NFPA® 1006

Standard for Technical Rescuer Professional Qualifications

2008 Edition

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NFPA® 1006

Standard for

Technical Rescuer Professional Qualifications

2008 Edition

This edition of NFPA 1006, *Standard for Technical Rescuer Professional Qualifications*, was prepared by the Technical Committee on Rescue Technician Professional Qualifications and released by the Technical Correlating Committee on Professional Qualifications. It was issued by the Standards Council on December 11, 2007, with an effective date of December 31, 2007, and supersedes all previous editions.

This edition of NFPA 1006 was approved as an American National Standard on December 31, 2007.

Origin and Development of NFPA 1006

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

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

For the 2008 edition of NFPA 1006, the document has been rewritten, and additional chapters for Swiftwater, Ice Rescue, and Surf Rescue have been written. The Subterranean chapter has been broken into two chapters: one on Mines and Tunnels and the other on Caves.

Each chapter in the document has been broken into two levels, Level I and Level II, and the document has been re-titled as *Standard for Technical Rescuer Professional Qualifications*. Additional language has been added to clarify the use of this document.

Dedication

This document is dedicated to Hugh A. Pike, who was a USAF Fire Protection member from 1/95 to 5/03 and was the first chair of the committee, and whose leadership, vision, drive, and uncompromising desire to create a quality user-driven document drove our members to new limits.

This document is dedicated to William J. Renaker, who, having served on the committee from 1/97 to 7/05, was brother, mentor, friend, and ever-patient team member, and who worked hard to build consensus, maintain cohesiveness, and not allow any of us to ever forget that our primary responsibility was to the users of this document and to the rescuer in the field.

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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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A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex J. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

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* Application.

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

1.3.2 The authority having jurisdiction (AHJ) 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 AHJ. Evaluators shall be individuals who were not involved as instructors for the performance requirements being evaluated.

1.3.4 In this standard, the terms *rules*, *regulations*, *procedures*, *supplies*, *apparatus*, and *equipment* shall imply those that are available to or used by the AHJ.

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

1.3.6* Rescuers at Level I and Level II shall remain current with technical rescue practices and applicable standards.

1.4 General.

1.4.1 Job performance requirements do not need to be mastered in the order in which they appear.

1.4.2 The AHJ is responsible to determine which disciplines are required to achieve the desired types of service and to provide training or certification as necessary to satisfy the service needs.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. (Reserved)

2.3 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 1, *Uniform Fire Code™,* 2006 edition.

NFPA 402, *Guide for Aircraft Rescue and Fire-Fighting Operations,* 2008 edition.

NFPA 1000, *Standard for Fire Service Professional Qualifications Accreditation and Certification Systems,* 2006 edition.

NFPA 1002, *Standard for Fire Apparatus Driver/Operator Professional Qualifications,* 2003 edition.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program,* 2007 edition.

NFPA 1581, *Standard on Fire Department Infection Control Program,* 2005 edition.

NFPA 1620, *Recommended Practice for Pre-Incident Planning,* 2003 edition.

NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents,* 2004 edition.

NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services,* 2006 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

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

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

3.2.5 Shall. Indicates a mandatory requirement.

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

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

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

3.3.2 Access. See 3.3.31, Confined Space Approach.

3.3.3 Anchor Point. A single, structural component used either alone or in combination with other components to create an anchor system capable of sustaining the actual and potential load on the rope rescue system. [**1670**, 2004]

3.3.3.1 ***High-Point Anchor.*** A point above an obstacle to be negotiated used for attachment of rescue systems.

3.3.4 Anchor System. One or more anchor points rigged in such a way as to provide a structurally significant connection point for rope rescue system components. [**1670**, 2004]

3.3.4.1* ***Multiple-Point Anchor System.*** System configuration providing load distribution over more than one anchor point, either proportionally or disproportionally.

3.3.4.2* ***Single-Point Anchor System.*** An anchor system configuration utilizing a single anchor point to provide the primary support for the rope rescue system.

3.3.5 Ascending (Line). A means of safely traveling up a fixed line with the use of one or more ascent devices. [**1670**, 2004]

3.3.6 Ascent Device. An auxiliary equipment system component; a friction or mechanical device utilized to allow ascending a fixed line. [**1670**, 2004]

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

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

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

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

3.3.11* Belay. The method by which a potential fall distance is controlled to minimize damage to equipment and/or injury to a live load. [**1670**, 2004]

3.3.12 Belayer. The rescuer who operates the belay system.

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

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

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

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

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

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

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

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

3.3.21 Cave. A natural underground void formed by geologic process.

3.3.22 Cave-In. The separation of a mass of soil or rock material from the side of an excavation or trench, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person. [**1670**, 2004]

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

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

3.3.25 Collapse Zone. See 3.3.148, Rescue Area.

3.3.26 Common Passenger Vehicle. Light or medium duty passenger and commercial vehicles commonly encountered in the jurisdiction and presenting no unusual construction,

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occupancy, or operational characteristics to rescuers during an extrication event.

3.3.27 Communications Team. As related to caves, a specific combination of resources with a leader, personnel, and common equipment assembled for the purpose of establishing and maintaining communications between various locations in and out of the cave.

3.3.28* Community Resource List. A list that includes all private and public contact numbers that provide the available community resources to mitigate a specified type or range of rescue incidents and hazardous conditions in the community.

3.3.29 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.

3.3.30* Confined Space. An area large enough and so configured that a member can bodily enter and perform assigned work but which has limited or restricted means for entry and exit and is not designed for continuous human occupancy. [**1500**, 2007]

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

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

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

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

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

3.3.36 Confined Space Rescue Team. A combination of individuals trained, equipped, and available to respond to confined space emergencies. [**1670**, 2004]

3.3.37 Confined Space Retrieval Equipment. See 3.3.153, Retrieval Equipment (Retrieval System).

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

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

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

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

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

3.3.43 Critique. A post-incident analysis of the effectiveness of the rescue effort.

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

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

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

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

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

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

3.3.50 Descent Control Device. An auxiliary equipment item; a friction or mechanical device utilized with rope to control descent. [**1983**, 2006]

3.3.51 Dewatering Equipment. Electric- or fuel-powered pumps, hose, and appliances that are used in combination to remove water.

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

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

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

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

3.3.56 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 in line between the two closed valves.

3.3.57 Edge Protection. A means of protecting software components within a rope rescue system from the potentially harmful effects of exposed sharp or abrasive edges. [**1670**, 2004]

3.3.58 Emergency. A fire, explosion, or hazardous condition that poses an immediate threat to the safety of life or damage to property. [**1**, 2006]

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3.3.59 Emergency Medical Care. The provision of treatment to patients, including first aid, cardiopulmonary resuscitation, basic life support (first responder or EMT level), advanced life support (paramedic level), and other medical procedures that occur prior to arrival at a hospital or other health care facility. [**1581**, 2005]

3.3.60 Entrant. See 3.3.9, Authorized Entrant.

3.3.61 Entry. The action by which a person passes into a confined space. Entry includes ensuing work or rescue activities in that environment and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space, trench, or excavation. [**1670**, 2004] *(See also 3.3.32, Confined Space Entry.)*

3.3.62 Entry Opening. See 3.3.33, Confined Space Entry Opening.

3.3.63 Environmental Controls. See 3.3.23, Collapse Support Operations.

3.3.64 Excavation. Any man-made cut, cavity, trench, or depression in an earth surface, formed by the removal of earth. [**1670**, 2004]

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

3.3.66* Face(s). The vertical or inclined earth surface formed as a result of excavation work. [**1670**, 2004]

3.3.67 Failure. The breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities. [**1670**, 2004]

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

3.3.69 Fixed Line System. A rope rescue system consisting of a nonmoving rope attached to an anchor system. [**1670**, 2004]

3.3.70 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.

3.3.71 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.

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

3.3.73 Hardware. Rigid mechanical auxiliary equipment that can include, but is not limited to, anchor plates, carabiners, and mechanical ascent and descent control devices. [**1670**, 2004]

3.3.74 Harness. See 3.3.101, Life Safety Harness.

3.3.75 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.

3.3.76 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.

3.3.77* Hazardous Atmospheres. Any atmosphere that can expose personnel to the risk of death, incapacitation, injury, acute illness, or impairment of ability to self-rescue. [**1670**, 2004]

3.3.78 Hazardous Material. A substance or material that has been determined to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated.

3.3.79 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. *(See Annex D.)*

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

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

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

3.3.83* Heavy Vehicle. Heavy duty highway, off-road, construction, or mass transit vehicles constructed of materials presenting resistance to common extrication procedures, tactics, and resources and posing multiple concurrent hazards to rescuers from occupancy, cargo, size, construction, weight, or position.

3.3.84 High Angle. Refers to an environment in which the load is predominantly supported by the rope rescue system. [**1670**, 2004]

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

3.3.86 Hitch. A knot that attaches to or wraps around an object so that when the object is removed, the knot will fall apart. [**1670**, 2004]

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

3.3.88* Incident. In a mine or tunnel, an event or condition that threatens life or property and adversely affects the environment in the space.

3.3.89 Incident Command System (ICS). A standardized on-scene emergency management construct specifically designed to provide for the adoption of an integrated organizational structure that reflects the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries. ICS is a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure, designed to aid in the management of resources during incidents. It is used for all kinds of emergencies and is applicable to small as well as large and complex incidents. ICS is used by various jurisdictions and functional agencies, both

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public and private, to organize field-level incident management operations.

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

3.3.91 Initial Response Team. As related to caves, a specific combination of resources with a leader, personnel, and common equipment assembled for the purpose of making initial contact to the patient and initiating patient care in the cave.

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

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

3.3.94 Job Performance Requirement (JPR). A written 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. [**1000**, 2006]

3.3.95* Knot. A fastening made by tying together lengths of rope or webbing in a prescribed way. [**1670**, 2004]

3.3.96 Large Machinery. Complex machines (or machinery systems) constructed of heavy materials, not capable of simple disassembly, and presenting multiple concurrent hazards (e.g., control of energy sources, hazardous materials, change in elevation, multiple rescue disciplines, etc.), complex victim entrapment, or partial or complete amputation, and requiring the direct technical assistance of special experts in the design, maintenance, or construction of the device or machine.

3.3.97 Laser Target. A square or rectangular plastic device used in conjunction with a laser instrument to set the line and grade of pipe. [**1670**, 2004]

3.3.98 Level I Technical Rescuer. See 3.3.215.1.

3.3.99 Level II Technical Rescuer. See 3.3.215.2.

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

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

3.3.102 Life Safety Rope. See 3.3.158.1.

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

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

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

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

3.3.107 Lip-In. See 3.3.106, Lip Collapse.

3.3.108 Litter. A transfer device designed to support and protect a victim during movement. [**1670**, 2004]

3.3.109 Litter Tender. A rescuer designated to manage a litter and/or person packaged in a litter during a rope rescue operation.

3.3.110 Load (Mass). That which is being lowered, raised, or otherwise supported by a rope rescue system. Relative to rope rescue qualification, a minimum weight of 45.5 kg (100 lb).

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

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

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

3.3.114 Low Angle. Refers to an environment in which the load is predominantly supported by itself and not the rope rescue system (e.g., flat land or mild sloping surface). [**1670**, 2004]

3.3.115* Lowering System. A rope rescue system used to lower a load under control. [**1670**, 2004]

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

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

3.3.118 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. [**1670**, 2004]

3.3.119 Mechanical Advantage System.

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

3.3.119.2* ***Single 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 mass; and may contain one or more stationary pulleys (or similar devices), so that the force on the system is distributed approximately evenly among its supporting rope segments.

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

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

3.3.122 MSDS. Material safety data sheets.

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3.3.123 Nonintersecting Trench. See 3.3.224.2.

3.3.124 One-Call Utility Location Service. A service from which contractors, emergency service personnel, and others can obtain information on the location of underground utilities in any area. [**1670**, 2004]

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

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

3.3.127 Patient Evacuation Team. As related to caves, a specific combination of resources with a leader, personnel, and common equipment assembled for the purpose of evacuating the patient from the cave.

3.3.128 Permit-Required Confined Space. See 3.3.34, Confined Space Entry Permit.

3.3.129 Personal Escape. See 3.3.172, Self-Rescue.

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

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

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

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

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

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

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

3.3.136* Pre-Incident Plan. A document developed by gathering general and detailed data used by responding personnel to determine the resources and actions necessary to mitigate anticipated emergencies at a specific facility. [**1620**, 2003]

3.3.137 Probability of Area (POA). The chances that the subject, or clues, are in the area being searched.

3.3.138 Probability of Detection (POD). The chances of finding the subject, or clues, given that they are in the area being searched.

3.3.139* 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. [**1670**, 2004]

3.3.140 Public Safety Diving. Underwater diving, related to team operations and training, performed by any member, group, or agency of a community or government-recognized public safety diving or water rescue team. [**1670**, 2004]

3.3.141 Qualification. Having satisfactorily completed the requirements of the objectives.

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

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

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

3.3.145 Redundant Air System. An independent secondary underwater breathing system (i.e., a pony bottle with first and second stage or a pony bottle supplying a bailout block). [**1670**, 2004]

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

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

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

3.3.149 Rescue Attendant. See 3.3.8, Attendant.

3.3.150 Rescue Entrant. See 3.3.9, Authorized Entrant.

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

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

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

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

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

3.3.156 Rigging Team. As related to caves, a specific combination of resources with a leader, personnel, and common equipment assembled for the purpose of rigging rope systems to negotiate obstacles to assist patient and rescuer movement in or out of the cave.

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

3.3.158 Rope. A compact but flexible, torsionally balanced, continuous structure of fibers produced from strands that are twisted, plaited, or braided together, and that serve primarily to support a load or transmit a force from the point of origin to the point of application. *(See also 3.3.158.1, Life Safety Rope.)*

3.3.158.1 ***Life Safety Rope.*** Rope dedicated solely for the purpose of supporting people during rescue, fire fighting, other emergency operations, or during training evolutions. *(See also 3.3.158, Rope.)*

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

3.3.159 Rope Rescue Equipment. Components used to build rope rescue systems including life safety rope, life safety harnesses, and auxiliary equipment. [**1670**, 2004]

3.3.160 Rope Rescue System. A system comprised of rope rescue equipment and an appropriate anchor system intended for use in the rescue of a subject. [**1670**, 2004]

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

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

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

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

3.3.165 SCUBA. Self-contained underwater breathing apparatus.

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

3.3.167 Search Measures.

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

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

3.3.168 Search Parameters. The defined search area and scope.

3.3.169 Search Team. As related to caves, a specific combination of resources with a leader, personnel, and common equipment assembled for the purpose of searching an area in the cave identified by the incident command.

3.3.170* Secondary Collapse. A subsequent collapse in a building or excavation.

3.3.171 Security Measures. See 3.3.163, Scene Security.

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

3.3.173 Sheeting and Shoring.

3.3.173.1 ***Supplemental Sheeting and Shoring.*** Sheeting and shoring operations that involve the use of commercial sheeting/shoring systems and/or isolation devices or that involve cutting and placement of sheeting and shoring when greater than 0.61 m (2 ft) of shoring exists below the bottom of the strongback.

3.3.173.2 ***Traditional Sheeting and Shoring.*** The use of 1.22 m × 2.44 m (4 ft × 8 ft) sheet panels, with a strongback attachment, supplemented by a variety of conventional shoring options such as hydraulic, screw, and/or pneumatic shores. [**1670**, 2004]

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

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

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

3.3.177 Shoring System. A system that supports unstable surfaces.

3.3.178 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. [**1670**, 2004]

3.3.179 Sides. See 3.3.66, Face(s).

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

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

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

3.3.183* 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.

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

3.3.185 Small Machine. Machinery or equipment capable of simple disassembly, or constructed of lightweight materials, presenting simple hazards, which are capable of being controlled by the rescuer(s).

3.3.186 Software. A flexible fabric component of rope rescue equipment that can include, but is not limited to, anchor straps, pick-off straps, and rigging slings. [**1670**, 2004]

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

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

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

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

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

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

3.3.193 Stabilization System. See 3.3.41, Cribbing.

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

3.3.195 Stemple. A man-made or natural beam or bar that, when wedged, serves as a removable anchor point.

3.3.196 Stiffbacks. See 3.3.228, Trench Upright.

3.3.197 Strongbacks. See 3.3.228, Trench Upright.

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

3.3.199 Structural Support System. See 3.3.177, Shoring System.

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

3.3.201 Superimposed Load. See 3.3.203, Surcharge Load.

3.3.202 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. [**1670**, 2004]

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

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

3.3.205 Surface Encumbrance. A natural or man-made structural object adjacent to or in the immediate vicinity of an excavation or trench.

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

3.3.207 Swift Water. Water moving at a rate greater than 1 knot [1.85 km/hr (1.15 mph)]. [**1670**, 2004]

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

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

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

3.3.211* Tabulated Data. Any set of site-specific design data used by a professional engineer to design a protective system at a particular location. [**1670**, 2004]

3.3.212 Task. A specific job behavior or activity. [**1002**, 2003]

3.3.213 Team. See 3.3.36, Confined Space Rescue Team.

3.3.214 Technical Rescue. The application of special knowledge, skills, and equipment to safely resolve unique and/or complex rescue situations. [**1670**, 2004]

3.3.215 Technical Rescuer. A person who is trained to perform or direct the technical rescue.

3.3.215.1 ***Level I Technical Rescuer.*** This level applies to individuals who identify hazards, use equipment, and apply limited techniques specified in this standard to perform technical rescue operations.

3.3.215.2 ***Level II Technical Rescuer.*** This level applies to individuals who identify hazards, use equipment, and apply advanced techniques specified in this standard to perform technical rescue operations.

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

3.3.217* 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.

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

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

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

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

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

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

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

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

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

3.3.225 Trench Box. See 3.3.175, Shield or Shield System.

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

3.3.227 Trench Floor. The bottom of the trench.

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

3.3.229 Triage. The sorting of casualties at an emergency according to the nature and severity of their injuries. [**402**, 2008]

3.3.230 Triage Tag. A tag used in the classification of casualties according to the nature and severity of their injuries. [**402**, 2008]

3.3.231 Upright. See 3.3.228, Trench Upright.

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

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

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

3.3.235 Water Rescue Rope. See 3.3.158.2.

3.3.236 Waterbound Victim. A victim that is in the water needing assistance.

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

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

3.3.239 Watermanship Skills. Capabilities that include swimming, surface diving, treading water, and staying afloat with a reasonable degree of comfort appropriate to the required task. [**1670**, 2004]

3.3.240 Wedges and Shims. Material used to tighten or adjust cribbing and shoring systems.

Chapter 4 Technical Rescuer

4.1* General Requirements.

4.1.1 Because technical rescue is inherently dangerous and technical rescuers are frequently required to perform rigorous activities in adverse conditions, regional and national safety standards shall be included in agency policies and procedures.

4.1.2 Technical rescuers 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 technical rescuer.

4.2* Entrance Requirements. Before beginning training activities or engaging in rescue operations, technical rescuers shall comply with the following requirements:

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

4.3* Minimum Requirements. Qualification is specific to a specialty area. For qualification, a rescuer shall perform all of the job performance requirements in Chapter 5 and all job performance requirements listed in at least one level of a specialty area (Chapters 6 through 14). Technical rescuers will be identified by their specialty area and level of qualification (i.e., Rope Rescuer — Level I, Confined Space Rescuer — Level II, etc.).

4.3.1 Level I. This level shall apply to individuals who identify hazards, use equipment, and apply limited techniques specified in this standard to perform technical rescue operations.

4.3.2 Level II. This level shall apply to individuals who identify hazards, use equipment, and apply advanced techniques specified in this standard to perform technical rescue operations.

Chapter 5 Job Performance Requirements

5.1 General Requirements. The job performance requirements defined in Sections 5.2 through 5.5 shall be met prior to being qualified as a technical rescuer.

5.2 Site Operations.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5.2.7* Terminate a technical rescue operation, given an incident scenario, assigned resources, and site safety data, so that rescuer risk and site safety are managed, scene security is maintained and custody transferred to a responsible party, personnel and resources are returned to a state of readiness, record keeping and documentation occur, and post event analysis is conducted.

(A) Requisite Knowledge. Incident Command functions and resources, hazard identification and risk management strategies, logistics and resource management, personnel accountability systems, and AHJ-specific procedures or protocols related to personnel rehab.

(B) Requisite Skills. Hazard recognition, risk analysis, use of site control equipment and methods, use of data collection and management systems, and use of asset and personnel tracking systems.

5.3 Victim Management.

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

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

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

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

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

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

5.3.3 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.

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

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

5.4 Maintenance.

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

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

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

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

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

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

5.5 Ropes/Rigging.

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

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

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

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

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

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

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

5.5.3 Place edge protection, given life safety rope or webbing traversing a sharp or abrasive edge, edge protection, and other auxiliary rope rescue equipment, so that the rope or webbing is protected from abrasion or cutting, the rescuer is safe from falling while placing the edge protection, the edge protection is secure, and the rope or webbing is securely placed on the edge protection.

(A) Requisite Knowledge. Materials and devices that can be used to protect ropes or webbing from sharp or abrasive edges, fall protection measures, dangers associated with sharp or abrasive edges, and methods for negotiation of sharp or abrasive edges.

(B) Requisite Skills. The ability to select protective devices for rope and webbing, provide personnel fall protection while working near edges, secure edge protection, and secure ropes or webbing in a specific location.

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

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

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

5.5.5 Direct a team in the operation of a simple rope mechanical advantage system in a low-angle raising operation, given rescue personnel, a minimum load haul distance of 3 m (10 ft), an established rope rescue system incorporating a simple rope mechanical advantage system, a load to be moved, and an anchor system, so that the movement is controlled, the load can be held in place when needed, operating methods do not stress the system to the point of failure, commands are

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used to direct the operation, and potential problems are identified, communicated, and managed.

(A) Requisite Knowledge. Principles of mechanical advantage, capabilities and limitations of various simple rope mechanical advantage systems and low-angle raising operations, correct operation of simple rope mechanical advantage systems, personnel assignments, and operational commands.

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

5.5.6 Direct a team in the operation of a simple rope mechanical advantage system in a high-angle raising operation, given rescue personnel, an established rope rescue system incorporating a simple rope mechanical advantage system, a minimum load haul distance of 3 m (10 ft), a load to be moved, and an anchor system, so that the movement is controlled, the load can be held in place when needed, operating methods do not stress the system to the point of failure, commands are used to direct the operation, and potential problems are identified, communicated, and managed.

(A) Requisite Knowledge. Principles of mechanical advantage, capabilities and limitations of various simple rope mechanical advantage systems and high-angle raising operations, correct operation of simple rope mechanical advantage systems, personnel assignments, and operational commands.

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

5.5.7 Function as a litter tender in a low-angle lowering or hauling operation, given a rope rescue system, a minimum lower or haul distance of 6.1 m (20 ft), 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, and the terrain is negotiated while minimizing risks to equipment or persons.

(A) Requisite Knowledge. Task-specific selection criteria for life safety harnesses, personal protective equipment selection criteria, variations in litter design and intended purpose, low-angle litter attachment principles, techniques and practices for low-angle environments, and common hazards imposed by the terrain.

(B) Requisite Skills. The ability to select and use rescuer harness and personal protective equipment for common environments, attach the life safety harness to the rope rescue system, maneuver across the terrain, manage the litter while suspended from the rope rescue system, and evaluate surroundings for potential hazards.

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

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

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

5.5.9 Direct a lowering operation in a low-angle environment, given rescue personnel, an established lowering system, a minimum load travel distance of 3 m (10 ft), and a load to be moved, so that the movement is controlled, the load can be held in place when needed, operating methods do not stress the system to the point of failure, rope commands are used to direct the operation, and potential problems are identified, communicated, and managed.

(A) Requisite Knowledge. Application and use of descent control devices, capabilities and limitations of various lowering systems in a low-angle environment, operation of lowering systems in a low-angle environment, personnel assignments, and operational commands.

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

5.5.10 Direct a lowering operation in a high-angle environment, given rescue personnel, an established lowering system, a minimum load travel distance of 3 m (10 ft), and a load to be moved, so that the movement is controlled, the load can be held in place when needed, operating methods do not stress the system to the point of failure, rope commands are used to direct the operation, and potential problems are identified, communicated, and managed.

(A) Requisite Knowledge. Application and use of descent control devices, capabilities and limitations of various lowering systems in a high-angle environment, operation of lowering systems in a high-angle environment, personnel assignments, and operational commands.

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

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

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

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

5.5.12 Operate a belay system during a lowering or raising operation in a high-angle environment, given an operating lowering or hauling system, a minimum load travel distance of 3 m (10 ft), a belay system, and a load, so that the belay line is not loaded during operation of the primary rope rescue system, the

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belay system is prepared for actuation at all times during the operation, the belayer is attentive at all times during the operation, the load's position is continually monitored, and the belayer moves rope through the belay device as designed.

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

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

5.5.13 Belay a falling load in a high-angle environment, 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 otherwise incapacitated during actuation of the belay system.

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

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

5.5.14 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, use of personal protective equipment, equipment inspection criteria, signs of equipment damage, principles of rigging, and equipment replacement criteria.

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

Chapter 6 Rope Rescue

6.1 Level I General Requirements. The job performance requirements defined in 6.1.1 through 6.1.6 shall be met prior to Level I qualification in rope rescue.

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

(A)* Requisite Knowledge. Relationship of angles to forces created in the rigging of multiple-point anchor systems, safety issues in choosing anchor points, system safety check methods that allow for visual and physical assessment of system components, methods to evaluate the system during operations, integrity concerns, weight distribution issues and methods, knots and applications, selection and inspection criteria for hardware and software, formulas needed to calculate safety factors for load distribution, and the concepts of static loads versus dynamic loads.

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

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

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

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

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

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

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

6.1.4 Direct the operation of a compound rope mechanical advantage system in a high-angle environment, given a rope rescue system incorporating a compound rope mechanical advantage system and a load to be moved, and a minimum load haul distance of 6.1 m (20 ft), 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

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system to the point of failure; operational commands are clearly communicated; and potential problems are identified, communicated, and managed.

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

(B) Requisite Skills. The ability to determine incident needs, evaluate incident operations as related to interference concerns, complete a system safety check, continually evaluate system components for compromised integrity, direct personnel effectively, communicate commands, analyze system efficiency, manage load movement, and identify concerns.

6.1.5 Ascend a fixed rope in a high-angle environment, given an anchored fixed rope system, a minimum ascending distance of 6.1 m (20 ft), a system to allow ascent of a fixed rope, a structure, a belay system, a life safety harness worn by the person ascending, and personal protective equipment, so that the person ascending is secured to the fixed rope in a manner that will not allow him or her to fall, the person ascending is attached to the rope by means of ascent control device(s) with at least two points of contact, injury to the person ascending is minimized, the person ascending can stop at any point on the fixed rope and rest suspended by his or her harness, the system will not be stressed to the point of failure, the person ascending can convert his or her ascending system to a descending system, obstacles are negotiated, the system is suitable for the site, and the objective is reached.

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

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

6.1.6 Descend a fixed rope in a high-angle environment, given an anchored fixed-rope system, a minimum descent distance of 6.1 m (20 ft), a system to allow descent of a fixed rope, a belay system, a life safety harness worn by the person descending, and personal protective equipment, so that the person descending is attached to the fixed rope in a manner that will not allow him or her to fall, the person descending is attached to the rope by means of a descent control device, the speed of descent is controlled, injury to the person descending is minimized, the person descending can stop at any point on the fixed rope and rest suspended by his or her harness, the system will not be stressed to the point of failure, the system is suitable for the site, and the objective is reached.

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

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

6.2 Level II General Requirements. The job performance requirements defined in Section 6.1 and 6.2.1 through 6.2.6 shall be met prior to Level II qualification in rope rescue.

6.2.1* Complete an assignment while suspended from a rope rescue system in a high-angle environment, given a rope rescue system, a minimum working height of 6.1 m (20 ft), an assignment, life safety harnesses, litters, bridles, and specialized equipment necessary for the environment, so that risks to victims and rescuers are minimized, the means of attachment to the rope rescue system is secure, selected specialized equipment facilitates efficient rescuer movement, and specialized equipment does not unduly increase risks to rescuers or victims.

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

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

6.2.2 Move a victim in a high-angle environment, given a rope rescue system, a minimum vertical travel distance of 6.1 m (20 ft), victim transfer devices, and specialized equipment necessary for the environment, so that risks to victims and rescuers are minimized, undesirable victim movement within the transfer device is minimized, the means of attachment to the rope rescue system is maintained, the victim is removed from the hazard, selected specialized equipment facilitates efficient victim movement, and the victim can be transported to the local EMS provider.

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

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

6.2.3 Function as a litter tender in a high-angle lowering or hauling operation, given a rope rescue system, a minimum

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lower or haul distance of 6.1 m (20 ft), 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, and the terrain is negotiated while minimizing risks to equipment or persons.

(A) Requisite Knowledge. Task-specific selection criteria for life safety harnesses, personal protective equipment selection criteria, variations in litter design and intended purpose, high-angle litter attachment principles, techniques and practices for high-angle environments, and common hazards imposed by the various structures.

(B) Requisite Skills. The ability to select and use rescuer harness and personal protective equipment for common environments, attach the life safety harness to the rope rescue system, maneuver the litter past obstacles or natural structural features, manage the litter while suspended from the rope rescue system, and evaluate surroundings for potential hazards.

6.2.4 Direct a team in the removal of a victim suspended from rope or webbing in a high-angle environment, given a victim suspended by a harness attached to anchored rope or webbing, devices for removal of the victim from the rope or webbing, and a means of removal of the victim to the ground or other safe area, so that risks to victims and rescuers are minimized, injury to the victim is minimized, the means of attachment to the rope rescue system is maintained, the victim is removed from the rope or webbing, and the victim is brought to a safe area for transfer to EMS.

(A)* Requisite Knowledge. Techniques and systems for safe transfer of suspended victims from an existing anchored rope or webbing to a rope rescue system, various techniques for handling suspended victims, and principles of suspension-induced injuries.

(B) Requisite Skills. Select and construct systems for rapid removal of victims from lanyards or rope or webbing, manage operation of the selected system, determine condition of the suspended victim, reduce hazards for rescuers and victims, and determine specialized equipment needs for victim movement.

6.2.5 Direct a team in the construction of a highline system, given rescue personnel, life safety rope, rope rescue equipment, a minimum span of 6.1 m (20 ft), and suitable anchor system capable of supporting the load, so that personnel assignments are made and clearly communicated, the system constructed can accommodate the load, tension applied within the system will not exceed the rated capacity of any of its component parts, a system safety check is performed, movement on the system is efficient, and loads can be held in place or moved with minimal effort over the desired distance.

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

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

6.2.6 Direct a team in the operation of a highline system, given rescue personnel, an established highline system with a minimum span of 6.1 m (20 ft), a load to be moved, and personal protective equipment, so that the movement is controlled, the load is held in place when needed, operating methods do not stress the system to the point of failure, personnel assignments are made and tasks are communicated, and potential problems are identified, communicated, and managed.

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

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

Chapter 7 Confined Space Rescue

7.1 Level I General Requirements. The job performance requirements defined in 7.1.1 through 7.1.5 shall be met prior to Level I qualification in confined space rescue.

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

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

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

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

(A) Requisite Knowledge. Effects of hazardous atmospheres on victims and rescuers, types and operation of required

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hazard-specific monitoring equipment, organization protocol for medical and psychological evaluation related to entry, methods of entry into confined space in accordance with operational protocols, and rescuer evaluation methods.

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

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

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

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

7.1.4* 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 for other types of rescue.

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

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

7.2 Level II General Requirements. The job performance requirements defined in Section 7.1 and 7.2.1 through 7.2.3 shall be met prior to Level II qualification in confined space rescue.

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

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

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

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

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

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

7.2.3 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

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physical hazards; and victims are protected from further harm.

(A) Requisite Knowledge. 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.

Chapter 8 Trench Rescue

8.1 Level I General Requirements. The job performance requirements defined in 8.1.1 through 8.1.7 shall be met prior to Level I qualification in trench rescue.

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

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

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

8.1.2* Implement a trench emergency action plan, given size-up information and a trench incident, so that initial size-up information is utilized; prebriefing is given to rescuers; documentation is ongoing; the collapse zone is established; a risk–benefit analysis is conducted; rapid, nonentry rescues or victim self-rescues are performed; the rescue area and general area are 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.

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

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

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

8.1.4* Support a nonintersecting straight wall trench of 2.4 m (8 ft) or less 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) remains in a safe zone; any slough-in and wall shears are mitigated; emergency procedures and warning systems are established and understood by participating personnel; incident-specific personal protective equipment is utilized; physical hazards are identified and managed; victim and rescuer protection is maximized; victim extrication methods are considered; and a rapid intervention team is staged.

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

(B) Requisite Skills. The ability to interpret tabulated data information and tables, place shoring and shielding systems, install supplemental shoring, use protocols, choose methods

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to stabilize, use personal protective equipment, anticipate extrication logistics, and create systems in trenches 2.4 m (8 ft) deep.

8.1.5* Release a victim from soil entrapment by components of a nonintersecting collapsed trench of 2.4 m (8 ft) or less in depth, 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 required 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.

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

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

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

8.1.7* Disassemble support systems at a trench emergency incident, given personal protective equipment, trench tool kit, and removal of victim(s), so that soil movement is minimized, 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 its location, shoring and shielding tactics and order of placement, shoring removal protocols, criteria for a "safe zone" within the trench, personnel accountability, emergency procedures, manufacturer's recommended care and maintenance procedures, and briefing protocols.

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

8.2 Level II General Requirements. The job performance requirements defined in Section 8.1 and 8.2.1 through 8.2.6 shall be met prior to Level II qualification in trench rescue.

8.2.1* Support an intersecting trench as a member of a team, given size-up information and 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) in the trench remains 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.

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

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

(B) Requisite Skills. The ability to interpret tabulated data information and tables, place shoring and shielding systems, identify supplemental sheeting and shoring, use all trench rescue protocols, identify 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.

8.2.3* 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

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

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

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

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

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

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

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

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

8.2.6* 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 required 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.

Chapter 9 Structural Collapse

9.1 Level I General Requirements. The job performance requirements defined in 9.1.1 through 9.1.13 shall be met prior to Level I qualification in structural collapse rescue.

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

(A) Requisite Knowledge. Identification of light frame construction types, characteristics, and probable occupant locations; methods to assess rescue needs; expected behavior of light frame construction 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 light frame construction types, evaluate structural stability and hazards, and implement resource and security (scene management) protocols.

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

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

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

9.1.3 Develop a collapse rescue incident action plan, given size-up information and a light frame 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.

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9.1.4 Implement a collapse rescue incident action plan, given an action plan and a light frame 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.

9.1.5 Search a light frame 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. *(See also Annex E.)*

(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.

9.1.6* 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 required 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.

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

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

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

9.1.8 Release a victim from entrapment by components of a light frame 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 required 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 of light frame structures; 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.

9.1.9* Remove a victim from a light frame 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 required care of personal protective equipment resources for structural collapse incidents; general hazards associated with structural collapse; identification of light frame 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.

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

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

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

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

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

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

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

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

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

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

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

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

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

9.2 Level II General Requirements. The job performance requirements defined in Section 9.1 and 9.2.1 through 9.2.16 shall be met prior to Level II qualification in structural collapse rescue.

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

(A) Requisite Knowledge. Identification of heavy construction types, characteristics, and probable occupant locations; methods to assess rescue needs; expected behavior of heavy construction 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 heavy construction types, evaluate structural stability and hazards, and implement resource and security (scene management) protocols.

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

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

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

9.2.3 Develop a collapse rescue incident action plan, given size-up information and a heavy 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.

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9.2.4 Implement a collapse rescue incident action plan, given an action plan and a heavy construction–type 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.

9.2.5 Search a heavy construction–type 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. *(See also Annex E.)*

(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.

9.2.6 Stabilize a collapsed heavy construction–type 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 required 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.

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

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

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

9.2.8 Release a victim from entrapment by components of a heavy construction–type 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 required 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 of heavy construction–type structures; 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.

9.2.9 Remove a victim from a heavy construction–type 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 required care of personal protective equipment resources for structural collapse incidents; general hazards associated with structural collapse; identification of heavy 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 sec-

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ondary 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; and selection and use of patient packaging equipment.

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

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

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

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

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

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

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

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

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

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

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

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

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

(B) Requisite Skills. The ability to select and construct shoring systems for heavy construction–type collapses, use personal protective equipment, perform structural load calculations, determine resource needs, select and operate basic and specialized tools and equipment, implement communications and rescuer safety protocol, and mitigate specific hazards associated with shoring tasks.

9.2.15 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.

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

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

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

Chapter 10 Vehicle and Machinery Rescue

10.1 Level I General Requirements. Level I rescue skills are applicable to vehicle or machinery events involving common passenger vehicles, simple small machinery, and environments where rescuer intervention does not constitute a high level of risk based upon the environment or other factors. The job performance requirements defined in 10.1.1 through 10.1.10 shall be met prior to Level I qualification in vehicle and machinery rescue.

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

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

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

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

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

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

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

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

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

10.1.4* Stabilize a common passenger vehicle or small machine, given a vehicle and machinery 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 common passenger vehicle and small machinery movement, types of stabilization points, types of stabilization surfaces, AHJ policies and procedures, and types of vehicle and machinery construction components as they apply to stabilization.

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

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

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

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

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

(A) Requisite Knowledge. Common passenger vehicle or small machinery construction/features, entry and exit points, routes and hazards operating systems, AHJ standard operating procedure, and emergency evacuation and safety signals.

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

10.1.7 Create access and egress openings for rescue from a common passenger vehicle or small machinery, given a vehicle and machinery tool kit, specialized tools and equipment, per-

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sonal protective equipment, and an assignment, so that the movement of rescuers and equipment complements victim care and removal, an emergency escape route is provided, the technique chosen is expedient, victim and rescuer protection is afforded, and vehicle stability is maintained.

(A) Requisite Knowledge. Common passenger vehicle or small machinery 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 common passenger vehicle or small machinery construction features, select and operate tools and equipment, apply tactics and strategy based on assignment, apply victim care and stabilization devices, perform hazard control based on techniques selected, and demonstrate safety procedures and emergency evacuation signals.

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

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

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

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

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

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

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

10.2 Level II General Requirements. Level II skills apply to those incidents where commercial or heavy vehicles are involved, complex extrication processes have to be applied, or multiple uncommon concurrent hazards are present, or that involve heavy machinery or more than digital entrapment of a victim. The job performance requirements defined in Section 10.1 and 10.2.1 through 10.2.5 shall be met prior to Level II qualification in vehicle and machinery rescue.

10.2.1* Plan for a commercial heavy vehicle or large machinery incident, and conduct initial and ongoing size-up, given agency guidelines, planning forms, and operations-level vehicle/machinery incident or simulation, so that a standard approach is used during training and operational scenarios, emergency situation hazards are identified, isolation methods and scene security measures are considered, fire suppression and safety measures are identified, vehicle/machinery stabilization needs are evaluated, and resource needs are identified and documented for future use.

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

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

10.2.2* Stabilize commercial/heavy vehicles and large machinery, given a vehicle and machinery 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 heavy vehicle and machinery movement, types of stabilization points, types of stabilization surfaces, AHJ policies and procedures, and types of vehicle and machinery construction components as they apply to stabilization.

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

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

(A) Requisite Knowledge. Heavy vehicle and large machinery construction/features, entry and exit points, routes and hazards, operating systems, AHJ standard operating procedure, and emergency evacuation and safety signals.

(B) Requisite Skills. The ability to identify entry and exit points and probable victim locations, and assess and evaluate impact of heavy vehicle or large machinery stability on the victim(s).

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

(A) Requisite Knowledge. Heavy vehicle and large machinery construction and features; electrical, mechanical, hydraulic, pneumatic systems, 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 heavy vehicle and large machinery construction features, select and operate tools and equipment, apply tactics and strategy based on assignment, apply victim care and stabilization devices, perform hazard control based on techniques selected, and demonstrate safety procedures and emergency evacuation signals.

10.2.5 Disentangle victim(s), given a Level II extrication incident, a vehicle and machinery tool kit, personal protective equipment, and specialized equipment, so that undue victim injury is prevented, victim protection is provided, and stabilization is maintained.

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

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

Chapter 11 Surface Water Rescue

11.1 Level I General Requirements. This chapter is for rescue situations with water moving less than 1 knot. Level I water rescue skills are applicable only to basic swimming and support of Level II water rescue. The job performance requirements defined in Chapters 4 and 5 and 11.1.1 through 11.1.15 shall be met prior to Level I qualification in surface water rescue.

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

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

(B) Requisite Skills. The ability to interpret reference materials, perform a scene assessment, evaluate site conditions, complete risk–benefit analysis, and select and use necessary personal protective equipment.

11.1.2* Select water rescue personal protective equipment, given a water rescue assignment and assorted items of personal protective and life-support equipment, so that rescuer is protected from temperature extremes and environmental hazards, correct buoyancy is maintained, AHJ protocols are complied with, swimming ability is maximized, routine and emergency communications are established between components of the team, self-rescue needs have been evaluated and provided for, and pre-operation safety checks have been conducted.

(A) Requisite Knowledge. Manufacturer's recommendations; standard operating procedures; basic signals and communications techniques; selection criteria of insulating garments; buoyancy characteristics; personal escape techniques; applications for and capabilities of personal escape equipment; hazard assessment; AHJ protocols for equipment positioning; classes of personal flotation devices; selection criteria for personal protective clothing, personal flotation devices, and water rescue helmets; personal escape techniques; applications for and capabilities of personal escape equipment; and equipment and procedures for signaling distress.

(B)* Requisite Skills. The ability to use personal protective equipment according to the manufacturer's directions, proficiency in emergency escape procedures, proficiency in communications, don and doff equipment in an expedient manner, use pre-operation checklists, select personal flotation devices, don and doff personal flotation devices, select water rescue helmets, don and doff water rescue helmets, select personal protective clothing and equipment, don and doff in-water insulating garments, proficiency in emergency escape procedures, and proficiency in communicating distress signals.

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

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

(B) Requisite Skills. Not applicable.

11.1.4 Develop an action plan for a shore-based rescue of a single or multiple waterbound victim(s), given an operational plan and a water rescue tool kit, so that all information is factored, risk–benefit analysis is conducted, protocols are followed, hazards are identified and minimized, personnel and equipment resources will not be exceeded, assignments are

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defined, consideration is given to evaluating changing conditions, and the selected strategy and tactics fit the conditions.

(A) Requisite Knowledge. Elements of an action plan; types of 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.

11.1.5 Conduct a witness interview, given witnesses and checklists, so that witnesses are secured, information is gathered, last seen point can be determined, last known activity can be determined, procedures to re-contact the witnesses are established, and reference objects can be utilized.

(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.

11.1.6* Deploy a water rescue reach device to a waterbound victim, given required equipment and personal protective equipment so that the deployed equipment reaches the victim(s), the rescue equipment 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 device.

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

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

11.1.7* Deploy a water rescue rope to a waterbound victim, given a water rescue rope in a throw bag, a coiled water rescue rope 15.24 m to 22.86 m (50 ft to 75 ft) in length, and personal protective equipment, so that the deployed rope lands within reach of the victim, 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 waterbound victims, water rescue rope-handling techniques, incident-specific hazard identification, criteria for selecting victim retrieval locations based on water environment and conditions, hazards and limitations of shore-based rescue, local policies and procedures for rescue team activation, and information on local water environments.

(B) Requisite Skills. The ability to deploy both a water rescue rope bag and a coiled water rescue rope, select personal protective equipment specific to the water environment, don personal protective equipment, identify water hazards (e.g., upstream or downstream, current or tides), identify hazards directly related to the specific rescue, and demonstrate appropriate shore-based victim removal techniques.

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

(A) Requisite Knowledge. Entry/exit procedures, communications techniques, boat operation techniques, design limitations, climactic conditions, tides, and currents.

(B) Requisite Skills. Implement entry/exit procedures and communications with watercraft crew, use emergency/safety equipment, identify hazards, and operate within the rescue environment.

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

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

(B) Requisite Skills. The ability to determine applicability of air operations, establish and control landing zones, assess fire

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protection needs, communicate with air crews, identify hazards, rig aircraft for anticipated rescue procedures, apply crash survival procedures, select and use personal protective equipment, and work with air crews to rescue a victim from the water.

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

(A) Requisite Knowledge. Limitations and uses of available watercraft, dynamics of moving water and its effects on watercraft handling, launch and docking procedures, conditional requirements for personal protective equipment, applications for motorized and nonmotorized craft, managing 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.

11.1.11 As a member of a team, use techniques appropriate for the water environment to extricate an incapacitated waterbound victim from the water, given a water hazard that is representative of the bodies of water existing or anticipated within the geographic confines of the AHJ, watercraft that is available to the team (if applicable), nets, webbing, blankets, tarpaulins or ropes, a means of securement, and water rescue personal protective equipment, so that the watercraft is not broached, control of the watercraft is maintained, risks to victim and rescuers are minimized, and the victim is removed from the hazard expediently and efficiently.

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

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

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

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

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

11.1.13* Escape from a simulated life-threatening situation, given water rescue personal protective equipment, swim aids as required, and flotation aids, so that the rescuer reaches safety at a predetermined area.

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

(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; don and doff personal protective equipment; select and use personal protective equipment, flotation aids, and swim aids; utilize communications systems; and evaluate water conditions to identify entry points and hazards.

11.1.14 Identify procedures for operation of rope systems particular to the water rescue needs of the AHJ, given rescue personnel, an established rope system, a load to be moved, and personal protective equipment, so that the movement is controlled, the load is held in place when needed, and operating methods do not stress the system.

(A) Requisite Knowledge. Ways to determine incident needs as related to the operation of rope systems, capabilities and limitations of various rope 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 rope system problems and ways to minimize or manage them, and ways to increase the efficiency of load movement.

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

11.1.15 Support Level II operations, given a designated mission, safety equipment, props, and water body, so that skills are demonstrated in a controlled environment, performance parameters are achieved, hazards are continually assessed, correct buoyancy control is maintained, and emergency procedures are demonstrated.

(A) Requisite Knowledge. Support procedures, including search patterns, operation support equipment, and communications issues.

(B) Requisite Skills. Basic support skills, including the ability to assist technicians in different water conditions including ice, surf, swiftwater conditions, and so forth.

11.2* Level II General Requirements. The job performance requirements defined in Chapters 4 and 5, Section 11.1, and 11.2.1 through 11.2.4 shall be met prior to Level II qualification in surface water rescue.

11.2.1* Swim a designated water course, given a course that is representative of the bodies of water existing or anticipated within the geographic confines of the AHJ, water rescue personal protective equipment, and swim 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.

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(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 floatation aids or swim 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.

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

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

(B) Requisite Skills. The ability to swim and float in different water conditions with and without flotation aids or swim aids; apply water survival skills; manage combative waterbound 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.

11.2.3 Demonstrate defensive tactics in the water rescue environment given a waterbound victim in a stressed or panicked situation so that the rescuer can maintain separation from the victim to create or maintain personal safety, and can perform self-defense techniques to prevent rescuer submersion if direct contact is made between a panicked victim and the rescuer.

(A) Requisite Knowledge. Basic emergency procedures for applicable environments and situations with stressed or panicked victims at water rescues.

(B) Requisite Skills. The ability to effectively release oneself from the grasp of a panicked victim, including blocks, releases, and escapes.

11.2.4 Supervise, coordinate, and lead rescue teams during operations, given incident checklists, maps, topographic surveys, and charts, so that teams are managed, personnel are supervised, hazards are assessed and identified, safety and health of team is ensured, qualifications/abilities of rescuers are verified, pre-entry briefing is conducted, and debriefing is performed.

(A) Requisite Knowledge. Supervisory practices, emergency procedures, communications procedures, local protocols, and safety checks.

(B) Requisite Skills. The ability to implement emergency procedures, communications procedures, and leadership/management skills.

Chapter 12 Swiftwater Rescue

12.1 Level I General Requirements. Level I water rescue skills are applicable only to survival swimming skills and Level II support of swiftwater rescue. The job performance requirements defined in Chapters 4, 5, and 6, Section 11.1, and 12.1.1 through 12.1.4 shall be met prior to Level I qualification in swiftwater rescue.

12.1.1 Construct rope systems particular to the swiftwater rescue needs of the AHJ, given rescue personnel, rope equipment, a load to be moved, and personal protective equipment, so that the movement is controlled, the load is held in place when needed, and operating methods do not stress the system.

(A) Requisite Knowledge. Rope systems specific to the swiftwater environment, capabilities and limitations of various rope systems, incident site evaluation as related to interference concerns and obstacle negotiation, system safety check protocol, procedures to evaluate system components for compromised integrity, common personnel assignments and duties, common and critical operational commands, and methods to increase the efficiency of load movement.

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

12.1.2 Support Level II operations, given a designated mission, safety equipment, props, and water body, so that skills are demonstrated in a controlled environment, performance parameters are achieved, hazards are continually assessed, and emergency procedures are demonstrated.

(A) Requisite Knowledge. Support procedures, including search patterns, equipment setup, operation support equipment, and communications issues.

(B) Requisite Skills. Basic support skills, including the ability to serve as an upstream or downstream safety or spotter, and tend a "go" rescuer.

12.1.3 Assess moving water conditions, characteristics, and features in terms of hazards to the rescuer and victims, given an incident scenario and swiftwater tool kit, so that flow and conditions are estimated accurately, mechanisms of entrapment are considered, hazards are assessed, depth and surrounding terrain are evaluated, and findings are documented.

(A) Requisite Knowledge. Flow calculation methods, map or chart reading, local water hazards and conditions, entrapment mechanisms, and human physiology and survival factors.

(B) Requisite Skills. Determination of flow and environmental factors, the effect on victims and rescuers, and interpretation of maps or charts.

12.1.4 Perform a nonentry rescue in the swiftwater/flooding environment, given an incident scenario, personal protective equipment, and swiftwater rescue tool kit, so that rescue is accomplished, and adopted policies and safety procedures are followed.

(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 waterbound victims, water rescue rope-handling techniques, incident-specific hazard identification, criteria for

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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. Select personal protective equipment specific to the water environment, don personal protective equipment, identify water hazards (i.e., upstream or downstream, current or tides), identify hazards directly related to the specific rescue, and demonstrate appropriate shore-based victim removal techniques.

12.2 Level II General Requirements. The job performance requirements defined in Sections 11.2 and 12.1 and 12.2.1 and 12.2.2 shall be met prior to Level II qualification in swiftwater rescue.

12.2.1 Perform an entry rescue in the swiftwater/flooding environment, given an incident scenario, personal protective equipment, and swiftwater rescue tool kit, so that rescue is accomplished, and adopted policies and safety procedures are followed.

(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 waterbound victims, water rescue rope-handling techniques, incident-specific hazard identification, criteria for selecting victim retrieval locations based on water environment and conditions, hazards and limitations of shore-based rescue, local policies/procedures for rescue team activation, and information on local water environments.

(B) Requisite Skills. Select personal protective equipment specific to the water environment, don personal protective equipment, identify water hazards (i.e., upstream or downstream, current or tides), identify hazards directly related to the specific rescue, and demonstrate appropriate victim removal techniques.

12.2.2 Negotiate a designated swiftwater course, given a course that is representative of the bodies of swiftwater existing or anticipated within the geographic confines of the AHJ, water rescue personal protective equipment, and swim 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 swim 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.

Chapter 13 Dive Rescue

13.1 Level I General Requirements. Level I dive rescue skills shall be applicable to supporting dive technical rescuers only. The job performance requirements defined in Chapters 4, 5, and 11 and 13.1.1 through 13.1.8 shall be met prior to Level I qualification in dive rescue.

13.1.1* Select dive rescue personal protective equipment, given a dive rescue assignment and assorted items of personal protective and life-support equipment, so that rescuer is protected from temperature extremes, water contaminants, injury from debris, out-of-air/gas emergencies, unconscious/needy diver incidents, and entanglements; correct buoyancy is maintained; AHJ protocols are complied with; swimming ability is maximized; routine and emergency communications are established between components of the team; self-rescue needs have been evaluated and provided for; and pre-dive safety checks have been conducted.

(A) Requisite Knowledge. Manufacturer's recommendations; standard operating procedures; basic signals and communications techniques; selection criteria of insulating garments, buoyancy characteristics; personal escape techniques; applications for and capabilities of personal escape equipment; hazard assessment; AHJ protocols for equipment positioning; classes of personal flotation devices; selection criteria for in-water insulation garments, personal flotation devices, and water rescue helmets; personal escape techniques; applications for and capabilities of personal escape equipment; and equipment and procedures for signaling distress.

(B) Requisite Skills. The ability to use personal protective equipment according to the manufacturer's directions, proficiency in emergency escape procedures, proficiency in communications, don and doff equipment in an expedient manner, and use pre-dive checklists. The ability to use water rescue personal protective equipment, so that the rescuer will be protected from temperature extremes and blunt trauma, the rescuer will have flotation for tasks to be performed, swimming ability will be maximized during rescue activities, self-rescue needs have been evaluated and provided for, and a means of summoning help has been provided. The ability to select personal flotation devices, don and doff personal flotation devices, select water rescue helmets, don and doff water rescue helmets, select in-water insulating garments, don and doff in-water insulating garments, proficiency in emergency escape procedures, and proficiency in communicating distress signals.

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

(A) Requisite Knowledge. Criteria for determining rescue versus recovery modes, human physiology related to dive environment, re-float theory, topographical map components, hydrologic factors, methods to determine high probability of detection areas, critical interview questions and practices, methods to identify track traps, ways to identify spotter areas and purposes for spotters, personnel available and effects on parameter definition, the effect of search strategy defining the parameter, communication methods, and reporting requirements.

(B) Requisite Skills. The ability to interpret reference materials, perform a scene assessment, evaluate site conditions, complete risk–benefit analysis, and select and use necessary personal protective equipment.

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13.1.3* Implement an action plan for a dive operation, given an operational plan and a dive rescue tool kit, so that all information is factored, risk–benefit analysis is conducted, protocols are followed, hazards are identified and minimized, personnel and equipment resources will not be exceeded, assignments are defined, consideration is given to evaluating changing conditions, and the selected strategy and tactics fit the conditions.

(A) Requisite Knowledge. Elements of an action plan; types of and information provided by reference materials and size-up; hydrology; types of hazards associated with dive 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; determine rescue personnel requirements; and monitor and record submerged diver location, breathing, and dive times.

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

(A) Requisite Knowledge. Entry/exit procedures, communications techniques, boat anchoring procedures specific to dive operations, and boat diving operation techniques.

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

13.1.5 Support Level II dive rescue operations, given a designated mission, safety equipment, props, and confined water body, so that skills are demonstrated in a controlled environment, performance parameters are achieved, hazards are continually assessed, correct buoyancy control is maintained, and emergency procedures are demonstrated.

(A) Requisite Knowledge. Support procedures, including search patterns, dive equipment setup, operation support equipment, air panels, and communications issues.

(B) Requisite Skills. Basic support skills, including the ability to assist technicians in different water conditions (e.g., ice, surf, or swiftwater conditions).

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

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

(B) Requisite Skills. Interview skills of corroborating witnesses and basic drawing skills.

13.1.7 Select and assemble personal protective equipment to assist rescue divers, given a subsurface mission and personal protective and life-support equipment, so that rescuer is protected from temperature extremes, correct buoyancy is maintained, AHJ protocols are complied with, swimming ability is maximized, routine and emergency communications are established between components of the team, self-rescue needs have been evaluated and provided for, and pre-dive safety checks have been conducted, to include complete encapsulation, including dry suit with attached hood, boots, and gloves and respiratory protection.

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

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

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

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

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

13.2* Level II General Requirements. In addition to the requirements of Level I, candidates shall possess accepted advanced dive training SCUBA certification from a nationally recognized agency. At the entry level, and for any specialties utilized by an organization at Level II, the AHJ shall ensure provision of qualifying in that specialty by a nationally recognized certifying agency. The curriculum for such qualification shall be oriented toward the needs and operational requirements of public safety diving as defined herein.

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

(A) Requisite Knowledge. Use of references; use of dive tables; searcher limitations; incident management systems resource capabilities; search technique and theory; SCUBA limitations/abilities; float/re-float theory; and movement of a

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body or evidence on the surface, during descent, and once on the bottom in still water and, if applicable, in moving water.

(B) Requisite Skills. The ability to use dive tables; develop plan; implement incident management; read and interpret maps; interview witnesses; translate information given into a search plan; use communications equipment; define search parameters; determine hydrology, critical interview questions, spotter placement, and strategies; and evaluate bottom topography, composition, debris, water visibility, current, and diver/tender capabilities to determine the safest and most appropriate search pattern.

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

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

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

13.2.3* Select and use a standard or full-face mask, given a subsurface mission and personal protective and life-support equipment, so that rescuer is protected from temperature extremes and environmental hazards, correct buoyancy is maintained, AHJ protocols are complied with, swimming ability is maximized, routine and emergency communications are established between components of the team, self-rescue needs have been evaluated and provided for, and pre-dive safety checks have been conducted.

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

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

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

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

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

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

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

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

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

(A) Requisite Knowledge. Manufacturer's recommendations, standard operating procedures, basic signals and communications techniques, selection criteria of personal protective equipment, including full-face masks, if applicable, and redundant air systems, buoyancy characteristics, personal escape techniques, applications for and capabilities of personal escape equipment, hazard assessment, AHJ protocols for equipment, personal escape techniques, applications for and capabilities of personal escape equipment, and equipment and procedures for signaling distress.

(B) Requisite Skills. The ability to use personal protective equipment, including full-face mask equipment and redundant air systems, according to the manufacturer's directions; proficiency in emergency escape procedures; proficiency in communications; can don and doff equipment in an expedient manner; use pre-dive checklists; use water rescue personal protective equipment, so that the rescuer will be protected from temperature extremes and blunt trauma, the rescuer will have flotation for tasks to be performed, swimming ability will be maximized during rescue activities, self-rescue needs have been evaluated and provided for, and a means of summoning help has been provided; proficiency in emergency escape procedures; and communicating distress signals.

13.2.7 Procedures to manage physiological and psychological stressors in the aquatic environment for the diver and surface support personnel, given a simulated life-threatening situation, so that problems are recognized, corrective actions are initiated, and situation is stabilized.

(A) Requisite Knowledge. Hazard identification and management techniques specific to the stressors and problems present with the environment of public safety diving, and commonly encountered life-threatening problems in the underwater environment.

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(B) Requisite Skills. Diver monitoring and observation, communication and intervention techniques, use of diver checklists, and diver recall procedure implementation.

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

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

(B) Requisite Skills. The ability to use personal protective equipment, techniques for rescue or assistance of conscious and unconscious divers, buoyancy control devices, regulators, weight belt removal, communication via hand signals, and emergency ascents.

13.2.9* Escape from a simulated life-threatening situation, given safety equipment, a pool or controlled water environment, SCUBA equipment, and props, so that hazards are recognized, emergency procedures are performed, diver escapes from situation to safety, and problems can be identified prior to work in a high-stress environment.

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

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

13.2.10 Perform environment-specific search of the water body, given search parameters for a dive rescue incident, hydrologic data (including speed and direction of current or tides), descriptions of missing persons and incident history, checklists, conditions affecting overlap, pattern selection, water body representative of the AHJ, and safety and SCUBA equipment, so that areas with high probability of detection are differentiated from other areas, witnesses are interviewed, critical interview information is recorded, personnel resources are considered, search parameters are communicated, search is performed, and object is found.

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

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

Chapter 14 Ice Rescue

14.1 Level I General Requirements. Level I ice rescue skills are applicable to survival swimming and support of ice rescue Level II only. The job performance requirements defined in 14.1.1 through 14.1.3 shall be met prior to individuals qualifying in Level I water rescue.

14.1.1 Support Level II operations, given a designated mission, safety equipment, props, and water body, so that skills are demonstrated in a controlled environment, performance parameters are achieved, hazards are continually assessed, and emergency procedures are demonstrated.

(A) Requisite Knowledge. Support procedures, including search patterns, equipment setup, operation support equipment, and communications issues.

(B) Requisite Skills. Basic support skills, including the ability to serve as an upstream or downstream safety or spotter and tend a "go" rescuer.

14.1.2 Assess ice and water conditions, characteristics, and features in terms of hazards to the rescuer and victims, given an incident scenario and ice rescue tool kit, so that conditions are estimated accurately, mechanisms of entrapment are considered, hazards are assessed, depth and surrounding terrain are evaluated, and findings are documented.

(A) Requisite Knowledge. Ice assessment, flow calculation methods, map or chart reading, local water hazards and conditions, entrapment mechanisms, and human physiology and survival factors.

(B) Requisite Skill. Determination of flow and environmental factors and the effect on victims and rescuers, and interpretation of maps and charts.

14.1.3 Perform a nonentry rescue in the ice rescue environment, given an incident scenario, personal protective equipment, and ice rescue tool kit, so that rescue is accomplished and adopted policies and safety procedures are followed.

(A) Requisite Knowledge. Types and capabilities of personal protective equipment, effects of hydrodynamic forces on rescuers and victims, physiological effects of immersion and cold water near-drowning, hydrology and characteristics of water/ice, behaviors of victims, water rescue rope-handling techniques, incident-specific hazard identification, criteria for selecting victim retrieval locations based on water/ice 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 ice rescue environment, don personal protective equipment, identify water hazards (e.g., upstream or downstream, current or tides), identify hazards directly related to the specific rescue, and demonstrate appropriate shore-based victim removal techniques.

14.2 Level II General Requirements. The job performance requirements defined in Sections 11.2 and 14.1 and 14.2.1 and 14.2.2 shall be met prior to Level II qualification in ice rescue.

14.2.1 Demonstrate techniques for movement on ice, given an ice formation that is representative of the bodies of water/ice existing or anticipated within the geographic confines of the AHJ, ice rescue personal protective equipment, and swim 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 ice rescue environments (shoreline, in-water, and climatic), selection criteria for ice rescue

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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 swim aids as required, apply water survival skills, don and doff personal protective equipment, select and use swim aids, utilize communications systems, use task-specific equipment, and evaluate water/ice conditions to identify entry points and hazards.

14.2.2 Perform an entry rescue in the ice rescue environment, given an incident scenario, personal protective equipment, and ice rescue tool kit, so that independent positive buoyancy is established for the victim, rescue is accomplished, and adopted policies and safety procedures are followed.

(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 victims, physiological effects of immersion and cold water near-drowning, 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 entry 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/ice environment, don personal protective equipment, identify water/ice hazards (i.e., upstream or downstream, current or tides), identify hazards directly related to the specific rescue, and demonstrate appropriate victim removal techniques.

Chapter 15 Surf Rescue

15.1 Level I General Requirements. Rescuers using this standard shall also meet the requirements of the technical rescuer general requirements (Chapters 4 and 5). Surf rescue Level I skills include Chapter 11, Surface Water Rescue skills and basic rescue skills in surf from 1 ft to 6 ft (0.3 m to 2 m) in height. The Surf Rescue Level I also includes the ability to support surf rescue Level II and other rescue personnel in motorized watercraft, boat, and helicopter surf rescues. The job performance requirements defined in Chapters 4 and 5, Section 11.1, and 15.1.1 through 15.1.4 shall be met prior to Level I qualification in surf rescue.

15.1.1 Develop a site survey for an existing surf site, given historical data, personal protective equipment for conducting site inspections, rescue equipment for effecting surf rescues, tide tables, currents, and wave heights and meteorological projections, so that life safety hazards are anticipated, risk–benefit analyses are included, site inspections are completed, ocean conditions are projected, site-specific hazards are identified, routes of access and egress are identified, boat ramps are identified, entry and exit points to surf sites are identified, methods of entrapment are considered, and areas with high probability for victim location are determined.

(A) Requisite Knowledge. 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 ocean rescue practice scenarios, inspection practices, and consideration techniques; risk–benefit analyses; identification of personal protective equipment; identification of rescue equipment for effecting surf rescues; 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, perform a scene assessment, evaluate site conditions, complete risk–benefit analyses, select and use necessary personal protective equipment, and select and use appropriate rescue equipment for effecting surf rescues.

15.1.2* Demonstrate survival swimming skills in low-surf environment, given safety equipment and a water body with low surf, so that basic survival skills are demonstrated in a representative environment as found in the jurisdiction, performance parameters are achieved, and problems can be identified prior to working in a low-surf environment.

(A) Requisite Knowledge. Types of fundamental swimming skills to enter a surf zone, maneuver within the surf zone, and exit the surf zone, and fundamental surf knowledge that includes knowing how waves form, why waves are seasonal, how to judge wave heights, recognizing the difference between plunging and spilling waves, knowing the dynamics of surf-related currents such as long-shore and riparian (or rip) currents, and familiarity with the user groups in the surf zone and the types of equipment they use.

(B) Requisite Skills. The ability to perform fundamental swimming skills in a surf zone, including the ability to enter, maneuver in, and exit the surf zone; swim in different surf conditions with and without flotation aids or swim aids; apply water survival skills; complete a distance swim in any open body of water using any stroke and without the aid of any surf rescue equipment; identify different types of waves, different types of currents, and the user groups in the surf zone and the types of equipment they use.

15.1.3* Deploy a nonmotorized watercraft and rescue a water-bound surf victim, given watercraft used by the AHJ, so that watercraft predeployment checks are completed, watercraft launch or recovery is achieved as stipulated by AHJ operational protocols, both onboard and surf rescue operations conform with watercraft operational protocols and capabilities, communications are clear and concise, and the candidate is familiar with watercraft nomenclature, operational protocols, design limitations, and launch/recovery site issues.

(A) Requisite Knowledge. Types of fundamental skills to enter a surf zone, maneuver within the surf zone, and exit the surf zone on a nonmotorized watercraft; fundamental surf knowledge that includes knowing how waves form, why waves are seasonal, how to judge wave heights, recognizing the difference between plunging and spilling waves, knowing the dynamics of surf-related currents such as longshore and rip currents, and familiarity with the user groups in the surf zone and the types of equipment they use; and victim retrieval and removal techniques.

(B) Requisite Skills. The ability to perform fundamental deployment and maneuvering skills in a surf zone on a nonmotorized watercraft, including the ability to enter, maneuver in, and exit the surf zone; perform in different surf conditions; negotiate a measured distance in any open body of water using the watercraft used by the AHJ; identify different types of waves, different types of currents, and the user groups in the surf zone and the types of equipment they use; and maneuver

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in the surf zone after retrieving a victim and demonstrate appropriate victim removal techniques.

15.1.4* Define procedures to provide support for boat surf rescue operations within the area of responsibility for the AHJ, given boat used by the AHJ, protocols and procedures, boat-to-shore communication, extraction issues, and safety procedures, so that communications are clear and concise, and the candidate is familiar with boat nomenclature, operational protocols, and design limitations.

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

(B) Requisite Skills. The ability to ride the boat, evaluate conditions for launch, don water rescue personal protective equipment, utilize communications systems, and apply procedures for rescuing a victim in the surf zone, including assisting the victim into the boat.

15.2 Level II General Requirements. Surf rescue Level II skills include surface water rescue skills, surf rescue Level I skills in high surf, the ability to deploy and operate a motorized surf rescue watercraft, and the ability to support other rescue personnel in motorized watercraft, boat, and helicopter surf rescues. The job performance requirements defined in Section 15.1 and 15.2.1 through 15.2.3 shall be met prior to Level II qualification at surf rescue.

15.2.1 Demonstrate advanced swimming skills in the surf environment, given safety equipment and a water body with high surf, so that advanced skills are demonstrated in an environment representative of conditions experienced in the jurisdiction, performance parameters and objectives are achieved, and problems can be identified prior to working in a high surf environment.

(A) Requisite Knowledge. Types of fundamental swimming skills to enter, maneuver, and exit a surf zone; wave formation theory; wave types; dynamics of surf-related currents such as longshore and rip currents; and familiarity with victim behavior and recreational equipment used.

(B) Requisite Skills. The ability to perform advanced swimming skills in the surf zone, including the ability to enter, maneuver in, and exit the surf zone; swim in different surf conditions with and without flotation aids or swim aids; apply water survival skills; complete a distance swim in any open body of water using any stroke without the aid of any surf rescue equipment; and identify wave types, current types, and potential victim behavior.

15.2.2 Perform a swimming rescue for a water-bound surf victim, given personal protective equipment, including a pair of swimming fins and a surf rescue tube with a shoulder strap, safety equipment, and a water body with high surf representative of the jurisdiction's conditions, so that the victim is secured within the surf rescue tube and towed out of the surf impact zone to shore or to a surf-free zone for pickup by a watercraft, boat, or helicopter.

(A) Requisite Knowledge. Types of fundamental swimming skills to enter, maneuver, and exit a surf zone; wave formation theory; wave types; dynamics of surf-related currents such as longshore and rip currents; and familiarity with victim behavior and recreational equipment used.

(B) Requisite Skills. The ability to perform advanced swimming skills in the surf zone, including the ability to enter, maneuver in, and exit the surf zone; swim in different surf conditions with and without flotation aids or swim aids; apply water survival skills; complete a distance swim in any open body of water using any stroke without the aid of any surf rescue equipment; identify wave types, current types, and potential victim behavior; and maneuver in the surf zone with a surf rescue tube, tow a victim with the tube, and demonstrate victim removal techniques.

15.2.3 Perform a subsurface retrieval of a submerged victim in a surf environment, given personal protective equipment; swimming fins, mask, and snorkel; and a water body with high surf representative of the jurisdiction's conditions, so that the victim is located and brought to the surface, removed out of the surf impact zone to shore or to a surf-free zone for pickup by a watercraft, boat, or helicopter.

(A) Requisite Knowledge. Types of fundamental swimming skills to enter, maneuver, and exit a surf zone; wave formation theory; wave types; dynamics of surf-related currents such as longshore and rip currents; and familiarity with victim behavior and recreational equipment used.

(B) Requisite Skills. The ability to perform free diving skills in the surf zone, including the ability to enter, maneuver in, and exit the surf zone while towing a victim; swim in different surf conditions with and without flotation aids or swim aids; apply water survival skills; complete a distance swim in any open body of water using any stroke without the aid of any surf rescue equipment; identify wave types, current types, and potential victim behavior; and maneuver in the surf zone with a surf rescue tube, tow a victim with the tube, and demonstrate victim removal techniques.

Chapter 16 Wilderness Rescue

16.1 Level I General Requirements. The job performance requirements defined in 16.1.1 through 16.1.11 shall be met prior to Level I qualification in wilderness search and rescue.

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

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

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

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

(A) Requisite Knowledge. How to maintain the chain of evidence, scene search procedures, evidence protection

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methods, documentation and catalog methods, and evidence collection procedures.

(B) Requisite Skills. The ability to operate photography equipment, utilize standard evidence collection tools, and implement procedures to collect, document, and catalog evidence.

16.1.3* Prepare to work in a wilderness environment for a 24-hour period of time, given survival equipment, so that the rescuer can be self-sustaining in the wilderness environment.

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

(B) Requisite Skills. The ability to prepare for wilderness navigation, orienteering, and wilderness survival techniques.

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

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

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

16.1.5 Construct an emergency shelter in a wilderness environment, given the natural resources of the area, so that the rescuer is protected from the elements.

(A) Requisite Knowledge. Environmental hazards, signs and symptoms of environmental injuries, and the natural resources of the area.

(B) Requisite Skills. The ability to construct an emergency shelter from the existing environment resources.

16.1.6 Collect and purify water, given a natural source of water in the wilderness environment, so that the rescuer can have potable water to consume.

(A) Requisite Knowledge. Water filters and purifiers, collection methods, and potential water sources.

(B) Requisite Skills. The ability to use water filters and purifiers, collect water, and identify water sources.

16.1.7 Identify potential natural food source(s) in a wilderness environment, given the natural food resources of the area, so that the rescuer is able to survive in an emergency situation for an extended period of time.

(A) Requisite Knowledge. Edible vegetation indigenous to the area, methods of food collection, food preparation, and rationing.

(B) Requisite Skills. The ability to collect natural food sources and ration food.

16.1.8 Establish the need for specialized resources in wilderness search and rescue operations, such as aircraft, watercraft, or specialized vehicles, given operational protocols and specialized vehicle resources, so that resources are allocated and utilized during the operation to locate and/or remove the subject.

(A) Requisite Knowledge. Available specialized resources and their capabilities, landing zone requirements, risk factors associated with specialized resource operations, and local protocols and procedures.

(B) Requisite Skills. The ability to establish and control landing zones, assess fire protection needs as they pertain to landing zones, and identify hazards associated with specialized resources.

16.1.9 Locate a victim in a wilderness environment, given a lost person profile, established search area, navigation equipment, topographical maps, and communication equipment, so that the victim's location can be determined.

(A) Requisite Knowledge. Man-tracking skills, search patterns, communication skills, passive and active search techniques, and sign cutting techniques.

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

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

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

(B) Requisite Skills. The ability to provide medical care in a wilderness environment.

16.1.11* Move a victim in a wilderness environment a minimum of 0.4 km (0.25 mi), given victim transport equipment, litters, other specialized equipment, and victim removal systems specific to the rescue environment, so that the victim is moved without undue further injuries, risks to rescuers are minimized, the integrity of the victim's packaging within the transfer device is established and maintained, and the victim is removed from the hazard.

(A) Requisite Knowledge. Types of transport equipment and removal systems, selection factors with regard to specific rescue environments, methods to reduce and prevent further injuries, types of risks to rescuers, ways to establish and maintain victim packaging transport techniques, 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.

16.2 Level II General Requirements. The job performance requirements defined in Section 16.1 and 16.2.1 through 16.2.3 shall be met prior to Level II qualification in wilderness search and rescue.

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

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

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

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16.2.2 Develop a wilderness rescue incident action plan, given an incident, size-up information, and local weather forecasts and current conditions, so that the incident management system is utilized, communication needs are addressed, existing and potential conditions are identified, the search area is designated, operations periods are identified, safety plan(s) are developed, and objectives are established.

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

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

16.2.3 Manage and direct a team at a wilderness search and rescue incident, given rescue personnel, capabilities and limitations of rescue members, and incident and site information, so that an incident management system is established, needed support resources are identified, the rescue action plan is communicated, tasks are communicated, resources are allocated, the incident is stabilized, personnel assignments are made, potential problems are identified and managed, and accountability is provided.

(A) Requisite Knowledge. Incident Command Systems, procedures to evaluate incidents, common personnel assignments and duties, common and critical operational commands, safety protocols, and ways to increase efficiency.

(B) Requisite Skills. The ability to implement an incident management system, evaluate an incident, evaluate personnel, and implement procedures.

Chapter 17 Mine and Tunnel Rescue

17.1 General Requirements.

17.1.1 The job performance requirements defined in 17.2.1 through 17.3.16 shall be met prior to be Level I and II qualification in mine and tunnel rescue.

17.1.2* The requirements of this chapter shall apply to members that respond to incidents in tunnels under construction or other underground excavations formerly classified as mines or tunnels.

17.1.3 Definition.

17.1.3.1* Incident. In a mine or tunnel, an event or condition that threatens life or property and adversely affects the environment in the space. *(See 3.3.88.)*

17.2 Level I General Requirements.

17.2.1* Conduct a size-up of a mine/tunnel rescue incident, given an incident and background information, site maps, charts, diagrams, blueprints, forms, information from technical resources and on-site personnel, monitoring equipment, and personal protective equipment necessary to perform the assessment, so that existing and potential conditions within the mine/tunnel and the rescue area are evaluated, general and site-specific hazards are identified, witnesses are interviewed, the total number and probable locations of victims are determined, a risk–benefit analysis is performed, ventilation requirements are determined, entry and egress points are identified, and specialized resource needs are identified.

(A) Requisite Knowledge. Mine/tunnel hazards, specialized resource requirements, information sources, search guidelines, risk–benefit analysis criteria, ventilation requirements, means of controlled entry and egress of mine/tunnel spaces, and terminology.

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

17.2.2* Establish "scene" safety zones, given a mine/tunnel incident, 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 personnel access to the rescue scene is managed.

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

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

17.2.3* Establish fire protection, given a mine/tunnel rescue incident and fire control support, so that fire and explosion potential is determined, identified hazards are mitigated or isolated, and rescue objectives are communicated to the fire support team.

(A) Requisite Knowledge. Types of fire and explosion hazards at mine/tunnel incidents, incident management system, types of extinguishing devices, agency policies and procedures, potential sources of ignition, 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.

17.2.4* Conduct atmospheric monitoring of the mine/tunnel environment, given personal protective equipment, atmospheric monitoring equipment, and reference material, so that atmospheric readings are continually assessed, readings are documented, and changes in the involved area are tracked and communicated to the Incident Command Post.

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

(B) Requisite Skills. The ability to use and calibrate atmospheric monitoring equipment, interpret resource information,

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choose and utilize personal protective equipment, operate communications equipment, and utilize tracking documents.

17.2.5* Establish mine/tunnel ventilation, given size-up information and atmospheric monitoring results, so that airflow needs are determined, the required airflow is established and maintained, required air changes are accomplished, and atmospheric hazards are monitored and controlled.

(A) Requisite Knowledge. Airflow criteria for mine/tunnel rescue, potential space configurations, types of ventilation equipment, and atmospheric hazards that are present in work spaces and that can pose problems during the rescue.

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

17.2.6 Establish dewatering operations, given a mine/tunnel collapse incident, dewatering pumps, hose, and appliances, so that water is removed and directed away from the affected area, atmospheric conditions are not affected by the pumping equipment, and there are no power or flow interruptions during the operation.

(A) Requisite Knowledge. Basic pump theory and hydraulics, hose and pump configurations for mines and tunnels, and power supply requirements for dewatering equipment.

(B) Requisite Skills. The ability to connect components and create a dewatering system, pump operation, trouble shooting, and hose management.

17.2.7* Implement support operations at mine/tunnel rescue scene given an assignment, equipment, and other resources, so that a resource staging area is established and managed, scene lighting is provided for the tasks to be undertaken, environmental concerns are managed, supplemental power is provided for all equipment, atmospheric monitoring and ventilation are implemented, personnel rehab is facilitated, provisions for extended patient care and prolonged search and recovery are established, and the support operations facilitate operational objectives.

(A) Requisite Knowledge. Equipment organization and tracking methods, lighting resources, dewatering methods, thermal control options, hand and power tool applications, atmospheric monitoring protocol, rehab criteria, extrication and removal equipment options, and logistics and supply methodology for extended operations.

(B) Requisite Skills. The ability to track equipment inventory, provide power, use lighting, choose and deploy dewatering techniques, use thermal control personal protective equipment (PPE) for rescuers and victims, select rehab areas and personnel rotations, and operate atmospheric monitoring and ventilation equipment.

17.3 Level II General Requirements. The job performance requirements defined in 17.3.1 through 17.3.16 shall be met prior to Level II qualification in mine/tunnel rescue.

17.3.1* Develop a mine/tunnel rescue incident action plan, given a mine/tunnel collapse incident and size-up information, so that size-up information and the incident management system are utilized, safety requirements and communication needs are addressed, existing and potential conditions in the mine/tunnel space are identified, and incident objectives are established and resources are managed.

(A) Requisite Knowledge. Incident-specific size-up information, incident management system, safety planning, communication resources, mine/tunnel hazards and work conditions, and specialized resources for mine/tunnel rescue.

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

17.3.2* Coordinate the use of specialized resources at a mine/tunnel rescue incident, given personal protective equipment, communications equipment, size-up information, specialized resources, and an incident action plan, so that specialized resources usage supports incident objectives; hazards are identified, avoided, monitored, or controlled; and rescuer and resource safety is maintained.

(A) Requisite Knowledge. Specialized resources specific to mine/tunnel rescue, incident management system (IMS), use of incident action plans, communications methods, and mine/tunnel rescue hazards.

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

17.3.3 Breach debris components, given an assignment, personal protective equipment, various types of construction materials, and a mine/tunnel collapse tool kit, so that the opening supports the rescue objectives, the necessary tools are selected, and debris stability is maintained.

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

(B) Requisite Skills. The ability to select and use breaching tools, implement breaching techniques based on construction type, use personal protective equipment, and apply stabilization where required.

17.3.4 Cut through steel components, given a mine/tunnel rescue tool kit, and personal protective equipment, so that the steel is 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 mine construction.

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

17.3.5* Move a heavy load as a team member, given a mine/tunnel rescue tool kit, so that the load is moved the required distance to gain access and control is constantly maintained.

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

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

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

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

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

17.3.7* Stabilize a collapsed mine/tunnel as a member of a team, given size-up information, personal protective equipment, a collapse assignment, a mine/tunnel rescue tool kit, engineering resources if needed, and specialized equipment necessary to complete the task, so that hazards are identified and acknowledged by team members, all unstable structural components are identified, egress routes are established, expert resource needs are determined and requested from command, load estimates are calculated for support system requirements, cribbing and shoring systems are constructed and monitored continuously for integrity, safety protocols are followed, RIC is staged, an accountability system is established, and progress is communicated as required.

(A) Requisite Knowledge. Identification and required care of personal protective equipment, structural load calculations for required shoring system for stabilization, specific hazards associated with mine/tunnel collapse, hazard warning systems, specialized resource and equipment needs, communications and rescuer safety protocols, atmospheric monitoring equipment needs, identification of mine/tunnel configurations, characteristics and cause and associated effects of mine/tunnel collapse incidents, and recognition of potential signs of impending secondary collapse.

(B) Requisite Skills. The ability to select and construct shoring systems to carry heavy loads, use personal protective equipment, perform load calculations, determine resource needs, select and operate basic and specialized tools and equipment, implement communications and rescuer safety protocol, and mitigate specific hazards associated with shoring tasks.

17.3.8 Prepare for entry into a mine/tunnel space, given size-up information, mine/tunnel classification, site map, and a mine/tunnel rescue tool kit, so that personal protective equipment is checked for readiness, specific routes for rescue are identified, accountability is maintained, the RIC is standing by, entry team readiness is confirmed, communication systems are in place, continuous atmospheric monitoring capabilities are used, lighting is established, and safe access and egress control points are identified and managed.

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

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

17.3.9* Enter a mine/tunnel for rescue as a member of a team, given personal protective equipment, identified access/egress routes, a mine/tunnel rescue tool kit, and a pre-entry briefing, so that identified routes are followed, specific mine/tunnel environmental obstacles are negotiated, the victims are located, patient respiratory protection is initiated, disentanglement is accomplished, atmospheric monitoring is maintained, hazard assessment continues, and secondary collapse potential is assessed.

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

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

17.3.10 Determine potential victim locations, given size-up information, witness reports, a mine/tunnel rescue tool kit, and the type and area of the collapse, so that search areas are established and victims can be located.

(A) Requisite Knowledge. Capabilities and limitation of search instruments and resources, types of mine/tunnel construction, and potential collapse patterns, victim behavior, and potential areas of survivability.

(B) Requisite Skills. The ability to use size-up information, use of search devices, and assessment and mapping of the collapse areas.

17.3.11 Conduct a search in a mine/tunnel collapse environment, given personal protective equipment, the mine/tunnel rescue tool kit, 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, mine/tunnel construction and potential 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.

17.3.12* Stabilize a vehicle or machine in a mine/tunnel environment, given a basic extrication tool kit and personal protective equipment, so that the vehicle or machinery is locked/tagged out during the rescue operation, vehicle or machinery is supported, rescue activities will not compromise vehicle or

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machinery stability, stabilization equipment can be monitored, and the risk to rescuers is minimized.

(A) Requisite Knowledge. Types of stabilization devices, lockout/tag-out procedures for vehicles and machinery, methods of vehicle and machinery movement, types of stabilization points and surfaces, AHJ policies and procedures, and vehicle and machinery construction components as they apply to stabilization.

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

17.3.13 Disentangle victim(s), given a mine/tunnel incident involving vehicles or machinery, a mine/tunnel tool kit, personal protective equipment, and specialized equipment as needed, so that victim injury is prevented, victim protection is provided, and stabilization is maintained.

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

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

17.3.14 Package the victim for removal from a mine/tunnel, given a mine/tunnel tool kit and patient transfer devices, so that design limitations are not exceeded, the victim is given the best profile for removal, and further harm to the victim is minimized.

(A) Requisite Knowledge. Spinal management techniques, victim packaging techniques, use of low-profile packaging devices and equipment, methods to ensure packaging equipment design limitations are not exceeded, methods for preventing and treating hypothermia during a prolonged egress, identify and treat hypovolemia during a prolonged egress, and the similarities and differences between packaging for mine/tunnel space and other types of rescue.

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

17.3.15 Evacuate all personnel from a mine/tunnel incident, given personal protective equipment, rope and related rescue equipment, support personnel to operate rescue systems, and a mine/tunnel rescue tool kit, so that internal obstacles and hazards are negotiated, all rescuers and victims are removed from the area, the rescuers and victims are decontaminated as necessary, and the victims are delivered to the EMS provider.

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

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

17.3.16 Terminate the mine/tunnel rescue incident, given isolation barriers, documentation forms, and a mine/tunnel 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 secured.

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

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

Chapter 18 Cave Rescue

18.1 General Requirements.

18.1.1 The job performance requirements defined in 18.2.1 through 18.2.14 shall be met prior to Level I qualification in cave rescue.

18.1.2 The Level II job performance requirements defined in 6.1.1 through 6.2.6 shall be met prior to Level II qualification in cave rescue.

18.2 Level I General Requirements.

18.2.1 Establish and maintain entrance control, given perimeter markings that can be recognized and understood by others, perimeter boundaries are communicated to incident command, and only authorized personnel are allowed access to the rescue scene, so that all known entrances are identified and secured.

(A) Requisite Knowledge. Traffic control flow and concepts, types of existing and potential hazards, methods of hazard mitigation, organizational standard operating procedure, types of zones and staffing requirements, and familiarity with cave and topographic maps.

(B) Requisite Skills. The ability to apply traffic control concepts, position traffic control devices, identify and mitigate existing or potential hazards, apply perimeter identification and personal safety techniques, and read and understand cave and topographic maps.

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

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

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

18.2.3 Select personal protective equipment and provisions for extended cave rescue search, recovery, and extraction operations, given lights, food, water, batteries, hypothermic protection, self-rescue equipment, personal medical kit, and a

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low-profile durable carrying container, so that the rescuer can be self-sufficient for a minimum of 24 hours.

(A) Requisite Knowledge. Psychological considerations, risk of hypothermia, basic first aid techniques, self-extraction techniques, and rationing.

(B) Requisite Skills. Self-assessment situational evaluation and the ability to carry equipment and provisions in a manner conducive to efficient movement and maneuverability throughout the cave environment.

18.2.4 Select personal protective equipment for use in a cave rescue environment that includes water hazards, given a cave/water rescue assignment and assorted items of personal protective and life-support equipment, so that rescuer is protected from temperature extremes and environmental hazards, correct buoyancy is maintained, AHJ protocols are in compliance, and self-rescue needs have been evaluated and met.

(A) Requisite Knowledge. Manufacturer's recommendations, selection criteria of insulating garments, buoyancy characteristics, applications for and capabilities of personal escape equipment, hazard assessment, and AHJ protocols for equipment positioning.

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

18.2.5* Maneuver in the cave rescue environment, given personal protective equipment, established routes, cave rescue tool kit (cache), size-up information, and cave map, so that obstacles specific to the cave environment are negotiated and situational awareness is maintained.

(A) Requisite Knowledge. Use of technical and size-up information, construction and use of rope or other systems for access as applicable to a given environment, and methods for following identified routes.

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

18.2.6 Use single rope techniques to ascend a minimum of 30.5 m (100 ft) in free space, given an anchored fixed rope system, so that the rescuer is secured to the rope with an ascending system that utilizes at least two gripping points of attachment at or above the waist and a quick attachment safety device, the person ascending can stop at any point on the fixed rope and rest suspended by his or her harness, the rescuer can convert the ascending system to a descent system at any time, and a rescuer demonstrates a level of proficiency and fitness that allows the rescuer to continue assigned operations immediately following the ascent.

(A) Requisite Knowledge. Equipment and methodology for fixed rope ascension, rigging principles, down climbing, weight transfer, knot passing, changeovers, passing re-belays, ascent-to-descent system conversion, and alternative techniques designed to cope with adverse environmental conditions and limited light sources.

(B) Requisite Skills. The ability to select equipment appropriate to length of the ascent, secure harness to ascending system and fixed line, self start, ascend line, maneuver around environmental and system-specific obstacles, rest while suspended, convert the ascending system to a descending system while suspended, and complete an edge transition.

18.2.7* Respond as a member of an initial response team given a known patient location so that access routes are established and marked, patient care is initiated, patient packaging considerations are communicated to the medical team, and obstacles to evacuation are identified and communicated to the rigging team.

(A) Requisite Knowledge. Fixed line systems used in the cave environment, methods for marking the route, patient care techniques specific to the cave environment, and concepts and operation of the incident management system as applied to communicating critical information to the other operational task forces.

(B) Requisite Skills. The ability to construct fixed line systems, flag, treat hypothermia, stabilize traumatic injuries common to cave rescue victims, and package patients for long-term extractions.

18.2.8* Establish communications in a cave rescue environment as a member of a communications team, given size-up information and established routes, so that communications are established and maintained between the incident commander and the initial response team, search team, medical in-cave team, rigging teams, evacuation teams, communication teams, and patient transport teams.

(A) Requisite Knowledge. Incident management system, communications protocols, construction and operation of wired radio systems, emergency repair techniques, and familiarity with low-frequency cave radios and the use of runners.

(B) Requisite Skills. The ability to maintain communication logs, install wired communications, operate field telephones, troubleshoot communications failure, and emergency repair of wired communications systems.

18.2.9* Conduct a search in a cave environment as a member of a search team, given a specific area identified by the probability of area plan, personal protective equipment, the cave rescue 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, and potential victim locations as related to the probability of detection (POD) and the probability of area (POA).

(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.

18.2.10 Working as a member of a team, extract a victim from both vertical and horizontal crack and crevice entrapments, given extraction tools, stemples, airbags, and a medical kit, so that the victim is extracted without creating further harm and the rescuers are not exposed to undue risk.

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(A) Requisite Knowledge. Lifting techniques, anchoring techniques including use of stemples and airbags, and signs and symptoms of contact hypothermia, diaphragm breathing, compartment syndrome, and other medical considerations specific to the mode of entrapment.

(B) Requisite Skills. The ability to lift and move victim manually and with mechanical advantage, construct anchor systems utilizing stemples and airbags, and care for patients.

18.2.11* Manage a victim in a cave environment as part of a medical in-cave team, given a victim and basic life support kits and extended patient care plan, so that the basic support medical care of the victim is managed during transport and the potential for further injury is minimized.

(A) Requisite Knowledge. Medical care in a wilderness environment, long-term patient planning, extended medical management techniques, and logistical planning.

(B) Requisite Skills. The ability to develop chronological patient care and action plan, communicate logistical needs, perform ongoing patient assessment, and provide long-term medical care and basic life support in a wilderness environment.

18.2.12 Package the victim for removal from a cave, given a cave tool kit (cache) and patient transfer devices, so that design limitations are not exceeded, the victim is given the best profile for removal, methods and packaging devices selected are compatible with the intended routes of transfer, and further harm to the victim is minimized.

(A) Requisite Knowledge. Spinal management techniques, victim packaging techniques, use of vapor barriers to minimize further hypothermic injury, limitations and use of low-profile packaging devices and equipment, methods to ensure design limitations are not exceeded, and the similarities and differences between packaging for cave space and other types of rescue.

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

18.2.13* Construct and use rope rescue systems as a member of a cave rescue rigging team, given rope rescue equipment designed for the cave rescue environment, so that natural anchor points are identified; anchoring hardware compatible with available anchor points is selected; load factors are considered; an anchor system is constructed; and ascent, descent, lifting, and lowering systems are attached and utilized as required.

(A) Requisite Knowledge. Selection of natural anchors, characteristics of unsafe formations, and selection of anchoring hardware and loading anchors.

(B) Requisite Skills. The ability to select natural anchors, use anchoring techniques using stemples, operate hand and electric drills, and site selection and setting of bolts and hangers correctly oriented.

18.2.14* Remove all victims from a cave as a member of a patient evacuation team, given personal protective equipment, rope and related rescue equipment, personnel to operate rescue systems, and a cave rescue tool kit, so that internal obstacles and hazards are negotiated, victims are extricated from the cave in the selected transfer device, and victims are delivered to the EMS provider.

(A) Requisite Knowledge. Personnel and equipment resource lists, specific personal protective equipment, internal obstacles and hazards, rescue systems and equipment (including applicable rope rescue systems for lowering, raising, and/or traversing a given area), operations protocols, medical protocols, and personnel staging to facilitate patient extraction.

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

18.3 Level II General Requirements.

18.3.1* Conduct a size-up of a cave rescue incident, given an incident and background information, maps, charts, diagrams, forms, information from technical resources and on-site personnel, and personal protective equipment necessary to perform the assessment, so that existing and potential conditions within the cave and the rescue area are evaluated, general and site-specific hazards are identified, witnesses are identified, the total number and probable locations of victims are determined, a risk–benefit analysis is performed, entry and egress are identified, and specialized resource needs are identified.

(A) Requisite Knowledge. Cave hazards, specialized resource requirements, information sources, search guidelines, risk–benefit analysis, means of controlled entry and egress of cave spaces, and terminology.

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

18.3.2 Develop a probability of area plan, given witnesses, local information statements, and scene assessments, so that intelligence is developed and correlated; last known location, activity, and direction of travel of the victim(s) are determined; procedures to recontact the witnesses are established; references are utilized; and an initial direction or pattern of search is determined.

(A) Requisite Knowledge. Elements of an action plan; types of information provided by reference materials and size-up; types of hazards associated with cave 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.

18.3.3* Develop a cave rescue incident action plan, given an incident, size-up information, probability of detection report, and reports from reporting persons or witnesses, so that size-up information and the incident management system are utilized, safety requirements and communication needs are addressed, existing and potential conditions in the cave space are identified, and incident objectives are established and followed.

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

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

18.3.4 Coordinate the use of specialized resources, given a cave rescue scenario outside of the scope of training for a cave technical rescuer, so that specialized resources are considered with respect to the incident management system; specialized resource usage supports incident objectives; hazards are identified, avoided, monitored, and controlled; and rescuer and resource safety is maintained.

(A) Requisite Knowledge. Specialized resources specific to cave rescue, Incident Command System (ICS), use of incident action plans, communications methods, and cave rescue hazards.

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

18.3.5 Terminate the cave rescue incident, given isolation barriers, documentation forms, and a cave 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 secured.

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

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

Annex A Explanatory Material

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

A.1.1 The committee believes that this document specifies the minimum standards for technical rescuers. The committee recognizes that emergency services organizations might have to invest considerable resources to provide the equipment and training needed to perform technical rescues safely and efficiently. The committee does not mean to imply that organizations with limited resources cannot provide technical rescue services, only that the individuals charged with performing technical rescues be qualified at the operations or technician level according to this standard.

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

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

A.1.3.6 Ongoing training and continuing education are necessary to ensure that rescuers remain current in the ever-changing field of technical rescue. Attending workshops and seminars, reading professional publications, and participating in refresher training are ways in which technical rescuers can update their knowledge and skills. Proficiency in current rescue practices can be demonstrated by achieving and maintaining certification through a nationally recognized certifying body.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

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

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

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

A.3.3.4.2 Single-Point Anchor System. A single point anchor system includes those anchor systems that utilize one or more additional nonloaded anchor points as backup to the primary anchor point.

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Table A.1.3 General Duties Table

Site Operations	Patient Management	Maintenance	Rope/Rigging
Size-up	Access	Tools and equipment	Tie knots
Establish incident management system	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

Table A.1.3.3 Chapter Location of Specific Rescue Disciplines or Rescue Technical Matrix

Discipline	Chapter(s)
High/low angle	6
Surface water	11
Vehicle and machinery	10
Confined space	7
Building collapse	9
Trench	8
Mines and tunnels	17
Dive	13
Wilderness	16
Caves	18
Tower	6
Urban	6, 7, 9
Industrial	6, 7, 10
Farm	6, 7, 10
Fireground (rapid intervention)	6, 9
Elevator and escalator	6, 7, 10
Silo	6, 7, 10
Elevated train/subway	6, 7, 10, 17
Wells/cisterns	6, 7
Utility vault/switching station	6, 7
Scaffolding collapse	6, 9
Tram/gondola/ski lift	6, 10
Elevated crane	6, 10
Shipboard	6, 7, 10
Bridges	6, 11
Winery tanks	7
Aircraft	10
Train/light rail	10
Swiftwater	11, 13
Surf	15
Ice	14

A.3.3.8 Attendant. An attendant does all of the following:

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

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

A.3.3.9 Authorized Entrant. The authorized entrant meets the following training requirements:

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

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

A.3.3.10 Basic First Aid Kit. See Table A.3.3.10.

A.3.3.11 Belay. This method can be accomplished by a second line in a raise or lowering system or by managing a single line with a friction device in fixed-rope ascent or descent. Belays also protect personnel exposed to the risk of falling who are not otherwise attached to the rope rescue system.

A.3.3.17 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.

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Table A.3.3.10 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 to 25 mmG flow
Portable suction	
Additional items determined by the AHJ	

A.3.3.28 Community Resource List. A form of agreement or contract negotiated prior to the potential incident with participating concerns will enhance reliability of the resources.

A.3.3.30 Confined Space. A confined space also has one or more of the following characteristics:

(1) Contains or has the potential to contain a hazardous atmosphere
(2) Contains a material that has the 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 have to be addressed by other specialized training and equipment.

A.3.3.35 Confined Space Rescue Preplan. See Figure A.3.3.35.

A.3.3.38 Confined Space Type. Figure A.3.3.38 shows predefined types of confined spaces normally found in an industrial setting. Classifying spaces by "types" can be used to prepare a rescue training plan to include representative permit spaces for simulated rescue practice as specified by OSHA. These types focus mainly on the OSHA-specified criteria of opening size, configuration, and accessibility. Another important factor to consider is the internal configuration (i.e., congested or noncongested).

A.3.3.40 Construction Type. The construction categories, types, and occupancy usage of various structures might necessitate the utilization of a variety of different techniques and materials. The four construction categories that the rescuer most likely will encounter in collapse situations are light frame, heavy wall, heavy floor, and precast concrete construction. These four categories usually comprise the majority of structures affected by a collapse.

A.3.3.45 Crush Syndrome. This muscle death can lead to myoglobinuria, renal failure, muscle loss, and contractions.

A.3.3.46 Cut Sheet. The cut sheet is utilized by an excavating crew to assist them in completing a job. Usually the competent person or job supervisor will have this document in his or her possession.

A.3.3.54 Dive Tables. Figure A.3.3.54 is an illustration of a Recreational Dive Planner.

A.3.3.65 Extinguishing Devices. Many extinguishing mediums can be ineffective if used inappropriately to combat fires involving incompatible materials. The extinguishing medium should be appropriately matched to the class of fire. For instance, use of the wrong type of foam can be completely ineffective based on the type of material being extinguished. The foam should be matched to the specific incident (e.g., polar solvents, nonpolar solvents, pressurized fire, nonpressurized fire).

A.3.3.66 Face(s). Also called *wall*, *side*, or *belly*.

A.3.3.72 General Area. Within the general area, access by people, heavy machinery, and vehicles is limited and strictly controlled.

A.3.3.77 Hazardous Atmospheres. Hazardous atmosphere can result from one or more of the following:

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

A.3.3.83 Heavy Vehicle. Incidents involving multiple common passenger vehicles or complex extrication, or that exceed the resources of the AHJ due to other factors, might also fall into this category.

A.3.3.88 Incident. It is not intended to include medical emergencies or other conditions exclusive of, or not caused by, a condition inside the space.

A.3.3.92 Isolation. Some methods of isolation include blanking or blinding of pipes, misaligning or removing sections of pipe lines or ducts, a double block and bleed system, lockout or tagout of all sources of energy, or blocking or disconnecting all mechanical linkages.

A.3.3.93 Isolation System. Examples of isolation devices include concrete or steel pipe, corrugated pipe, concrete vaults, or other pre-engineered structures that sufficiently isolate and protect the victim.

A.3.3.95 Knot. A knot will maintain its integrity. Although more accurately classified as "ties," the term *knot* is commonly used to refer to knots, bends, and hitches.

A.3.3.112 Load Test. A load test is generally performed by multiple personnel to exert force on the system at the load attachment point in the manner of function before life loading.

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CONFINED SPACE RESCUE PREPLAN

SPACE DESIGNATION: *(e.g., name, ID#, etc.)*

SPACE LOCATION:

STAGING AREA:

SPACE CATEGORY:
❑ Category I–Rescue Available (RA)
❑ Category II–Rescue Standby (RS)

SPACE TYPE (1–6): _____
Elevated ❑ Yes ❑ No
Congested ❑ Yes ❑ No

MEANS TO SUMMON RESCUE SERVICE
❑ Phone ❑ Intercom ❑ Audible Signal
❑ Pager ❑ Radio ❑ Other _____

METHODS OF RESCUE

❑ ***Confirm that attendant has been trained in emergency procedures***

Pre-rigging required? ❑ Yes ❑ No

❑ External (retrieval):

❑ Internal: _____ ❑ Congestion: _____

❑ Hauling system required

❑ Lowering system required/Lowering area: _____

Anchorage ❑ Beam ❑ Welded Steel Handrail ❑ Support Strut ❑ Tripod
❑ Stairwell ❑ Anchored Steel Pipe ❑ Support Column ❑ Other _____

SUGGESTED CSR PREPLANNED TECHNIQUE:
CSR #_____ (1–5)

RESCUE EQUIPMENT REQUIREMENTS *(indicate quantity needed)*

	Hauling System		Carabiners		Pulleys
	Ascenders		Prusiks		Shock Absorbers
	Anchor Straps		Webbing		Line Transfer System
	Swivel				

RESCUE ROPES *(indicate quantity needed; do not include ropes in pre-built systems listed above)*

	Main Line(s) (interior)		Safety Line(s)		Lowering Line(s) (exterior)

MEDICAL & PACKAGING EQUIPMENT *(indicate quantity needed)*

	Spinal Immobilization: ❑ LSB ❑ OSS		Stretcher device: ❑ SKED ❑ STOKES
	Cervical Collar		Medical Kit

ADDITIONAL PPE *(See Permit/MSDS):*

RESCUE PERSONNEL* *(last name, first initial):*

First Responder(s): _____
Team Leader: _____
Safety Line(s): _____
Back-up Rescuer: _____
Rigger: _____
Attendant: _____
Air Watch: _____

** if more than one name listed, list in order of primary responsibility*

SPACE DESCRIPTION/PLAN OF ACTION *(continue on back if necessary):*

ENTRY SUPERVISOR: PHONE #:

REPORT COMPLETED BY: DATE:

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FIGURE A.3.3.35 Sample Confined Space Rescue Preplan Form.

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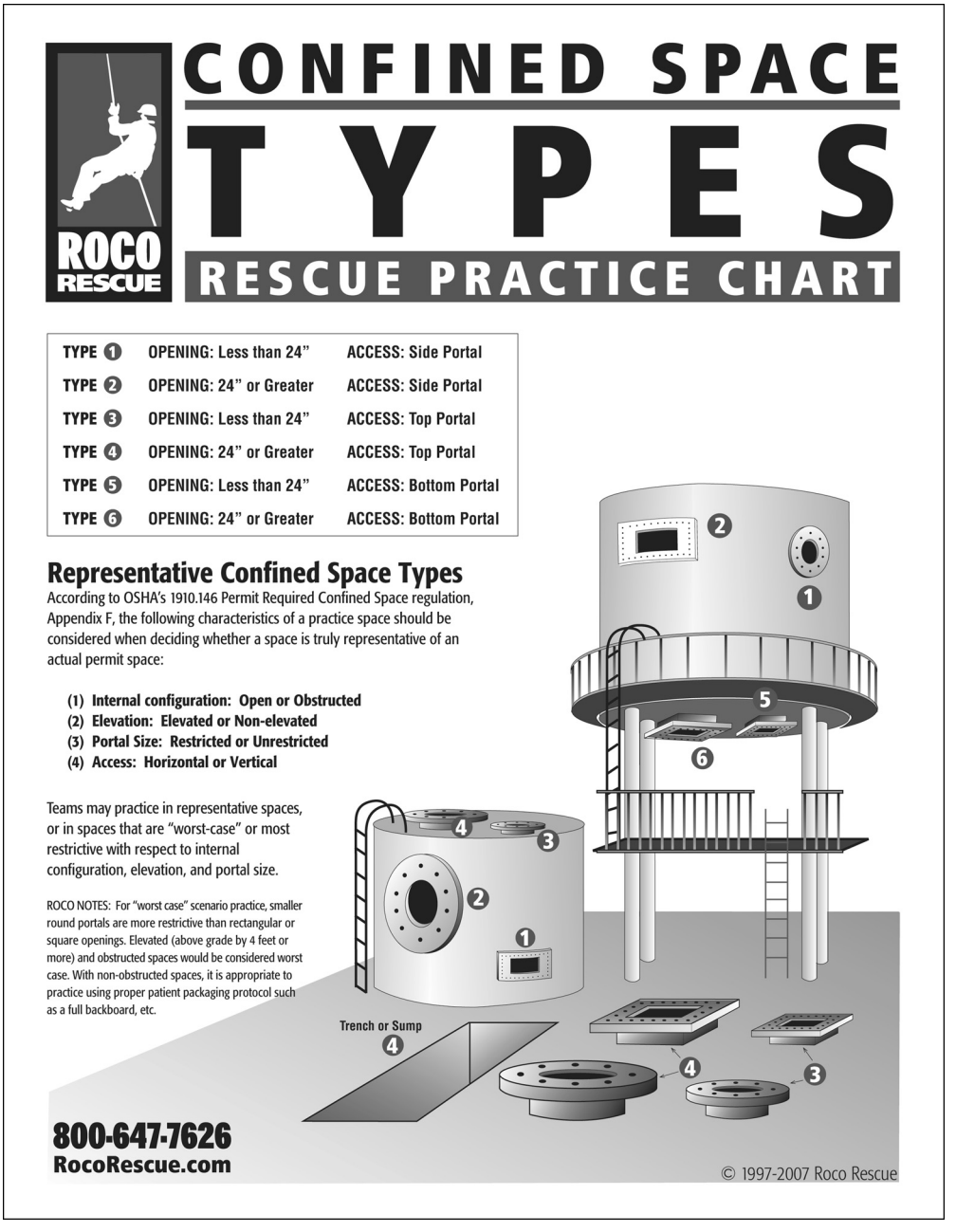

FIGURE A.3.3.38 Confined Space Types.

A.3.3.115 Lowering System. Lowering systems should incorporate a mechanism to prevent the uncontrolled descent of the load during the lowering operation. This mechanism can reduce the need for excessive physical force to control the lowering operation. [**1670,** 2004]

A.3.3.119.2 Single Rope Mechanical Advantage System. Figure A.3.3.119.2 illustrates such a system.

A.3.3.130 Personal Flotation Device (PFD). PFDs are classified by performance criteria into five types with specific limitations on where and under what circumstances each type can be used.

A.3.3.131 Personal Protective Equipment (PPE). Personal protective equipment includes both personal protective clothing and respiratory protection specific to a particular rescue discipline. Adequate personal protective equipment should appropriately protect the respiratory system, skin, eyes, face, hands, feet, head, body, and hearing.

A.3.3.131.1 Water Rescue Personal Protective Equipment. At a minimum, consideration should be given to mobility, flotation, and thermal protection. Rescuers should also evaluate potential for blunt head trauma; entanglement in lines and vegetation; exposure to chemical, biological, and etiological contaminants; the need for an auxiliary emergency air supply; and a means of summoning help when in distress.

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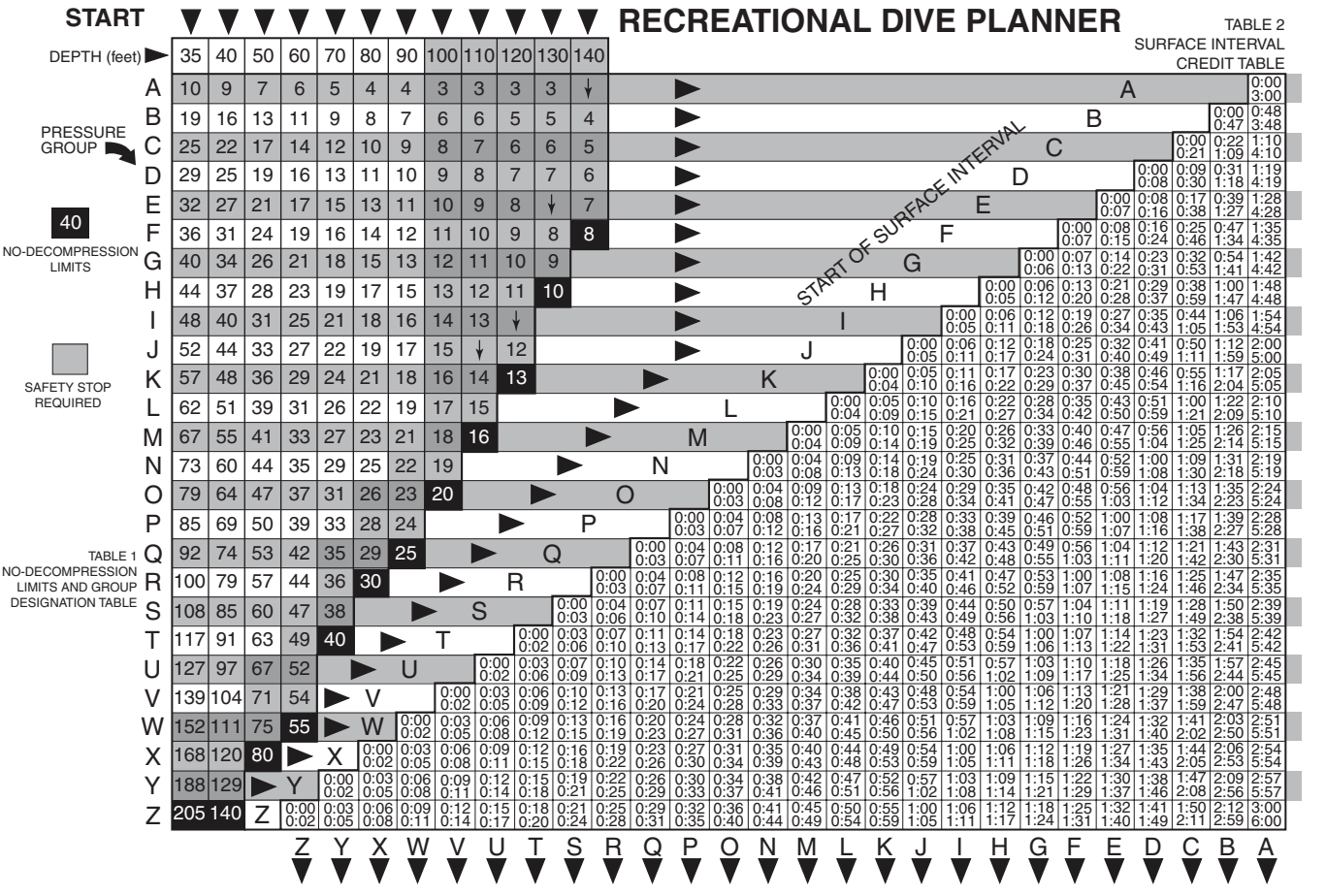

FIGURE A.3.3.54 Dive Table.

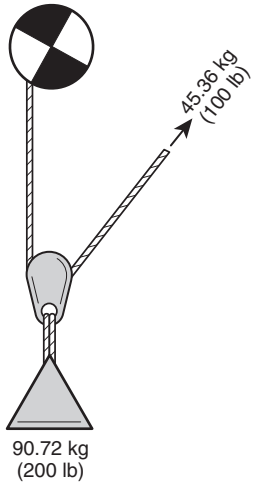

FIGURE A.3.3.119.2 A Simple 2:1 System.

A.3.3.132 Pneumatic Struts. Also refers to devices (which contain potentially hazardous stored energy) mounted on vehicles or machinery to stabilize or hold open doors or hatches.

A.3.3.136 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/tagout 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 are not limited to, the following:

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

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

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

A.3.3.139 Protective System. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection. [**1670,** 2004]

A.3.3.142 Rapid Intervention Crew/Company (RIC). Fire departments respond to many incidents that present a high risk to fire fighter safety. Departments in compliance with OSHA 29 CFR 1910.134, "Respiratory Protection Regulations," have to 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 RIC into their management system. Many departments have redefined their response plans to include the dispatch of an additional company (engine, rescue, or truck) to respond to incidents and stand by as the RIC. Incident commanders can assign additional RICs based on the size and complexity of the incident scene. This OSHA rule is also included as part of special operations incidents in NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program [see sample standard operating procedures (SOPs, in Section 8.8 of NFPA 1500)]*, for RICs. In some departments, an RIC can also be known as a Rapid Intervention Team.

A.3.3.146 Registered Licensed Professional Engineer. However, a professional engineer registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in the construction of protective systems.

A.3.3.152 Rescue Team. The number of persons required for an effective team is dependent upon variables such as the task(s) to be completed, the abilities of the individual team members, and the individuals' ability to work together efficiently. Although many recommendations exist as to an ideal minimum number of team members, this should be based on the circumstances surrounding the incident and the logistics involved. NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents*, recognizes the need for minimum staffing levels for certain technical rescue incidents and contains guidelines to that effect.

A.3.3.153 Retrieval Equipment (Retrieval System). Retrieval includes the operation of common nonentry retrieval systems. Examples include simple winch and block devices used in conjunction with tripods, quadpods, or other manufactured portable anchor systems or existing structural systems. A nonentry retrieval can simply involve operating the crank on a winch/tripod system where anchors and protection systems are already in place. These systems are required wherever an authorized entrant enters a confined space unless the retrieval system would increase the overall risk of entry or would not contribute to the rescue of the entrant. For confined space rescue operations, these systems should be in place prior to entry (into vertical or horizontal spaces) in such a manner that retrieval of rescue entrants can begin immediately in the event of an emergency. Retrieval systems can also be used to act as fall-arresting devices for rescue personnel.

A.3.3.167.1 Active Search Measures. Of primary and immediate importance is locating the point last seen (PLS) of the missing subject. Sometimes, the reporting person (RP) will have no direct knowledge of what happened. For example, the RP can be a family member reporting a group of canoeists overdue at a takeout. At other times, the RP will have witnessed a river accident such as a raft overturning or a fisherman being swept away, and will be able to give a description of the victims and a fairly exact PLS. RPs should be interrogated for all information they might have about the victim, to include physical description, clothing, destination, experience, time the incident occurred, and any other details that might help the search (e.g., the type of shoes worn by the victim).

A.3.3.167.2 Passive Search Measures. The searches at this point are detailed, formal searches, not hasty ones. It is better to have small, trained groups of searchers thoroughly search an area repeatedly than to search with large groups of untrained people, since these frequently trample more evidence than they find. As the search progresses, the incident commander should debrief team leaders frequently and revise the search plan as necessary.

A.3.3.170 Secondary Collapse. Indications of potential for secondary collapse include the following:

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

A.3.3.175 Shield or Shield System. Shields can be permanent structures or can be designed to be portable. They can be either manufactured or job-built. Shields used in trenches are usually referred to as *trench boxes* or *trench shields*.

A.3.3.180 Signaling Device. Examples of signaling devices include, but are not restricted to, flares, strobe lights, mirrors, brightly colored (air) panels, flags, light-emitting devices, smoke pyrotechnics, air horns, and whistles.

A.3.3.183 Sloping System. The angle of incline required to prevent a cave-in varies with the differences in such factors as

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soil type, environmental conditions of exposure, and application of surcharge loads.

A.3.3.190 Specialized Teams. These teams can include, but are not limited to, hazardous materials teams, fire suppression teams, and medical teams.

A.3.3.208 Swim. For the purposes of this standard, any purposeful body positioning in water that a rescuer demonstrates that facilitates movement to a desired objective is construed as swimming.

A.3.3.209 Swim Aids. Examples include, but are not restricted to, webbed gloves, swim fins, boogie boards, and surfboards.

A.3.3.210 System Safety Check. Personnel should review all system components carefully to ensure correct assembly. Personnel should preload the system in a safe manner (e.g., standing away from edges while preloading). A signal is issued by the person performing the system safety check to confirm the completion of the first two steps. The signal should address other rescuers utilizing the system and should be acknowledged by one or more of them.

A.3.3.211 Tabulated Data. Also, the term is applied to six tables found in Appendix C of 29 CFR 1926, Subpart P. [**1670,** 2004]

A.3.3.217 Tidal Water. Due to the connection to the ocean, all tidal water has some degree of salinity, which nontidal water lacks.

A.3.3.220 Tool Kit. See Annex G, Technical Rescuer Tool Kit. The tool kits given as examples are not intended to dictate the items necessary for the specific disciplines they address, nor do they prohibit any jurisdiction from exceeding or deviating from the list. These tool boxes are identified to provide guidance or equipment needed to evaluate candidates.

A.3.3.224 Trench (Trench Excavation). In general, the depth of a trench is greater than the width, but the width, measured at the bottom, is no greater than 4.57 m (15 ft). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 4.57 m (15 ft) or less, the excavation is also considered a trench.

A.3.3.224.1 Intersecting Trench. Common configurations are "L," "X," and "T."

A.3.3.237 Watercraft. Examples include basic paddle boats, powered inflatable boats (I.R.B.), rigid hulled craft, hovercraft, air boats, and one- and two-person water jet–driven (personal) watercraft.

A.3.3.238 Watercraft Conveyance. Examples include trailers, pickup trucks, forklifts, and davits.

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

A.4.2 The following list elaborates these requirements:

(1) *Age Requirements.* The AHJ is empowered to set minimum and maximum age requirements. Due to the fact that technical rescue requires a level of maturity inherent to the rescue environment, it is recommended that the minimum age required to begin training as a technical rescuer be set at 18 years. However, some fire and rescue organizations have set requirements to allow participation by individuals under the age of 18.

(2) *Medical Requirements.* The AHJ should establish medical requirements for initiation of training and continued participation as a technical rescuer. It is recommended that the AHJ adopt NFPA 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments,* in whole or in part as part of their own standard development process.

(3) *Minimum Physical Fitness.* Technical rescue operations involve activities that pose great physical and mental challenges. Technical rescue is an inherently demanding activity requiring the rescuer to perform challenging physical activities in a high-stress environment.

(4) *Emergency Medical Care Training.* Prior to beginning training as a technical rescuer, a minimum medical training requirement should be met. Technical rescuers should be trained at minimum to the level of emergency medical technician–basic, as described in the National Standard Curriculum issued by the U.S. Department of Transportation (DOT), National Highway Transportation Safety Authority. (DOT recommends all emergency responders be trained to the EMT–paramedic level.)

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

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

A.4.3 To be qualified as a rescuer at any level of any specialty, a person first needs to meet a series of core requirements that the committee considers universal to technical rescue activities.

A.5.2.6 It is the intent of this section that technical rescuers 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 technical rescuers be aware of and provide for fire suppression in the event of an aircraft mishap while on location. *(See Figure A.5.2.6.)*

A.5.2.7 The committee recognizes that technical rescue incidents pose unique challenges in terms of safely concluding or demobilizing an event. The sequence and manner in which resources are transitioned out of an event require careful analysis to ensure that scene and rescuer safety are not compromised. Risk management strategies can include both active and nonintervention strategies, such as not removing (abandoning in place) equipment, denying entry to a site, and so forth. A large number of catastrophic events have occurred during the end or termination stages of such events when personnel are fatigued and resources are in a state of transition from active event participation to a return to service.

A.5.4.1 Technical rescuers 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,

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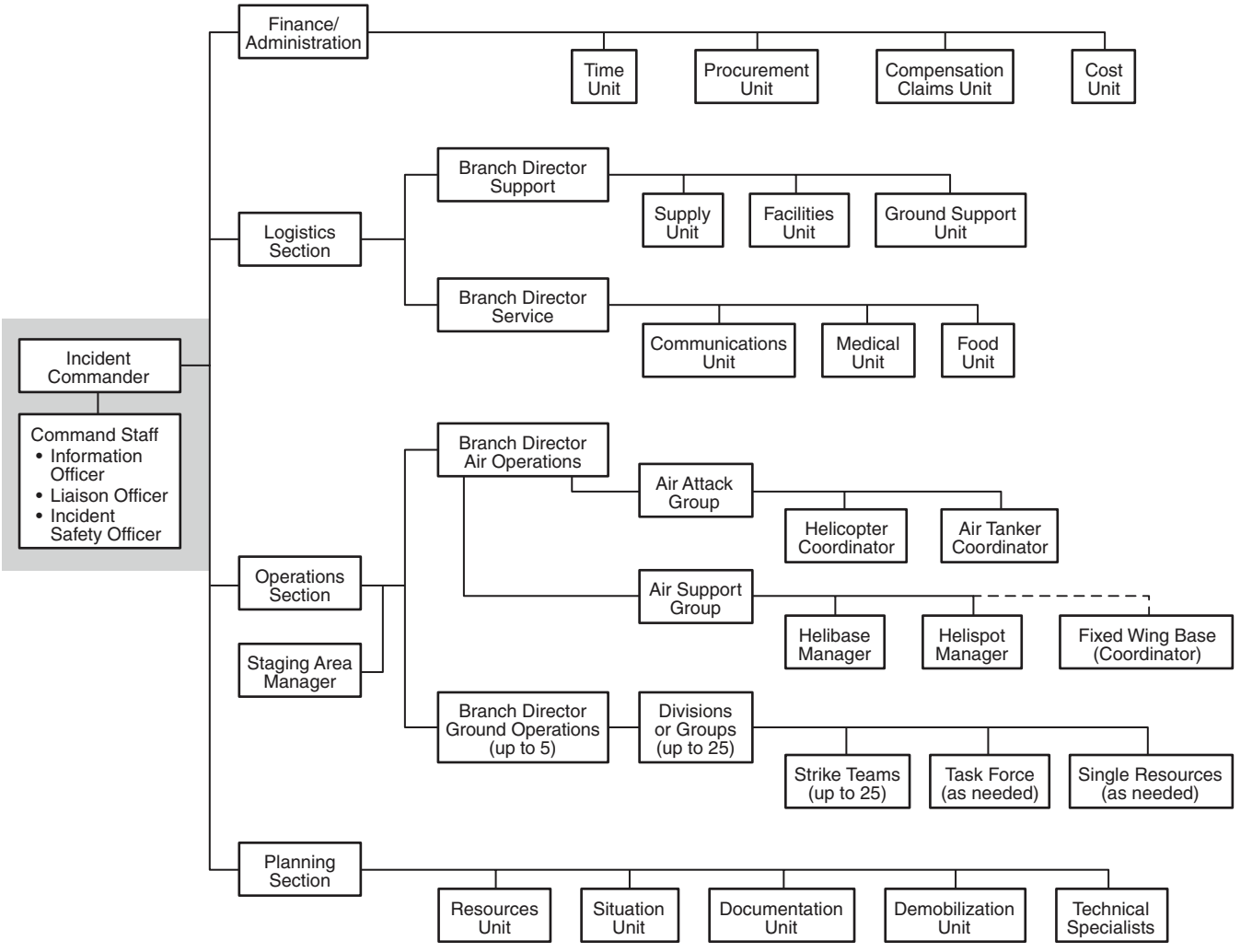

FIGURE A.5.2.6 Sample Incident Management System Organizational Chart.

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 technical rescuer and not addressed within the scope of this standard.

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

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

With reference to the relationship between angles and force within multiple-point anchor systems: When a rope (web) is connected between two anchor points and a load placed in between, an angle is formed. This interior angle acts as a force multiplier. As the angle increases, the force directed along the rope (web) is amplified, increasing the force felt on the anchors. For example, at 120 degrees, the force on each anchor is equivalent to the load. As the angle continues to increase, the force on each anchor rapidly increases *[see Table A.6.1.1(A) and Figure A.6.1.1(A)]*.

In Table A.6.1.1(A), assume a load mass of 200 lb (91 kg) creating a force of approximately 200 lbf (0.89 kN) at the point of attachment.

A.6.2.1 Examples of activities that can be completed can include, but are not limited to, attaching a victim in midair to a rope rescue system, placing edge protection, and transferring a victim suspended from a static webbing or rope lanyard to a separate rope rescue system.

A.6.2.4(A) The urgency of performing transfers of patients suspended from fall protection lanyards (pick offs) has received much attention due to increased awareness of the profound effects and rapid onset of Suspension Induced Shock Syndrome. Rescuers should recognize the need for rapid removal of persons from these potentially life-threatening situations.

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Table A.6.1.1(A) Force Conversion Table

	Force at Each Anchor	
Angle	**lbf**	**kN**
0	100	0.44
30	103	0.46
45	108	0.48
60	115	0.51
90	141	0.63
120	200	0.89
160	575	2.56
170	1,147	5.10
179	11,459	50.97

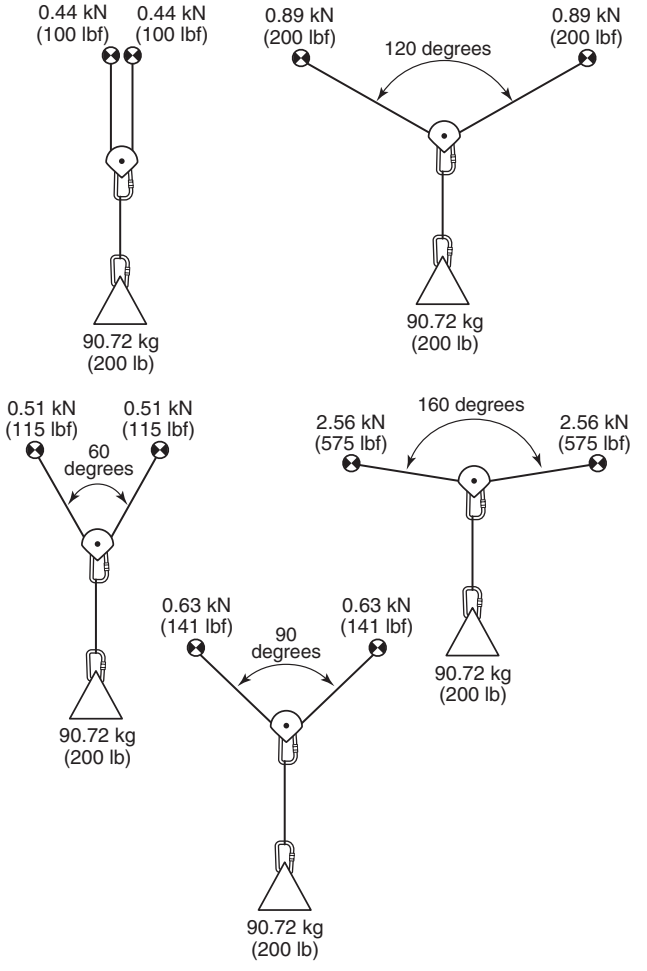

FIGURE A.6.1.1(A) The Effect of Angle Forces on Anchors and Lines: Critical Angles.

A.7.1.1 Acceptable entry conditions for confined spaces are as follows:

(1) Acceptable limits for oxygen concentration in air should be within 19.5 percent and 23.5 percent. An oxygen-enriched atmosphere is considered to be greater than 23.5 percent and poses a flammability hazard. An oxygen-deficient atmosphere is considered to be lower than 19.5 percent and can lead to asphyxiation without fresh air breathing apparatus.
(2) Flammability is measured as a percentage of a material's lower explosive limit (LEL) or LFL. Rescuers should not enter confined spaces containing atmospheres greater than 10 percent of a material's LEL, regardless of the personal protective equipment worn. There is no adequate protection for an explosion within a confined space.
(3) Acceptable toxicity levels are specific to the hazardous material involved, and chemical properties have to be assessed to determine the level of the hazard for a given environment and time frame. The confined space technical rescuer 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 steps:

(1) Identification of the hazards found within confined spaces and an understanding of how those hazards influence victim viability and rescue/recovery operations
(2) Selection and use of monitoring equipment to assess the following hazards:
   (a) Oxygen-deficient atmospheres
   (b) Oxygen-enriched atmospheres
   (c) Flammable environments
   (d) Toxic exposures
   (e) Radioactive exposures
   (f) Corrosive exposures

The confined space technical rescuer should understand the limiting factors associated with the selection and use of the atmospheric and chemical monitoring equipment provided by the AHJ for confined space emergencies. This equipment can include, but is not limited to, the following:

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

Skills relating to use of such equipment include, but are not limited to, calibration, proper operation, response time, detection range, relative response, sensitivity, selectivity, inherent safety, environmental conditions, and nature of hazard.

"Limitations of detection and monitoring equipment" refers to the extent to which the equipment can provide specific readings and how external factors influence the instrument readings and reliability. For example, the following factors should be considered:

(1) Temperature extremes
(2) Cross-sensitivity
(3) Calibration
(4) Power
(5) Time of sampling period
(6) Location of sample
(7) Condition of instrument sensors

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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 (TLVSTEL)
(6) Threshold limit value — time-weighted average (TLVTWA)
(7) IDLH
(8) MSDS
(9) Reference manuals
(10) Computerized reference databases
(11) Technical information centers
(12) Technical information specialists and monitoring equipment

A *confined space rescue on-scene prioritized action plan* is a plan used to mitigate the incident. The components of the plan are as follows:

(1) *Priority 1: Make the scene safe*
   (a) Hazard assessment: Approach to the space and entrance into the space
   (b) Hazard mitigation: Control or remove the hazard
   (c) De-energize and protect the sources of electricity, fluids, hydraulics, and so forth
(2) *Priority 2: Victim contact by primary responder*
   (a) Establish victim location
   (b) Primary medical survey (ABCs)
   (c) Determine mode of injury
   (d) Begin psychological first aid
   (e) Determine feasibility of safe retrieval and retrieve if possible
(3) *Priority 3: Size-up*
   (a) Information gathering
   (b) Resource identification
   (c) Primary responder report
   (d) Brainstorm strategy: risk/reward
   (e) Incident management system (IMS)
   (f) Team member assignments
(4) *Priority 4: Preparation*
   (a) Rescuer personal protective equipment
   (b) Anchoring and rigging rescue equipment
   (c) Authorized entrant review
(5) *Priority 5: Access patient*
   (a) Designate access team leader: one team leader for each group of two or more
   (b) Utilize rescuer retrieval (high-point)
   (c) Designate backup personnel
(6) *Priority 6: Stabilize and package patient*
   (a) First aid to life-threatening injuries
   (b) Secure packaging for rescue transport
(7) *Priority 7: Evacuate*
   (a) Move victim to a safe location
   (b) Provide medical report to EMS
   (c) Remove rescuers
   (d) Emergency retrievals
(8) *Priority 8: Response termination*
   (a) Pick up and inventory gear
   (b) Decontaminate (if necessary)
   (c) Rebuild gear packages for the next call
   (d) Field-evaluate rescuer mental state

A.7.1.4 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.7.2.2 Printed information resources can include, but are not limited to, entry permits, MSDS, and site plans or drawings.

The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

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

It is the intent of the committee that safety and operational protocols include some form of checklist or "permit" for technical 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 472, *Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents*, and 29 CFR 1910.120, "Regulation on Hazardous Waste"
(3) Recognition of the need for a confined space rescue service or additional resources when nonentry retrieval is not possible
(4) Notification of the designated rescue service and other resources necessary for initiation of confined space rescue
(5) 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

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(4) Lockout/tagout 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/tagout 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 Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents*

Competence of Responders to Hazardous Materials Incidents, and 29 CFR 1910.120, "Regulation on Hazardous Waste."

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

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

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

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

The AHJ should address the possibility of members of the organization having physical and/or psychological disorders that can impair their ability to perform technical 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.7.2.2)*; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

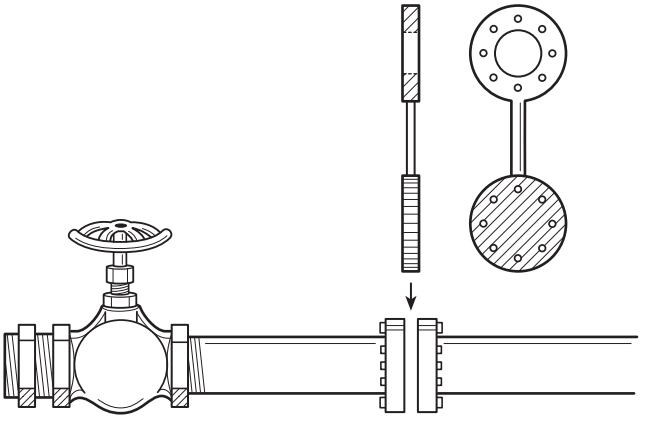

FIGURE A.7.2.2 Blanking or Blinding.

A.8.1.1 Personnel operating at Level I need to be able to recognize hazardous situations and rescue problems that are beyond their capabilities. In these situations, Level I responders need to know where and how to request Level II resources to manage difficult trench collapse rescue events. See Annex F for a full list of hazards and a better understanding of situations that can require a Level II response.

A.8.1.2 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

An example of a tactical checklist is shown in Figure A.8.1.2.

Rapid, nonentry rescues can include placing a ladder to allow a victim to perform a self-rescue or to allow noninjured workers already in the trench to remove a victim. The ladder can be dropped in quickly at the end(s) of the trench by first responders before ground pads are placed. See also *Rapid, Nonentry Rescues* in Annex F.

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TRENCH RESCUE TACTICAL WORKSHEET

Location of incident: _____ Date: _____

_____ Time: _____

SITE ASSESSMENT/INCIDENT INFORMATION

❑ Knowledgeable contact person: _____

❑ Cut sheet ❑ Tabulated data ❑ Other documentation

❑ # and condition of victims: Total burial _____ Partial burial _____ Not trapped _____

❑ Determine mode of operation: ❑ Rescue mode ❑ Recovery mode

❑ Size and area of collapse: Width _____ Length _____ Depth _____

❑ Soil type: A B C Typing method used: ❑ Visual ❑ Manual ❑ Mechanical device

HAZARD ASSESSMENT

❑ Utilities
❑ Secondary collapse
❑ Water in trench
❑ Atmospheric hazards
❑ Ground-level hazards
❑ Tripping hazards
❑ Surface encumbrances
❑ Building instability
❑ Heavy equipment
❑ Blasting
❑ Road traffic
❑ Railroads
❑ Other vibration sources

RESOURCE ASSESSMENT/REQUEST

❑ Trench rescue staffing
❑ Trench rescue equipment
❑ EMS
❑ Police department
❑ Hazardous materials resources
❑ Utility companies
❑ Heavy equipment
❑ Other resources

HAZARD CONTROL

❑ Secure perimeter
❑ Establish an entry control point
❑ Stage incoming apparatus
❑ Atmospheric monitoring
❑ Ventilation
❑ Control vibrations
❑ Remove tripping hazards
❑ Control trench lip (ground pads)
❑ Install ladder in trench
❑ Control utility leaks
❑ Support utilities
❑ Move spoil pile as needed
❑ Install shoring

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FIGURE A.8.1.2 Sample Trench Rescue Tactical Worksheet.

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TRENCH RESCUE TACTICAL WORKSHEET *(continued)*

MANAGEMENT & COORDINATION

- ❑ Scene control
- ❑ Hazard control
- ❑ Team briefing
- ❑ Establish tool/equipment area
- ❑ Assign panel and shore install teams
- ❑ EMS care from outside of trench
- ❑ Plan extrication
- ❑ Prepare patient packaging materials
- ❑ Prepare patient removal rigging
- ❑ EMS interface with patient after trench is shored
- ❑ Removal and transport of patient
- ❑ Rehab of personnel
- ❑ Termination operations
- ❑ Documentation

FUNCTIONS

- ❑ Incident Commander
- ❑ Logistics
- ❑ Rescue Group Supervisor
- ❑ Panel Installation Crew
- ❑ Safety
- ❑ Shore Installation Crew

NOTES

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FIGURE A.8.1.2 ***Continued***

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

(1) Placing ground pads around the lip of the trench to minimize the effect of rescuers' weight on secondary collapse potential.
(2) Controlling or limiting traffic and sources of vibration in the area, including shutting down all vehicles and equipment.
(3) Controlling or limiting access to the area by unnecessary personnel.
(4) Identifying general hazards and affected utilities, and isolating, removing, and/or reducing their impact; also refer to *General Hazards* in Annex F, for more detailed information on general and other hazard types.
(5) Controlling of the utilities in and around a trench or excavation emergency to ensure the safety of responding personnel and victims; the AHJ should have available to rescuers or local public works employees training in the control of these services in order to provide a safe environment in which to operate and to ensure the safety of victims. The following utilities should be considered when providing training:
   (a) Electrical services (primary and secondary)
   (b) Gas, propane, fuel oil, or other alternative energy sources (primary systems)
   (c) Water/steam
   (d) Sanitary systems
   (e) Communications
   (f) Secondary service systems (such as compressed, medical, or industrial gases)

An RIC, as specified in Section 8.5 of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, should consist of rescuers at or above the capability level at which the incident is operating.

A.8.1.3 Support operations can include, but are not limited to, the following functional sectors in the incident management system:

(1) *Ventilation Sector.* Monitors and ventilates personnel
(2) *Extrication Sector.* Prepares for extrication methods and tactics
(3) *EMS Sector.* Plans for ongoing patient care, transfer, and transport in coordination with the incident commander and receiving hospital
(4) *Support Sector.* Can handle lighting, power, and environmental management
(5) *Cut Station*. Handles construction and fabrication of shoring materials

A.8.1.4 It is the intent of the committee to define the outcomes desired for each job performance requirement. The methods and equipment used to reach that outcome, in this case the shoring of a "nonintersecting" trench, should be those that best suit the particular needs and resource availability of the AHJ.

The term *tabulated data* usually refers to the six tables found in Appendix C of 29 CFR 1926, Subpart P. Tabulated data can also be in other written form where the protective system and its installation have 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.8.1.5 Trench rescue by nature is a time-consuming endeavor. The time can be minimized by careful planning and division 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., an extrication sector). Any unwarranted delay can severely affect the survivability of the victim. In addition, an EMS sector should be assigned so that information on victim injuries and stabilization equipment can be processed so that treatment can be initiated and maintained. The treatment of crush syndrome must begin *before* the victim is released from the offending compressive weight, or the victim will quickly succumb to the effects of the toxins released into the bloodstream.

A.8.1.6 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.8.1.7 Disassembly of trench support systems is often the most dangerous portion of a rescue operation. The victim has been removed and transported, the tension and adrenaline have subsided, and it is a setting for potential catastrophe. Rescuers must maintain their attentiveness and safety policies until all equipment and shoring material is removed from the trench. The trench entrants must be vigilant about staying within the "safe zone" while removing struts in the reverse order that they were placed. They must leave the trench completely before pulling the last shores out with ropes. Arrangements should be made to have physical barriers placed to minimize further opportunities for an accident and to turn control of the incident site over to the AHJ or jobsite contractor. Equipment should be cleaned thoroughly and maintained to the manufacturers' recommendations. Damaged and lost equipment should be documented as such, and reports should be completed for recordkeeping and review. And, finally, the rescue team should have a postbriefing to discuss effectiveness of strategies, tactics, equipment, and personnel. Signs of critical incident stress syndrome should be monitored and addressed.

A.8.2.1 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

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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.8.2.2 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.8.2.3 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.8.2.4 See A.8.2.3.

A.8.2.5 Deciding the mode of operation (rescue vs. recovery) and conducting a risk–benefit analysis should guide the selection of strategy in the possible use of heavy equipment. Strong consideration has to 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 the following:

(1) Placing a trench box or isolation system
(2) Excavating around an existing protective reinforced or engineered structure for access
(3) Sloping or 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.8.2.6 Trench rescue by nature is a time-consuming endeavor. The time can be minimized by careful planning and division of the tasks that need to be performed simultaneously. The rescuers in the trench should identify the tools needed to disentangle the victim. These tools can be limited to shovels to remove entrapping soil or can include exothermic torches, air bags, and cribbing, depending on the nature of the entrapment. There should be rescuers assigned topside to assemble, prepare, and deploy whatever resources are necessary to complete disentanglement (i.e., extrication sector).

Any unwarranted delay can severely affect the survivability of the victim. In addition, an EMS sector should be assigned so that information on victim injuries and stabilization equipment can be processed and so that treatment can be initiated and maintained. The treatment of crush syndrome must begin *before* the victim is released from the offending compressive weight, or the victim will quickly succumb to the effects of the toxins released into the bloodstream.

A.9.1.1 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, commercial)
(6) Number of known and potential victims
(7) Access to the scene
(8) Environmental factors
(9) Available and necessary resources

A.9.1.6 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.9.1.9 Utilization of the victim transfer devices authorized by the AHJ should include horizontal and vertical applications, proper patient securing methods, and rigging attachments.

A.9.1.10 When lifting a load by utilizing basic hand tools (prybars), jacks, and airbags available in the tool kits, the load should be stabilized during the lifting operation using a recognized cribbing stabilization system so that movement of the load is controlled throughout the lift.

A.9.1.11 The load should be moved a distance of 6.10 m (20 ft) utilizing pipes as rollers. This process includes main-

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taining constant control of the load and its direction of travel and application of any necessary rigging to complete the task.

A.9.1.13 Cribbing systems should consist of the following five basic configurations of cribbing, shown in Figure A.9.1.13:

(1) Two-piece layer crosstie
(2) Three-piece layer crosstie
(3) Platform crosstie
(4) Triangle crosstie
(5) Modified crosstie

Included in this section are the knowledge of the advantages, disadvantages, and limitations of each type of system.

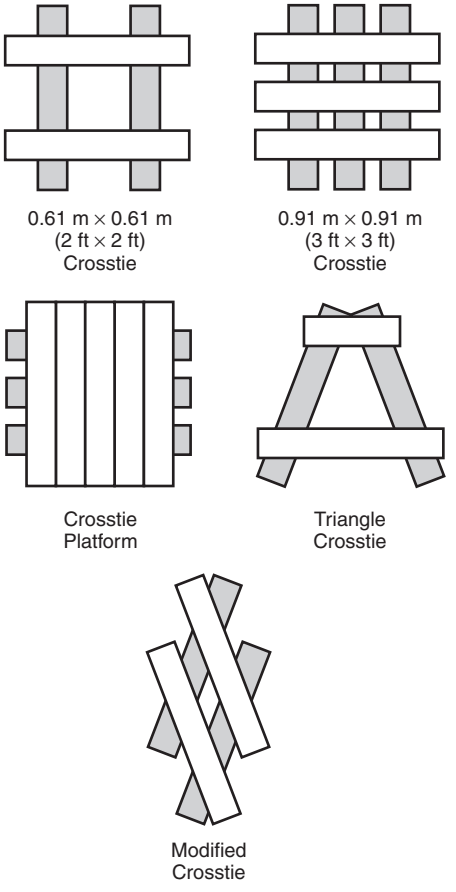

FIGURE A.9.1.13 Five Basic Configurations of Cribbing.

A.9.2.14 Application of the methods, materials, and devices necessary to shore windows, doors, floors/roofs, and walls in heavy construction–type structure should include the usage of the Ellis clamp systems, Ellis post screw jacks, pneumatic/mechanical shores, Lace post shoring systems, horizontal shores, and cross-tied Raker shores (single, double, and triple diagonal).

A.10.1.2 The intent of this section is to establish working zones in, around, or near a working incident. It is expected that the established zones function with AHJ incident management systems currently in place.

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

A.10.1.3 The intent of this section is to provide fire control measures and teams at the scene of working rescue incidents. These teams should be in the ready position with a charged hose line of at least 38 mm (1½ in.) diameter or greater (no booster lines) to function as a rapid intervention and extinguishment team. This section implies having an independent water source (i.e., attack pumper) with sufficient extinguishment agent on board to mitigate any unforeseen fires or explosions. Further, it is the intent of this section to have the rapid intervention personnel standing by in donned, self-contained breathing apparatus but not necessarily hooked up/into breathing air. This state of readiness should be maintained until the incident management structure authorizes de-escalation in accordance with AHJ procedures.

A.10.1.4 The five directional movements to be considered during the stabilization process are defined as follows:

(1) *Horizontal Movement.* Vehicle moves forward or rearward on its longitudinal axis or moves horizontally along its lateral axis.
(2) *Vertical Movement.* Vehicle moves up and down in relation to the ground while moving along its vertical axis.
(3) *Roll Movement.* Vehicle rocks side to side while rotating about on its longitudinal axis and remaining horizontal in orientation.
(4) *Pitch Movement.* Vehicle moves up and down about its lateral axis, causing the vehicle's front and rear portions to move left or 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.10.1.5 It is the intent of the committee that rescue personnel 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.10.1.10 It is the intent of the committee that specific attention be given to maintaining scene safety and security during termination activities due to the high frequency of responder injuries during this operational phase. Hazards present at the conclusion of an event must be communicated to the party responsible for the scene, including damage or modification to equipment or vehicles due to the extrication process, and responsibility for scene control transferred to them. Consideration should also be given to preserving the integrity of the scene for investigation by AHJs.

A.10.2.1 It is the intent of the committee that the differentiation between Level I and Level II incidents correlate to both the environment in which the rescue is to be conducted as well as the level or degree of entrapment. It is recommended that provider agencies develop clear guidelines for making this determination based on the AHJ's resources and capabilities.

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Level I rescue skills are applicable to vehicle or machinery events involving common passenger vehicles or simple small machinery, and involving environments where rescuer intervention does not constitute a high level of risk based upon the environment or other factors.

Level II skills apply to those incidents where commercial or heavy vehicles are involved or that involve heavy machinery; complex extrication processes have to be applied; multiple uncommon concurrent hazards are present; or that involve more than digital entrapment of a victim.

This is an example of a standard operating guideline (SOG) dealing with making this determination for transportation incidents:

(1) *Level I Intervention*: Any situation involving rescue of entrapped civilians or personnel that involves common passenger vehicles (autos, light trucks)
(2) *Level II Intervention*: Any situation that exceeds the criteria for a Level I Intervention or meets the following criteria:
    (a) Complex passenger extrications
    (b) Extrications involving other disciplines (hazmat, changes in elevation, etc.)
    (c) Truck, bus, or special vehicle extrications
    (d) Multi-vehicle extrications exceeding AHJ resources

This is an example of an SOG dealing with making this determination for machinery incidents:

(1) *Level I Intervention*: Any situation involving rescue of entrapped civilians or personnel that meets the following criteria:
    (a) Small machinery with any entrapment
    (b) Machinery parts easily disassembled or exposed
    (c) Machinery parts made of lightweight materials
(2) *Level II Intervention*: Heavy vehicles or machinery

A.10.2.2 See A.10.2.1.

A.11.1.1 Water environments can include, but are not limited to, swiftwater, still water, ice-covered water, and tidal water. Rescuers should demonstrate the requisite knowledge of each water environment anticipated within the geographical confines of the AHJ and their associated tactical and safety considerations as part of this competency.

A.11.1.2 Temperature extremes include both hypo- and hyperthermia. Personal protective equipment users have to be aware of the potential for either condition to develop strategies for avoidance and recognition. Adequate flotation is dependent upon the mode of operation. As an example, for surface rescue, positive buoyancy is desired, whereas for underwater operations, neutral buoyancy should be maintained. Proper fit of personal protective equipment is determined by the manufacturers' specifications and related documentation; the primary intent is that the safety and efficiency of the rescuer is not impaired or the garments' capabilities exceeded.

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

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

A.11.1.2(B) Selection of water rescue personal protective equipment, so that the rescuer will be protected from temperature extremes and blunt trauma, the rescuer will have flotation for tasks to be performed, swimming ability will be maximized during rescue activities, self-rescue needs have been evaluated and provided for has been established, and a means of summoning help has been provided.

A.11.1.3 *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 might 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, in order to aid the trackers).

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

A.11.1.6 Both throw rope deployments should be conducted sequentially, to the same victim, within a span of approximately 40 seconds to a victim 12.19 m (40 ft) away from the rescuer.

A.11.1.7 See A.11.1.6.

A.11.1.8 The committee's intent is for the candidate to know what procedures are used when using watercraft in their jurisdiction, or at least basic watercraft deployment and recovery techniques, even if the AHJ does not have its own watercraft. This includes the rescuer's role on the boat, nomenclature, and use of emergency/safety equipment (fire extinguishers, flares, flotation devices, etc.). The committee understands that not all water rescue teams have boats and not all boat operators are knowledgeable about deploying rescuers. In this case, the technician should be able to act as a liaison between the team and the boat operator.

A.11.1.9 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

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

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

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

A.11.1.12 Many programs exist to evaluate a minimum swim capability through a designated water course. These programs range from recreational to swiftwater applications. The AHJ should devise or adopt a minimum swim capability based on the response area needs.

A.11.1.13 Water conditions and temperature will be assessed and the appropriate levels of protection identified by the AHJ based on its response area and conditions present. Classes of personal flotation devices are identified by the AHJ and applicable regulatory agencies [e.g., U.S. Coast Guard, International Maritime Organization (IMO)].

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

A.11.2 This chapter is for rescue situations with water moving less than 1 knot.

A.11.2.1 A realistic evaluation of the rescuer's water survival skills should be conducted by the AHJ to meet this requirement. It is recommended that the AHJ use an annual swim test that meets or exceeds the IADRS Annual Watermanship Test. Example: Swim 91.4 m (100 yards) unassisted with any stroke, no time limit, and tread water for 10 minutes.

A.11.2.2 The committee includes the IADRS Annual Watermanship Test *(see Annex I)* as an example of a method of evaluating swimming surface rescue as it applies to this standard but recommends that rescue swimmers conduct the "tow" exercise with the appropriate PPE used for surface water rescue, not SCUBA.

A.13.1.1 Communication procedures could include routine electronic voice communication and rope signals to be used for redundancy to communication failures. Procedures to provide for underwater breathing techniques should provide for the ability to deliver air to a diver with mask failure.

A.13.1.3 Resources should include the consideration of high-tech electronics such as sonar, underwater video, ROV units, and the use of canine teams.

A.13.1.4 The committee's intent is for the candidate to know the procedures for using watercraft in the AHJ's jurisdiction, or at least basic watercraft deployment and recovery techniques, even if the AHJ does not have its own watercraft. This includes the diver's role on the boat, nomenclature, and use of emergency/safety equipment (fire extinguishers, flares, flotation devices, etc.). The committee understands that not all dive teams have boats and not all boat operators are knowledgeable about deploying divers. In this case, the technician should be able to act as a liaison between the team and the boat operator.

A.13.1.6 Drowned victims can be treated as potential homicides until proven otherwise. Therefore, the search area should be treated as a potential crime scene and appropriate evidence secured and documented *(see Figure A.13.1.6)* according to AHJ protocol.

A.13.1.8 The committee intends that this JPR should measure the technical rescuer's ability to assist (or rescue) other divers, including his/her buddy, on the surface. Surfaced divers, because of the nature of their injuries or the equipment they are using, can require specialized assistance.

A.13.2 The committee is of the opinion that Advanced Open Water certification provided by most nationally recognized certifying agencies (agencies associated with the Recreational SCUBA Training Council) build an acceptable foundation for the basic SCUBA skills required for dive technical rescuer. These courses do not, however, offer all of the skills required to meet these standards, and further training and experience in special hazards expected to be encountered in the AHJ's territory should be sought.

Candidates should have experience diving in various environments by taking additional specialties. Examples of specialties include ice, current, hazardous materials, dry suit, and lifting operations. Annual confirmation of these skills should be performed to ensure continued competency. An example of these skills can be found in Figure A.13.2.

Candidates should demonstrate leadership skills similar to that of a "Divemaster" as defined by the Recreational SCUBA Training Council. The dive technical rescuer should have documented substantial dive experience in varied environments and have the ability to supervise and lead others. These personnel should also be able to employ checklists to identify pre- and post-dive needs.

Examples of specialty diving include dry suit, full face mask, underwater communications, deep diving, night and limited visibility, current, polluted water, leadership, lifting, cave, surface supplied, and ice.

A.13.2.2 Examples of personal protective equipment utilized in dive rescue are buoyancy control devices, masks, fins, snorkels, regulator sets (including first and second stages), redundant air systems, consoles (with submersible pressure gauge, depth gauge, dive timer), thermal protection, and lighting systems. Figure A.13.2.2 is an illustration of a pre-dive safety checklist.

A.13.2.3 The committee recommends the diver perform these skills in a blacked-out mask to test ability to perform in a low-visibility environment. The reason this is being done in a pool or confined water environment is so that the student can be observed for problems prior to being exposed to the actual low-visibility environment. These skills involve locating and utilizing personal emergency equipment (not limited to cutting devices, secondary air system, communications equipment, etc.) positioned according to AHJ protocols. PPE should include the use of dry suits.

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DIVE SITE DIAGRAM

Incident location:

GPS coordinates: **Lat:** **Long:**

Closest access:

Type of access:

Conditions	**Witness name and phone**
❑ Weather _____ ❑ Surface _____ ❑ Current _____ ❑ Visibility _____ ❑ Water temp. _____ ❑ Thermocline _____ ❑ Surf _____ ❑ High tide _____ ❑ Low tide _____	❑ **1** _____ ❑ **2** _____ ❑ **3** _____ ❑ **4** _____

Scene diagram

Number indicates witness location.
Letter indicates evidence location.

Block = ___ ft (___ m)

FIGURE A.13.1.6 Sample Form for Dive Site Diagram.

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I.A.D.R.S. Annual Basic Scuba Skills Evaluation

Diver's Name: _____ Department: _____

Air Consumption: Start _____psi / Finish _____psi Time: Start _____ / Finish _____ / Total _____

Water Depth: _____Pool / Open Water (circle one) Examiner: _____

Task grading: S = Satisfactory N = Needs Improvement (specify) N/A = Not Applicable (use for equipment only)

Equipment Handling and Set-Up

_____ - properly assembles equipment (basic gear / specialty gear)
_____ - shows familiarity and comfort with equipment
_____ - properly protects equipment (i.e. tank valve / regulator)
_____ - review (line & hand signals / air consumption rates / buddy awareness / emergencies / diver log)

Watermanship Skills

_____ - 500 yard continuous forward stroke swim - no swim aids for time (refer to grading criteria)
_____ - 15 minute tread / last 2 minutes with hands out of water (refer to grading criteria)
_____ - 800 yard snorkel swim (refer to grading criteria)
_____ - 100 yard inert diver rescue tow (refer to grading criteria)

Skin Diving Skills

_____ - mask clearing
_____ - snorkel clearing (popping & expansion)
_____ - snorkel without mask (led by partner, 1 lap)
_____ - fin kicks (flutter / dolphin) one length each, using mask and snorkel
_____ - in water surface dives (head first / feet first)

SCUBA Diving Skills

_____ - entries (giant stride / seated or controlled entry)
_____ - neutral buoyancy control (oral / power) inflation
_____ - dry suit buoyancy control and emergency procedures (i.e. hose disconnect or flooding)
_____ - regulator clearing (blowing / purging) and retrieval
_____ - regulator without mask (led by partner, 1 lap)
_____ - full face mask (removal / switch to regulator / clearing full face mask / replace full face mask)
_____ - descent procedures (signal / check time & air / raise inflator hose / feet first descent / clear ears)
_____ - ascent procedures (signal / check time & depth / + buoyancy / raise inflator hose / ascend @ 20ft/min)
_____ - air sharing at depth and during ascent
_____ - buddy breathing at depth and during ascent
_____ - emergency swimming ascent procedures (simulate out of air / signals / ascends / continuous exhaling / surfaces / inflates BC orally using bobbing technique)
_____ - emergency buoyant ascent procedures (simulate out of air / signals / drops weights / ascends / continuous exhaling / surfaces / inflates BC orally using bobbing technique)
_____ - weight belt (removal / replacement) on surface and bottom
_____ - buoyancy control device (removal / replacement) on surface and bottom
_____ - OPTIONS: Blackout Mask / Night Dive / Navigation / Confidence Obstacle Course

Performance Comments: _____

Equipment Care and Storage

_____ - properly disassembles equipment
_____ - cleans and restores equipment properly

Additional copies available at no charge via the International Association of Dive Rescue Specialists webpage. Visit www.IADRS.org

FIGURE A.13.2 IADRS Annual Basic SCUBA Skills Evaluations Form.
(Courtesy of Dive Rescue International.)

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PRE-DIVE SAFETY CHECKLIST

Position	Name
Incident commander	
Safety officer	
Rescue group supervisor	
Line tender	
Diver	
Safety diver	

Buddy Checklist

- ❑ Buddy equipment check
- ❑ Hand signals
- ❑ Lost buddy/communications procedure
- ❑ Emergency ascent procedure
- ❑ Line signals
- ❑ Procedure for diver in need of assistance

Conditions

- ❑ Weather _____
- ❑ Surface _____
- ❑ Current _____
- ❑ Visibility _____
- ❑ Water temp. _____
- ❑ Thermocline _____
- ❑ Surf _____
- ❑ High tide _____
- ❑ Low tide _____

Safety Procedures

- ❑ Max. depth _____
- ❑ Max. bottom time _____
- ❑ Min. PSI to surfacing _____
- ❑ Direction _____
- ❑ Compass heading _____

Search

- ❑ **RESCUE VS. RECOVERY**
- ❑ Search pattern _____
- ❑ Review procedure for found object

Equipment Recommendations

- ❑ Tank size _____
- ❑ Suit _____
- ❑ Hood & gloves _____
- ❑ Mask/fins/snorkel/booties
- ❑ Weight belt
- ❑ BCD
- ❑ Regulator & alternate
- ❑ Depth gauge & pressure gauge
- ❑ Compass
- ❑ Comm. device _____
- ❑ 2 cutting devices _____
- ❑ Other equipment: _____
- ❑ _____
- ❑ _____

Back-Up Diver Information

- ❑ Has recommended equipment
- ❑ Weight _____
- ❑ Pressure group start _____
- ❑ PSI start _____
- ❑ Safety diver ready _____
- ❑ PSI ending _____
- ❑ Pressure group ending _____

Primary Diver Information

- ❑ Has recommended equipment
- ❑ Weight _____
- ❑ Pressure group start _____
- ❑ PSI start _____
- ❑ Time on air _____
- ❑ PSI ending _____
- ❑ Pressure group ending _____

FIGURE A.13.2.2 Sample Pre-Dive Safety Checklist.

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A.13.2.4 The understanding of the committee is that candidates for this specialty should have obtained prior SCUBA certification and, as a result, have met basic watermanship requirements. The committee's opinion is that candidates should have the ability to swim a designated watercourse similar to the conditions that will be encountered in the AHJ's territory in order to determine the candidate's ability to perform self-rescue. The committee recommends that the skills involved in this test be more strenuous than what is expected for civilians to perform for enrolling in an Open Water SCUBA course.

An example of a Divemaster-level watercourse for watermanship would be a concurrent 365.76 m (400 yard) swim, 15-minute water tread or "drownproofing," 731.52 m (800 yard) swim using mask, fins, and snorkel, and a 91.44 m (100 yard) inert diver tow. At no point should the diver utilize flotation aids to assist in the swim. The inert diver is not permitted to assist in propulsion, but the task is not to be a "rescue" skill. See Figure A.13.2.4.

A.13.2.6 Examples of personal protective equipment utilized in dive rescue are buoyancy control devices, masks, fins, snorkels, regulator sets (including first and second stages), redundant air systems, consoles (with submersible pressure gauge, depth gauge, dive timer), thermal protection, and lighting systems.

A.13.2.8 The committee intends that this JPR should measure the technical rescuer's ability to assist (or rescue) other divers, including his/her buddy, at depth. Because of the nature of their injuries or the equipment they are using, some divers may require specialized assistance. Rescue divers must be cognizant of buoyancy and barotrauma issues in relation to the ascent of the diver they are trying to assist.

A.13.2.9 The committee's intent is that skills should be performed in a controlled situation that replicates the worst conditions expected to be encountered in the AHJ's territory. The intent is to determine the candidate's ability to perform assigned tasks and to effect self-rescue. The skills involved in this test should be at least as strenuous as what is expected for civilians to demonstrate for Divemaster certification.

A.15.1.2 Surf (wave) heights are defined by the distance on the face, or front, of a wave from the trough (bottom) to the crest (top) just before the wave breaks. Low surf should be defined as surf that is found to be normal for the environment found in the AHJ. High surf can be described as being greater than normal for the environment found in the AHJ.

A.15.1.3 Nonmotorized watercraft refers to items like kayaks, surfboards, rafts, or boats.

A.15.1.4 Motorized watercraft includes items like motorboats, Jet Skis, and other motorized personal watercraft.

A.16.1.2 It is the intent of the committee that wilderness technical rescuers recognize the need to document and preserve evidence, especially at the potential scene of a crime. Knowledge and skills include understanding and maintaining the "chain of evidence," camera operations, scent article handling and preservation, clue awareness, interview skills of corroboration witnesses, basic drawing skills, and specific scene situation considerations (e.g., evidence of crash, injury, and dead bodies).

A.16.1.3 It is the intent of the committee that the technical rescuer have enough survival equipment, food, water, and other necessary materials to operate independently for 3 days in the wilderness environment. Wilderness skills and knowledge include the ability to construct improvised shelter, prepare supplied food, purify drinking water, utilize established primary and emergency communications mediums, select and use layered clothing, and apply land navigation resources.

A.16.1.10 It is the intent of the committee that a person working in a wilderness environment will be able to manage the long-term medical care of a victim, with *long-term* meaning the time it takes to remove the victim from the wilderness environment and deliver him or her to a medical facility (possibly ranging from 1 hour to 5 days or longer, depending on the environment). The wilderness technician should have at least a thorough knowledge of basic life support, and advanced life support training is recommended so that IV fluids and other advanced life support measures can be utilized.

A.16.1.11 Packaging materials can include spinal care devices, thermal barrier, vapor barrier, and splints. Victim transport devices can include rigid basket-type litters and flexible wrap-around litters.

A.17.1.2 The requirements of this chapter do not apply to operating mines, tourist mines, basements, or subterranean structures that are complete and in use or that meet the definition of a confined space.

Other standards and regulations already cover rescue and emergency procedures for many underground structures and excavations. It is the intent of the committee to provide responders with minimum standard of emergency response and training for structures not otherwise covered and to provide this minimum standard as an adjunct or additional resource where this document overlaps with existing regulations.

Entry into tunnels under construction is regulated by local, state, and federal statute, which place specific requirements on all entrants. These requirements include, but are not limited to, site familiarization, local emergency procedures, and access to "egress only" respiratory protection (i.e., self rescuers, self-contained self rescuers).

In some cases, emergency response to incidents in the completed structure may be not be regulated at all because of installed fire and life safety systems. Examples of this include subway stations, road tunnels, and parking garages. In such instances, this document strives to offer insight to emergency responders who are called to the scene of such structures for events that have compromised those safety systems. Such structures require comprehensive planning to ensure adequate response in the event of an emergency.

Emergency services that are the primary provider of rescue services for operational mines are required to comply with Department of Labor, Mine Safety and Health Administration rules regarding emergency response. Emergency services that are the primary provider of rescue services for tunnels under construction are required to comply with federal and local laws regarding tunnel rescue.

A.17.1.3.1 The definition is not intended to include medical emergencies or other conditions exclusive of, or not caused by, a condition inside the space.

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I.A.D.R.S. ANNUAL WATERMANSHIP TEST

Evaluation Parameters

There are five exercises that evaluate stamina and comfort in the water, each rated by points.
The diver must successfully complete all stations and score a minimum of 12 points to pass the test.
The test should be completed with not more than 15 minutes between exercises.

Exercise 1: 500 Yard Swim

The diver must swim 500 yards without stopping using a forward stroke and without using any swim aids such as a dive mask, fins, snorkel, or flotation device. Stopping or standing up in the shallow end of the pool at any point during this exercise will constitute a failure of this evaluation station.

Time to Complete	Points Awarded
Under 10 minutes	5
10–13 minutes	4
13–16 minutes	3
16–19 minutes	2
More than 19 minutes	1
Stopped or incomplete	Incomplete

Exercise 2: 15 Minute Tread

Using no swim aids and wearing only a swimsuit the diver will stay afloat by treading water, drown proofing, bobbing or floating for 15 minutes with hands only out of the water for the last 2 minutes.

Performance Criteria	Points Awarded
Performed satisfactorily	5
Stayed afloat, hands not out of water for 2 minutes	3
Used side or bottom for support at any time	1
Used side or bottom for support >twice	Incomplete

Exercise 3: 800 Yard Snorkel Swim

Using a dive mask, fins, snorkel, and a swimsuit (no BCD or other flotation aid) and swimming the entire time with the face in the water, the diver must swim non stop for 800 yards. The diver must not use arms to swim at any time.

Performance Criteria	Points Awarded
Under 15 minutes	5
15–17 minutes	4
17–19 minutes	3
19–21 minutes	2
More than 21 minutes	1
Stopped at any time	Incomplete

Exercise 4: 100 Yard Inert Rescue Tow

The swimmer must push or tow an inert victim wearing appropriate PPE on the surface 100 yards non stop and without assistance.

Performance Criteria	Points Awarded
Under 2 minutes	5
2–3 minutes	4
3–4 minutes	3
4–5 minutes	2
More than 5 minutes	1
Stopped at any time	Incomplete

Exercise 5: Free Dive to a depth of nine feet and retrieve an object

Performance Criteria	Points Awarded
Performed satisfactorily	Pass
Stopped or incomplete	Incomplete

Additional copies available at no charge via the International Association of Dive Rescue Specialists webpage. Visit www.IADRS.org

FIGURE A.13.2.4 Sample Divemaster-Level Watermanship Test.
(Courtesy of Dive Rescue International.)

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A.17.2.1 Size-up conditions in a mine/tunnel incident have to be evaluated beyond the normal emergency response since many will occur far below the surface. Critical background information has to, as a minimum, include the following:

(1) Schematic drawings of the spaces
(2) Known or potential hazards from the space as well as the equipment working within the space
(3) Number of workers and their potential positions based on job type
(4) Access/egress problems
(5) Environmental problems either naturally occurring or man-made
(6) Special rescue resource availability
(7) Risk–benefit analysis based on information that has been gathered

A.17.2.2 Scene safety zones will be established based on the involved area and the projected resources needed to control the incident. These should be easily identified work areas, regardless of the incident size or type, and should share some of the same characteristics, as follows:

(1) Well marked and easy to access
(2) Large enough to contain the equipment and personnel operating in the area
(3) Secure from media, general public, and non-essential personnel access
(4) With personnel accountability entry and exit points

A.17.2.3 Fire protection requirements for these incidents can be specialized and quite substantial. Pre-incident surveys by members who could be potentially operating in these environments are essential and should include some of the following factors:

(1) Built-in fire protection system might be available in certain applications. Personnel should be familiar with the type and activation mechanism for these systems.
(2) Logistics of equipment/personnel access should be evaluated and contingency plans established for additional entry points.
(3) Hazard recognition of existing and potential ignition sources.
(4) Ability to de-water a space during fire-fighting operations.

A.17.2.4 The intent of this section was for the rescuer to anticipate additional atmospheric hazards during the rescue operation. Atmospheric monitoring information can be derived from several sources at the time of the incident. Rescuers should be in contact with the responsible person at the incident to determine what atmospheric records have been kept during the normal operation periods so they have a basis to determine the projected hazard levels.

A.17.2.5 Each space will have specific airflow needs based on size, air hazards, and air change requirements. Rescuers need to be familiar with the methods and procedures to support, maintain, or re-establish air movement within the space(s) utilizing in-place air movement systems. Rescuers also need to be familiar with the types, uses, applications, and limitations of auxiliary air movement equipment used in these spaces.

A.17.2.7 This section addresses the need to support the rescue operation within the incident command system for both short-term and long-term operations. The rescuer might be working as an individual or as a member of a team to set up rehab, shelter, infrastructure, physical needs, and a support area during the incident. The incident needs could change several times during the incident, and the rescuer should be familiar with various tools, shelters, and environmental systems.

A.17.3.1 The technician should have thorough knowledge of the components necessary to assemble an incident action plan (IAP) for the incident. Working under the Incident Commander (IC) or Plans Officer, the technician must assemble the information that is available from the size-up and anticipate additional needs of the incident. The technician must then develop a written plan to address the priorities, objectives, actions, and resource needs for the incident.

A.17.3.2 The intent of this section is for the technician to be able to coordinate resources from fire, rescue, EMS, and private sector in support of the IAP and maintain accountability, scene safety, and rescue activities. The technician should have strong command and control skills as well as the ongoing ability to forecast problems, develop contingency plans, maintain personnel safety, and maintain an adequate resource level for the operation.

A.17.3.5 The technician is required to have the knowledge, skills, and abilities to utilize various systems for moving a heavy load. The distance for evaluations is 30 m (10 ft). The technician should be aware of the mechanical advantage systems that could be available at the rescue scene.

A.17.3.7 The intent of this section is for the rescuer to operate as a team member in the construction of shoring systems to stabilize the collapsed area of a mine or tunnel. The team member should have the following skills:

(1) Hazard recognition and escape procedures
(2) Common and specialty tool knowledge and application
(3) Shoring construction methods
(4) Load limitations for shoring systems
(5) Ability to work with specialized resources and personnel

A.17.3.9 Tunnel and mine rescue operations in hazardous atmospheres require that SCBA with a service life of a minimum of 2 hours be available and that entrants be trained in their donning, care, and use.

A.17.3.12 Because of the limited work area in these situations and the unique vehicles that can be found in these environments, the technician needs to be familiar with specific support procedures used in these incidents and how they differ from the similar types of abovegrade rescues.

A.18.2.5 Maneuvering in a cave rescue environment involves extreme physical fitness and preparation. The obstacles found in the cave environment might differ depending on regional location, but nearly all caves include movement in three dimensions.

Crawling, bouldering, and chimneying are commonplace ways to move through spaces and voids. The use of helmet-mountable lighting is essential, and utilizing kneepads and elbow pads will help during extended operations.

Chances of being injured are reduced by danger awareness and by knowledge of equipment and techniques. Statistically, caving accidents are mostly attributed to poor judgment, little or no caving experience, or falls. The most common causes of caving accidents include falling, being struck by falling objects, and hypothermia, detailed as follows:

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(1) *Falling:* To reduce the risk of falling, one should avoid jumping and uncontrolled sliding down slopes, wear proper footwear, check and discard any faulty or worn vertical equipment, and obtain proper training.
(2) *Falling Objects:* Injury caused by falling objects is best avoided by always wearing a helmet, staying clear of the base of drops and climbs, and securing all items of equipment so that they will not drop on cavers below.
(3) *Hypothermia:* If the temperature drops more than a few degrees, the body can no longer function properly. Extra clothing, a blanket, or other protection against the cold should be carried.
(4) *Other Hazards:* Not all caving problems involve injuries. A few people do get lost in caves, become stuck, or are unable to climb up a ledge or rope to get out of the cave. Exhaustion and a lack of light (or light failure) can cause someone to become lost who might otherwise have found their way out of the cave.

The committee recommends the following web sites for more information: http://www.caves.org/pub/aca/ and http://www.caves.org/safety/.

A.18.2.7 The role of an initial response task force is to respond to a subject at a known location and to bring the highest level of medical assistance currently available to the subject(s); provide hypothermia protection; carry to the subject the initial equipment and materials required for subject evacuation, including equipment for raises and lowers if necessary; mark the trail to the subject for subsequent responders; sketch and note obstacles to the evacuation; advise command of findings; and begin evacuation of the subject.

A.18.2.8 The role of this communications task force is to develop a system of in-cave communications from the entrance to the subject, with appropriate communications stations along the way that will ensure effective communications between the various operational teams and command, ensure the safety of the rescuers, and provide information on the status of the subject and the rescuers.

A.18.2.9 The role of a search task force is to look for, preserve, record, and recover clues that will lead to finding the missing person or persons.

A.18.2.11 The role of the underground medical officer, or the medical task force, is to upgrade the level of care following the initial response, to continuously monitor and treat the physical condition of the subject during the evacuation and until transferred to hospital-based providers, to monitor the condition of the rescuers, and to notify command of findings. This resource is only deployed if the medical credentials or experience of the resource(s) are greater than those of the initial responders.

A.18.2.13 The role of rigging task forces is to develop a system of rappel and climbing lines. Rope rescue equipment used in the cave rescue environment typically falls under the requirements outlined in NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services.*

A.18.2.14 The role of the patient evacuation team is to safely move the subject. This includes bringing the litter to the subject, if a litter is necessary for subject evacuation and this task has not already been performed; assisting the subject to walk out, or carrying the subject in the litter; rigging the litter, or the subject, for hauls, lowers, and belays; monitoring subject packaging; ensuring good route finding; and ensuring that enough personnel remain in front of the subject to assure safe movement.

A.18.3.1 Considerations should be given for the need to manage a prolonged cave rescue operation in a primitive setting. Considerations can include relief crews, rehabilitation of rescuers, and provisions for waste management during long-term operations.

Although some consideration should be given to the assessment of potentially hazardous gaseous atmospheres, the rescuer should note the following when considering the need for ventilation:

(1) Caves typically self ventilate. Mechanical ventilation might be impossible, impractical, or even increase the risk to the rescuers.
(2) Atmospheric monitoring might be needed in a few regional caves. Contact local caving organizations for reports of bad air caves in the area.
(3) Bad atmosphere could be created by the rescuers themselves in special circumstances.

A.18.3.3 Assessment information used to formulate the incident action plan includes the following:

(1) Scope, magnitude, and nature of incident
(2) Location, number, and condition of victims
(3) Rescue versus recovery decision
(4) Access and egress points for the cave
(5) Environmental factors
(6) Resource requirements and availability
(7) Hazards and hazard control requirements
(8) Availability of accurate information

Incident action plans include measurable strategic objectives, tactical assignments to accomplish strategic goals, benchmark plans, safety plans, communications plans, and alternative tactical consideration. The use of outside experts should be incorporated into the incident action plan. Nearly all of cave, cliff, land search, or wilderness incidents involve one or more of the following tasks:

(1) Responding to the needs of a subject whose location is known
(2) Sharing information about the status of the mission, the rescuers, and the subject
(3) Evacuating injured persons
(4) Providing a system of rappel and climbing lines and haul and lower systems for the safe removal of the injured person or persons
(5) Searching for persons who are lost or overdue in a cave or surface environment
(6) Transferring equipment from the staging area to the rescue scene

The Incident Commander, or Operations Chief if one has been appointed, should assign and brief one or more of the following teams to manage these tasks:

(1) Initial response *(see A.18.2.7)*
(2) Search *(see A.18.2.9)*
(3) Communications underground *(see A.18.2.8)*
(4) Rigging *(see A.18.2.13)*
(5) Evacuation *(see A.18.2.14)*

Medical considerations can be addressed by operations either through a team *(see 18.2.11)* or using single resources. Equipment can be moved to the rescue site through the use of a team or teams *(see A.18.2.14).*

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Annex B Collapse Types

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B.1 Collapse Patterns. Collapse patterns and potential victim locations include the following:

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

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

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

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

(5) *A-Frame.* An A-frame collapse occurs when flooring separates from the exterior bearing walls but still is supported by one or more interior bearing walls or nonbearing partitions. The highest survival rate for trapped victims will be near these interior partitions. Other victims will be located in the debris near both exterior walls. See Figure B.1(e).

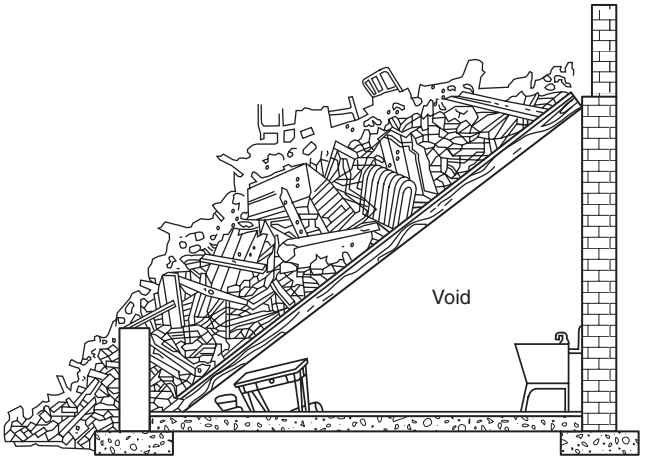

FIGURE B.1(a) Lean-To Floor Collapse. *(Courtesy of U.S. Department of Civil Defense.)*

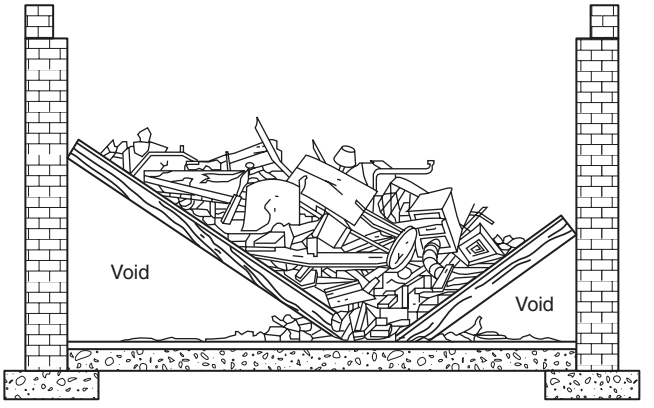

FIGURE B.1(b) V-Shape Floor Collapse. *(Courtesy of U.S. Department of Civil Defense.)*

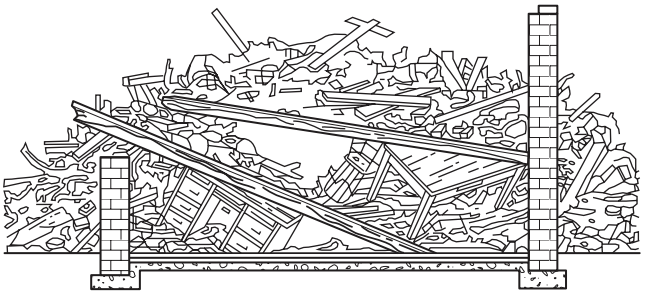

FIGURE B.1(c) Pancake Floor Collapse. *(Courtesy of U.S. Department of Civil Defense.)*

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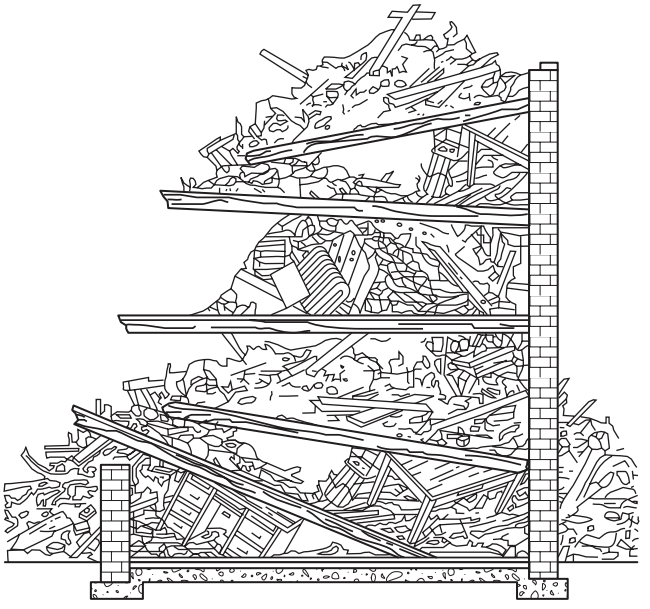

FIGURE B.1(d) Cantilever Floor Collapse. *(Courtesy of U.S. Department of Civil Defense.)*

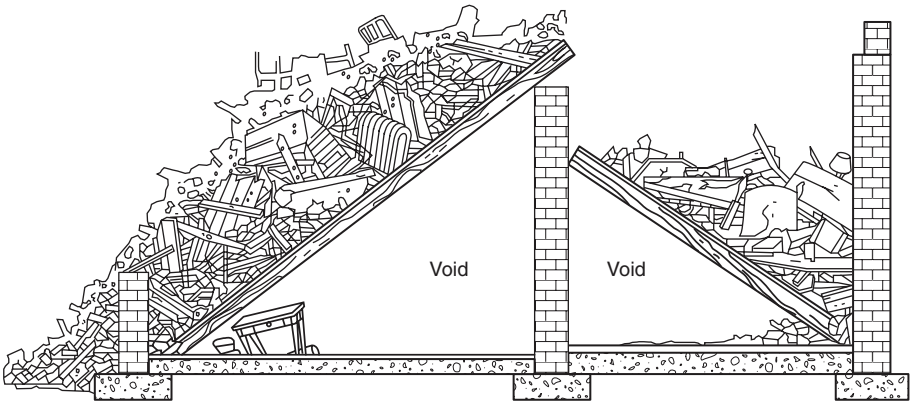

FIGURE B.1(e) A-Frame Floor Collapse. *(Courtesy of U.S. Department of Civil Defense.)*

Annex C Confined Space Entry Permit

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

C.1 Confined Space Sample Forms. In certain industries, U.S. federal law does not require a permit system even though spaces that meet the characteristics of confined spaces, as defined within this standard, can be present. In these cases, as well as cases of unauthorized or nonregulated entry into confined spaces, a permit might not be available for reference by the rescue team. The space must be assessed completely before entry can be made safely. U.S. federal law does not require rescuers to have a permit to rescue, although it is advisable for the rescue team to follow similar procedures to ensure safety. See Figure C.1(a) through Figure C.1(d).

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ENTRY PERMIT

Address: _____

RP name: _____ Title: _____

RP or Witness Account of Incident: _____

_____

If no witness, what clues are available at the site: _____

_____

Space type: Tank: _____ Pipe: _____ Silo: _____ Evacuation: _____

Confined Space Permit obtained? ❑ Yes ❑ No

Product involved: _____

Product hazards: LEL _____ % TLV _____ ppm IDLH _____ ppm

Explosive? ❑ Yes ❑ No

Establishment of zones? ❑ Yes ❑ No Isolation of area: _____ hr(s)

Lockout completed: _____ hr(s)

Number of victims: _____ Time victims trapped: _____ (24-hr clock)

Victim status: _____

_____

Victim #	Age	Name	Medical HX
1.			
2.			
3.			
4.			

Victim #	Location	Priority
1.		1 2 3 4
2.		1 2 3 4
3.		1 2 3 4
4.		1 2 3 4

Communications established with victims? ❑ Yes ❑ No

FIGURE C.1(a) Sample Entry Permit Form.

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ENTRY PERMIT FORM

Access points	Location	Entry accessible		Ventilation point	
1.	_____	Yes	No	Yes	No
2.	_____	Yes	No	Yes	No
3.	_____	Yes	No	Yes	No
4.	_____	Yes	No	Yes	No

Is there an adequate number of trained personnel on the scene to perform the tasks associated with the rescue? (minimum of eight required) ❑ Yes ❑ No

Is the proper equipment present at the scene to complete the operation?

	Yes	No
Atmosphere monitoring equipment	❑	❑
Explosionproof lighting	❑	❑
Explosionproof communications	❑	❑
Supplied-air breathing apparatus or remote aid	❑	❑
Cascade system	❑	❑
Victim removal systems/equipment	❑	❑
Ventilation equipment with CFM of 4,000–5,000 and necessary duct work	❑	❑

Request for haz mat and/or rescue units: _____ hr(s)

Diagram of confined space (including entry and egress locations):

FIGURE C.1(a) ***Continued***

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CONFINED SPACE ENTRY TEAM CHECKLIST

Entry Team member's name: _____

Filled out by: _____

- ❑ Confined space atmosphere evaluated
- ❑ Medical checkout by ALS unit
- ❑ Jump suit donned
- ❑ 2.2 cylinders on remote air topped off
- ❑ Escape bottle topped off
- ❑ Remote air tested and operational
- ❑ Communications check
- ❑ Life line attached
- ❑ Atmosphere monitors attached and on
- ❑ Helmet on
- ❑ Gloves on

ENTRY TEAM MEDICAL CHECKLIST

Entry time: _____ BP ____ / ____ Pulse _____ Resp _____ Skin _____

Notes: _____

Exit time: _____ BP ____ / ____ Pulse _____ Resp _____ Skin _____

Notes: _____

FIGURE C.1(b) Sample Confined Space Entry Team Checklist.

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ATMOSPHERE MONITORING LOG

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

FIGURE C.1(c) Sample Atmosphere Monitoring Log.

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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, that is, triage, closest response, etc.

FIGURE C.1(d) Sample Agreement to Provide Rescue Response.

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Annex D Structural Types

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

D.1 Materials and Construction Types. Table D.1 and Figure D.1(a) through Figure D.1(n) can be used to clarify material on structural types found in the body of the document.

Table D.1 Combinations of Materials in Structural Types (after ATC, 1987)

Structural Type Identifier	General Description
W	Wood buildings of all types
S1	Steel moment-resisting frames
S2	Braced steel frames
S3	Light metal buildings
S4	Steel frames with cast-in-place concrete shearwalls
C1	Concrete moment-resisting frames
C2	Concrete shearwall buildings
C3/C5	Concrete or steel frame buildings with unreinforced masonry in-fill walls
TU	Tilt-up buildings
PC2	Precast concrete frame buildings
RM	Reinforced masonry
URM	Unreinforced masonry

[**1670**, Table C.1]

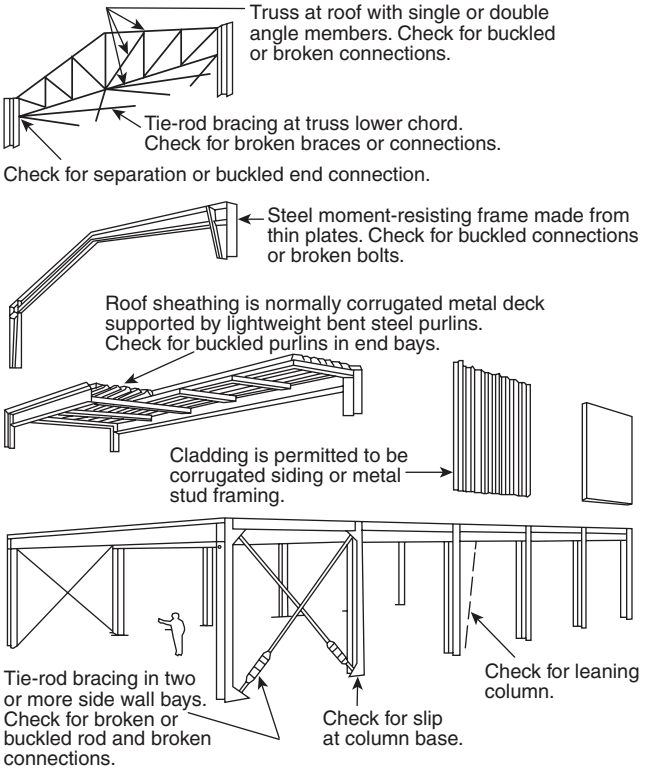

FIGURE D.1(a) Light Metal Buildings.

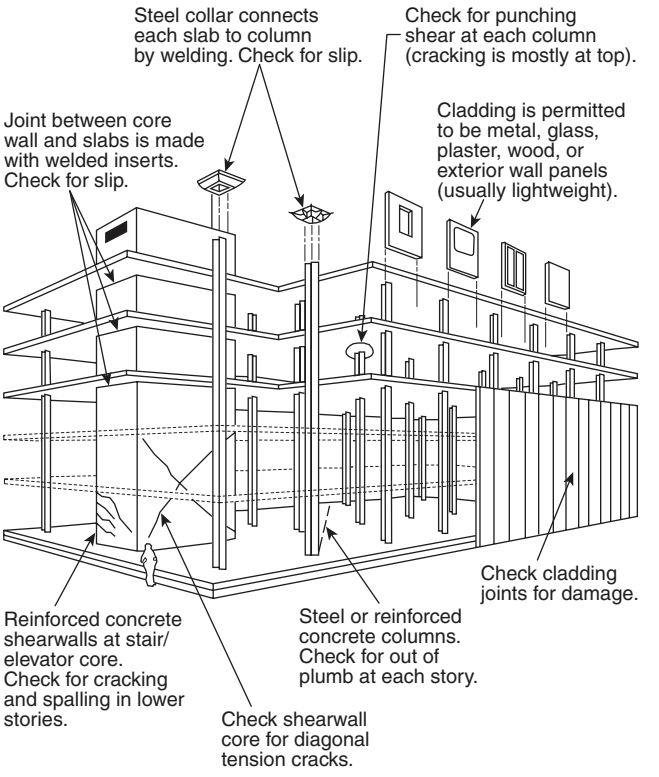

FIGURE D.1(b) Post-Tensioned Lift Slab Building.

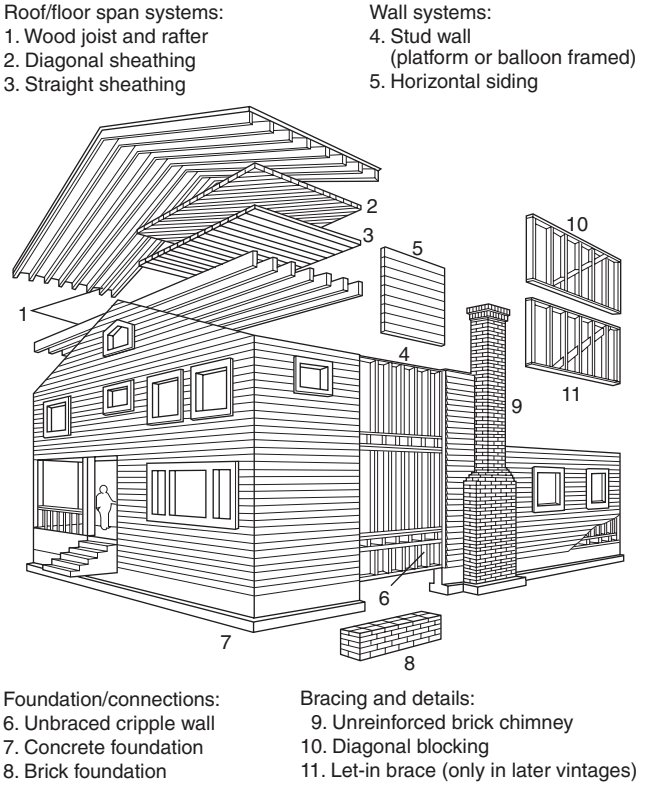

FIGURE D.1(c) Wood Stud Frame Construction.

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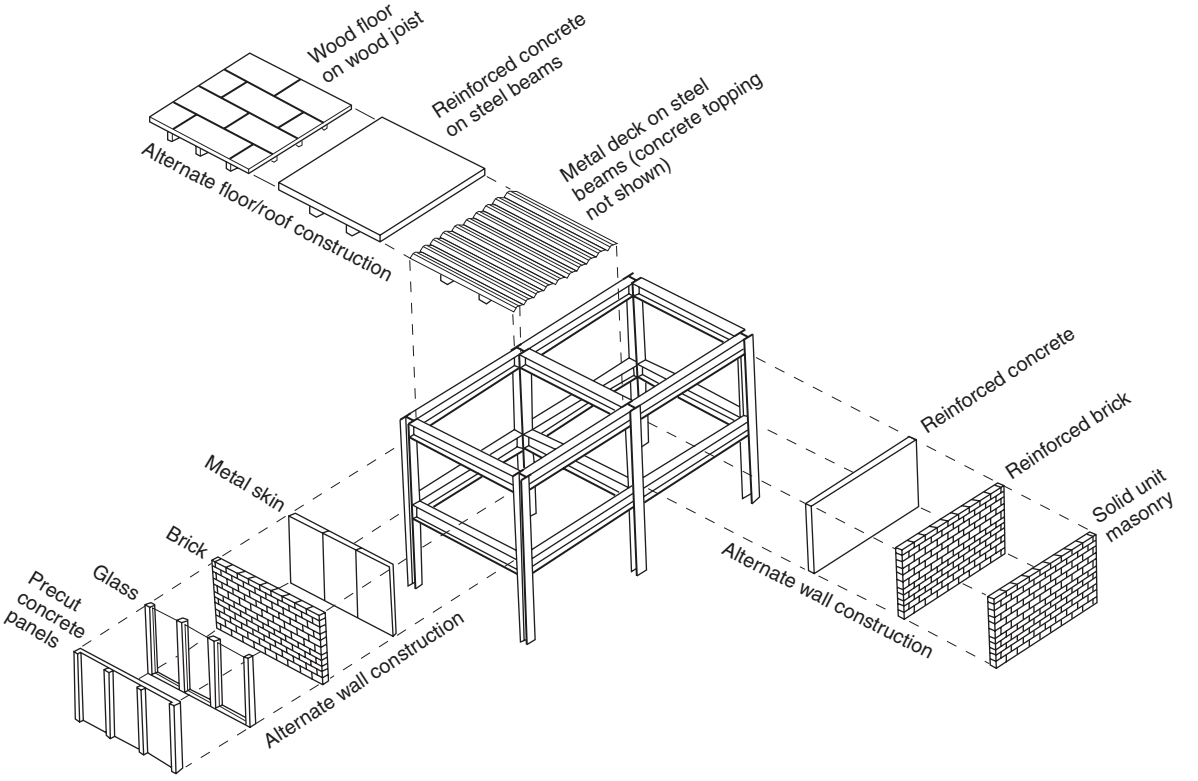

FIGURE D.1(d) Steel Moment-Resisting Frame.

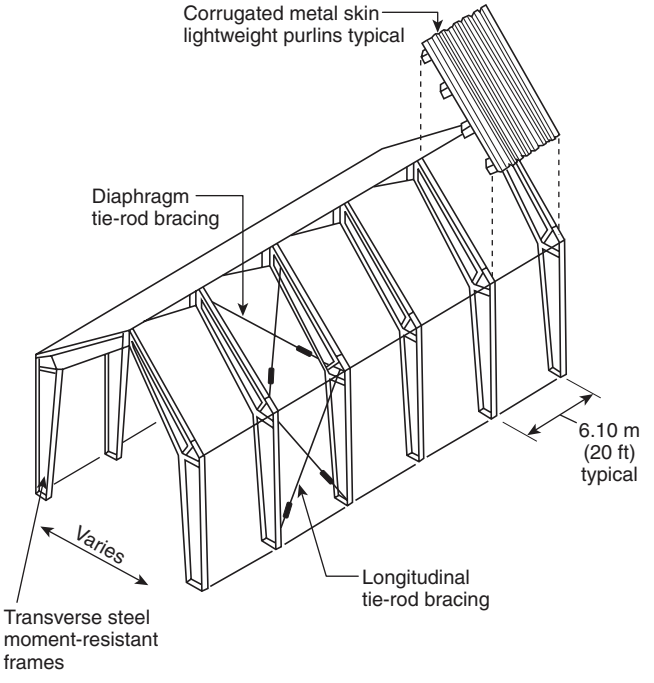

FIGURE D.1(e) Light Metal Construction.

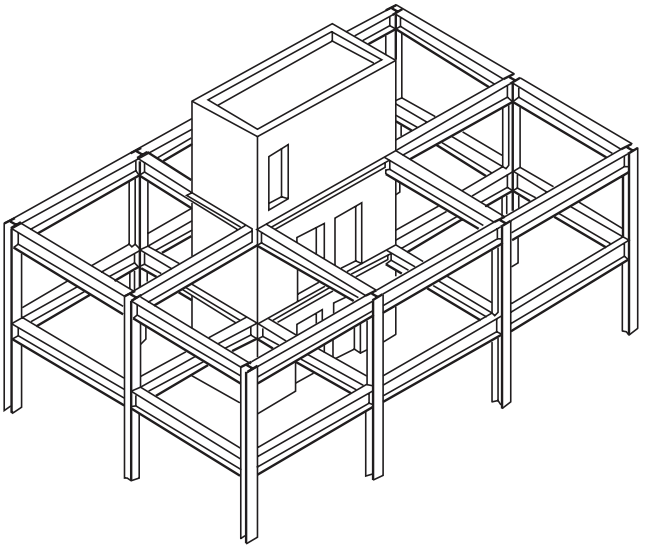

FIGURE D.1(f) Steel Frame with Shearwall.

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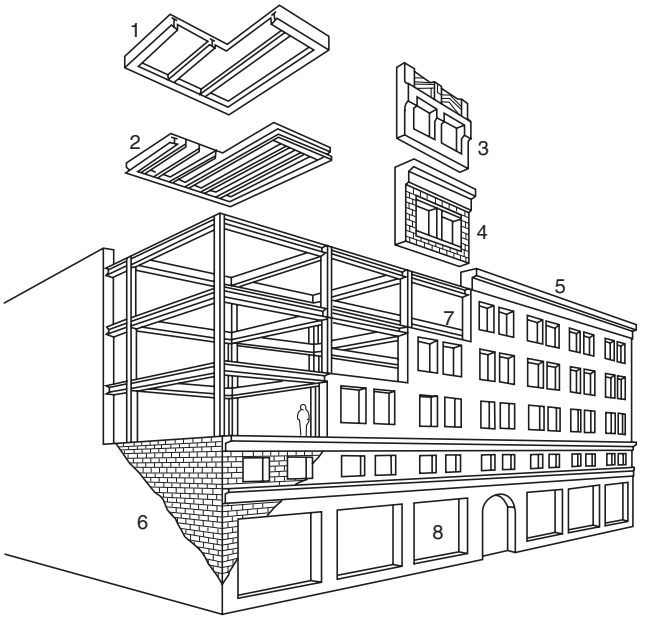
Roof/floor span systems:
1. Steel framing with concrete cover
2. Wood floor joist and diaphragm (diagonal and straight)

Wall systems:
3. Non-load-bearing concrete wall
4. Non-load-bearing unreinforced masonry cover wall



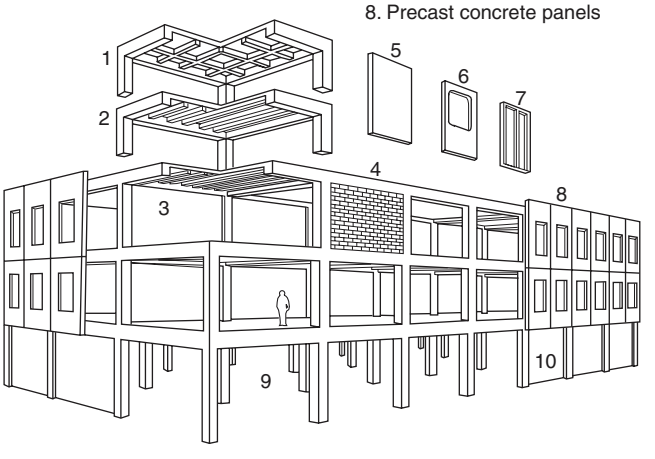
Details:
5. Unreinforced and unbraced parapet and cornice
6. Solid party walls

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

FIGURE D.1(g) Steel Frame with Unreinforced Masonry (URM) In-Fill.

Roof/floor diaphragms:
1. Concrete waffle slab
2. Concrete joist and slab
3. Steel decking with concrete topping

Curtain wall/nonstructural infill:
4. Masonry infill walls
5. Stone panels
6. Metal skin panels
7. Glass panels
8. Precast concrete panels



Structural system:
9. Distributed concrete frame

Details:
10. Typical tall first floor (soft story)

FIGURE D.1(h) Concrete Moment-Resisting Frame.

Roof/floor span systems:
1. Heavy timber rafter roof
2. Concrete joist and slab
3. Concrete flat slab

Wall system:
4. Interior and exterior concrete beating walls
5. Large window penetrations of school and hospital buildings

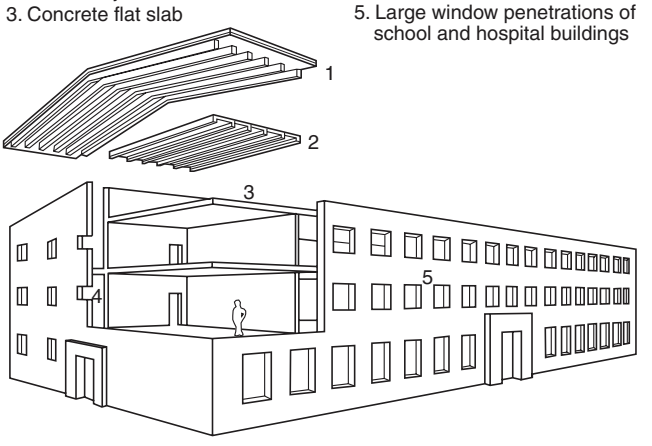
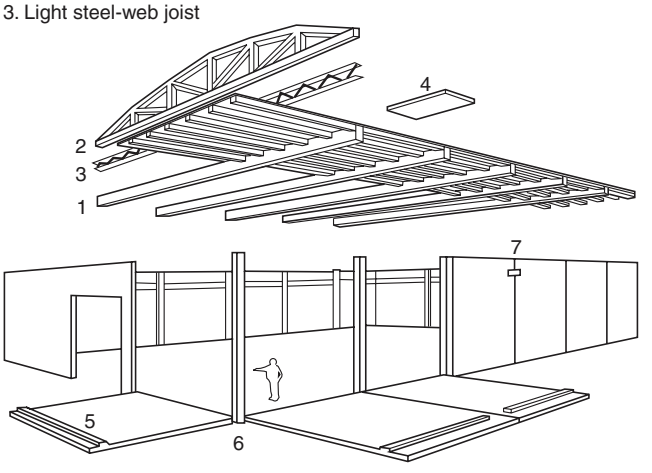


FIGURE D.1(i) Concrete Shearwall.

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

Roof/floor diaphragms:
4. Plywood sheathing



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

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

FIGURE D.1(j) Tilt-Up Construction Typical of the Western United States. (Tilt-up construction in the eastern United States can incorporate a steel frame.)

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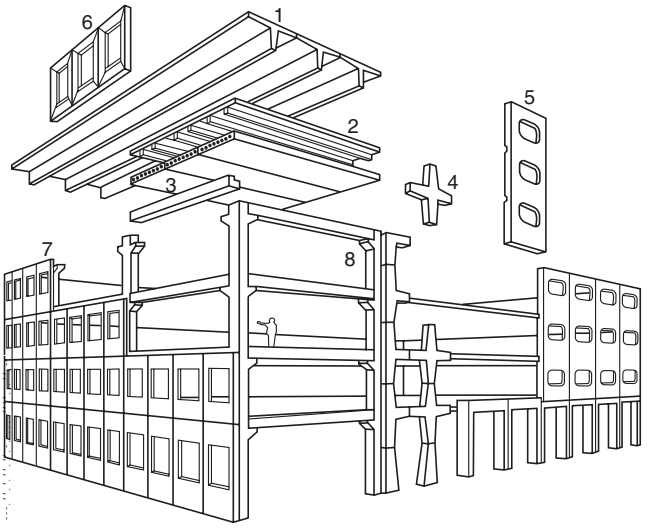
Roof/floor span systems:
1. Structural concrete T sections
2. Structural double T sections
3. Hollow-core concrete slab

Wall systems:
4. Load-bearing frame components (cross)
5. Multistory load-bearing panels



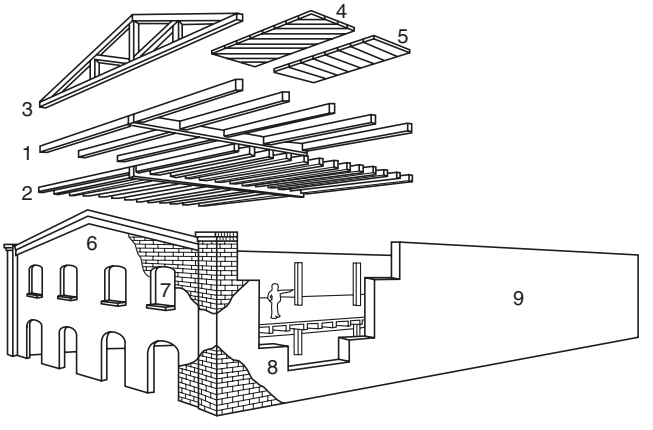
Curtain wall system:
6. Precast concrete panels
7. Metal, glass, or stone panels

Structural system:
8. Precast column and beams

FIGURE D.1(k) Precast Concrete Frame.

Roof/floor span systems:
1. Wood post and beam (heavy timber)
2. Wood post, beam, and joist (mill construction)
3. Wood truss-pitch and curve

Roof/floor diaphragms:
4. Diagonal sheathing
5. Straight sheathing



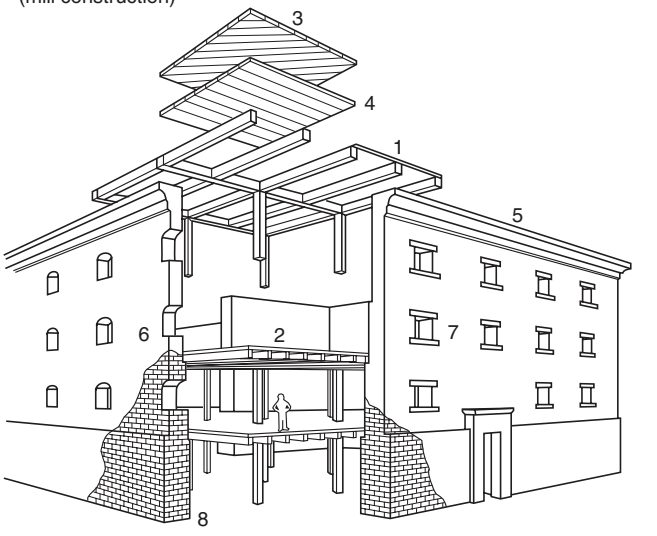
Details:
6. Typical unbraced parapet and cornice
7. Flat arch window openings

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

FIGURE D.1(l) Unreinforced Masonry Bearing Wall, Example 1 of 3.

Roof/floor span systems:
1. Wood post and beam (heavy timber)
2. Wood post, beam, and joist (mill construction)

Roof/floor diaphragms:
3. Diagonal sheathing
4. Straight sheathing



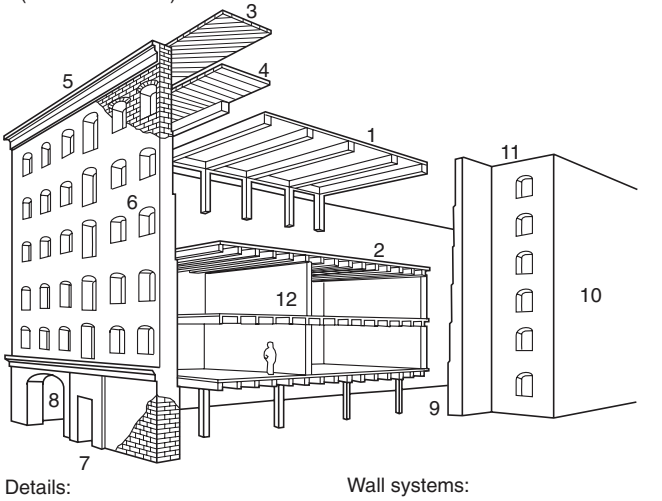
Details:
5. Typical unbraced parapet and cornice
6. Flat arch window openings
7. Small window penetrations (if building is originally a warehouse)

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

FIGURE D.1(m) Unreinforced Masonry Bearing Wall, Example 2 of 3.

Roof/floor span systems:
1. Wood post and beam (heavy timber)
2. Wood post, beam, and joist (mill construction)

Roof/floor diaphragms:
3. Diagonal sheathing
4. Straight sheathing



Details:
5. Typical unbraced parapet and cornice
6. Flat arch window openings
7. Typical penetrated facade of residential buildings
8. Large openings of ground-floor shops

Wall systems:
9. Bearing wall — four to eight wythes of brick
10. Typical long solid party wall
11. Light/ventilation wells in residential building
12. Nonstructural wood stud partition walls

FIGURE D.1(n) Unreinforced Masonry Bearing Wall, Example 3 of 3.

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D.2 Light Frame Construction. Materials used for light frame construction are generally lightweight and provide a high degree of structural flexibility in response to forces such as earthquakes, hurricanes, tornados, and so forth.

These structures typically are constructed with skeletal structural frame systems of wood or light-gauge steel components that provide support to the floor and roof assemblies.

Examples of this construction type include wood frame structures used for residential, multiple low-rise, and light commercial occupancies up to four stories in height. Light-gauge steel frame buildings include commercial, business, and light manufacturing occupancies and facilities.

D.3 Heavy Construction.

D.3.1 Heavy Wall Construction. Materials used for heavy wall construction are generally heavy and utilize an interdependent structural or monolithic system. These types of materials and their assemblies tend to produce a structural system that is inherently rigid.

This construction type usually is built without a skeletal structural frame. It utilizes a heavy wall support and assembly system that provides support for the floors and roof areas.

Occupancies utilizing tilt-up concrete construction are typically one to three stories in height and consist of multiple, monolithic concrete wall panel assemblies. They also use an interdependent girder, column, and beam system for providing lateral wall support of floor and roof assemblies. Such occupancies typically include commercial, mercantile, and industrial usage. Materials other than concrete now are being utilized in tilt-up construction.

Examples of this type of construction include reinforced and unreinforced masonry buildings typically of low-rise construction, one to six stories in height, and of any occupancy type.

D.3.2 Heavy Floor Construction. Structures of heavy floor construction are built utilizing cast-in-place concrete construction consisting of flat slab panel, waffle, or two-way concrete slab assemblies. Pretensioned or posttensioned reinforcing steel rebar or cable systems are common components used for structural integrity. The vertical structural supports include integrated concrete columns, concrete enclosed steel frame, or steel frame, which carry the load of all floor and roof assemblies. This type of structure includes heavy timber construction that might use steel rods for reinforcement.

The reinforcing steel, along with the varying thicknesses of concrete structural slab and girder supports utilized in this construction assembly, poses significant concerns with respect to breaching and void penetration.

The loss of reinforcement capability and the integrity of structural loading capacity of the floor and wall assemblies creates significant safety and operational considerations during collapse operations.

Structural steel frame construction utilizes a skeletal framing system consisting of large-load-carrying girders, beams, and columns for structural support. These components represent a substantial weight factor for individual and assembly components. Floor systems consist of cast-in-place concrete slabs of varying thicknesses poured onto metal pans or structural metal floor decks and also might include precast and posttensioned concrete plank systems. These concrete/metal pan floor assemblies are supported by the structural steel framing system.

The exterior construction might consist of metal or masonry veneer, curtain wall, or composite material panel systems. Additionally, precast concrete or stone-clad panel systems might be present.

Multiple assembly or component failures might be present in a collapse situation where isolated or multiple collapse conditions or collapse configurations exist.

Examples of this type of construction include offices, schools, apartments, hospitals, parking structures, and multipurpose facilities. Heights vary from single-story to high-rise structures.

D.3.3 Precast Construction. Structures of precast construction are built utilizing modular precast concrete components that include floors, walls, columns, and other subcomponents that are field-connected at the site.

Individual concrete components utilize imbedded steel reinforcing rods and welded wire mesh for structural integrity and might utilize either steel beam and column or concrete framing systems for the overall structural assembly and building enclosure.

These structures rely on single or multipoint connections for floor and wall enclosure assembly and are a safety and operational concern during collapse operations.

Examples of this type of construction include commercial, mercantile, office, and multiuse or multifunction structures, including parking structures and large occupancy facilities.

Annex E Marking Systems

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

E.1 Structure Hazard Evaluation. Structure and hazards evaluation and search assessment procedures are designed to identify specific information pertinent to each affected building. Either of these analyses can be completed independently of the other, although the structure and hazards evaluation normally is completed first. Symbols should be drawn conspicuously with orange spray paint. *(See FEMA US&R Response System, Appendix C, "Task Force Building Marking System.")*

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

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

E.2 FEMA Task Force Search and Rescue Marking System. Distinct markings should be made within the four quadrants of an "X" to denote clearly the search status and findings during the search. Figure E.2 illustrates the search marking system.

An "X" measuring 0.61 m × 0.61 m (2 ft × 2 ft) should be spray-painted in the color orange. The information for each quadrant should be written in the quadrant using carpenter's chalk or a lumber crayon.

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In addition, search personnel should mark the exact location of a victim(s) with orange spray paint. Surveyor's tape can be used as a flag to identify the appropriate area in conjunction with the spray paint. To reduce needless duplication of search efforts, markings should be made at each point of entry or separate area of the structure. Where updated information of previously searched structures is needed, the old information should be crossed out and the most recent information should be indicated below or next to the old, using the marking system. See Figure E.2.



Make a large 2 ft × 2 ft "V" with orange spray paint near the location of the **potential** victim. Mark the name of the search team or crew identifier in the top part of the "V" with paint or a lumber marker–type device.



Paint a circle around the "V" when a potential victim is **confirmed** to be **alive** either visually, vocally, or from specific sounds that would indicate a high probability of a live victim. If more than one confirmed live victim, mark the total number of victims under the "V."



Paint a horizontal line through the middle of the "V" when a **confirmed** victim is determined to be **deceased**. If more than one confirmed deceased victim, mark the total number of victims under the "V." Use both the live and deceased victim marking symbols when a combination of live and deceased victims is determined to be in the same location.



Paint an "X" through the confirmed victim symbol after **all** the victim(s) have been removed from the specific location identified by the marking.



An arrow, pointing towards the victim, might need to be painted next to the "V" when the victim's location is not immediately near where the "V" is painted. Show distance on arrow.

FIGURE E.2 FEMA Task Force Search and Rescue Marking System.

E.3 FEMA Task Force Building Marking System (Structure/Hazard Evaluation). This system is designed to identify specific hazards associated with any collapsed structure. Personnel should be cognizant of the nationally accepted marking system and should be proficient in the use of the system. *(See FEMA US&R Response System, Appendix D, "Structure Triage, Assessment & Marking System.")*

After performing a building hazard assessment, the responder uses international orange spray paint to make a 0.61 m × 0.61 m (2 ft × 2 ft) square box on the building adjacent to the most accessible point of entry.

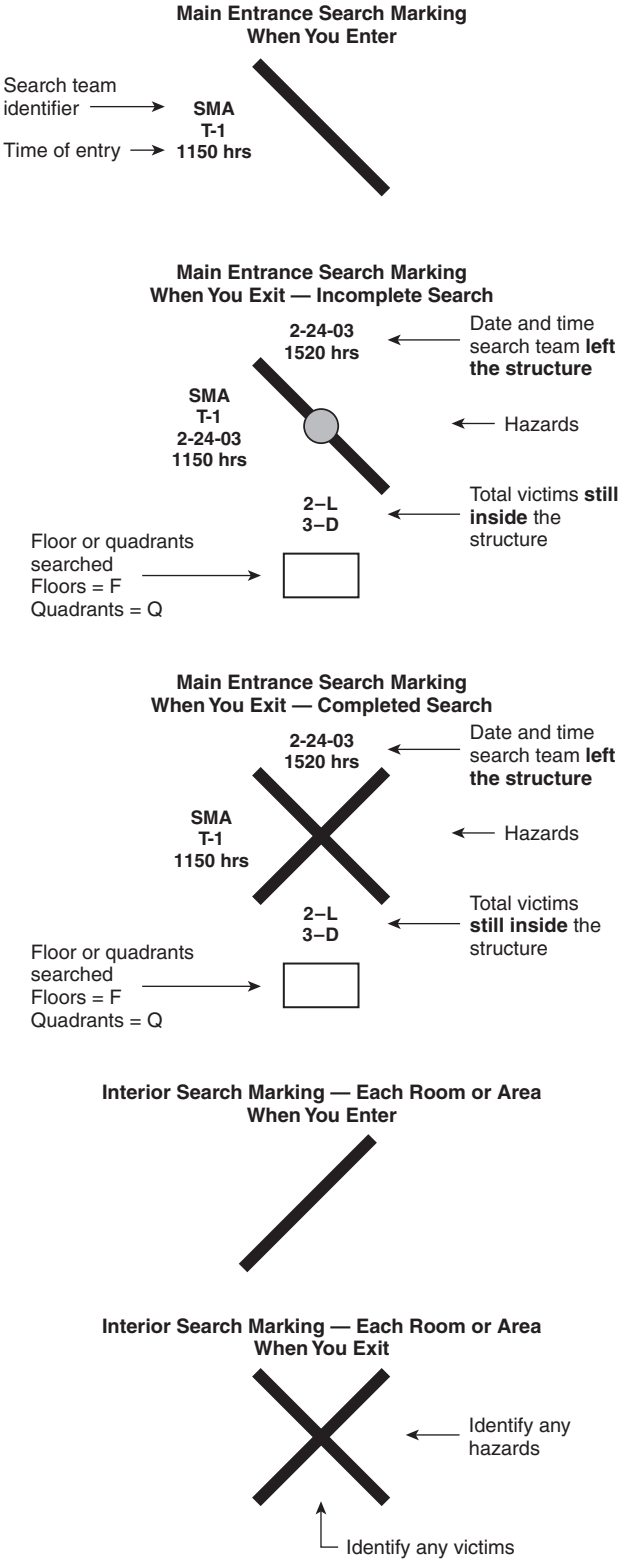

FIGURE E.3 Task Force Building Marking System (Structure/Hazard Evaluation).

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An empty box indicates the building is relatively safe for search and rescue operations and that damage is such that there is little danger of further collapse. One diagonal line in the box indicates the structure is significantly damaged and that some areas might need shoring, bracing, or removal of hazards in spite of the fact that some areas might be safe. Two diagonal lines in the box (an "X") indicate that the building is not safe for search and rescue operations and might be subject to sudden collapse. An arrow next to the marking box indicates the direction of safest entry to the structure. To the right of the marking box, text is used to indicate the time and date of the search, the team designation, and hazard(s) found. The letters "HM" to the right of the box (in the text area) indicate a hazmat condition in or adjacent to the structure. When "HM" is used, search and rescue operations normally will not be allowed until the condition is better defined or eliminated. See Figure E.3.

E.4 FEMA Task Force Structure Marking System (Structure Identification Within a Geographic Area). Structure identification within a geographic area is used to differentiate buildings by groups, such as by block(s) or jurisdictional area. This geographic area identification should be consolidated at the command post of the AHJ and used to deploy search and rescue personnel.

International orange spray paint is used to mark buildings with their street number so that personnel can differentiate one building from another. Existing numbers should be used to fill in any unknown numbers. If all numbers are unknown, arbitrary numbers can be used (odd and even used on opposite sides of the street). The primary method of identification should include the existing street name, hundred block, and 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.")*

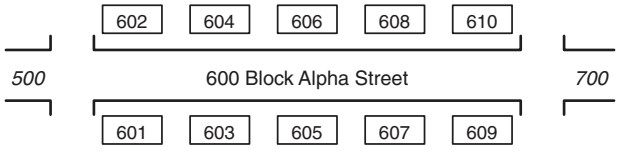
An important duty of a structure triage team is to differentiate buildings clearly in groupings such as by block(s) or jurisdictional areas/sectors. This geographic (area/sector) identification of buildings should be consolidated at the command post and used to deploy search and rescue personnel and/or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

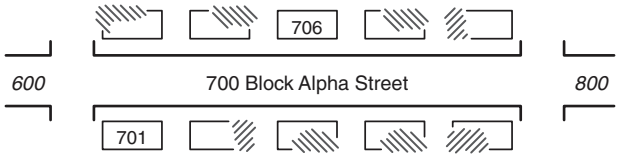
It is important to identify each separate structure clearly within a geographic area when information is being disseminated to other operational entities. The primary method of identification should be the existing street name, hundred block, and building number. Obviously, such identification is not 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:

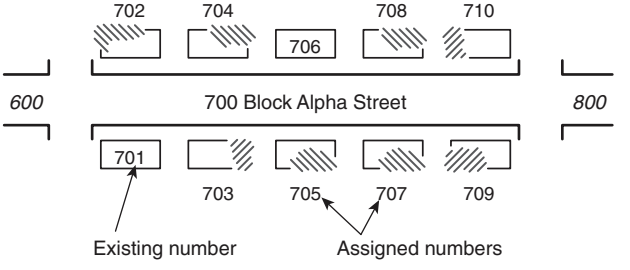
1. Each structure should be identified by existing street name and building number.



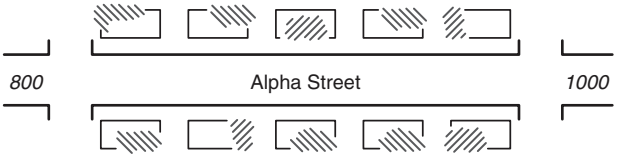
2. If some previously existing numbers have been obliterated, an attempt should be made to re-establish the numbering system based upon one or more structures that still display an existing number.



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.

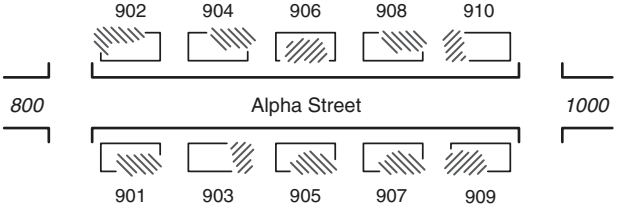


FIGURE E.4(a) Task Force Marking System for Structure Identification Within a Geographic Area.

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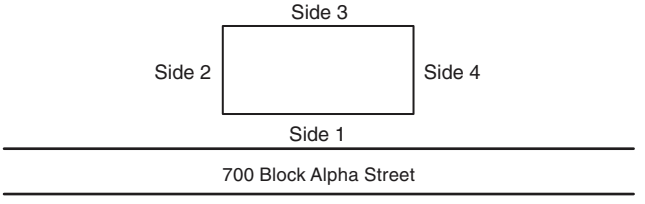
A standard approach to describing each building's layout is also used. The street side of the building is side 1. Subsequent sides (2, 3, 4) are labeled in a clockwise direction around the building. Internally, quadrants are described starting with the front left corner (while standing at the front, 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.

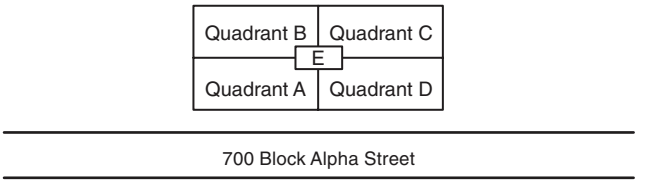
It is imperative that personnel clearly identify each structure within a geographic area. This identification will assist both in the specific ongoing search and rescue effort and the long-term, postdisaster identification of the site. See Figure E.4(a) and Figure E.4(b).

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.

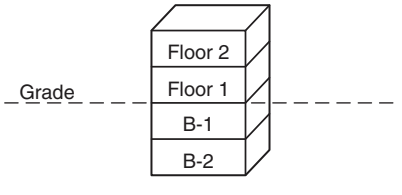


FIGURE E.4(b) Task Force Structure Marking and System Structure Identification Within a Geographic Area — Single Structure.

Annex F Trench and Excavation Rescue Incidents

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

F.1 Trench Types and Considerations. 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 in order to operate safely. Examples of these situations can include, but are not limited to, very deep trenches [more than 4.57 m (15 ft) 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 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:

(1) Spoil pile collapse (spoil-in), where the excavated earth piled on the side of the trench slides into the trench.
(2) 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.
(3) Shearwall collapse (shear-in), where the side(s) of the trench shears away from the wall of the trench. Possible indicators for an impending shearwall 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.
(4) Slough collapse (slough-in), where a below-grade section collapses, leaving the potential for the collapse of an overhanging ledge.

F.2 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)

F.3 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,

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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 any of the following situations exit:

(1) The soil is fissured.
(2) The soil is subject to vibration from heavy traffic, pile driving, or similar effects.
(3) The soil has been previously disturbed.
(4) 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.
(5) 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 (144 kPa) or one of the following:

(1) 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
(2) Previously disturbed soils except those that would otherwise be classed as Type C soil
(3) Soil that meets the unconfined compressive strength or cementation requirements for Type A but is fissured or subject to vibration
(4) Dry rock that is not stable
(5) 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 one of the following:

(1) Granular soils including gravel, sand, and loamy sand
(2) Submerged soil or soil from which water is freely seeping
(3) Submerged rock that is not stable
(4) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper

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

F.4 General Hazards. General hazards associated with search and rescue operations at trench and excavation collapses can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members:

(1) *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.

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(2) *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.
(3) *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.
(4) *Confined Space.* All trench collapses, and many excavation collapses, necessitate a confined space rescue. Responding personnel should be familiar with and trained in confined space rescue requirements and techniques. The AHJ should determine the applicable laws and standards related to confined space rescue and should provide training to members in confined space rescue.
(5) *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.

F.5 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.

F.6 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

F.7 Rapid, Nonentry Rescues. A quick look in the trench from an end can show that a victim might 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."

F.8 Personnel/Equipment Resources. A trench or excavation collapse often requires resources that the AHJ is unable to provide. A community resource list with supporting standard operating procedures should include activation of and contact numbers for mutual-aid contracts, public works and private contractor response agreements, rental and construction supply house agreements, and utility one-call services.

Annex G Technical Rescuer Tool Kit

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

G.1 Sample Tool Kit Contents. Table G.1 contains a list of sample tool kits that can be used with the various rescue specialties. The table is not intended to imply a minimum or all-inclusive listing of equipment necessary to perform a rescue. These tool boxes are identified to provide guidance on equipment needed to evaluate candidates.

Table G.1 Tool Kit Contents

Kit Contents	Basic Kit	Rope Rescue	Confined Space Rescue	Water Rescue	Vehicle and Machinery Rescue	Trench Rescue	Structural Collapse	Cave Rescue	Dive Rescue	Wilderness Rescue	Mines and Tunnels Rescue
Air-monitoring equipment			X			X	X	X			X
Anemometer								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	X	X	X	
Binoculars	X	X	X	X	X		X		X	X	
Boards, short- and long-spine	X	X	X	X	X	X	X	X	X	X	X
Boogie board				X							
Boots								X		X	X
Buoyancy control devices									X		
Camera							X			X	X
Camming devices		X	X	X		X	X	X		X	X

(continues)

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Table G.1 *Continued*

Kit Contents	Basic Kit	Rope Rescue	Confined Space Rescue	Water Rescue	Vehicle and Machinery Rescue	Trench Rescue	Structural Collapse	Cave Rescue	Dive Rescue	Wilderness Rescue	Mines and Tunnels Rescue
Carabiners, locking	X	X	X	X		X	X	X		X	
Chain saw, electric or gas						X	X				
Chain sling, 9 ft					X	X	X				
Chain sling, 5 ft					X	X	X				
Charged 1½ in. hose line					X						
Clamp, "Ellis"							X				
Class 2 and Class 3 harnesses	X	X	X	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	X	X	X	X
Community resource lists				X	X	X	X		X		
DECON equipment			X	X			X		X		
Descending/ ascending devices (friction or mechanical)	X	X	X	X		X	X	X		X	
Detector, electrical energy	X	X	X	X	X	X	X	X	X		
Dewatering pumps			X			X	X	X			
Edge protection, hard and soft	X	X	X	X		X	X	X			
Extension cords			X		X	X	X				
Fins, swim				X					X		
Fire extinguisher	X	X	X	X	X	X	X	X	X		X
First aid and oxygen kits	X	X	X	X	X	X	X	X	X	X	X
Flathead ax	X			X	X		X				
Food, packable								X		X	
Generator	X		X		X	X	X				X
Gloves	X	X	X	X	X	X	X	X	X	X	X
Halligan bar	X				X		X	X			
Hammer, demolition, 45 lb, bull and chisel							X				
Hammer, demolition, 60 lb, bull and chisel							X				
Hammer, 1½ in. rotary, with carbide-tipped bits ⅛ in. to 2 in., and bull point bit							X				
Hand tools kit	X		X		X	X	X	X	X		X
Heavy excavating equipment resources						X	X	X			
Helmets	X	X	X	X	X	X	X	X		X	X
Hose inflator				X					X		
Hydraulic cutters					X		X	X			X
Hydraulic rams					X	X	X	X			X
Hydraulic shores					X	X	X	X			X
Hydraulic spreaders					X	X	X	X			X
Jacks, screw, scissor, and/or hydraulic						X	X	X			

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Table G.1 *Continued*

Kit Contents	Basic Kit	Rope Rescue	Confined Space Rescue	Water Rescue	Vehicle and Machinery Rescue	Trench Rescue	Structural Collapse	Cave Rescue	Dive Rescue	Wilderness Rescue	Mines and Tunnels Rescue
Junction box, electrical	X				X	X	X				
KED or equivalent	X	X	X		X	X	X	X		X	
Knife, rescue	X	X	X	X	X	X	X	X	X	X	
Lighting, flood	X			X	X	X	X	X			X
Lighting, hand and/or helmet (Factory Mutual approved)	X	X	X	X	X	X	X	X		X	
Line gun				X			X		X		
Lumber and timber (assorted)					X	X	X	X			
Lockout/tagout kit			X			X		X			
Marking kit, paint, chalk, crayon, pencil					X	X	X	X		X	
Navigational instruments — compass, GPS	X			X				X	X	X	
Packs								X		X	
Pens/pencils	X	X	X	X	X	X	X	X	X	X	
Perimeter or scene-marking devices	X	X	X	X	X	X	X	X	X	X	
Personal flotation devices (PFDs)	X			X				X	X	X	
Personal toiletry items								X		X	
Personnel accountability system	X	X	X	X	X	X	X	X	X	X	
Personal alarm device			X			X	X	X			
Pickets, steel stakes	X	X		X	X	X	X			X	
Plastic bags								X			
Pneumatic bags					X	X	X	X			
Pneumatic chisels					X	X		X			X
Pneumatic shores					X	X	X	X			
Pneumatic soil knife						X		X			
Pneumatic soil vacuum (hand and/or truck)						X		X			
PPE — bunker gear					X	X	X				
PPE — HazMat, Levels B and C			X								
PPE — helmet water rescue				X					X		
PPE — knee pads			X				X	X		X	X
PPE — mask and snorkel									X		
PPE — SABA			X					X			
PPE — SCBA	X		X	X	X		X	X			X
PPE — SCUBA with console, secondary									X		
PPE — suit, dry				X					X		
PPE — Personal escape pack			X					X		X	
PPE — suit, wet				X				X	X		
Preplans/maps	X	X	X	X	X	X	X	X	X	X	
Prusik cord	X	X	X	X	X	X	X	X		X	
Pulleys, selection of	X	X	X	X		X	X	X		X	
Reach extension devices	X			X					X		

(continues)

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Table G.1 *Continued*

Kit Contents	Basic Kit	Rope Rescue	Confined Space Rescue	Water Rescue	Vehicle and Machinery Rescue	Trench Rescue	Structural Collapse	Cave Rescue	Dive Rescue	Wilderness Rescue	Mines and Tunnels Rescue
Rope — life safety	X	X	X	X	X	X	X	X	X	X	X
Rope — utility	X	X	X	X	X	X	X	X	X	X	X
Rope — water rescue				X					X		
Safety glasses and hearing protection	X	X	X	X	X	X	X	X	X	X	X
Saw, circular, carbide tip, metal cutting, and continuous 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	X	X	X	X	
Sleeping material/bag										X	
Spring-loaded center punch	X			X	X		X		X		
Tactical worksheets	X	X	X	X	X	X	X	X	X	X	
Tarps						X	X	X	X	X	
Thermal imager			X				X	X		X	
Throw bags				X					X		
Torch, kit, oxyacetylene					X		X				X
Torpedo buoy, ring buoy, or equivalent				X					X		
Traffic control devices	X	X	X	X	X	X	X	X	X		
Trench box, shield						X					
Tripod			X		X		X				
Victim protective coverings	X	X	X	X	X	X	X	X	X	X	
Watercraft — manual or motorized				X					X		
Water	X	X	X	X	X	X	X	X	X	X	
Webbing	X	X	X	X	X	X	X	X		X	
Weight belt and weights									X		
Winches	X				X						
Stokes basket w/lanyards											X
Personal escape packs											X
Mine/tunnelers' safety belt or Class 3 harness											X
Pass ports											X
DELSAR system											X
Thermal imaging cameras (TICs)											X
Intrinsic ventilation fans w/ducting											X

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Annex H Explanation of the Standard and Concepts of JPRs

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H.1 Explanation of the Standard 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.

H.2 Breaking Down the Components of a JPR. The JPR is the assembly of three critical components. *(See Table H.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

H.2.1 The Task to Be Performed. The first component is a concise statement of what the person is supposed to do.

Table H.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 1.22 m × 1.22 m (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

H.2.2 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.

H.2.3 Evaluation Parameters and/or Performance Outcomes. This component defines how well one must perform each task — for both the performer and the evaluator. The JPRs guide performance toward 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.

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.

H.2.3.1 Example 1. Ventilate a pitched roof, given an ax, a pike pole, an extension ladder, and a roof ladder, so that a 1.22 m × 1.22 m (4 ft × 4 ft) 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.

H.2.3.2 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.

H.3 Examples of Potential Uses.

H.3.1 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

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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 H.2.3.1, 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 1.22 m × 1.22 m (4 ft × 4 ft) 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 H.2.3.2, 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.

H.3.2 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 H.3.2(a).

Using Example 1 in H.2.3.1, a terminal instructional objective might read as follows:

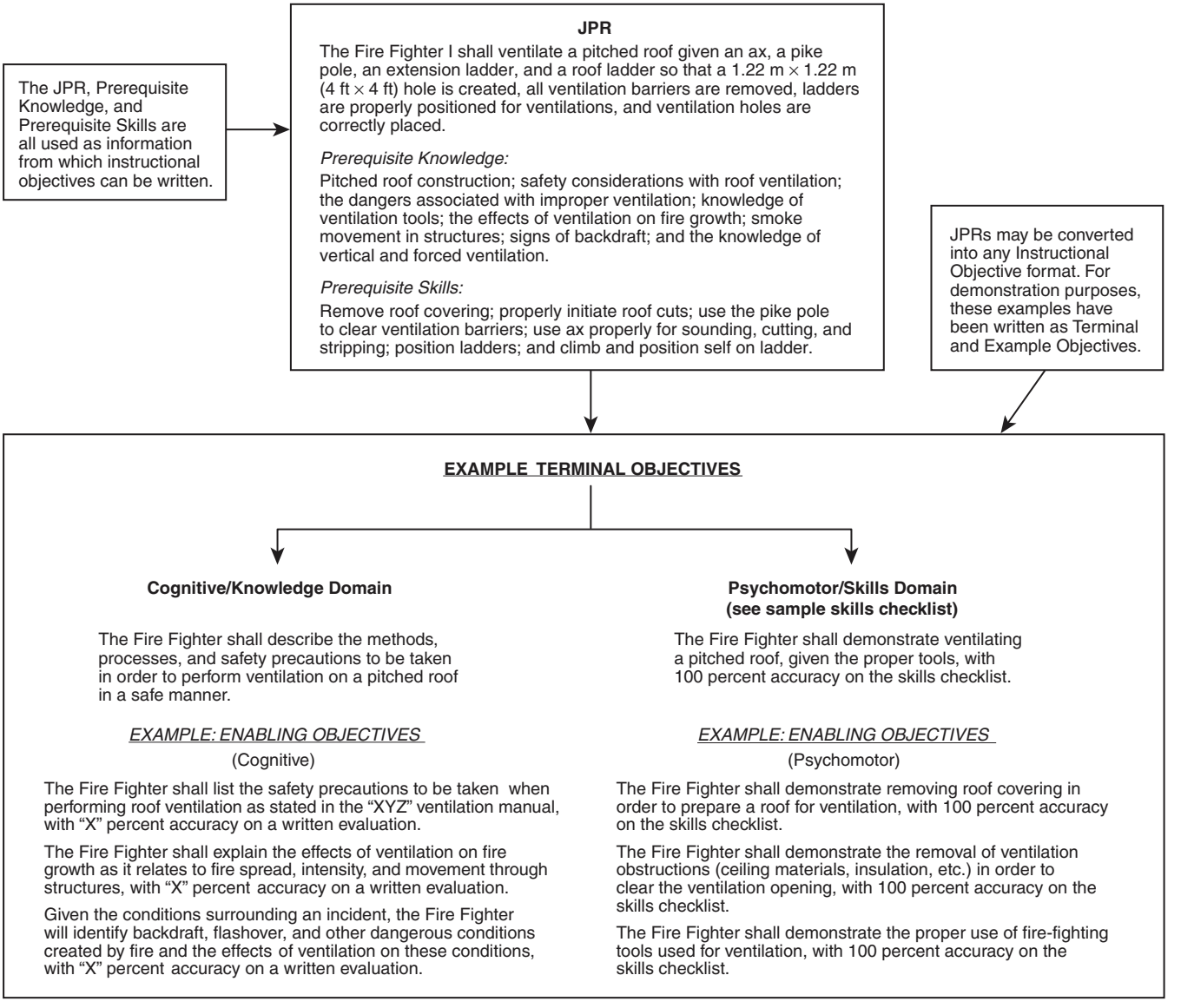

FIGURE H.3.2(a) Converting JPRs into Instructional Objectives.

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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 H.3.2(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 H.3.2(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.

Objective:
The fire fighter shall demonstrate ventilating a pitched roof, given the proper tools, within 5 min and with 100 percent accuracy on the skills checklist.

1. A 1.22 m × 1.22 m (4 ft × 4 ft) hole was created.	❑ Yes	❑ No
2. All ventilation barriers were removed.	❑ Yes	❑ No
3. Ladders were properly positioned.	❑ Yes	❑ No
4. Ventilation holes were correctly placed (directly over fire, at highest point, etc.)	❑ Yes	❑ No
5. Task completed within validated time parameters established by authority having jurisdiction. (Time to complete task:_____.)	❑ Yes	❑ No

FIGURE H.3.2(b) Sample Skills Checklist (Roof Ventilation).

H.4 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.

(1) *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.

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

(3) *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.

(4) *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.

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

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Annex I IADRS Annual Watermanship Test

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

I.1 Evaluation Parameters. There are five exercises that evaluate stamina and comfort in the water, each rated by points. The swimmer must successfully complete all stations and score a minimum of 12 points to pass the test. These scores are recorded on the Annual Watermanship Evaluation Form.

I.2 Stamina Exercise 1: 500-Yard Swim. The diver must swim 500 yards without stopping using a forward stroke and without using any swim aids such as dive mask, fins, snorkel, or flotation device. Stopping or standing up in the shallow end of the pool at any point during this exercise will constitute a failure of this evaluation station.

Time to Complete and Points Awarded:

(1) Under 10 minutes: 5
(2) 10 to 13 minutes: 4
(3) 13 to 16 minutes: 3
(4) 16 to 19 minutes: 2
(5) More than 19 minutes: 1
(6) Stopped or incomplete: Incomplete

I.3 Stamina Exercise 2: 15-Minute Tread. Using no swim aids and wearing only a swimsuit, the diver will stay afloat by treading water, drownproofing, bobbing, or floating for 15 minutes, with hands only out of the water for the last 2 minutes.

Performance Criteria and Points Awarded:

(1) Performed satisfactorily: 5
(2) Stayed afloat, hands not out of water for 2 minutes: 3
(3) Used side or bottom for support at any time: 1
(4) Used side or bottom for support > twice: Incomplete

I.4 Stamina Exercise 3: 800-Yard Snorkel Swim. Using a dive mask, fins, snorkel, and swimsuit (no BCD or other floatation aid) and swimming the entire time with the face in the water, the diver must swim nonstop for 800 yards. The diver must not use arms to swim at any time.

Performance Criteria and Points Awarded:

(1) Under 15 minutes: 5
(2) 15 to 17 minutes: 4
(3) 17 to 19 minutes: 3
(4) 19 to 21 minutes: 2
(5) More than 21 minutes: 1
(6) Stopped at any time: Incomplete

I.5 Stamina Exercise 4: 100-Yard Inert Rescue Tow. The swimmer must push or tow an inert victim on the surface 100 yards nonstop without assistance.

Performance Criteria and Points Awarded:

(1) Under 2 minutes: 5
(2) 2 to 3 minutes: 4
(3) 3 to 4 minutes: 3
(4) 4 to 5 minutes: 2
(5) More than 5 minutes: 1
(6) Stopped at any time: Incomplete

I.6 Surface Dive Exercise 5: Free Dive to a Depth of 9 ft (2.7 m) and Retrieve an Object

Performance Criteria and Points Awarded:

(1) Performed satisfactorily: Pass
(2) Stopped or incomplete: Incomplete

Annex J Informational References

J.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

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3.3.78 Effective Ground-Fault Current Path. An intentionally constructed, permanent, low impedance electrically conductive path designed and intended to carry ~~underground~~ electric fault current ~~conditions~~ from the point of a ground fault on a wiring system to the electrical supply source.

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