

# General

## Lesson One

# Rescue Equipment

**DOMAIN:** COGNITIVE / PSYCHOMOTOR

**LEVEL OF LEARNING:** COMPREHENSION /  
APPLICATION

### **MATERIALS**

Fire Service Search and Rescue, 7th Edition, IFSTA 5th edition Essentials of Firefighting; NFPA 1006, Standard for Technical Rescuer Professional Qualifications; NFPA 1670, Standard on Operations and Training for Technical Rescue Incidents. Have available the various powered and non-powered (hand-operated) rescue equipment including generators and lighting equipment used by the AHJ (Authority Having Jurisdiction). Laptop computer, multimedia projector; whiteboard or flipchart, and marker pens.

### **NFPA 1006, 2008 edition JPRs**

- 5.2.1 Identify the needed support resources
- 5.2.2 Size up a rescue incident
- 5.2.3 Manage incident hazards
- 5.2.4 Manage resources in a rescue incident
- 5.2.5 Conduct a search
- 5.3.1 Victim Triage
- 5.4.2 Inspect and maintain rescue equipment

### **Junior Member Statement:**

Junior Member training activities should be supervised by qualified instructors to assure that the cognitive and psychomotor skills are completed in a safe and non-evasive manner. While it is critical that instructors be constantly aware of the capabilities of all students both mentally and physically to complete certain tasks safely and successfully, the instructor should take every opportunity to discuss with departmental leaders and students the maturity and job

awareness each participant has for the hazards associated with fire and rescue training.

**TERMINAL OBJECTIVE**

The Technical Rescuer candidate shall correctly identify various types of rescue equipment and describe or demonstrate its function for various rescue incidents.

**ENABLING OBJECTIVES**

1. The Technical Rescuer candidate shall correctly describe or demonstrate the basic non-powered (hand-operated) rescue equipment associated with incidents involving the different rescue environments.
2. The Technical Rescuer candidate shall correctly describe or demonstrate the use of basic powered rescue equipment associated with incidents involving the different rescue environments.
3. The Technical Rescuer candidate shall correctly describe and demonstrate the techniques for inspecting, servicing, and maintaining rescue apparatus, equipment, and tools used for various rescue disciplines.

# General

## Lesson One

# Rescue Equipment

### MOTIVATION

Rescue skills and techniques have changed very little over the years. However, rescue equipment seems to evolve every day. The development of newer and lighter equipment is making rescue operations easier and safer. Each of us must spend time evaluating and using our equipment so that we can rapidly adapt to a particular emergency scene.

### PRESENTATION

#### ENABLING OBJECTIVE #1

The Technical Rescuer shall correctly describe or demonstrate the use of basic non-powered (hand operated) rescue equipment associated with incidents involving the different rescue environments.

1. Start this discussion by listing all the rescue disciplines. Then have the class identify the non-powered (hand operated) rescue equipment that may be needed for an incident involving each discipline and discuss each one.
2. Make note of the various equipment that is used in most or all of the rescue disciplines such as ropes, a knife, and a flashlight.
3. Discuss the different types of extinguishers and the agents used in each one.
4. Discuss the difference between dry chemical and dry powder agents, and the classes of fire for which each agent is used.

5. Demonstrate common rescue equipment.
  - a) Striking tools such as an axe, battering ram, sledge hammer, mallet, and punch.
  - b) Prying tools such as a pry-axe, Halligan bar, spanner wrench, and Kelly Bar.
  - c) Chopping tools such as flat-head axes and pick-axes.
  - d) Snipping tools such as side cutters and cable cutters.
  - e) Handsaws such as carpenter's saw, hacksaw, coping saw, and keyhole saws.
  - f) Knives such as pocket, seatbelt (V-saw), linoleum, and razor knives.
  - g) Pulling tools (tripods, winches, come-a-longs).
  - h) Chains such as alloy steel.
  - i) Jacks such as bar screw jacks, trench screw jacks, and ratchet lever jacks.
  - j) Cribbing – be aware of large knots found in wooden cribbing blocks as they can affect the strength of the block.
  
6. Point out what each of these tools is used for, and discuss how they have been designed to accomplish specific tasks?

Reference: Fire Service Search and Rescue, 7th Edition, Pages 72 through 76, 84 through 87, 93 and 94, and 213 through 215, and 303.

## **PRESENTATION**

### **ENABLING OBJECTIVE #2**

The Technical Rescuer candidate shall correctly describe or demonstrate the use of basic powered rescue equipment associated with incidents involving the different rescue environments.

1. Start this discussion by listing all the rescue disciplines. Then have the class identify the powered rescue equipment that may be needed for an incident involving each discipline and discuss each one.
  
2. Identify the various types of hydraulic powered equipment that may be used for various rescue incidents. Briefly discuss their capabilities, safety rules,

and point out the different rescue environments that require the use of these tools.

- a) Spreaders.
  - b) Shears.
  - c) Combination spreader / shears.
  - d) Extension rams.
  - e) Porta-power tools.
  - f) Hydraulic jacks.
3. Identify the various types of pneumatic (air) powered tools. Briefly discuss their capabilities and safety rules.
- a) Air chisels.
  - b) Pneumatic nail guns.
  - c) Air compressors.
4. Discuss air bags and their safety rules.
- a) Plan the lifting operation.
  - b) Be familiar with equipment.
  - c) Follow manufacturer's guidelines.
  - d) Position bags on solid surface.
  - e) Support load with cribbing.
  - f) Prevent bags from coming into contact with temperatures of 220° F.
  - g) When stacking bags follow the manufacturer's guidelines

Reference: Fire Service Search and Rescue, 7th Edition, Pages 81 and 81, and 87 through 90

5. Identify the various types of power saws. Briefly discuss their capabilities and safety rules.
- a) Whizzer saw – can cut case harden locks and steel up to  $\frac{3}{4}$  inches in diameter.
  - b) Circular saw.
  - c) Reciprocating saw.
  - d) Chain saw.
  - e) Wear appropriate PPE.
  - f) Operate saws within their design limits.
  - g) Use blades designed for the specific saw.
  - h) Keep blade guards intact.
  - i) Do not operate saw in a flammable / explosive atmosphere.
  - j) Follow manufacturer guidelines.
  - k) Protect the patient and rescuer from flying sparks and debris.

Reference: Fire Service Search and Rescue, 7th Edition,  
Pages 81 through 84

**NOTE: OSHA requires the use of helmets, safety glasses, hearing protection and chaps when operating a chain saw.**

6. Identify the various types of cutting and burning equipment. Discuss their capabilities and hazards.
  - a) Oxyacetylene.
  - b) MAPP Gas.
  - c) Exothermic torch.
  - d) Petrogen torch.
  - e) Plasma cutter.
  - f) Propane torch.

Reference: Fire Service Search and Rescue, 7th Edition,  
Pages 90 through 92

7. If used by the AHJ, give a brief demonstration of some of the specialized tools such as a thermal imaging camera, pneumatic shoring devices, and nail guns.
8. Identify the various types of power-generating and lighting equipment. Discuss their capabilities and safety rules.
  - a) Power plants such as inverters and generators. Can convert a vehicles 12 or 24 volt DC current to 110 or 220 volts of AC current.
  - b) Lighting equipment such as fixed lights and portable lights.
  - c) Auxiliary lighting equipment such as electrical cables, extension cords, twist lock receptacles, and junction boxes.
  - d) Ventilation equipment.

Reference: Fire Service Search and Rescue, 7th Edition,  
Pages 69 through 71

9. Emphasize the advantages each piece of equipment can afford to the rescuer. Base the advantages on speed, efficiency, and increased safety.
10. Show and discuss some manufacturer's recommended guidelines on the use of equipment used commonly in the jurisdiction in which you are teaching.

11. After the classroom discussion, give the candidates hands on instruction with various pieces of available equipment used by the AHJ.
12. Go over the equipment carefully to explain its operation and safety guidelines.
13. Demonstrate first, and then have each student operate the various pieces of equipment while wearing the proper PPE and following safety guidelines.

Reference: IFSTA 5th edition Essentials of Firefighting, pages 330 through 346.

## **APPLICATION**

Make arrangements to have a rescue truck available for show and tell of equipment.

## **PRESENTATION**

### **ENABLING OBJECTIVE #3**

The Technical Rescuer candidate shall correctly describe and demonstrate the techniques for inspecting, servicing, and maintaining rescue apparatus, equipment, and tools used for various rescue disciplines.

1. Discuss the importance of proper maintenance of all types of rescue apparatus, equipment, and tools.
2. Discuss the importance of developing proper SOGs for maintaining all types of rescue apparatus, equipment, and tools.
3. Discuss the importance of proper record keeping for maintaining all types of rescue apparatus, equipment, and tools.
4. Discuss the different types of inspections that are required for rescue service apparatus.
  - a) Battery check.
  - b) Braking systems.
  - c) Coolant system.
  - d) Electrical system.

- e) Fuel.
  - f) Hydraulic fluids.
  - g) Lubrication.
  - h) Oil.
  - i) Tire care.
  - j) Steering system.
  - k) Belts.
  - l) Tools, appliances, and equipment.
5. Point out that in order to perform certain apparatus component inspections for the verification of operational capability, appropriate testing equipment may be required. Consult the manufacturer's maintenance manuals to determine the appropriate test instruments and test parameters.

Reference: Fire Service Search and Rescue, 7th Edition, Pages 62 through 66; IFSTA 7th edition Fire Department Pumping Apparatus, pages 192-194; NFPA 1002 Standard for Driver / Operator, page 5; Manufacturer's Operation and Maintenance manuals.

6. Briefly discuss the need for proper record keeping and reporting procedures to maintain the correct documentation for an apparatus.
- a) Recording procedures.
  - b) Reporting procedures.
7. Discuss the purpose for having a preventative maintenance record keeping system for apparatus and equipment.
- a) Safety.
  - b) Reliability.
  - c) Assessment of functional capability.
  - d) Operator confidence.
  - e) Budgeting analysis.
  - f) Assessment of apparatus and equipment longevity.
  - g) Prediction of future departmental apparatus and equipment requirements.
8. Discuss the various types of inspection / maintenance records that may be required for any type of rescue apparatus.
- a) Time-frequency record keeping: daily, weekly, and periodic records.

- b) Component replacement records due to mechanical failure of a part.

Reference: IFSTA 7th edition Fire Department Pumping Apparatus, pages 192-193.

9. Discuss the engine lubrication system of an available rescue apparatus from the AHJ.
  - a) Engine oil.
  - b) Oil filters.
  - c) Oil pumps.
  
10. Discuss the engine air induction system of an available rescue apparatus from the AHJ.
  - a) Cartridge type filters.
  - b) Oil bath type.
  
11. Discuss the fuel system and its individual components with regard to an available rescue apparatus from the AHJ.
  - a) Fuel filters.
  - b) Fuel lines.
  - c) Fuel tank.
  - d) Fuel pumps, electrical, and mechanical.
  
12. Discuss the engine cooling system components of an available rescue apparatus from the AHJ.
  - a) Radiators.
  - b) Coolant pump, water pump.
  - c) Coolant hoses.
  - d) Thermostats.
  - e) Belts.
  - f) Heat exchangers.
  - g) Freeze plugs.
  - h) Coolant requirements.
  - i) Coolant overflow reservoir.
  
13. Discuss the electrical system and its components with regard to an available rescue apparatus from the AHJ.
  - a) The battery.
  - b) Generators and alternators.
  - c) Voltage regulator.
  - d) Electrical motors.
  - e) Lighting systems.

Reference: IFSTA 7th edition Fire Department Pumping Apparatus, pages 191-200; Manufacturer's Specification manuals.

**NOTE: For proper engine care, always allow the engine to warm up to normal operating temperature prior to shutting it down.**

### **APPLICATION**

Divide the class into small groups of 3 to 5 candidates, assign each group to a specific area of the available rescue service apparatus engine to inspect and / or service. For example: cooling system, electrical system, oil and lubrication system, air induction system, and the fuel system. Appoint a group leader to examine and record the conditions found in the assigned area before and after any servicing. Upon completion of the exercise have the group leaders individually address the class to report their findings utilizing a flipchart or chalkboard. Critique each group's findings as they complete their presentation. Allow one hour for this application.

14. Discuss the brake system components of an available rescue apparatus from the AHJ.
  - a) Hydraulic systems.
  - b) Air systems.
  - c) Parking brake.
  
15. Discuss the steering system components of an available rescue apparatus from the AHJ.
  - a) Manual steering systems.
  - b) Power assisted steering systems.
  
16. Discuss the driveline components of an available rescue apparatus from the AHJ.
  - a) Transmission.
  - b) Drive shafts and support bearings.
  - c) The differential.
  - d) The universal joints.
  
17. Discuss the components of the exhaust system of an available rescue apparatus from the AHJ.
  - a) Exhaust manifold.
  - b) Muffler.
  - c) Tail pipe.
  - d) Catalytic converters.

18. Discuss the tire and wheel conditions and their components of an available rescue apparatus from the AHJ.
  - a) Tire pressure.
  - b) Tire condition, depth of tread, type of tread, and wear points.
  - c) Lug nuts; torque in place at the correct foot-pounds.
  - d) Rim condition; single or split rim design.

Reference: IFSTA 7th edition Fire Department Pumping Apparatus, pages 191-202; Manufacturer's Specification manuals.

## **APPLICATION**

Divide the class into small groups of 3 to 5 candidates, and assign each group to a specific area of the available rescue service apparatus frame and chassis to inspect and / or service. For example: the brake system, steering system, exhaust system, driveline components, and the wheel and tires. Appoint a group leader to examine the frame or chassis and record the conditions found in the assigned area before and after any servicing. Upon completion of the exercise have the group leaders individually address the class to report their findings utilizing a flipchart or chalkboard. Critique each group's findings as they complete their presentation. Allow one hour for this application.

19. Discuss general maintenance procedures for striking tools, prying tools, chopping tools, scissors or snipping tools, saws and knives.
  - a) Striking tool handles should be solid and well set into the head.
  - b) Handles can be protected from fracturing by securing rubber tubing or tape (duct tape or electrical tape) around the handle near the head.
  - c) Striking surfaces should be routinely serviced.
  - d) Axes or pointed tools should be kept sharp, but not be razor sharp.
  - e) Blunt striking surfaces should be kept free of chips or cracks.
  - f) Chopping tool heads should not be re-painted.

- g) Chopping tool heads should be covered with a thin coat of light grade oil such as silicone lubricant or light machine oil.
  - h) Chopping tool head should have a slightly sharp edge.
  - i) Chopping tool handles should be checked for fractures, looseness and warping.
  - j) All handsaws should be free of rust, kept sharp or replaced when dulled and lightly oiled.
  - k) Knife blades should be sharpened or replaced after each use.
20. Cables and chains should be periodically inspected especially after being subjected to high stress and or heavy loads.
- a) Chains and cables should be rated for pulling a specific load. Check manufacturer's recommendations for rated capacity.
  - b) Check for bad weld points, cracked chain, heavy oxidation, frayed or broken cable strands, severe nicks, elongation, and bent links. Destroy damaged or worn out cables and chains.

Reference: Fire Service Search and Rescue, 7th Edition, Pages 72 through 75.

21. Point out that according to the National Safety Council, there is a maximum allowable wear for chains.
- a) Chain size- 1" MAW= 7/32".
  - b) Chain size- 1 1/2" MAW= 5/16".
22. Point out the importance of inspecting all tools before and after each use.

Reference: Fire Service Search and Rescue, 7th Edition, Pages 75 through 101.

23. To understand fire extinguishers, discuss the four elements that must be present for a fire to exist.
- a) There must be oxygen to sustain combustion, heat to raise the material to its ignition temperature, fuel to support the combustion and a chemical chain reaction between the other three elements.
  - b) Remove any one of the four elements to extinguish the fire.

- c) Not all fires are the same. Different fuels create different fires and require different types of fire extinguishing agents.
  - d) Class A fires are fires in ordinary combustibles such as wood, paper, cloth, trash, and plastics.
  - e) Class B fires are fires in flammable liquids such as gasoline, petroleum oil, and paint. Class B fires also include flammable gases such as propane and butane. Class B fires do not include fires involving cooking oils and grease.
  - f) Class C fires are fires involving energized electrical equipment such as motors, transformers, and appliances. Remove the power and the Class C fire becomes one of the other classes of fire.
  - g) Class D fires are fires in combustible metals such as potassium, sodium, aluminum, and magnesium.
  - h) Class K fires are fires in cooking oils and greases such as animal fats and vegetable fats.
24. Explain and describe the different types of fire extinguishers. Some types of fire extinguishing agents can be used on more than one class of fire. Others have warnings where it would be dangerous for the operator to use a particular fire extinguishing agents.
- a) Water and foam fire extinguishers extinguish the fire by taking away the heat element of the fire triangle. Foam agents also separate the oxygen element from the other elements. Water extinguishers are for Class A fires only; they should not be used on Class B or Class C fires. The discharge stream could spread the flammable liquid in a Class B fire or could create a shock hazard on a Class C fire. Foam extinguishers can be used on Class A and B fire only. They are not for use on Class C fires due to the shock hazard.
  - b) Carbon Dioxide fire extinguishers extinguish the fire by taking away the oxygen element of the fire triangle and also removing the heat with a very cold discharge. Carbon dioxide can be used on Class B and C fires. They are usually ineffective on Class A fires.
  - c) Dry chemical fire extinguishers extinguish the fire primarily by interrupting the chemical reaction of

the fire triangle. Today's most widely used type of fire extinguisher is the multipurpose dry chemical that is effective on Class A, Class B, and Class C fires. This agent also works by creating a barrier between the oxygen element and the fuel element on Class A fires. Ordinary dry chemical is for Class B and Class C fires only. It is important to use the correct extinguisher for the type of fuel. Using the incorrect agent can allow the fire to reignite after apparently being extinguished successfully.

- d) Wet chemical is a new agent that extinguishes the fire by removing the heat of the fire triangle and prevents re-ignition by creating a barrier between the oxygen and fuel elements. Wet chemical or Class K extinguishers were developed for modern, high efficiency deep fat fryers in commercial cooking operations. Some may also be used on Class A fires in commercial kitchens.
- e) Halogenated or Clean Agent extinguishers include the halon agents as well as the newer and less ozone depleting halocarbon agents. They extinguish the fire by interrupting the chemical reaction of the fire triangle. Clean agent extinguishers are primarily for Class B and Class C fires. Some larger clean agent extinguishers can be used on Class A, Class B, and Class C fires.
- f) Dry powder extinguishers are similar to dry chemical except that they extinguish the fire by separating the fuel from the oxygen element or by removing the heat element of the fire triangle. However, dry powder extinguishers are for Class D or combustible metal fires, only. They are ineffective on all other classes of fires.

25. Discuss the inspection, care, maintenance of portable fire extinguishers.
- a) NFPA 10 is the standard used for inspection, care and maintenance.
  - b) All portable extinguishers shall be hydrostatically tested in accordance with NFPA 10.
  - c) Test results on high and low pressure cylinders are recorded differently.

- d) Inspection includes checking the discharge nozzle for obstructions, cracks, dirt or grease deposits, checking cylinder shell for any deformity, confirm that operating instructions on name plate are legible, checking for presence of lock pins and tamper seals, and determine if cylinder is full by checking pressure gauge or weighing cylinder
- e) Check the inspection tag for date of previous inspection, maintenance, or charging.

26. Point out that if any extinguisher is deficient in weight by 10% or more, it should be removed from service and replaced.

Reference: IFSTA 5th edition Essentials of Firefighting, Page 252; Manufacturer's specification manuals.

## **APPLICATION**

Supply the candidates with, or have the candidates bring in their various types of portable extinguishers. Divide the candidates into small groups. Supply each group with an extinguisher and have them conduct an inspection.

27. List all power tools on the apparatus and describe their respective inspection procedures to ensure they are operable.
- a) Hydraulic tools: pumps / engines, spreaders, cutters, shears, jacks, etc.
  - b) Generators and associated electrical equipment and tools: lights, saws, etc.
  - c) Compressors, stored air systems, and all pneumatic equipment: air chisels, air bags, air shores, air hammers, etc.
  - d) Chainsaws, electrical and gas powered.
  - e) Power winches.
  - f) Fans, smoke ejectors, positive pressure ventilation fans, etc.

Reference: Fire Service Search and Rescue, 7th Edition, Pages 79 through 84; Manufacturer's Specification manuals.

28. Discuss preventive maintenance and inspection procedures for hydraulic spreaders.
- a) Inspection and cleaning should follow each use.
  - b) Check for proper fluid levels.

- c) Check for cracks and dents in the body and arms of the spreader.
- d) Check alignment of the arms.
- e) Follow the manufacturer's guidelines for any additional maintenance requirements.

Reference: Vehicle Rescue and Extrication, 2nd edition, pages 231-232.

29. Discuss preventive maintenance and inspection procedures for hydraulic cutters.
- a) Inspection and cleaning should follow each use.
  - b) Check for proper fluid levels.
  - c) Check for cracks and dents in the body and blade.
  - d) Check alignment of the arms.
  - e) Check that all nuts, bolts, retainer rings, screws, pins are in place and secured.
  - f) Follow the manufacturer's guidelines for any additional maintenance requirements.

30. Discuss preventive maintenance and inspection procedures for hydraulic rams.
- a) Inspection and cleaning should follow each use.
  - b) Check for proper fluid levels.
  - c) Check for cracks and dents in the body and plunger.
  - d) Check the controller for proper operation.
  - e) Check that all nuts, bolts, retainer rings, screws, pins are in place and secured.
  - f) Follow the manufacturer's guidelines for any additional maintenance requirements.

Reference: Vehicle Rescue and Extrication, 2nd edition, page 240.

31. Discuss general inspection procedures for air chisels.
- a) Lubricate all internal parts prior to putting tools into service.
  - b) Inspection and cleaning should follow each use.
  - c) Check for proper fluid levels.
  - d) Tighten all loose parts.
  - e) Keep inlets and exhaust free of debris.
  - f) Keep all bits sharpened.
  - g) Follow the manufacturer's guidelines for any additional maintenance requirements.

Reference: Vehicle Rescue and Extrication, 2nd edition, pages 248-249.

## **APPLICATION**

Using equipment provided by the AHJ, have the candidates demonstrate performing an inspection on a hydraulic spreader, cutter, ram, and an air chisel.

## **SUMMARY**

This class is designed to introduce the Technical Rescuer candidate to basic rescue equipment as well as some of the specialized equipment that candidates may encounter in the field. It is a general class, and the instructor should cover all the rescue disciplines. However, keep in mind that the more equipment the candidates can be exposed to, the sooner they will be effective and versatile in the field.

This is the instructor's "show and tell" class. Gather as much equipment as available for demonstration purposes. If possible, arrange for dealers to attend the class and demonstrate specific characteristics of the equipment they represent. Application of the tools will come later.

Continuously emphasize to the candidates that equipment is used to increase speed and efficiency, but never should safety be neglected for the sake of speed.