

(b) *Medical Requirement.* The authority having jurisdiction 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*, in whole or in part as part of their own standard development process.

(c) *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.

(d) *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:

(1) 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.

(2) 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.

(3) 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.

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

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

(6) 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.

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

(8) Lifts the stretcher [must be able to lift and carry 125 lb (56.699 kg)], places it in the ambulance and sees that the patient and stretcher are secured, and continues emergency medical care.

(9) 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 assure prompt medical care on arrival. Identifies assessment findings that can require communications with medical direction for advice and notification that special profes-

sional services and assistance be immediately available upon arrival at the medical facility.

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

(11) Reports verbally 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.

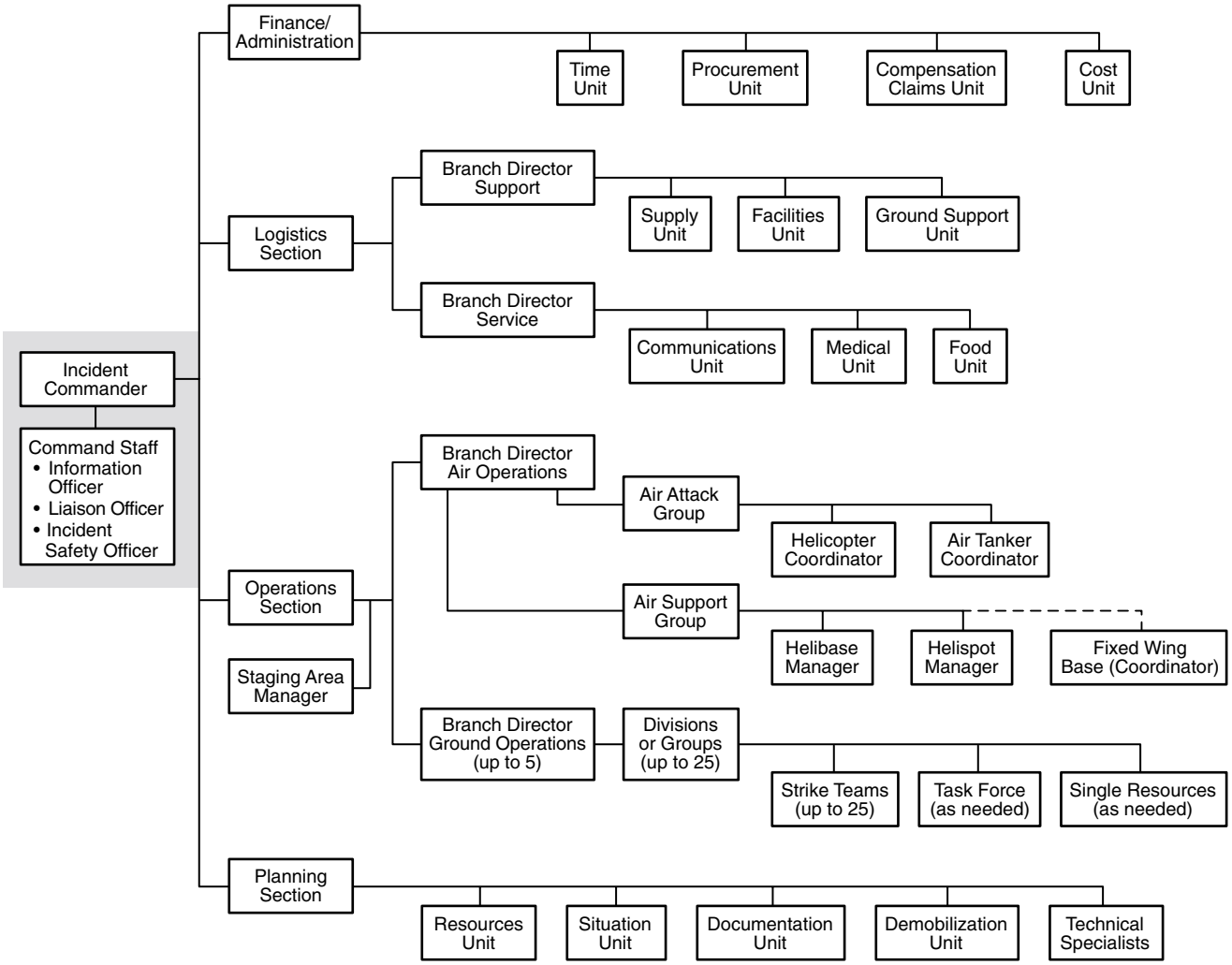
(e) *Educational Requirements.* Because rescue technicians can be required to read and comprehend standards and procedures, write written reports, and diagram and understand principles of mechanical advantage, structural engineering, and other related disciplines, it is recommended that the rescue technician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

(f) *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-2-3 *Minimum Requirements.* For any person to obtain certification as a professional rescuer in any discipline, he or she 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-3-2.6 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-3-2.6.)*

FIGURE A-3-2.6 Sample incident management system organizational chart.



A-3-3.5 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 (i.e., cervical immobilization device, long spine board, C-collar, Reeves Sleeve)
(2) A hard or soft evacuation device (i.e., SKED stretcher, Stokes basket)
(3) A vertical harness
(4) A low-angle harness (i.e., 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 (i.e., 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
(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 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 caused 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 (i.e., 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 check all equipment and put back into service

A-3-4.1 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-3-4.2 Rescue equipment should be inspected and maintained in accordance with manufacturers' recommendations and 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 authority having jurisdiction.

A-4-1.1(a) For the purposes of this document, *static loads* relates to forces applied within a system when the load is not moving. *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-5-1.1 Water environments can include but are not limited to swiftwater, still water, ice covered, and tidal water. Rescuers should demonstrate the requisite knowledge of each water environment anticipated within the geographical confines of the authority having jurisdiction and their associated tactical and safety considerations as part of this competency.

A-5-1.2 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 authority having jurisdiction 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) Physical hazard protection (i.e., abrasion, cuts, tears, punctures)
(4) Visibility
(5) Garment form, fit, and mobility
(6) Limited chemical and biological protection (i.e., bloodborne pathogens). Reference FEMA document FA 136, *Protective Clothing and Equipment for Emergency Responders for Urban Search and Rescue Missions*
(7) "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-5-1.3 Many programs exist to evaluate a minimum swim capability through a designated water course. These programs range from recreational to swift water applications. The authority having jurisdiction should devise or adopt a minimum swim capability based on the response area needs.

A-5-1.4 *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 IC should debrief team leaders frequently and revise the search plan as necessary.

A-5-1.5 Water conditions and temperature will be assessed and the appropriate levels of protection identified by the authority having jurisdiction based on its response area and conditions present. Classes of personal flotation devices are identified by the authority having jurisdiction and applicable regulatory agencies (e.g., United States Coast Guard, IMO).

Emergency disentanglement procedures and equipment are identified, specified, and defined by the authority having jurisdiction 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-5-1.6 Both throw rope deployments should be conducted sequentially, to the same victim, within a span of approximately 40 seconds to a victim 40 ft (12.192 m) away from the rescuer.

A-5-1.7 See A-5-1.6.

A-5-1.9 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 authority having jurisdiction.

All personnel (including the operator) should be competent in the use of self-rescue practices and procedures applicable to the scope of operation, included but not limited to drown proofing, swift water self rescue, current considerations (rip current, etc.), and basic swimming skills as identified by the authority having jurisdiction.

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-5-1.12 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 panic-crazed, 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 swift water applications. The authority having jurisdiction should devise or adopt a minimum swim capability based on the response area needs.

A-5-1.15 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-6-1.1 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 rescue providers. *Traffic control* also implies the control of pedestrians, rescuers, emergency vehicles, and equipment traffic.

A-6-1.2 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-6-1.5 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-6-1.6 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 $1^1/_2$-in. (38-mm) 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-7-1.2 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) Establishing 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 OSHA 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 OSHA 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 (chemical, atmospheric, temperature, etc.), harmful forms of energy (electrical, mechanical, movement due to gravity, hydraulic, etc.), 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 authority having jurisdiction 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.

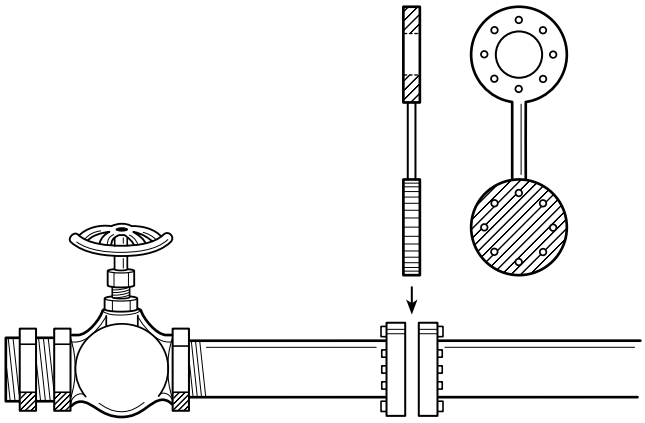
Some methods of isolation include blanking or blinding of pipes (see Figure A-7-1.2); misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tag-out of all sources of energy; or blocking or disconnecting all mechanical linkages.

A-7-1.3 Acceptable entry conditions for confined spaces are as follows.

(a) 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.

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

FIGURE A-7-1.2 Blanking or blinding.



(c) 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:

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

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

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

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 authority having jurisdiction 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) Immediately dangerous to life and health (IDLH)
(8) Material safety data sheets
(9) Reference manuals
(10) Computerized reference databases
(11) Technical information centers
(12) Technical information specialists and monitoring equipment

A *Confined Space Rescue On-Scene Prioritized Action Plan* is a plan used to mitigate the incident.

(a) *Priority 1: Make the scene safe*

(1) Hazard assessment: Approach to the space and entrance into the space
(2) Hazard mitigation: Control or remove the hazard
(3) De-energize and protect the sources of electricity, fluids, hydraulics, and so forth

(b) *Priority 2: Victim contact by primary responder*

(1) Establish victim location
(2) Primary medical survey (ABCs)
(3) Determine mode of injury
(4) Begin psychological first aid
(5) Determine feasibility of safe retrieval and retrieve if possible

(c) *Priority 3: Size-up*

(1) Information gathering
(2) Resource identification
(3) Primary responder report
(4) Brainstorm strategy: risk/reward
(5) Incident management system (IMS)
(6) Team member assignments

(d) *Priority 4: Preparation*

(1) Rescuer personal protective equipment
(2) Anchoring and rigging rescue equipment
(3) Authorized entrant review

(e) *Priority 5: Access patient*

(1) Designate access team leader: each group of two or more must have a team leader
(2) Utilize rescuer retrieval (high-point)
(3) Designate backup personnel

(f) *Priority 6: Stabilize and package patient*

(1) First aid to life-threatening injuries
(2) Secure packaging for rescue transport

(g) *Priority 7: Evacuate*

(1) Move victim to a safe location
(2) Provide medical report to emergency medical service
(3) Remove rescuers
(4) Emergency retrievals

(h) *Priority 8: Response termination*

(1) Pickup and inventory gear
(2) Decontamination (if necessary)
(3) Rebuild gear packages for the next call
(4) Field evaluation of rescuer mental state

A-7-1.7 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-8-1.1 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-8-1.6 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-8-1.7 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-8-1.10 Utilization of the victim transfer devices authorized by the authority having jurisdiction should include horizontal and vertical applications, proper patient securing methods, and rigging attachments.

A-8-1.11 When lifting a load by utilizing basic hand tools (pry-bars), 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.

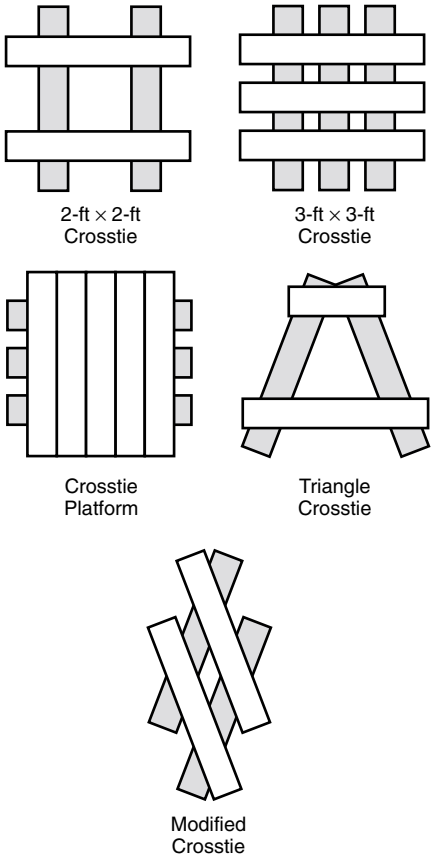
A-8-1.12 The load should be moved a distance of 20 ft (6.096 m) utilizing pipes as rollers. This process includes maintaining constant control of the load and its direction of travel and application of any necessary rigging to complete the task.

A-8-1.15 Cribbing systems should consist of the following five basic configurations of cribbing shown in Figure A-8-1.15: 2 ft × 2 ft (0.610 m × 0.610 m) crosstie, 3 ft × 3 ft (0.914 m × 0.914 m)

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.

FIGURE A-8-1.15 Five basic configurations of cribbing.



A-9-1.1 In all types of trench and excavation rescue incidents, the potential exists for extenuating circumstances and conditions that would require expertise beyond the normal capability of the organization to operate safely. Examples of these situations can include, but are not limited to, very deep trenches [more than 15 ft (4.572 m) deep], unusually shaped excavations, multiple complications (e.g., deep excavation and fluid soil), involvement of hazardous or toxic substances, completely buried subjects, or severe environmental conditions. Severe environmental conditions include operations involving frozen soil, running soil (e.g., gravel, sand, liquid), severe weather (e.g., heavy rain, snow, wind, or flooding), or night (dark) operations. These conditions should be evaluated during the initial size-up and risk assessment made on an incident-by-incident basis.

The types of collapse normally encountered at an excavation or trench incident include the following.

(a) Spoil pile collapse (spoil-in), where the excavated earth piled on the side of the trench slides into the trench.

(b) Lip collapse (lip-in), where a portion of the trench lip fails and falls into the trench. Lip collapse is usually secondary to surcharge or significant impact forces from the excavating bucket weakening the cohesive properties of the soil in the defined lip area.

(c) Shear wall collapse (shear-in), where one (or both) side(s) of the trench shears away from the wall of the trench. Possible indicators for an impending shear wall collapse are slough-ins on lower trench walls and/or stress cracks visible from the trench lip back to [a distance equal to] the depth of the trench.

(d) Slough collapse (slough-in), where a below-grade section collapses, leaving the potential for the collapse of an overhanging ledge.

Collapse. The reasons for and indicators of initial and secondary collapse of trenches and excavations are usually related to one or more of the following site characteristics:

(1) Soil composition
(2) Passage of time
(3) Unprotected trench (lack of protection systems)
(4) Surface encumbrances
(5) Surcharge or superimposed loads
(6) Standing water or water seeping into trench (saturated)
(7) Intersecting trenches
(8) Previously disturbed soil
(9) Vibrations (vehicles, nearby roads, airports, etc.)
(10) Exterior cracking of trench walls or collapse zone (fissures/stress cracks)

Soil Types. The following is excerpted from 29 *CFR* 1926.651, "Specific Excavation Requirements" and specifies soil types.

> "Cemented soil" means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.
>
> "Cohesive soil" means clay (fine grained soil) or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sides, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silt clay, clay, and organic clay.
>
> "Dry soil" means soil that does not exhibit visible signs of moisture content.
>
> "Fissured" means a soil material that has a tendency to break along definite planes of fracture with little resistance or a material that exhibits open cracks, such as tension cracks, in an exposed surface.
>
> "Granular soil" means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.
>
> "Layered system" means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.
>
> "Moist soil" means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.
>
> "Plastic" means a property of a soil that allows the soil to be deformed or molded without cracking or appreciable volume change.

"Saturated soil" means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or sheer vane.

"Soil classification system" means, for the purpose of this Subpart, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the characteristics of the deposits and the environmental conditions of exposure.

"Stable rock" means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

"Submerged soil" means soil that is underwater or is free seeping.

"Type A" means cohesive soils with an unconfined, compressive strength of 1.5 tons per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are clay, silty clay, sandy clay, clay loam, and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if

(a) The soil is fissured; or

(b) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or

(c) The soil has been previously disturbed; or

(d) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or

(e) The material is subject to other factors that would require it to be classified as a less stable material.

"Type B" means cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144kPa) or

(a) Granular cohesionless soils including angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and, in some cases, silty clay loam and sandy clay loam

(b) Previously disturbed soils except those that would otherwise be classed as Type C soil

(c) Soil that meets the unconfined compressive strength or cementation requirements for Type A but is fissured or subject to vibration; or

(d) Dry rock that is not stable; or

(e) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V) but only if the material would otherwise be classified as Type B.

"Type C" means cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less or

(a) Granular soils including gravel, sand, and loamy sand; or

(b) Submerged soil or soil from which water is freely seeping; or

(c) Submerged rock that is not stable; or

(d) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:IV) or steeper.

"Unconfined compressive strength" means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing or estimated in the field using a pocket penetrometer, by thumb penetration tests and other methods.

"Wet soil" means soil that contains significantly more moisture than moist soil but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

The classification of soil should be made based on the results of at least one visual and at least one manual analysis. Such analyses should be conducted by a competent person using tests described in 29 *CFR* 1926, Subpart P, Appendix A, "Soil Classification," or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials or the U.S. Department of Agriculture textural classification system.

The visual and manual analyses, such as those specified in 29 *CFR* 1926, Subpart P, Appendix A, "Soil Classification," should be designed and conducted to provide sufficient quantitative and qualitative information as can be necessary to identify properly the properties, factors, and conditions affecting the classification of the soil.

General hazards. General hazards associated with search and rescue operations at trench and excavation collapses can present the authority having jurisdiction (AHJ) with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members.

(a) *Utilities.* In many parts of the United States, a "one-call" underground utility location service is available to contractors and residents who are preparing to excavate. By making one telephone call (usually a toll-free number), excavators can find the location of all underground utility installations in the area of the planned excavation. This service quickly notifies all possible utility providers in the area who, in turn, either indicate that there is no utility in the area or have someone go to the site to mark the utilities. Such a service can be invaluable to emergency responders at the site of a trench or excavation emergency incident. Where no "one-call" system exists, all utility companies that might have underground equipment at or near the excavation site must be notified so they can have a representative respond to mark underground utility locations.

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

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

(d) *Confined space.* All trench, and many excavation collapses necessitate a confined space rescue. Responding personnel should be familiar with and trained in confined space rescue requirements and techniques. The AHJ should deter-

mine the applicable laws and standards related to confined space rescue and should provide training to members in confined space rescue.

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

Competent person. A competent person can be invaluable for quickly gathering information about the trench, will have possession of the "cut sheet," and will know the number and location of workers involved in the incident. He or she should also have knowledge regarding general hazards and nearby available resources for the size-up and subsequent action plan.

Victim locations. Procedures to identify probable victim locations include the following:

(1) Visualization of the victim
(2) Presence of drink cups or food containers, work tools, laser targets, buckets, grade poles, grease and brush, engineers hubs, or anything that can indicate the victim's last probable physical location
(3) Information from bystanders
(4) End of pipe string
(5) Sounds in pipes or presence of recently installed pipes
(6) "Cat" or tire tracks

Rapid, nonentry rescues. A quick look in the trench from an end can show that a victim can require only a ladder to leave the trench or a shovel lowered to him to dig out a trapped foot. This can mitigate the incident quickly before complication by secondary collapse or other hazards. A ladder or engineered ramp can be required for entry or egress from a trench. For instance, 29 *CFR* 1926.651 (c)(1)(v) requires, "A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet or more in depth so as to require no more than 25 feet of lateral travel for employees."

Personnel/equipment resources. A trench or excavation collapse often requires resources that the authority having jurisdiction is unable to provide. A community resource list with supporting standard operating procedures should include activation of and/or contact numbers for mutual-aid contracts, public works and private contractor response agreements, rental and construction supply house agreements, and utility one-call services.

A-9-1.2 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
(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 A-9-1.1, *rapid, nonentry rescues.*

The general area around a trench or excavation emergency is the entire area within 300 ft (91.440 m) (or more, as established by the incident commander). Making the general area safe includes, but is not necessarily limited to, the following:

(a) Placing ground pads around the lip of the trench to minimize the effect of rescuers' weight on secondary collapse potential.

(b) Controlling or limiting traffic and sources of vibration in the area including shutting down all vehicles and equipment.

(c) Controlling or limiting access to the area by unnecessary personnel.

(d) Identifying general hazards, affected utilities, and isolating, removing, and/or reducing their impact. Also refer to A-9-1.1, *General Hazards*, for more detailed information on general and other hazard types.

(e) Controlling of the utilities in and around a trench or excavation emergency to ensure the safety of responding personnel and victims. The authority having jurisdiction 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:

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

A rapid intervention crew company (RIC), as specified in Section 6-5 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-9-1.3 Support operations can include, but are not limited to, the following functional sectors in the incident management system.

(a) *Ventilation sector.* Monitors and ventilates personnel.

(b) *Extrication sector.* Prepares for extrication methods and tactics.

(c) *EMS sector.* Plans for ongoing patient care, transfer, and transport in coordination with the incident commander and receiving hospital.

(d) *Support sector.* Can handle lighting, power, and environmental management.

(e) *Cut station.* Handles construction and fabrication of shoring materials.

A-9-1.4 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-9-1.5 See A-9-1.4.

A-9-1.6 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-9-1.7 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 authority having jurisdiction.

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-9-1.8 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-9-1.9 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-9-1.10 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 impact the survivability of the victim. In addition, an emergency medical service 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 suc-

cumb to the effects of the toxins released into the bloodstream.

A-9-1.11 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-9-1.12 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 authority having jurisdiction 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.

Appendix B Rescue Technician Tool Kit

This appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.

B-1 Table B-1 lists the various tool kits and the tools needed for each type of rescue operation.

Table B-1 Tool Kit Contents

Kit Contents	Basic Kit	Rope Rescue	Confined Space Rescue	Water Rescue	Auto Truck Bus	Trench Rescue	Structural Collapse
Air-monitoring equipment (1)			X			X	X
Assorted 4 × 4 cribbing					X	X	X
Assorted 2 × 2 cribbing	X				X	X	X
Assorted wedges					X	X	X
Audio visual signaling device	X	X	X	X	X	X	X
Binoculars	X		X	X	X		X
Boards, short and long spine	X	X	X	X	X	X	X
Boogie board				X			
Camming devices		X	X	X			X
Carabiners, locking		X		X		X	X
Chain saw, electric or gas						X	X
Chain sling, 9 ft					X		X
Chain sling, 5 ft					X		X
Charged 1 $^{1}/_{2}$ in. hose line					X		
Clamp, "Ellis"							X
Class 2 and 3 harnesses (2)		X	X	X		X	X
Class B foam application supplies					X		
Come-along					X		X
Communication devices, fixed and portable	X	X	X	X	X	X	X
Community resource lists				X	X	X	X
DECON equipment (3)			X	X			X
Descending/ascending devices (friction or mechanical)	X	X	X	X		X	X
Detector, electrical energy			X			X	X
Dewatering pumps						X	X
Edge protection, hard and soft	X	X	X	X		X	X
Extension cords					X	X	X
Fins, swim				X			
Flat heat ax				X	X		X
Generator					X	X	X
Gloves (4)	X	X	X	X	X	X	X
Halligan bar	X				X		X
Hammer, demolition, 45 lb, bull and chisel							X

(Sheet 1 of 3)

Table B-1 Tool Kit Contents ***(Continued)***

Kit Contents	Basic Kit	Rope Rescue	Confined Space Rescue	Water Rescue	Auto Truck Bus	Trench Rescue	Structural Collapse
Hammer, demolition, 60 lb, bull and chisel							X
Hammer, 1.5 in. rotary, with carbide tipped bits $^{3}/_{8}$ in. to 2 in., and bull point bit							X
Hand tools kit (5)	X		X		X	X	X
Heavy excavating equipment resources						X	X
Helmets (6)	X	X	X	X	X	X	X
Hose line device				X			
Hydraulic cutters					X		X
Hydraulic rams					X		X
Hydraulic shores					X	X	X
Hydraulic spreaders					X		X
Jacks, screw, scissor, and/or hydraulic						X	X
Junction box					X	X	X
KED or equivalent	X	X	X		X	X	X
Knife, rescue	X	X	X	X	X	X	X
Lighting, flood					X	X	X
Lighting, hand and/or helmet (Factory Mutual approved)	X	X	X	X	X	X	X
Line gun				X			X
Lumber and timber (assorted)						X	X
Lockout tag-out kit			X			X	
Marking kit, paint, chalk, crayon, pencil					X	X	X
Navigational instruments	X			X			
Perimeter or scene-marking devices	X	X	X	X	X	X	X
Personal flotation devices (PFDs)	X			X			
Personnel accountability system	X	X	X	X	X	X	X
Personnel alarm device			X			X	X
Pickets, steel stakes	X	X		X	X	X	X
Pneumatic bags					X	X	X
Pneumatic chisels					X	X	
Pneumatic shores					X	X	X
Pneumatic soil knife						X	
Pneumatic soil vacuum (hand and/or truck)						X	
PPE — Bunker gear (7)					X	X	X
PPE — HazMat, Level B and C (8)			X				
PPE — Helmet water rescue				X			
PPE — SABA (9)			X				
PPE — SCBA (10)	X		X	X	X		X
PPE — suit, dry				X			
PPE — suit, wet				X			
Preplans/maps	X	X	X	X	X	X	X
Prussic cord (11)	X	X	X	X	X	X	X
Pulleys, selection of	X	X	X	X		X	X
Reach extension devices	X			X			
Rope — life safety (12)	X	X	X	X	X	X	X
Rope — utility	X		X		X	X	X
Rope — water rescue				X			
Safety glasses	X	X	X		X	X	X
Saw, circular, carbide tip, metal cutting, and contious rim diamond blades					X	X	X
Saw, reciprocating with wood and metal blades					X	X	X
Sheeting						X	
SKED or equivalent and/or rigid litter		X	X	X		X	X

(Sheet 2 of 3)

Table B-1 Tool Kit Contents *(Continued)*

Kit Contents	Basic Kit	Rope Rescue	Confined Space Rescue	Water Rescue	Auto Truck Bus	Trench Rescue	Structural Collapse
Spring loaded center punch	X			X	X		X
Tactical worksheets	X	X	X	X	X	X	X
Tarps						X	X
Trow bags				X			
Torch, kit, oxyacetylene					X		X
Torpedo buoy, ring buoy, or equivalent				X			
Traffic control devices	X	X	X	X	X	X	X
Trench box, shield						X	
Tripod			X		X		X
Victim protective coverings			X		X		X
Watercraft — manual or motorized				X			
Webbing	X	X	X	X		X	X
Winches	X				X		

(Sheet 3 of 3)

Appendix C Job Performance Requirements

This appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.

C-1 Explanation of the Standards and Concepts of Job Performance Requirements (JPRs). The primary benefit of establishing national professional qualification standards is to provide both public and private sectors with a framework of the job requirements for the fire service. Other benefits include enhancement of the profession, individual as well as organizational growth and development, and standardization of practices.

NFPA professional qualification standards identify the minimum JPRs for specific fire service positions. The standards can be used for training design and evaluation, certification, measuring and critiquing on-the-job performance, defining hiring practices, and setting organizational policies, procedures, and goals. (Other applications are encouraged.)

Professional qualification standards for a specific job are organized by major areas of responsibility defined as duties. For example, the fire fighter's duties might include fire suppression, rescue, and water supply, and the public fire educator's duties might include education, planning and development, and administration. Duties are major functional areas of responsibility within a job.

The professional qualification standards are written as JPRs. JPRs describe the performance required for a specific job. JPRs are grouped according to the duties of a job. The complete list of JPRs for each duty defines what an individual must be able to do in order to successfully perform that duty. Together, the duties and their JPRs define the job parameters; that is, the professional qualification standard as a whole is a job description.

C-2 Breaking Down the Components of a JPR. The JPR is the assembly of three critical components. See Table C-2. These components are as follows:

(1) Task that is to be performed
(2) Tools, equipment, or materials that must be provided to successfully complete the task
(3) Evaluation parameters and/or performance outcomes

The task to be performed. The first component is a concise statement of what the person is supposed to do.

Tools, equipment, or materials that must be provided to successfully complete the task. This component ensures that all individuals completing the task are given the same minimal tools, equipment, or materials when being evaluated. By listing these items, the performer and evaluator know what must be provided in order to complete the task.

Evaluation parameters and/or performance outcomes. This component defines how well one must perform each task — for both the performer and evaluator. The JPRs guide performance towards successful completion by identifying evaluation parameters and performance outcomes. This portion of the JPR promotes consistency in evaluation by reducing the variables used to gauge performance.

Table C-2 Example of a JPR

(a) Task	(a) Ventilate a pitched roof
(b) Tools, equipment, or materials	(b) Given an ax, a pike pole, an extension ladder, and a roof ladder
(c) Evaluation parameters and performance outcomes	(c) So that a 4 ft × 4 ft hole is created; all ventilation barriers are removed; ladders are properly positioned for ventilation; ventilation holes are correctly placed; and smoke, heat, and combustion by-products are released from the structure

In addition to these three components, the JPRs contain requisite knowledge and skills. Just as the term *requisite* suggests, these are the necessary knowledge and skills one must have prior to being able to perform the task. Requisite knowledge and skills are the foundation for task performance.

Once the components and requisites are put together, the JPRs might read as follows.

Example 1. Ventilate a pitched roof, given an ax, a pike pole, an extension ladder, and a roof ladder, so that a 4 ft × 4 ft (1.22 m × 1.22 m) hole is created, all ventilation barriers are removed, ladders are properly positioned for ventilation, and ventilation holes are correctly placed.

(a) *Requisite Knowledge:* Pitched roof construction, safety considerations with roof ventilation, the dangers associated with improper ventilation, knowledge of ventilation tools, the effects of ventilation on fire growth, smoke movement in structures, signs of backdraft, and the knowledge of vertical and forced ventilation.

(b) *Requisite Skills:* The ability to remove roof covering; properly initiate roof cuts; use the pike pole to clear ventilation barriers; use the ax properly for sounding, cutting, and stripping; position ladders; and climb and position self on ladder.

Example 2. Interpret burn patterns, given standard equipment and tools and some structural/content remains, so that each individual pattern is evaluated with respect to the burning characteristics of the material involved.

(a) *Requisite Knowledge:* Fire development and the interrelationship of heat release rate, form, and ignitibility of materials.

(b) *Requisite Skill:* The ability to interpret the effects of burning characteristics on different types of materials.

C-3 Examples of Potential Uses. *Certification.* JPRs can be used to establish the evaluation criteria for certification at a specific job level. When used for certification, evaluation must be based on the successful completion of JPRs.

First, the evaluator would verify the attainment of requisite knowledge and skills prior to JPR evaluation. Verification might be through documentation review or testing.

Next, the candidate would be evaluated on completing the JPRs. The candidate would perform the task and be evaluated based on the evaluation parameters, the performance outcomes, or both. This performance-based evaluation can be either practical (for psychomotor skills such as "ventilate a roof") or written (for cognitive skills such as "interpret burn patterns").

NOTE: Psychomotor skills are those physical skills that can be demonstrated or observed. Cognitive skills (or mental skills) cannot be observed but are evaluated on how one completes the task (process oriented) or on the task outcome (product oriented).

Using Example 1 in Section C-2, a practical performance-based evaluation would measure the ability to "ventilate a pitched roof." The candidate passes this particular evaluation if the standard was met, that is, a 4 ft × 4 ft (1.22 m × 1.22 m) hole was created, all ventilation barriers were removed, ladders were properly positioned for ventilation, ventilation holes were correctly placed, and smoke, heat, and combustion by-products were released from the structure.

For Example 2 in Section C-2, when evaluating the task "interpret burn patterns," the candidate might be given a written assessment in the form of a scenario, photographs, and drawings and then be asked to respond to specific written questions related to the JPR's evaluation parameters.

It is important to remember that when a candidate is being evaluated, he or she must be given the tools, equipment, or materials listed in the JPRs before he or she can be properly evaluated.

C-4 Curriculum Development/Training Design and Evaluation. The statements contained in this document that refer to job performance were designed and written as JPRs. Although a resemblance to instructional objectives might be present, these statements should not be used in a teaching situation until after they have been modified for instructional use.

JPRs state the behaviors required to perform specific skill(s) on the job, as opposed to a learning situation. These statements should be converted into instructional objectives with behaviors, conditions, and standards that can be measured within the teaching/learning environment. A JPR that requires a fire fighter to "ventilate a pitched roof" should be converted into a measurable instructional objective for use when teaching the skill. See Figure C-4(a).

Using Example 1 in Section C-2, a terminal instructional objective might read as follows:

> The candidate will ventilate a pitched roof, given a simulated roof, an ax, a pike pole, an extension ladder, and a roof ladder, so that 100 percent accuracy is attained on a skills checklist. (At a minimum, the skills checklist should include each of the measurement criteria from the JPR.)

Figure C-4(b) is a sample checklist for use in evaluating this objective.

Although the differences between job performance requirements and instructional objectives are subtle in appearance, the purpose of each statement differs greatly. JPRs state what is necessary to perform the job in the "real world." Instructional objectives, however, are used to identify what students must do at the end of a training session and are stated in behavioral terms that are measurable in the training environment.

By converting JPRs into instructional objectives, instructors will be able to clarify performance expectations and avoid confusion related to using statements designed for purposes other than teaching. Additionally, instructors will be able to add local/state/regional elements of performance into the standards as intended by the developers.

Requisite skills and knowledge should be converted into enabling objectives. These help to define the course content. The course content should include each of the requisite knowledge and skills. Using Figure C-4(b), the enabling objectives are pitched roof construction, safety considerations with roof ventilation, removal of roof covering, proper initiation of roof cuts, and so forth. These enabling objectives ensure that the course content supports the terminal objective.

NOTE: It is assumed that the reader is familiar with curriculum development or training design and evaluation.

FIGURE C-4(a) Converting JPRs into instructional objectives.

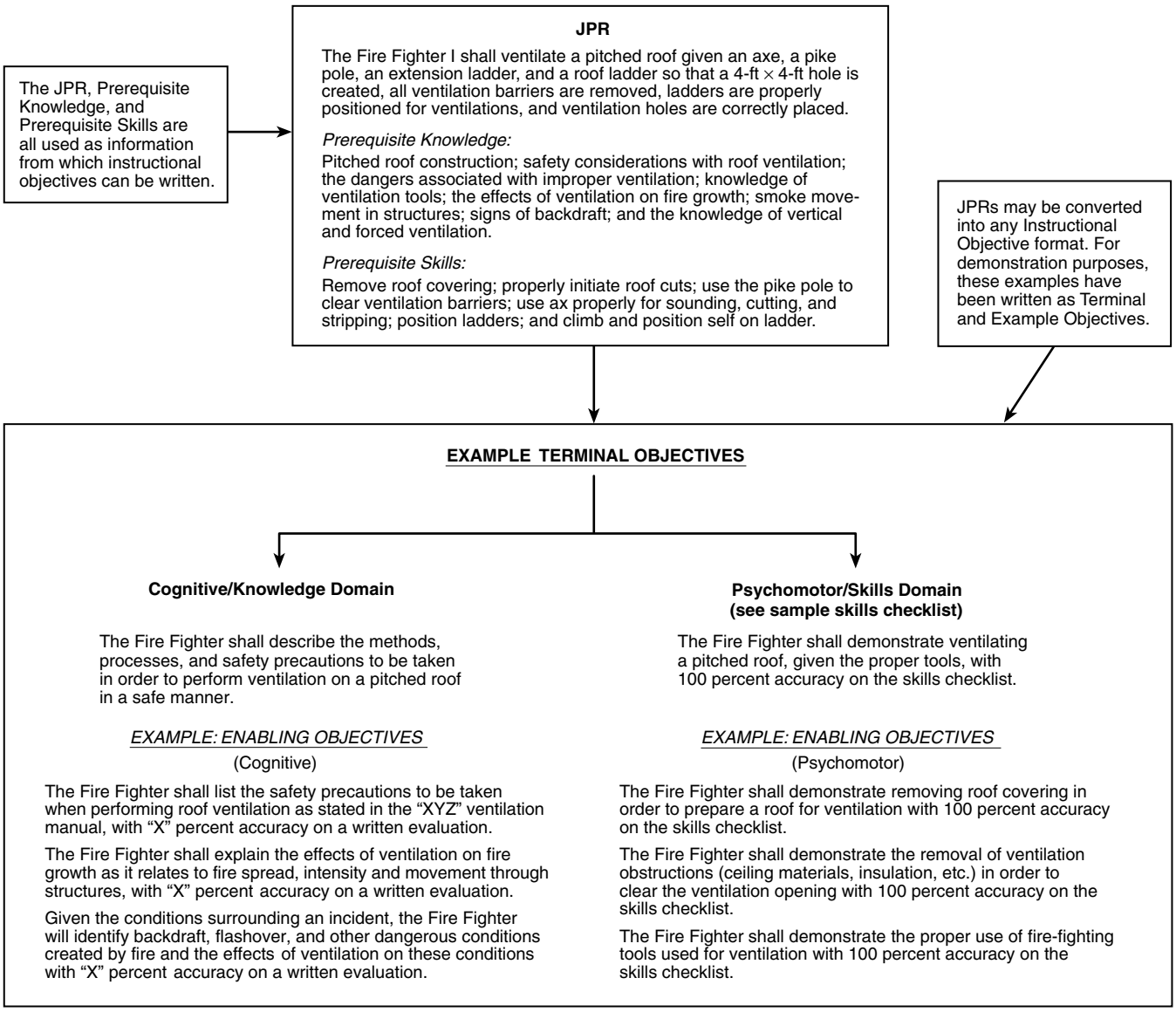


FIGURE C-4(b) Sample skills checklist (roof ventilation).

OBJECTIVE: The Fire Fighter shall demonstrate ventilating a pitched roof, given the proper tools, within 5 minutes and with 100% accuracy on the skills checklist.

YES	NO	
☐	☐	1. 4-ft × 4-ft hole was created.
☐	☐	2. All ventilation barriers were removed.
☐	☐	3. Ladders were properly positioned.
☐	☐	4. Ventilation holes were correctly placed (directly over fire, highest point, etc.)
☐	☐	5. Task completed within validated time parameters established by authority having jurisdiction. (Time to complete task: _____.)

C-5 Other Uses. While the professional qualifications standards are principally used to guide the development of training and certification programs, there are a number of other potential uses for the documents. Because they are written in JPR terms, they lend themselves well to any area of the profession where a level of performance or expertise must be determined. These areas might include the following.

(a) *Employee Evaluation/Performance Critiquing.* The JPRs can be used as a guide by both the supervisor and the employee during an evaluation. The JPRs for a specific job define tasks that are essential to perform on the job, as well as the evaluation criteria to measure when those tasks are completed.

(b) *Establishing Hiring Criteria.* Professional qualifications standards can be used in a number of ways to further the establishment of hiring criteria. The authority having jurisdiction could simply require certification at a specific job level (e.g., Fire Fighter I). The JPRs could also be used as the

basis for pre-employment screening by establishing essential minimal tasks and the related evaluation criteria. An added benefit is that individuals interested in employment can work toward the minimal hiring criteria at local colleges.

(c) *Employee Development.* The professional qualifications standards can be useful to both the employee and the employer in developing a plan for the individual's growth within the organization. The JPRs and the associated requisite knowledge and skills can be used as a guide to determine additional training and education required for the employee to master the job or profession.

(d) *Succession Planning.* Succession planning or career pathing addresses the efficient placement of people into jobs in response to current needs and anticipated future needs. A career development path can be established for targeted individuals to prepare them for growth within the organization. The JPRs and requisite knowledge and skills could then be used to develop an educational path to aid in the individual's advancement within the organization or profession.

(e) *Establishing Organizational Policies, Procedures, and Goals.* The JPRs can be incorporated into organizational policies, procedures, and goals where employee performance is addressed.

C-6 Bibliography. Boyatzis, R. E. 1982. *The Competent Manager: A Model For Effective Performance.* New York: John Wiley & Sons.

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Springer, J. 1980. *Job Performance Standards and Measures.* A series of research presentations and discussions for the ASTD Second Annual Invitational Research Seminar, Savannah, GA (November 5–8, 1979). Madison, WI: American Society for Training and Development.

Tracey W. R. 1984. *Designing Training and Development Systems,* New York: AMACOM.

Appendix D Structural Types

This appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.

D-1 Table D-1.1 and Figures D-1.1 through D-1.14 can be used to clarify material on structural types found in the body of the document.

Table D-1.1 General Construction Types

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

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

FIGURE D-1.1 Light metal buildings.

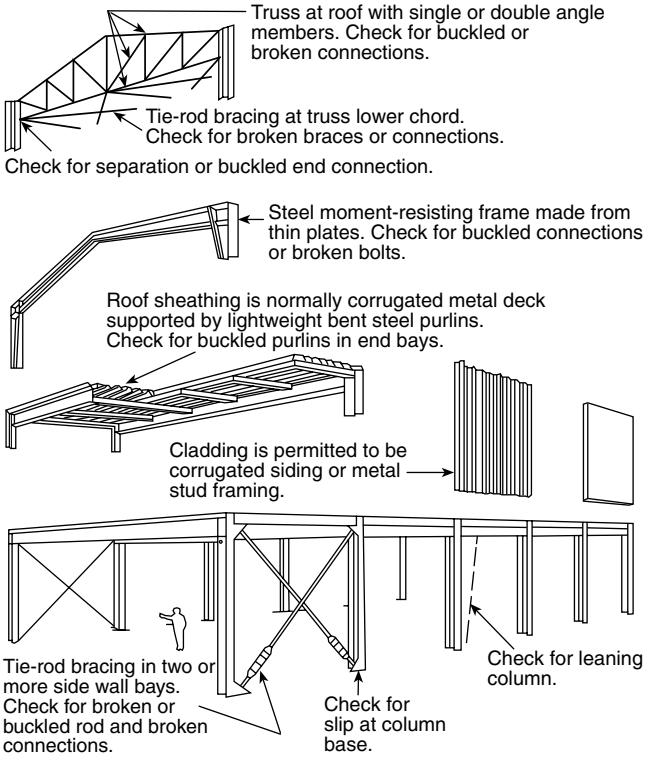


FIGURE D-1.2 Post-tensioned lift slab building.

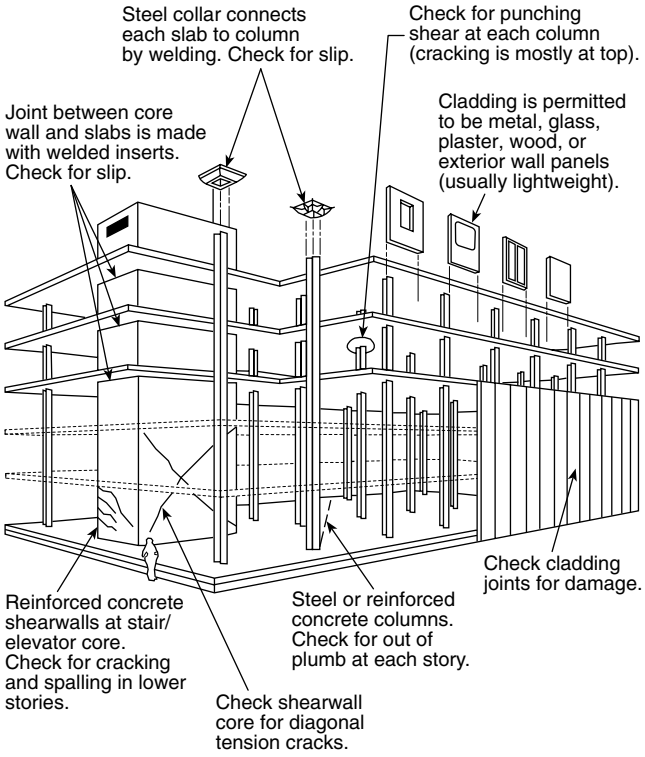
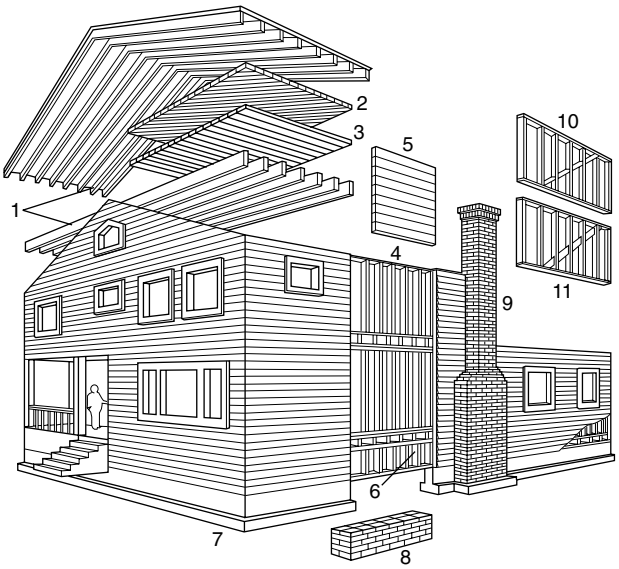


FIGURE D-1.3 Wood stud frame construction.

Roof/floor span systems:
1. Wood joist and rafter
2. Diagonal sheathing
3. Straight sheathing

Wall systems:
4. Stud wall (platform or balloon framed)
5. Horizontal siding



Foundation/connections:
6. Unbraced cripple wall
7. Concrete foundation
8. Brick foundation

Bracing and details:
9. Unreinforced brick chimney
10. Diagonal blocking
11. Let-in brace (only in later vintages)

FIGURE D-1.4 Steel moment-resisting frame.

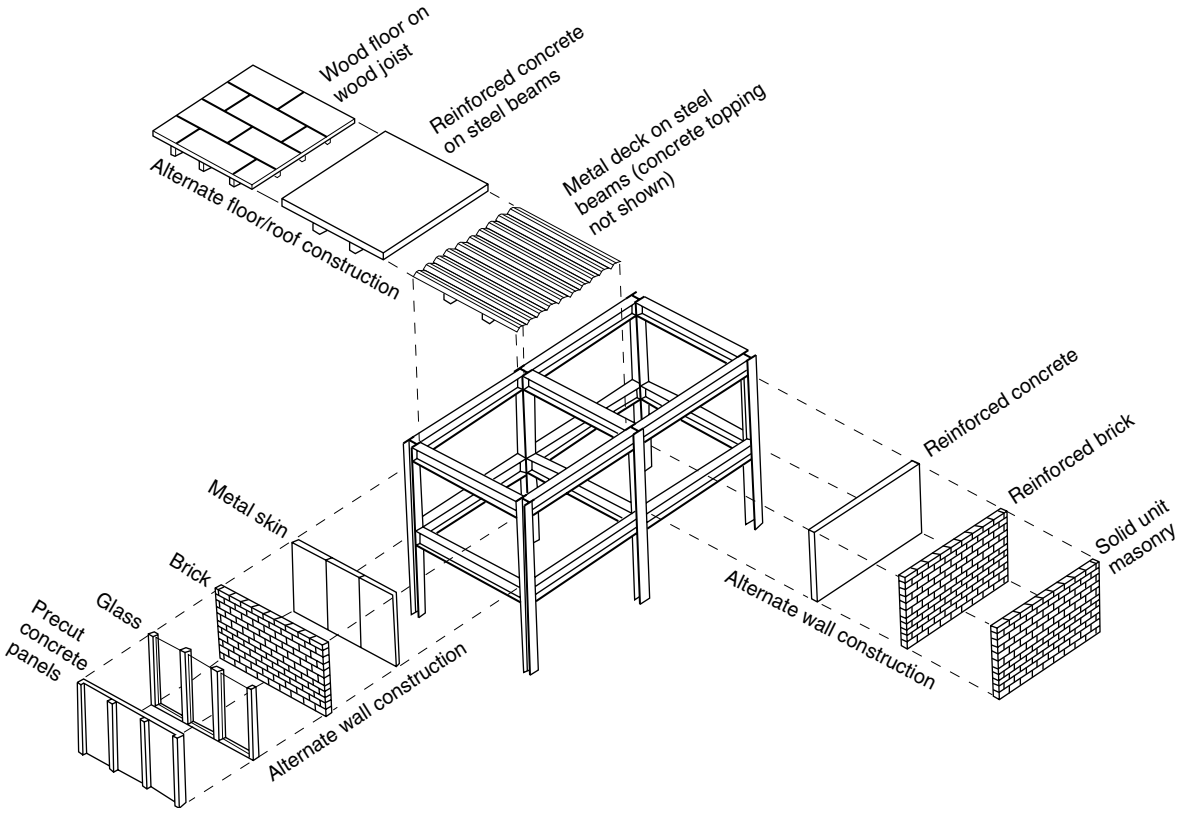


FIGURE D-1.5 Light metal construction.

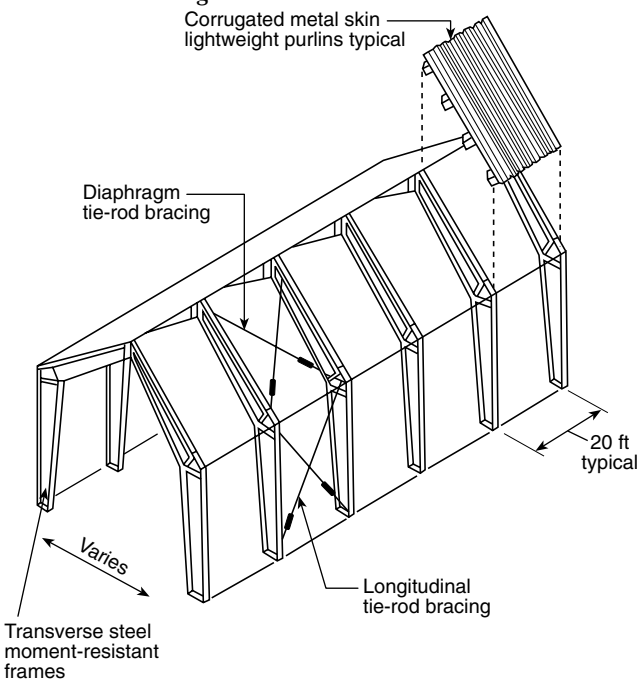


FIGURE D-1.6 Steel frame with shearwall.

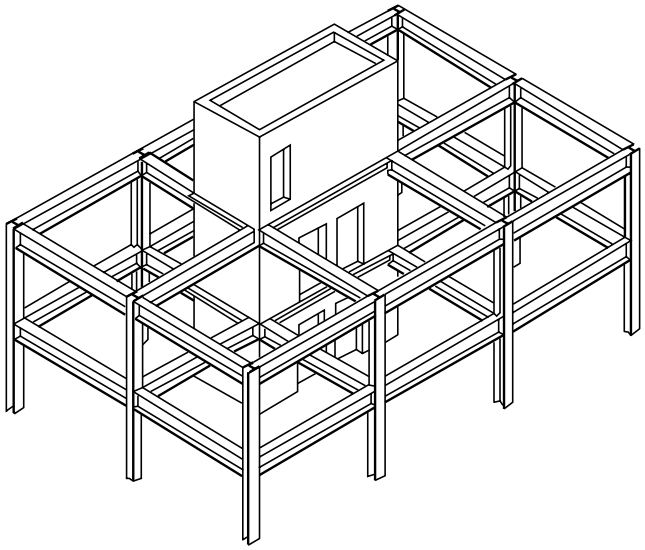
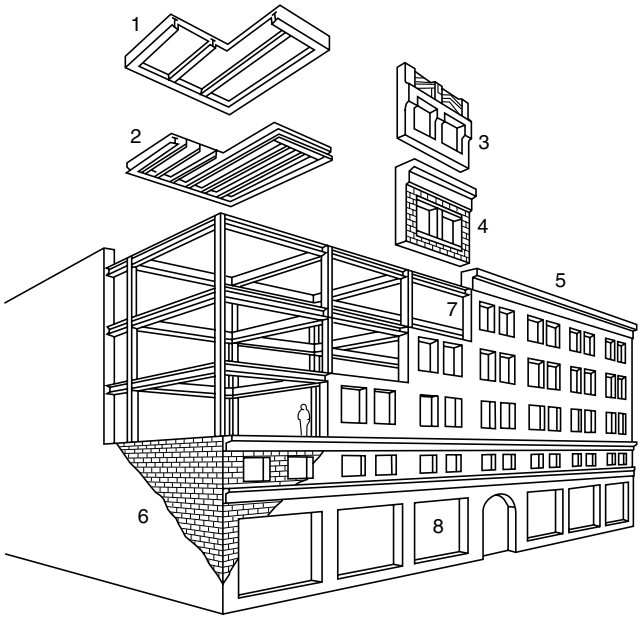


FIGURE D-1.7 Steel frame with unreinforced masonry (URM) in-fill.

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



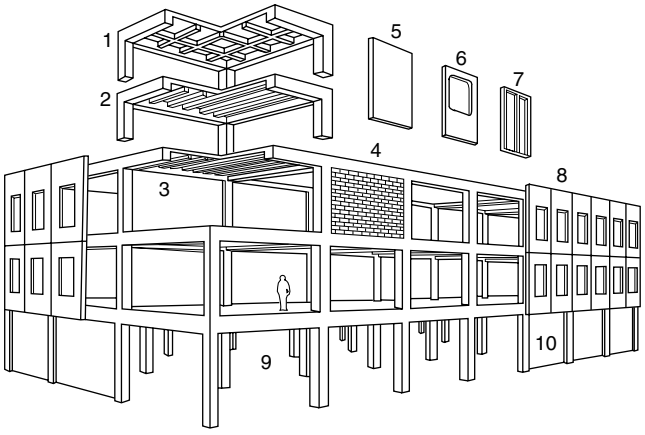
Details:
5. Unreinforced and unbraced parapet and cornice
6. Solid party walls

Openings and wall penetrations:
7. Window-penetrated front facade
8. Large openings of street-level shops

FIGURE D-1.8 Concrete moment-resisting frame.

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-1.9 Concrete shearwall.

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

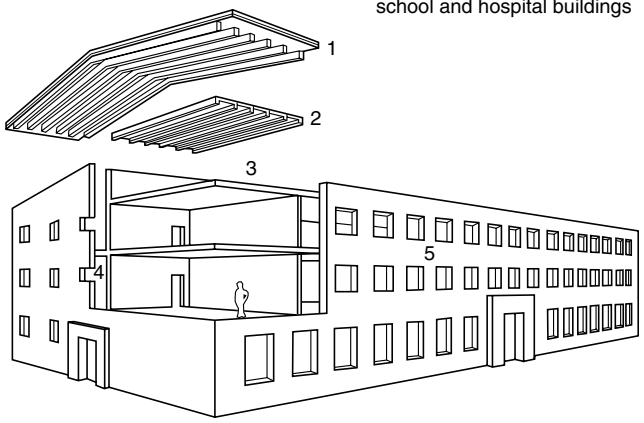
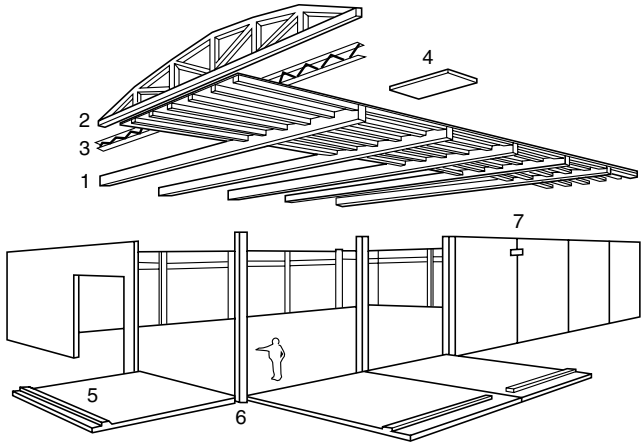


FIGURE D-1.10 Tilt-up construction typical of the western United States. Tilt-up construction in the eastern United States can incorporate a steel frame.

Roof/floor span systems:
1. Glue laminated beam and joist
2. Wood truss
3. Light steel-web joist

Roof/floor diaphragms:
4. Plywood sheathing



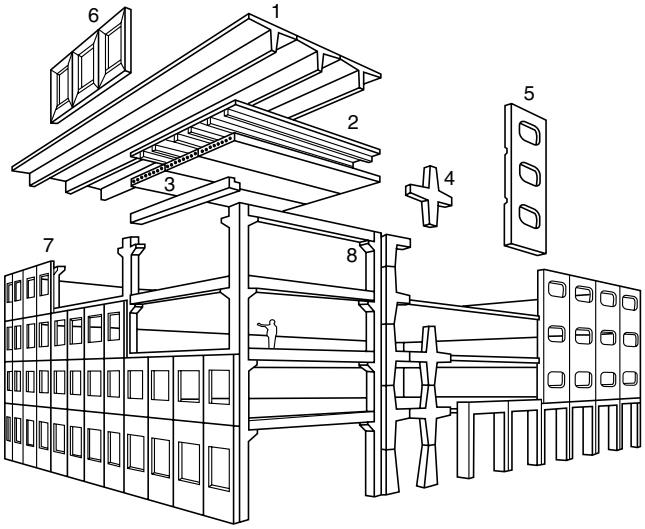
Details:
5. Anchor-bolted wooden ledger for roof/floor support

Wall systems:
6. Cast-in-place columns — square, T-shape, and H-shape
7. Welded steel plate–type panel connection

FIGURE D-1.11 Precast concrete 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



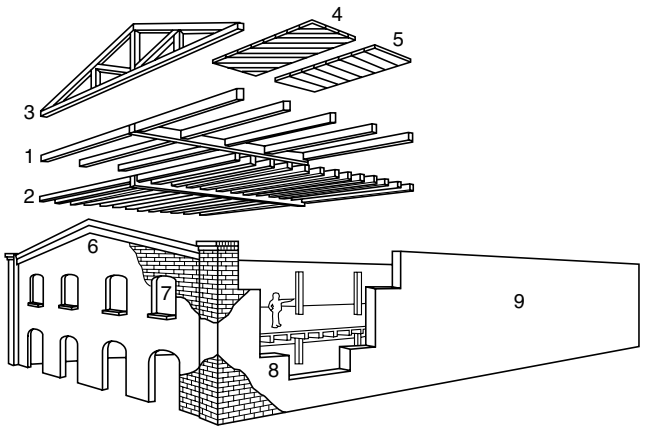
Curtain wall system:
6. Precast concrete panels
7. Metal, glass, or stone panels

Structural system:
8. Precast column and beams

FIGURE D-1.12 Unreinforced masonry bearing wall.

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



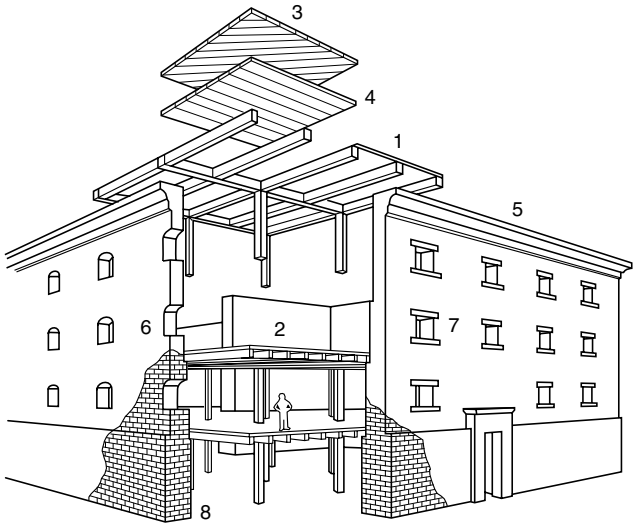
Details:
6. Typical unbraced parapet and cornice
7. Flat arch window openings

Wall systems:
8. Bearing wall — four or more wythes of brick
9. Typical long solid party wall

FIGURE D-1.13 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



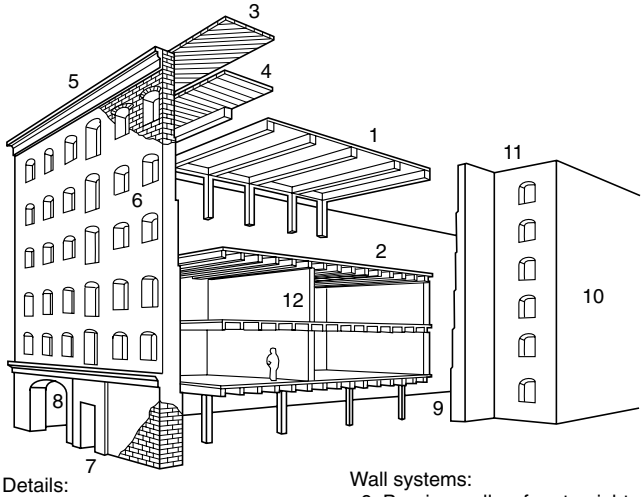
Details:
5. Typical unbraced parapet and cornice
6. Flat arch window openings
7. Small window penetrations (if building is originally a warehouse)

Wall systems:
8. Bearing wall — four to eight wythes of brick

FIGURE D-1.14 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

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 create 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.

Appendix E Referenced Publications

E-1 The following documents or portions thereof are referenced within this standard for informational purposes only and are thus not considered part of the requirements of this standard. The edition indicated here for each reference is the current edition as of the date of the NFPA issuance of this standard.

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

NFPA 220, *Standard on Types of Building Construction,* 1999 edition.

NFPA 471, *Recommended Practice for Responding to Hazardous Materials Incidents,* 1997 edition.

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

NFPA 1002, *Standard for Fire Apparatus Driver/Operator Professional Qualifications,* 1998 edition.

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

NFPA 1561, *Standard on Emergency Services Incident Management System,* 2000 edition.

NFPA 1582, *Standard on Medical Requirements for Fire Fighters,* 2000 edition.

NFPA 1670, *Standard on Operations and Training for Technical Rescue Incidents,* 1999 edition.

E-1.2 Other Publications.

E-1.2.1 BOCA Publication. Building Offices and Code Administrators International, 4051 W. Flossmoor Road, Country Club Hills, IL 60477.

National Building Code, 1999.

E-1.2.2 FEMA Publications. Federal Emergency Management Agency, 500 C Street, SW, Washington, DC 20472.

FA 136, *Protective Clothing and Equipment for Emergency Responders for Urban Search and Rescue Missions.*

FEMA US&R Response System.

E-1.2.3 ICBO Publication. International Conference of Building Officials, 5360 Workman Mill Road, Whittier, CA 90601.

Uniform Building Code, 1997.

E-1.2.4 SBCC Publication. Southern Building Code Congress International, 900 Montclair Road, Birmingham, AL 35213.

Standard Building Code, 1997.

E-1.2.5 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

"National Standard Curriculum," Department of Transportation, 1994.

Title 29, *Code of Federal Regulations*, Part 1910.120, "Regulation on Hazardous Waste."

Title 29, *Code of Federal Regulations*, Part 1910.134, "Respiratory Protection Regulations."

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

Title 29, *Code of Federal Regulations*, Part 1926.651, "Specific Excavation Requirements."

E-1.2.6 Additional Publication. *Webster's Third New International Dictionary of the English Language*, unabridged, Merriam Company.

Appendix F Resource Material

This appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.

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

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

NFPA 1001, *Standard for Fire Fighter Professional Qualifications*, 1997 edition.

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

NFPA 1561, *Standard on Emergency Services Incident Management System*, 2000 edition.

NFPA 1670, *Standard on Operations and Training for Technical Rescue Incidents*, 1999 edition.

F-2 U.S. Government Publication. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Title III SARA, 1986. P.L. 99-499, the Emergency Planning and Community Right to Know Act (EPCRA, also known as SARA, Title III) of 1986.

F-3 Other Publications.

Training for Hazardous Materials Response: Confined Space Rescue for First Responders, International Association of Fire Fighters, 1750 New York Ave., NW, Washington, DC 20006, 1995.

Rescue Systems 1, USFA/NFA-RSI-SM, Federal Emergency Management Agency, United States Fire Administration, National Fire Academy, 1993.

River Rescue; A Training Manual for Rescue Personnel, Ohio Department of Natural Resources Division of Watercraft, Instructional Materials Laboratory, The Ohio State University, 1980.

Swiftwater Rescue; A Manual for the Rescue Professional, Slim Ray, CFS Press, 1997.

Swiftwater Rescue Technician I, Jim Segerstrom, Mike Croslin, and Barry Edwards, Rescue International, 1995.

Confined Space and Structural Rope Rescue, Roop, Vines & Wright, Mosby Lifeline Publications.

Confined Space Entry and Rescue Protocol, AIHA Publications (American Industrial Hygiene Association).

Decontamination for Hazardous Materials Emergency, Timothy V. Henry, Delmar Publishers, 3 Columbia Circle, Box 15015 Albany, New York 12212-5015, 1998.

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