Fire Fighter I Chapter 8 **Learning Objectives**

8.1 Distinguish between rescue and extrication operations.

8.2 Summarize safety guidelines for search and rescue personnel operating within a burning building.

8.2A Describe a successful rescue operation and the firefighter's role in it.

8.2B List four rescue situations that would require respiratory protection to conduct a safe rescue.

8.2C Describe the psychological effects of operating in obscured conditions and ways to control these effects.

8.2D Describe the value of using forcible entry tools in rescue operations.

8.2E List three uses of ladders in rescue situations.

8.3 Explain the objectives of a building search.

8.3A Describe the methodology for finding victims in a rescue situation.

8.3B List four indicators of the presence of victims in a rescue situation.

8.3C List three ways of determining if an area is tenable.

8.4 Describe primary search and secondary search.

8.5 Discuss conducting search operations.

8.6 Explain what actions a firefighter should take when in distress.

8.7 Describe actions that should be taken by a rapid intervention crew (RIC) when a firefighter is in distress.

8.7A Describe the primary responsibility of the RIC team in fire attack situations.

8.8 Discuss victim removal methods.

8.8A List four victim/resident/firefighter removal methods.

8.9 Discuss emergency power and lighting equipment.

8.10 Conduct a primary and secondary search. (Skill Sheet 8-I-1)

8.10A Conduct a below or above grade structural fire rescue as part of a team, given a selection of ladders, tools, a training manikin, protective equipment, and an assignment. (FL Exercise 8-I-1)

8.10B Conduct a primary search as part of a team, given reduced visibility conditions, tools, protective equipment, attack line, utility rope, and an assignment. (FL Exercise 8-I-2)

8.11 Exit a hazardous area. (Skill Sheet 8-I-2)

8.12 Demonstrate the incline drag. (Skill Sheet 8-I-3)

8.13 Demonstrate the blanket drag. (Skill Sheet 8-I-4)

8.14 Demonstrate the webbing drag. (Skill Sheet 8-I-5)

8.14A Rescue a downed firefighter or civilian as part of a team, given protective equipment, a simulated hazardous environment, and an assignment. (FL Exercise 8-I-3)

8.14B Rescue a person from immediate hazard as part of a team, given a simulated injured person with selected injuries in proximity of an immediate hazard, tools, protective equipment, and an assignment. (FL Exercise 8-I-4)

8.15 Demonstrate the cradle-in-arms lift/carry — One-rescuer method. (Skill Sheet 8-I-6)

8.16 Demonstrate the seat lift/carry — Two-rescuer method. (Skill Sheet 8-I-7)

8.17 Demonstrate the extremities lift/carry — Two-rescuer method. (Skill Sheet 8-I-8)

8.18 Demonstrate the chair lift/carry method 1 — Two rescuers. (Skill Sheet 8-I-9)

8.19 Demonstrate the chair lift/carry method 2 — Two rescuers. (Skill Sheet 8-I-10)

8.20 Illuminate the emergency scene. (Skill Sheet 8-I-11)

Rescue and Extrication

Terms

Write the definition of the terms below on the blanks provided.

1. **Rescue** (305) _____

_____

2. **Extrication** (305) _____

_____

3. **Size-Up** (307) _____

_____

4. **Egress** (307) _____

_____

5. **All Clear** (308) _____

_____

6. **Carabiner** (312) _____

_____

7. **Rapid Intervention Crew (RIC)** (323) _____

_____

8. **Cardiopulmonary Resuscitation (CPR)** (327) _____

_____

9. **Supine** (329) _____

_____

10. **Inverter** (331) _____

_____

11. **Generator** (331)_____

_____

12. **Arc** (334) _____

_____

13. **Hydraulics** (334) _____

_____

14. **Shoring** (338)_____

_____

15. **Cribbing** (339)_____

_____

16. **Block and Tackle** (346) _____

_____

17. **Triage** (350) _____

_____

18. **Stabilization** (350)_____

_____

19. **Chock** (351) _____

_____

20. **Packaging** (356)_____

_____

21. **Safety Glass (Laminated Glass)** (357) _____

_____

22. **Tempered Glass** (357) _____

_____

23. **Unibody Construction** (360) _____

_____

24. **Secondary Collapse** (364) _____

_____

25. **Hypothermia** (372) _____

_____

26. **Tourniquet** (373) _____

_____

True/False

Write True or False on the blanks provided; if False, write the correct statements on the lines provided.

_____ 1. Rescue incidents involve the disentanglement and removal of victims from vehicles or machinery. (305)

_____

_____

_____ 2. If backdraft conditions are apparent during search and rescue, attempt entry before beginning ventilation. (306)

_____

_____

_____ 3. Searching for life requires at least two types of searches. (309)

_____

_____

_____ 4. The primary search is often carried out under extremely adverse conditions. (309)

_____

_____

_____ 5. The secondary search is performed either before or during fire suppression operations. (309)

_____

_____

_____ 6. During the primary search, teams should always use the buddy system. (309)

_____

_____

_____ 7. The first action a firefighter should take while in distress is to remain calm. (319)

_____

_____

_____ 8. When searching for a firefighter in distress, the first step rescuers should take is to listen for his or her PASS device. (324)

_____

_____

_____ 9. The three-person lift/carry is an effective way to lift a victim who is lying down. (329)

_____

_____

_____ 10. Inverters are the most common power source used for emergency services. (331)

_____

_____

Matching

Write the correct answers on the blanks provided.

_____ 1. Can be used by one rescuer to move a victim up or down a stairway (328)

_____ 2. Can be implemented by one rescuer using a rug or sheet (328)

_____ 3. Is effective for carrying children or very small adults if they are conscious (328)

_____ 4. Is often used for moving a victim from a bed to a gurney (329)

A. Blanket drag
B. Chair lift/carry
C. Cradle-in-arms lift/carry
D. Incline drag
E. Three-person lift/carry

Short Answer

Write the correct answers on the blanks provided.

1. What are the standard search priorities of a primary search? (309)

_____

_____

_____

_____

2. What three recommendations are made for attempting to breach an interior wall? (322)

_____

_____

_____

_____

3. What three outcomes can result from overtaxing the power plant? (332)

_____

_____

_____

_____

8

Multiple Choice

Write the correct answers on the blanks provided.

_____ 1. In a ___ search, be sure to check the known or likely locations of victims as rapidly as conditions allow. (309)

A. tertiary
B. primary
C. secondary
D. rapid intervention

_____ 2. In a ___ search, speed is not as important as thoroughness. (314-315)

A. tertiary
B. primary
C. secondary
D. rapid intervention

_____ 3. If in distress without a radio, the first step you should take is to: (320)

A. use your escape rope.
B. break through an interior or exterior wall.
C. try to retrace your steps to your original location.
D. search for an exit by locating a wall and crawling along it.

_____ 4. When moving a victim onto a long backboard or litter, ___ rescuers are required. (330)

A. 3
B. 4
C. 5
D. 6

_____ 5. Which of the following statements about inverters is LEAST accurate? (331)

A. They are fuel-efficient.
B. They have a limited power supply.
C. They are the most common power source used for emergency services.
D. They are used on emergency vehicles when small amounts of power are needed.

Fire Fighter II Chapter 8 **Learning Objectives**

8.1 Discuss maintaining emergency power and lighting equipment.

8.1A Describe the different cleaning methods for power plants, power tools, and lighting equipment.

8.2 Describe characteristics of hydraulic rescue tools.

8.3 Describe characteristics of nonhydraulic rescue tools.

8.3A Identify the advantages and disadvantages of hand, electric, hydraulic and pneumatic tools / extrication equipment.

8.3B Explain the safety procedures to be employed in using hand, electric, hydraulic, or pneumatic extrication tools.

8.4 Discuss cribbing for rescue operations.

8.5 Describe the characteristics of pneumatic tools.

8.6 Discuss lifting/pulling tools used in rescue operations.

8.7 Explain the size-up process for a vehicle incident.

8.7A Describe the fire department's role at a vehicle accident.

8.7B Describe the process of scene assessment and extrication size-up.

8.8 Describe items to look for when assessing the need for extrication activities.

8.8A Identify the points of strength and weakness in auto body construction. (FL Learning Activity 8-II-1)

8.8B Explain the difference between traumatic and non-traumatic disentanglement.

8.8C Explain the value of the Holmatro (or similar) vehicle extrication book from a safety perspective.

8.9 Discuss stabilizing vehicles involved in a vehicle incident.

8.9A Stabilize a vehicle for extrication using cribbing and/or pneumatic tools, hydraulic tools, or hand jacks, given cribbing/shoring material, extrication equipment, protective equipment. (FL Exercise 8-II-1)

8.10 List the three methods of gaining access to victims in vehicles.

8.11 List the most common hazards associated with wrecked passenger vehicles.

8.11A Identify five dangers associated with vehicle components and systems.

8.11B Identify three dangers unique to propane-, hydrogen-, and gas/electric-fueled vehicles.

8.12 Explain the dangers associated with Supplemental Restraint Systems (SRS) and Side-Impact Protection Systems (SIPS).

8.12A Explain how to recognize, disarm, or neutralize airbags.

8.12B Assess and neutralize any vehicle systems that might pose a threat to operations, given a simulated crash scene. (FL Exercise 8-II-2)

8.13 Describe basic actions taken for patient management.

8.14 Describe patient removal.

8.15 Describe laminated safety glass and tempered glass.

8.16 Discuss removing glass from vehicles.

8.17 Explain considerations when removing vehicle roof and doors.

8.18 Describe common patterns of structural collapse.

8.19 Describe the most common means of locating hidden victims in a structural collapse.

8.20 Describe structural collapse hazards.

8.21 Describe shoring.

8.22 Discuss technical rescue incidents.

8.22A Describe the firefighter's role at a special rescue operation.

8.22B Identify hazards associated with special rescue operations.

8.22C Recognize the types and uses of rescue tools.

8.22D Explain the intent of safe rescue practices.

8.22E Explain the goals of special rescue teams.

8.23 Service and maintain portable power plants and lighting equipment. (Skill Sheet 8-II-1)

8.23A Operate power plants, power tools, and lighting equipment. (FL Exercise 8-II-3)

8.23B Complete an assignment and document in accordance with procedure, given the procedures for documenting the cleaning and maintenance of equipment, equipment to clean or maintain, necessary supplies, and safety gear. (FL Exercise 8-II-4)

8.23C Report problems in accordance with procedure and take action as required, given the procedures for reporting problems found with equipment during maintenance and problems found. (FL Learning Activity 8-II-2)

8.24 Extricate a victim trapped in a motor vehicle. (Skill Sheet 8-II-2)

8.24A Assess a vehicle for extrication and choose and apply appropriate techniques for moving or removing vehicles roofs, doors, windshields, windows, steering wheels or columns, and the dashboard, given several simulated crash vehicles with simulated patients to be extricated, and hand, electric, hydraulic, and pneumatic tools and equipment. (FL Exercise 8-II-5)

8.25 Assist rescue teams. (Skill Sheet 8-II-3)

8.25A Identify tools and carry safely to complete an assignment, given a selection of rescue tools and an assignment to bring a specified rescue tool to the tool staging area. (FL Skill Sheet 8-II-1)

8.25B Establish public barriers utilizing existing and natural barriers, given a simulated rescue team situation and the assignment to secure the area. (FL Skill Sheet 8-II-2)

Rescue and Extrication

Terms

Write the definition of the terms below on the blanks provided.

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_____

2. **Extrication** (305) _____

_____

3. **Size-Up** (307) _____

_____

4. **Egress** (307) _____

_____

5. **All Clear** (308) _____

_____

6. **Carabiner** (312) _____

_____

7. **Rapid Intervention Crew (RIC)** (323) _____

_____

8. **Cardiopulmonary Resuscitation (CPR)** (327) _____

_____

9. **Supine** (329) _____

_____

10. **Inverter** (331) _____

_____

11. **Generator** (331)_____

_____

12. **Arc** (334) _____

_____

13. **Hydraulics** (334) _____

_____

14. **Shoring** (338)_____

_____

15. **Cribbing** (339)_____

_____

16. **Block and Tackle** (346) _____

_____

17. **Triage** (350) _____

_____

18. **Stabilization** (350)_____

_____

19. **Chock** (351) _____

_____

20. **Packaging** (356)_____

_____

21. **Safety Glass (Laminated Glass)** (357) _____

_____

22. **Tempered Glass** (357) _____

_____

23. **Unibody Construction** (360) _____

_____

24. **Secondary Collapse** (364) _____

_____

25. Hypothermia (372) _____

_____

26. **Tourniquet** (373) _____

_____

True/False

Write True or False on the blanks provided; if False, write the correct statements on the lines provided.

_____ 1. Spreaders were the first powered hydraulic tools to become available to the fire/rescue service. (335)

_____

_____

_____ 2. Screw jacks can fail under a heavy load. (338)

_____

_____

_____ 3. Cribbing is most often used to stabilize objects. (339)

_____

_____

_____ 4. Winches should be positioned as close to the object being pulled as possible. (342)

_____

_____

_____ 5. Winch operators should stay farther away from the winch than the length of the cable from the winch to the load. (342)

_____

_____

_____ 6. Scene size-up of a vehicle incident should begin as soon as the first emergency vehicle leaves the station. (347)

_____

_____

_____ 7. Emergency or parking brakes can be used as the sole means of horizontal stabilization. (351)

_____

_____

_____ 8. Rescuers inside a vehicle about to be extricated should wear PPE that is appropriate to the hazards. (355)

_____

_____

_____ 9. Shoring is intended to move extremely heavy objects. (365)

_____

_____

_____ 10. A trench may only be entered by those with specific trench-rescue skills. (366)

_____

_____

Matching

Write the correct answers on the blanks provided.

_____ 1. Are good for cutting medium- to heavy-gauge sheet metal and for popping rivets and bolts (340)

_____ 2. Can be used to drive nails or heavy-duty staples into wood or masonry (341)

_____ 3. Are ideal for disassembling machinery in which a victim is entangled (341)

_____ 4. Can almost instantly create a hole 1 foot (0.3 m) in diameter and depth (341)

_____ 5. Can be used to vacuum loose soil from around victims buried in a trench collapse (342)

_____ 6. Are used for delicate cutting operations; can cut case-hardened locks and steel (342)

A. Air chisels
B. Air knifes
C. Air vacuums
D. Impact tools
E. Impact vacuums
F. Pneumatic nailers
G. Whizzer saws

_____ 7. Allow rescuers to be safely lowered into confined spaces and rescuers and victims to be hoisted out of them (342)

_____ 8. Are excellent pulling tools and are usually located behind the front bumper of the vehicle (342)

_____ 9. Are a portable cable winch operated by a manual ratchet lever (343)

_____ 10. Are used along with winches and come-alongs (344)

_____ 11. Give rescuers the ability to lift or displace objects that cannot be lifted with other rescue equipment (344)

_____ 12. Convert a given amount of pull to a working force greater than the pull (346)

A. Block and tackle systems
B. Chains
C. Come-alongs
D. Hydraulic jacks
E. Pneumatic lifting bags
F. Tripods
G. Winches

8

Short Answer

Write the correct answers on the blanks provided.

1. List four requirements when servicing power and lighting equipment. (334)

_____

_____

_____

_____

2. When assessing the need for extrication activities, what things should be looked for in the immediate area around a vehicle? (349)

_____

_____

_____

_____

3. What are the three methods of gaining access to victims in vehicles? (353)

_____

_____

_____

_____

4. What are the most common hazards associated with wrecked passenger vehicles? (354)

_____

_____

_____

_____

5. What are the two ways in which vehicle roofs can be removed? (359)

_____

_____

_____

_____

6. List the most common means of locating hidden victims in a structural collapse. (364)

_____

_____

_____

_____

7. What are three environmental hazards that may be present at a structural collapse? (365)

_____

_____

_____

_____

8. What are some of the most common types of confined spaces? (367)

_____

_____

_____

_____

9. What is the difference between a rescue and a recovery? (370)

_____

_____

_____

_____

10. What are the water rescue methods? (370)

_____

_____

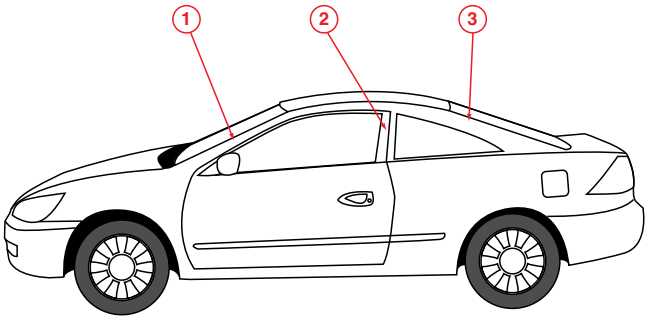
_____

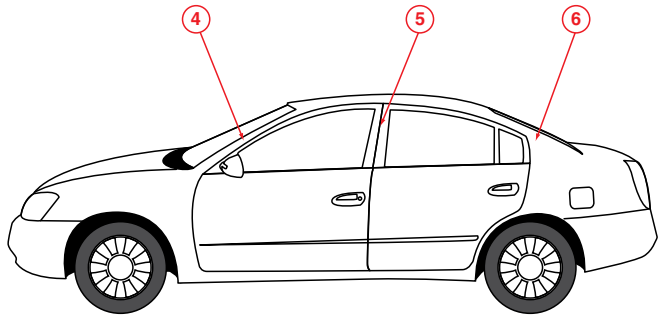
_____

8

Picture ID

A. Identify the vehicle door post designations on the lines provided. (359)

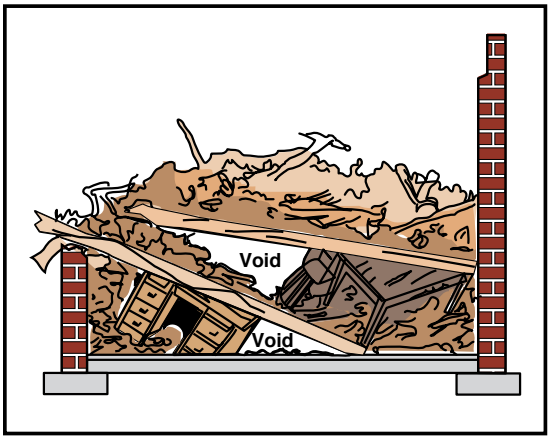


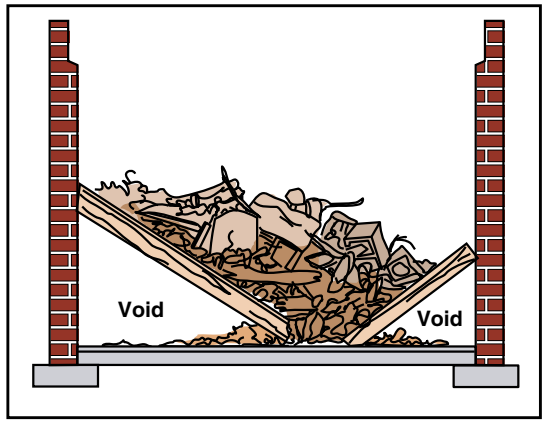


1. _____
2. _____
3. _____

4. _____
5. _____
6. _____

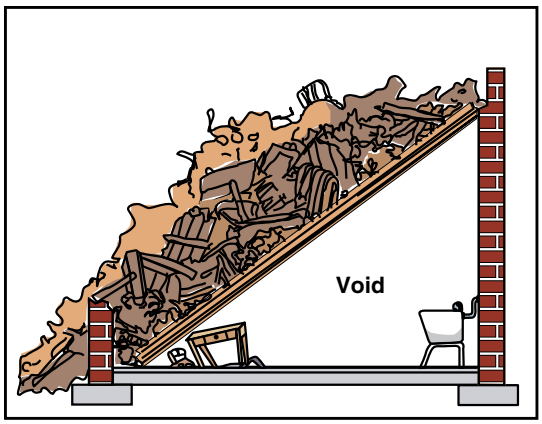
B. Identify the types of collapse shown in the illustrations below. (362-364)





8. _____
_____
_____

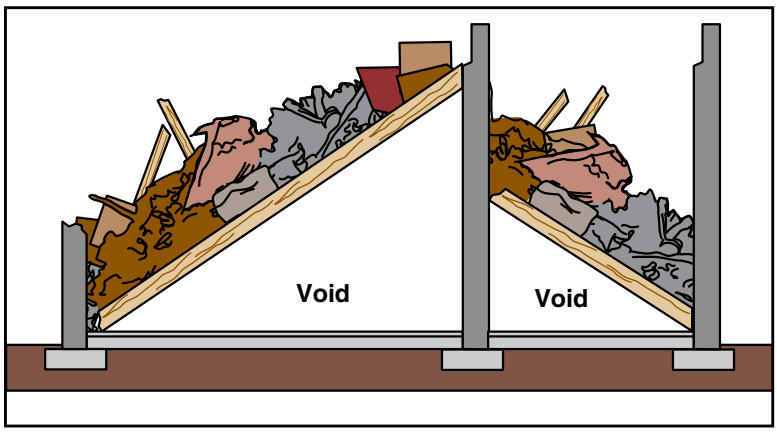
9. _____
_____
_____



10. _____

_____

_____



11. _____

_____

_____

_____

12. _____

_____

_____

_____

8

Multiple Choice

Write the correct answers on the blanks provided.

_____ 1. Which of the following hydraulic tools have an opening spread of approximately 7 inches (175 mm)? (335)

A. Shears
B. Spreaders
C. Porta-power tool systems
D. Combination spreader/shears

_____ 2. Which of the following hydraulic tools are useful when pushing objects farther than the maximum opening distance of hydraulic spreaders? (336)

A. Shears
B. Hydraulic jacks
C. Extension rams
D. Combination spreader/shears

_____ 3. Which of the following nonhydraulic jacks are used to hold an object in place? (338)

A. Electric jacks
B. Bar screw jacks
C. Trench screw jacks
D. Ratchet-lever jacks

_____ 4. Which of the following nonhydraulic jacks are easy to use, durable, and relatively inexpensive? (338)

A. Electric jacks
B. Bar screw jacks
C. Trench screw jacks
D. Ratchet-lever jacks

_____ 5. Which lifting/pulling tools create an anchor point above a manhole or other opening? (342)

A. Tripods
B. Winches
C. Come-alongs
D. Pneumatic lifting bags

_____ 6. Which lifting/pulling tools should be equipped with handheld remote-control devices? (342)
A. Chains
B. Winches
C. Pneumatic lifting bags
D. Block and tackle systems

_____ 7. High-pressure lifting bags inflate to a height of ___ inches (mm). (344)
A. 20 (500)
B. 30 (750)
C. 40 (1000)
D. 50 (1250)

_____ 8. Low- and medium-pressure lifting bags may be capable of lifting an object ___ feet (m). (344)
A. 5 (1.5)
B. 6 (2)
C. 7 (2.1)
D. 8 (2.4)

_____ 9. Pneumatic lifting bags should not be allowed to contact materials hotter than: (345)
A. 100°F (38°C).
B. 150°F (66°C).
C. 220°F (104°C).
D. 250°F (121°C).

_____ 10. Horizontal motion of a vehicle involved in a vehicle incident should be prevented by: (351)
A. using jacks.
B. using cribbing.
C. using pneumatic lifting bags.
D. chocking the vehicle's wheels.

_____ 11. The electrical power should be shut down to the vehicle to prevent all of the following EXCEPT: (353)
A. ignition.
B. movement of the vehicle.
C. electrocution to rescuers.
D. operation of restraint systems.

_____ 12. A reserve energy supply can maintain sufficient voltage to deploy an air bag for up to ___ minutes after the battery has been disconnected. (353)

A. 20
B. 30
C. 40
D. 50

_____ 13. Which of the following is NOT a way to prevent the activation of SRS or SIPS? (355)

A. Turn off the ignition switch
B. Run water into the systems
C. Disconnect both battery cables
D. Wait for the reserve power supply to drain down

_____ 14. Which of the following statements about SRS and SIPS is LEAST accurate? (355)

A. Fire suppression activities can accidentally activate the systems.
B. An accidental activation of these systems cannot be prevented.
C. The systems can deploy even after the battery has been disconnected.
D. Some systems do not require power from the vehicle's electrical system.

_____ 15. Which of the following statements about patient management is MOST accurate? (356)

A. The vehicle must be removed from around the patient.
B. Treatment cannot begin until the patient is removed from the vehicle.
C. Treatment should be administered before vehicle extrication is begun.
D. Rescuers should not enter a vehicle about to be extricated under any circumstances.

_____ 16. Which vehicle frame types are prone to collapse when their roofs are removed? (360)

A. Full
B. Rigid
C. Frame
D. Unibody

_____ 17. When is it safe for rescuers to enter a trench? (366)

A. After EMS has arrived on scene
B. Only after it has been safely shored
C. Immediately upon arrival on the scene
D. After hazardous materials personnel have arrived

_____ 18. How much area should be cordoned off from a trench? (366)

A. 50 feet (15 m)
B. 100 feet (30 m)
C. 150 feet (45 m)
D. 200 feet (60 m)

_____ 19. At a trench rescue, eliminate sources of vibration within ___ feet (m) of the trench. (366)

A. 200 (60)
B. 300 (90)
C. 400 (120)
D. 500 (150)

_____ 20. Which of the following is not a true emergency? (373)

A. Ice rescue
B. Water rescue
C. Elevator rescue
D. Industrial extrication

Scenarios

Scenario 1

You have responded to an accident involving three vehicles. Vehicle 1 has overturned, and two people are trapped inside, unconscious and possibly dead. Vehicle 2 is a pickup truck that is lying on its side, leaning against Vehicle 1. The driver of Vehicle 2 is sitting beside his pickup with blood on his head and a great deal of pain in his left leg. Vehicle 3 is approximately 30 feet (10 m) from the other two vehicles. Its front end is smashed with the hood pressed up against the windshield. There are apparently two people in the front seat behind deployed air bags.

1. What is your first priority upon arriving at the scene?

_____

_____

_____

2. How should each vehicle be stabilized?

   Vehicle 1 _____

   _____

   _____

   Vehicle 2 _____

   _____

   _____

   Vehicle 3 _____

   _____

   _____

3. The driver of Vehicle 2 appears to have a gash on his right temple and a possible concussion and a broken left leg. How should he be treated?

   _____

   _____

   _____

   _____

Scenario 2

You are in Command of a rescue team responding to a trench cave-in. Witnesses state that three workers have been buried at one end of the trench. One witness says that he suspects that the cave-in was caused by a ruptured gas pipeline.

1. What is your first priority upon arriving at the scene? _____

   _____

   _____

   _____

2. How should the incident area be prepared for the rescue? Address issues such as preventing further cave-ins and protecting the rescue team._____

   _____

   _____

   _____

Chapter 8

Vehicle Extrication and Technical Rescue

Vehicle Extrication

Fire department personnel are traditionally tasked with the responsibility of rescuing victims in motor vehicle accidents. Depending on the severity of the accident, it may be necessary for fire crews to forcibly manipulate the vehicle in order to access victims. There are several ways in which access to a vehicle can be obtained. As with forcible entry, firefighters should always use the path of least resistance to gain access. The easiest way is often the best way.

Traumatic disentanglement is the process of gaining access to a victim by cutting, pulling or spreading components of the vehicle. Removing a door or displacing a dashboard are both examples of traumatic disentanglement. Nontraumatic disentanglement is the process of gaining access to a victim by more traditional means of access. This includes accessing victims through functioning doors and even partial disassembly of the vehicle. Regardless of the method used, it is critical that firefighters avoid *tunnel vision* and have an alternative plan available should the need arise.

Dangers of Vehicle Components and Systems

As automotive technology and engineering evolves, vehicles become increasingly more complicated. There are numerous dangers firefighters encounter when performing vehicle extrication techniques. Adding to the challenge is that dangers vary based on the make and model of the vehicle. Books and electronic products produced by Holmatro® and others are valuable resources for firefighters who perform vehicle extrication. These materials are frequently used on scene and provide detailed information specific to the vehicle that is involved. Such information includes: restraint systems, cut/no cut points, and warnings specific to the vehicle. Firefighters should study these manuals frequently to identify dangers that are unique to specific vehicles.

Specific dangers associated with vehicle components and systems include the following:

- ***Airbags and curtains*** — With the inclusion of front, side and curtain airbags, there are now multiple *no cut areas* in modern vehicles. In some vehicles, this is marked with a small no cutting symbol and additional text. Airbags represent a significant threat to firefighters if they deploy. While some airbags may be disabled with the disconnection of the vehicle's battery, others can remain *armed* even with the power disconnected. It is therefore critical for personnel to use extreme caution when working inside the vehicle if airbags have not deployed.
- ***Inverters*** — Many vehicles come from the manufacturer already equipped with power inverters or are outfitted with an inverter by the owner. Some of these systems support various add-ons to normal vehicle functions. These units pose a threat to firefighters if they are not aware of their presence. Inverters add dangers associated with household electrical use to motor vehicle incidents.
- ***Modifications*** — Vehicle modifications are popular for car enthusiasts and pose hidden dangers to firefighters. Many modifications are made to fit in with the existing look of the vehicle, making them difficult to identify. Vehicle fuel systems are an increasingly popular area of modification. Do-it-yourself kits are now readily available to change-over fuel systems to propane, bio-diesel, natural gas, and ethanol. Personnel should pay close attention for any signs of modification and if possible should ask the driver for more information (**Fig. 1 p.126**).
- ***Survivability*** — Vehicles of the past were large, heavy, and substantially reinforced. New technology has allowed for vehicles to be made smaller and lighter, without sacrificing safety. Newer vehicle frames are designed to give way upon impact. Collision forces in these vehicles are absorbed and transmitted throughout the vehicle. Some vehicles now incorporate the same roll cage technology that is used in race cars. This

new technology requires special consideration and care during extrication. Cuts made in critical areas can seriously jeopardize the integrity of the vehicle frame.

- ***Closed containers*** — Vehicles have numerous closed containers, such as drive shafts, shocks, and pistons. In addition, vehicles can potentially be carrying items like portable propane tanks and aerosolized canisters. When heated, these containers fail at their weakest point, often with explosive force. Shrapnel from these container failures have the potential to cause serious injury.

Fig 8.1

Alternative Fuel Vehicles

Due to the increasing cost of gasoline and diesel, alternative fuels are becoming popular options. Commonly found alternative fuel vehicles include propane, hydrogen, and gas/electric. These vehicles have unique drive and fuel systems and present several unique dangers. Dangers of alternative fuel vehicles include the following:

Propane and Natural Gas Vehicles

- These vehicles look the same as traditional gasoline or diesel cars. While there are often labels and stickers identifying the fuel source, these markings can be removed or missing. Firefighters should be vigilant in looking for indications of alternative fuels.
- Propane and natural gas tanks are not located in the same place as a traditional tank. Fuel tanks for propane and natural gas vehicles are typically located in the trunk or cargo area of the vehicle (**Fig. 2 p. 127**).
- Both gases present a danger in the event of a tank rupture. The properties of the gases dictate actions that need to be taken. Natural gas rises rapidly and dissipates in the air, making it a minimal hazard in the event of a leak. Ignition sources should be removed from the area to prevent further issues. Propane is heavier than air and poses a greater risk to victims and firefighters should a leak occur.

Hydrogen Vehicles

- As with propane and natural gas, hydrogen vehicles appear the same as traditional vehicles from the exterior.
- Because hydrogen vehicles are still relatively new, their design and technology are still changing. Some vehicles utilize straight gas bases, while others use a combination of liquid and pressure. These cryogenic containers pose additional dangers to firefighters.
- The characteristics of hydrogen are such that the gas emits no visible flame or radiant heat when burned. A fire involving hydrogen with no impurities cannot be seen, even when using a thermal imaging camera. Hydrogen fires can be detected only in the ultraviolet range of the electromagnetic spectrum.

Fig 8.2

Gas/Electric

- These vehicles utilize both gasoline and electric power. Electricity is used to power the vehicle at low speeds. When higher speeds are necessary, a small gasoline engine automatically activates and provides the power needed to run the vehicle. Firefighters should realize that the electric system is silent when operating.
- The electric system in these vehicles generates a tremendous amount of power (**Fig. 3 p. 128**). The battery packs create 240 AC volts, which is enough to cause significant injury to firefighters. In some cases, electric vehicles involved in accidents have electrified guard rails, causing injury to persons touching the rail.
- The selection of cut, spread and pull points for extrication becomes critical due to the manner in which electrical power is transmitted through the vehicle.

Airbags

Airbags that have not deployed in an accident should be disarmed or disabled during vehicle extrication to prevent injury to personnel. Modern technology has added increased collision protection for vehicle occupants by means different airbag systems. These systems include: Supplemental Restraint Systems (SRS), Side Impact Protection Systems (SIPS), Head Protection Systems (HPS), and knee bolsters. Modern vehicles now implement as many as 12 airbags. Because restraint system technology is evolving so rapidly, all rescue personnel are encouraged to make every effort to stay current on what systems are being installed in new vehicles. Rescue personnel must know where airbags may be located and how to disarm them. All restraint systems can be identified by either words or initials displayed at various points on the vehicle.

Fig 8.3

Supplemental Restraint Systems (SRS)

Front-impact airbags are called supplemental systems because they are intended to *supplement* seat belts, not replace them. Electronically operated restraint systems receive their energy from the vehicle's battery. They are designed to activate through a system of inertia switches located forward of the passenger compartment and by microelectric controls that may be located under the front seats or in the console between the front seats. These systems have a reserve energy supply that is capable of deploying an airbag even if the battery is disconnected or destroyed in the collision. When the battery is disconnected, the reserve energy supply will eventually drain away, disarming the restraint system. Vehicle manufacturers list different time estimates on how long it takes for the reserve to deplete entirely. These estimates range from as little as 1 second to as much as 30 minutes. Most airbags are deactivated after about 10 minutes.

Both fire suppression and extrication activities are capable of accidentally activating either electrical or mechanical restraint systems. In electrically operated systems, an electrical impulse as small as .5 volt during the extrication process(such as the static discharge from an extrication tool) may cause the airbag to deploy. In mechanically operated systems, a sharp blow to the sensor or excessive pressure on the inside surface of the vehicle door can accidentally activate the airbag.

On many vehicles, the only way to deactivate electrically operated airbags is to turn the ignition switch to the *off* position, disconnect both battery cables (*negative* cable first), and wait for the reserve power supply to drain down. In addition, it is good practice to tape the ends of the battery cables after they have been disconnected from the battery. Some agencies also advocate grounding the vehicle. Some vehicles that have only a front seat are equipped with a key-operated switch that disables and drains the reserve power from the passenger-side airbag.

Side-Impact Protection Systems (SIPS)

Some side-impact protection systems are mechanically operated and do not require power from the vehicle's electrical system to activate. Therefore, these air bags may deploy even if the battery has been disconnected. In mechanical systems, isolating or preventing air bag deployment may require that the connection between the sensor and the air bag inflation unit be cut. How and where this is done is specific to each vehicle make and model. Electronically activated SIPS will need to be isolated by isolating the battery. This process will vary from vehicle to vehicle.

Head Protection Systems (HPS)

A growing number of vehicles have head protection systems (HPS) installed. On vehicles equipped with side-impact collision, these air bags deploy from a narrow opening between the headliner and the top of the door frame. Unlike SRS and SIPS that deflate immediately after deployment, HPS bags remain rigidly inflated after activation. However, they are easily removed by cutting the nylon straps or deflated by being punctured with a sharp object or being cut with a knife. A slightly different type of HPS curtain is inflated by a high-pressure cylinder. This curtain deflates automatically shortly after deployment. The two types of head protection systems are inflatable tubes and window curtains.

Inflatable Tubes — When inflatable tubes are activated, they inflate instantly. This shortens them and snaps them down into place across the side window. Unlike other air bags, inflatable tubes remain inflated after deployment. They are easily deflated by being punctured with a sharp tool or being cut with a knife.

Window Curtains — When window curtains are activated, they also inflate instantly. However, unlike inflatable tubes, window curtain head protection devices quickly deflate automatically.

One danger with both of these systems is that if a rescuer is working through the window opening, he is in the deployment path of the air bag. This danger can be mitigated by a complete roof removal. However, when cutting the posts for roof removal, rescuers must be careful not to cut into high-pressure cylinders.

Knee Bolsters

Some vehicles are equipped with restraint devices intended to protect the lower legs of the driver. They are also intended as "antisubmarine" devices — that is, they are intended to help prevent the driver from sliding forward and becoming wedged under the dashboard. The same precautions apply as with other front-impact restraints.

Technical Rescue

Firefighters must understand the dangers and risks of operating at technical rescue incidents. Such incidents include: structural collapses, water rescues, confined spaces, trenches, and others. Crews assigned to incidents where specialized rescue is necessary should be able to recognize the situation and request the appropriate resources. Many departments have teams that specialize in certain types of rescues. Trained commensurate to duty laws clearly state that firefighters should not perform any rescue for which they have not been adequately trained.

Short Answer

1. Describe the two means of obtaining access to a victim in a vehicle accident. _____

_____

_____

2. What are some commonly found alternative fuel vehicles?_____

_____

_____

3. What actions should be taken by crews assigned to incidents where specialized rescue is necessary?

_____

_____

_____

Multiple Choice

_____ 1. Which of the following dangers associated with vehicle components and systems is often identified by no-cutting symbols?

A. Inverters
B. Modifications
C. Closed containers
D. Airbags and curtains

_____ 2. Which of the following dangers associated with vehicle components and systems adds dangers associated with household electrical use to motor vehicle incidents?

A. Inverters
B. Modifications
C. Closed containers
D. Airbags and curtains

_____ 3. Which of the following dangers associated with vehicle components and systems are popular for car enthusiasts and pose hidden dangers to firefighters?

A. Inverters
B. Modifications
C. Closed containers
D. Airbags and curtains

_____ 4. Which of the following dangers associated with vehicle components and systems can cause serious injury from shrapnel?

A. Inverters
B. Modifications
C. Closed containers
D. Airbags and curtains

_____ 5. Which of the following statements about vehicles today is MOST accurate?

A. Smaller vehicles are safer than larger vehicles.
B. Larger vehicles are always safer than smaller vehicles.
C. Vehicles that are smaller and lighter must sacrifice safety.
D. Vehicles can be smaller and lighter, without sacrificing safety.

_____ 6. Where are propane and natural gas tanks typically located in a vehicle?

A. Trunk or cargo area
B. Underneath the hood area
C. Underneath the vehicle frame
D. In the same place as a traditional tank

_____ 7. Which of the following alternative fuels rises rapidly and dissipates in the air, making it a minimal hazard in the event of a leak?

A. Propane
B. Natural gas
C. Hydrogen
D. Biodiesel

_____ 8. Which of the following alternative fuels emits no visible flame or radiant heat when burned?

A. Propane
B. Natural gas
C. Hydrogen
D. Biodiesel

_____ 9. For which of the following alternative fuel vehicles does the selection of cut, spread, and pull points for extrication become critical?

A. Propane
B. Biodiesel
C. Hydrogen
D. Gas/electric

_____ 10. Which of the following types of airbags are referred to as supplemental restraint systems?
A. Knee Bolsters
B. Front-impact airbags
C. Head protection systems
D. Side-impact protection systems

_____ 11. Which of the following types of airbags remain rigidly inflated after activation?
A. Knee Bolsters
B. Front-impact airbags
C. Head protection systems
D. Side-impact protection systems

_____ 12. Which of the following types of airbags may be mechanically operated and not require power from the vehicle's electrical system to activate?
A. Knee Bolsters
B. Front-impact airbags
C. Head protection systems
D. Side-impact protection systems

Florida Learning Activity 8-II-1

Objective: 8.8A Identify the points of strength and weakness in auto body construction.

Directions:

Your instructor will provide you with an example of a vehicle. In the space provided below, identify the points of strength and weakness in auto body construction. Discuss how firefighters might react to at least one of the strengths or weaknesses.

Name of Student: _____

Instructor Initials: _____

Date Received: _____

Florida Learning Activity 8-II-2

Objective: 8.23C Report problems in accordance with procedure and take action as required, given the procedures for reporting problems found with equipment during maintenance and problems found.

Directions:

Your instructor will provide you with an example of a problem found during maintenance. Using the AHJ procedures for reporting problems found with equipment during maintenance, report the problems and take appropriate action. Follow all AHJ policies and complete any needed documentation.

Name of Student: _____

Instructor Initials: _____

Date Received: _____

Florida Skill Sheet 8-II-1

Objective: **8.25A** Identify tools and carry safely to complete an assignment, given a selection of rescue tools and an assignment to bring a specified rescue tool to the tool staging area.

Student Name: _____ **Date:** _____

Directions:

For this skill sheet checklist, the candidate will identify the proper tool for an assignment given by the AHJ. Student will choose the proper rescue tool and carry tool safely to the tool staging area. All steps in this skill sheet must be performed correctly for candidate to pass this skill.

Equipment and Materials:

- Appropriate PPE
- Rescue tools/equipment

Task Steps

1. Appropriate PPE worn properly.

2. Select the designated rescue tool/equipment without error.

3. Pick up and carry the tool safely to the designated staging area.

Florida Skill Sheet 8-II-2

Objective: 8.25B Establish public barriers utilizing existing and natural barriers, given a simulated rescue team situation and the assignment to secure the area.

Student Name: _____ **Date:** _____

Directions:
For this skill sheet checklist, the candidate will establish public barriers utilizing existing and natural barriers. All steps in this skill sheet must be performed correctly for candidate to pass this skill.

Equipment and Materials:
- Appropriate PPE
- Barriers (rope, cones, tape, etc.)

Task Steps

1. Appropriate PPE worn properly.
2. Secure area using appropriate existing/natural barriers.
   - **a.** Allow sufficient room for the team to have a staging, rehab, and work area.
   - **b.** Stretch fire line tape between naturally available objects.
   - **c.** Support tape by traffic cones as needed.
3. Report completion of the task.