CHAPTER 3

Personal Protective Equipment and Self-Contained Breathing Apparatus

CHAPTER OVERVIEW

Self-contained breathing apparatus (SCBA) and fire fighter personal protective equipment (PPE) are central to ensuring the safety of fire fighters operating at a fire ground. In this chapter, the fire fighter will become familiar with the proper use of both SCBA and PPE. After students complete this chapter and the related course work, they will understand the importance of safety and the knowledge fire fighters are expected to have as it relates to the PPE and SCBA.

OBJECTIVES AND RESOURCES

Fire Fighter I

Knowledge Objectives

After studying this chapter, you will be able to:

- List the components of personal protective equipment (PPE) or the structural firefighting ensemble. (NFPA 5.1.2, pp 44–49)
- Describe the type of protection provided by the structural firefighting ensemble. (pp 44–45)
- Explain how each design element of a fire helmet works to protect the head, face, and eyes. (pp 45–46)
- Explain why protective hoods are a part of the structural firefighting ensemble. (pp 46–47)
- Explain how each design element of a turnout coat works to protect the upper body. (pp 46–47)
- Describe how each design element of boots works to protect the feet. (p 48)
- Describe how each design element of gloves works to protect the hands and wrist. (p 48)
- Explain how a personal alert safety system (PASS) helps to ensure fire fighter safety. (NFPA 5.3, p 49)
- List the limitations of PPE. (p 50)
- Explain the role of the fighter’s work uniform as part of the PPE ensemble. (NFPA 5.1.2, pp 50–51)
- Describe how to inspect the condition of PPE. (NFPA 5.3, pp 51, 54)
- Describe how to properly maintain PPE. (NFPA 5.5.1, pp 51, 54)
- Describe the specialized protective clothing required for vehicle extrication and wildland fires. (p 54)
- List the respiratory hazards posed by smoke and fire. (NFPA 5.3.1A, pp 54–56)
- List the conditions that require respiratory protection or self-contained breathing apparatus (SCBA). (NFPA 5.3.1A, p 56)
- Describe the differences between open-circuit breathing apparatus and closed-circuit breathing apparatus. (p 56)
- Describe when a supplied-air respirator is used. (p 56)
- Describe the limitations of SCBA. (NFPA 5.3.1A, pp 58–59)
- Describe the physical and psychological limitations of an SCBA user. (NFPA 5.3.1A, pp 58–59)
- List and describe the major components of SCBA. (NFPA 5.3.1A, pp 59–64)
- Describe the devices on an SCBA that can assist the user in air management. (NFPA 5.3.1, p 62)
- Describe the pathway that air travels through an SCBA. (p 62)
- Explain the skip-breathing technique. (NFPA 5.3.1, 5.3.1B, p 62)
- Explain how to inspect SCBA to ensure that it is operation ready. (NFPA 5.5.1, p 73)
- List the complete sequence of donning PPE. (NFPA 5.1.2, 5.3.1A, 5.3.1, p 73)
- Describe the importance of SCBA inspections and SCBA operational testing. (NFPA 5.5.1, pp 73–78)
- Explain the procedures for refilling SCBA cylinders. (pp 78–81)
Skill Objectives

After studying this chapter, you will be able to perform the following skills:

- Don approved personal protective clothing. (NFPA 5.1.2, pp 51–52)
- Doff approved personal protective clothing. (NFPA 5.1.2, pp 51, 53)
- Don an SCBA from an apparatus seat mount. (NFPA 5.3.1B, pp 64–65)
- Don an SCBA from a compartment mount. (NFPA 5.3.1B, p 64)
- Don an SCBA from a storage case using the over-the-head method. (NFPA 5.3.1B, pp 66–67)
- Don an SCBA from a storage case using the coat method. (NFPA 5.3.1B, pp 66, 68)
- Don an SCBA from a seat-mounted position with a safety latch. (NFPA 5.3.1B, pp 66, 69)
- Don a face piece. (NFPA 5.3.1B, pp 67–72)
- Doff an SCBA. (p 73–74)
- Perform a visible inspection of an SCBA. (NFPA 5.5.1, pp 73–74)
- Perform an operational inspection of an SCBA. (NFPA 5.5.1, pp 75–78)
- Replace an SCBA cylinder. (NFPA 5.3.1B, pp 75–76, 79)
- Replace an SCBA cylinder on another fire fighter. (NFPA 5.3.1B, pp 78, 80)
- Refill an SCBA cylinder from a cascade system. (pp 78–79, 81)
- Clean an SCBA. (NFPA 5.5.1, pp 81–82)

Fire Fighter II

Knowledge Objectives

There are no knowledge objectives for Fire Fighter II candidates. NFPA 1001 contains no Fire Fighter II Job Performance Requirements for this chapter.

Skill Objectives

There are no skill objectives for Fire Fighter II candidates. NFPA 1001 contains no Fire Fighter II Job Performance Requirements for this chapter.

Additional NFPA Standards

- NFPA 1404, Standard for Fire Service Respiratory Protection Training
- NFPA 1500, Standard on Fire Department Occupational Safety and Health Program
- NFPA 1582, Standard on Comprehensive Operational Medical Program for Fire Departments
- NFPA 1851, Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting
- NFPA 1852, Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)
- NFPA 1971, Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting
- NFPA 1975, Standard on Station/Work Uniforms for Emergency Services
- NFPA 1977, Standard on Protective Clothing and Equipment for Wildland Fire Fighting
- NFPA 1981, Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services

Reading and Preparation

- Review all instructional materials, including Fundamentals of Fire Fighter Skills, Chapter 3, and all related presentation support materials.
- Review local firefighting protocols for Chapter 3.

Support Materials

- Dry erase board and markers or chalkboard and chalk
- LCD projector, slide projector, overhead projector, and projection screen
- PowerPoint presentation, overhead transparencies, or slides
- Full set of fire fighter PPE. If available, PPE that has been cut away to expose interior construction (i.e., cross-sectioned) will assist students in understanding how PPE is constructed to protect them.

Enhancements

- Direct the students to visit the Internet at www.FireFighter.jbpub.com for online activities.
- Direct the students to relevant sections in the Student Workbook for application of the content introduced in this chapter.
- Direct the students to take practice/final examinations in the Navigate Test Prep to prepare for examinations.
TEACHING TIPS AND ACTIVITIES

- It is important for the instructor to dispel the myth of fire fighter indestructibility. New fire fighters may operate under a false sense of security about their PPE. They can quickly develop an “it can’t happen to me” mentality that can lead them to take unacceptable risks on the fire ground. Instructors should use videotapes, newspaper articles, or in-person guests to relate the stories of fire fighters who have had close brushes with injury or death.

PRESENTATION OVERVIEW

<table>
<thead>
<tr>
<th>Total time: 3 hours, 0.5 minutes (with enhancements)</th>
<th>Activity Type</th>
<th>Time</th>
<th>Level</th>
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<tbody>
<tr>
<td>Pre-Lecture</td>
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<tr>
<td>You Are the Fire Fighter</td>
<td>Small Group Activity/Discussion</td>
<td>5 minutes</td>
<td>Fire Fighter I</td>
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<tr>
<td>Lecture</td>
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<tr>
<td>I. Introduction</td>
<td>Lecture/Discussion</td>
<td>16.5 minutes</td>
<td>Fire Fighter I</td>
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<tr>
<td>II. Personal Protective Equipment</td>
<td>Lecture/Discussion/Demonstration</td>
<td>25.5 minutes</td>
<td>Fire Fighter I</td>
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<tr>
<td>III. Respiratory Protection</td>
<td>Lecture/Discussion/Demonstration</td>
<td>49.5 minutes</td>
<td>Fire Fighter I</td>
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<tr>
<td>IV. Putting it All Together: Donning the Entire PPE Ensemble</td>
<td>Lecture/Discussion</td>
<td>7.5 minutes</td>
<td>Fire Fighter I</td>
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<tr>
<td>V. Inspection of SCBA</td>
<td>Lecture/Discussion/Demonstration</td>
<td>9 minutes</td>
<td>Fire Fighter I</td>
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<tr>
<td>VI. Summary</td>
<td>Lecture/Discussion</td>
<td>7.5 minutes</td>
<td>Fire Fighter I</td>
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<tr>
<td>Post-Lecture</td>
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<tr>
<td>I. Wrap-Up Activities</td>
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<tr>
<td>A. Fire Fighter in Action</td>
<td>Individual Activity/Small Group Activity/Discussion</td>
<td>40 minutes</td>
<td>Fire Fighter I and II</td>
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<tr>
<td>B. Technology Resources</td>
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<tr>
<td>II. Lesson Review</td>
<td>Discussion</td>
<td>15 minutes</td>
<td>Fire Fighter I</td>
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<td>III. Assignments</td>
<td>Lecture</td>
<td>5 minutes</td>
<td>Fire Fighter I and II</td>
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PRE-LECTURE

I. You Are the Fire Fighter

Time: 5 Minutes  
Level: Fire Fighter I  
Small Group Activity/Discussion

Use this activity to motivate students to learn the knowledge and skills needed to determine the correct protective equipment for the job, don the equipment, and care for it.

Purpose
To allow students an opportunity to explore the significance and concerns associated with PPE.

Instructor Directions
1. Direct students to read the “You Are the Fire Fighter” scenario found in the beginning of Chapter 3.
2. You may assign students to a partner or a group. Direct them to review the discussion questions at the end of the scenario and prepare a response to each question. Facilitate a class dialogue centered on the discussion questions.
3. You may also assign this as an individual activity and ask students to turn in their comments on a separate piece of paper.
I. Introduction

A. Two safety components used by fire fighters need special consideration:
   1. Personal protective equipment (PPE)

B. Fire fighters must understand the purpose of the equipment and what the equipment is and is not capable of.
   1. PPE protects the body against a limited amount of heat.
      a. Exceeding protection of equipment results in severe injury and death
   2. An SCBA allows fire fighters to enter smoky and toxic areas and provides respiratory protection for a limited amount of time.
      a. Exceeding the limits can be deadly
II. Personal Protective Equipment

Time: 25.5 Minutes
Slides: 12-28
Level: Fire Fighter I
Lecture/Discussion/Demonstration

A. Personal Protective Equipment
1. PPE is an essential component of a fire fighter’s safety system.
2. Different PPE ensembles are designed for specific hazardous conditions.
   a. The more you know about the protection your PPE can provide, the better you will be able to judge conditions that exceed its limitations.
3. A fire fighter’s PPE must provide full body coverage and protection from a variety of hazards.
4. To be effective, the entire ensemble must be worn whenever potential exposure to those hazards exists.
5. PPE must be cleaned, maintained, and inspected regularly.

B. Structural Firefighting Ensemble
1. Structural firefighting PPE enables fire fighters to work in areas with high temperatures and concentrations of toxic gases.
   a. Provides protection from fire.
   b. Keeps water away from the body.
   c. Reduces trauma from cuts or falls
2. Designed to be worn with self-contained breathing apparatus (SCBA)
3. Consists of:
   a. Protective coat
   b. Trousers or coveralls
   c. Helmet
   d. Hood
   e. Boots
   f. Gloves
4. Protection provided
   a. Tough outer layer of coat and trousers can withstand high temperatures, repel water, and provide protection from abrasions and sharp objects.
      i. Fluorescent/reflective trim adds visibility.
      ii. Insulating layers protect the skin from high temperatures.
      iii. A moisture barrier between the layers keeps liquids and vapors from reaching the skin.
   b. Helmet protects head from falling debris.
   c. Hood is fire retardant and covers exposed skin between collar and helmet.
   d. Gloves protect from heat, cuts, and abrasions.
   e. Boots protect from fire, moisture, punctures, and crushing injuries.
   f. An SCBA protects against toxic and hot gases by providing an independent air supply.
5. Helmet
   b. The hard outer shell provides impact protection against falling objects.
   c. The shape of the helmet helps to deflect water away from the head and neck.
   d. Face and eye protection can be provided by a face shield, goggles, or both.
   e. A chin strap must be worn to keep the helmet in the proper position.
   f. When entering a burning building, the fire fighter should pull down the ear tabs for maximum protection.
   g. Helmet shells are often color-coded according to the fire fighter’s rank and function.
   h. NFPA 1971 requires a label to be permanently attached to inside of helmet, listing:
      i. Manufacturer
6. Protective hood
   a. A fire-retardant hood covers any exposed skin between the coat collar and the helmet.
   b. Constructed of flame-resistant materials, such as Nomex or PBI
   c. Worn over the face piece but under the helmet

7. Turnout coat
   a. Turnout coats have three layers:
      i. Protective outer shell constructed of a sturdy, flame-resistant, water-repellant material, such as Nomex, Kevlar, or PBI
      ii. Moisture barrier, which helps prevent the transfer of water, steam, and other fluids to the skin
      iii. Thermal barrier, which insulates the body from external temperatures
   b. An overlapping flap provides a secure double seal.
   c. Wristlets prevent liquids or hot embers from getting between the sleeves and the skin.
   d. Come in two styles—long and short
   i. Both styles will protect as long as the matching style of pants or coveralls are also worn.

8. Bunker pants
   a. Constructed in a waist-length design or bib-overall configuration to match turnout coat
   b. Have the same three-layer protective system as is found in turnout coats
   c. Pants should be large enough to allow you to don them quickly and move easily

9. Boots
   a. Constructed of rubber or leather
   b. Must meet requirements of NFPA 1971
   c. The outer layer repels water and must be both flame- and cut-resistant.
   d. Boots must have:
      i. A heavy sole with a slip-resistant design
      ii. A puncture-resistant sole
      iii. A reinforced toe to prevent injury from falling objects
   e. An inner liner constructed of materials such as Nomex or Kevlar adds thermal protection.

10. Gloves
    a. Gloves protect the hands from heat, liquid, vapors, cuts, and penetration.
    b. Required wristlets prevent skin exposure at the wrist.
    c. Firefighting gloves are usually constructed of heat-resistant leather.
    d. Fire fighters must become accustomed to performing manual skills while wearing gloves.

11. Respiratory protection
    a. The PPE ensemble for structural firefighting is not complete without adequate respiratory protection.

12. Personal alert safety system (PASS)
    a. Electronic device that sounds a loud signal if a fire fighter is motionless for a set period or if activated by the fire fighter
    b. Can be separate from or integrated into the SCBA unit
       i. Integrated PASS devices automatically turn on when the SCBA is activated.
       ii. Separate PASS devices are often worn on the SCBA harness and must be turned on manually.
13. Additional PPE
   a. When additional eye protection (beyond that provided by a helmet face shield) is needed, fire fighters can use approved goggles.
   b. An intercom system on the apparatus can provide hearing protection from sirens.
   c. Flexible ear plugs are useful in other situations involving loud sounds.
   d. A fire fighter should always carry a hand light because most interior firefighting is done in near-dark, zero-visibility conditions.
   e. At least one member of each team working inside a burning building or in any hazardous area should always have a radio.
   f. A reflective vest that meets the ANSI Standard 207 should be worn when working close to traffic.
   g. A drag rescue device is a handle within the turnout coat that can be used to drag an incapacitated fire fighter to safety.

14. Limitations of the structural firefighting ensemble
   a. Components must be put on in the proper order and correctly secured to provide complete protection.
   b. PPE is nearly 50 lb, so the fire fighter requires energy and strength to complete tasks.
   c. PPE retains body heat and perspiration.
      i. Fire fighters in full protective gear can rapidly develop elevated body temperatures, even when the ambient temperature is cool.
   d. PPE limits mobility and range of motion.
   e. PPE also decreases normal sensory abilities.
   f. Practicing skills while wearing PPE will help a firefighter become accustomed to these limitations.

15. Work uniforms
   a. Clothing containing nylon or polyester may melt.
   b. Synthetic fibers, such as Nomex and PBI, are resistant to high temperature.

C. Donning Personal Protective Clothing
   1. Donning protective clothing must be done in a specific order to obtain maximum protection.
      a. It should also be done quickly.
   2. Donning PPE will be practiced in Skill Drill 3-1.

D. Doffing Personal Protective Clothing
   1. Reverse the procedure used in getting dressed.
   2. If necessary, PPE should be cleaned after it is used and then kept in a convenient location for the next response.
   3. PPE may be kept close to the apparatus, on the apparatus, or in an equipment locker.
      a. Follow your department’s policies on this.
   4. Doffing PPE will be practiced in Skill Drill 3-2.

E. Care of Personal Protective Clothing
   1. A complete set of approved turnout clothing (excluding SCBA) costs more than $2000.
   2. PPE is the only thing that stands between you and fire or a dangerous environment.
   3. Check the condition of PPE on a regular basis.
   4. Repair worn or damaged PPE at once.
   5. Clean PPE when necessary.
      a. PPE that has been badly soiled by exposure to smoke, other products of combustion, melted tar, petroleum products, or other contaminants needs to be cleaned as soon as possible.
      b. Items that have been exposed to chemicals or hazardous materials may have to be impounded for decontamination or disposal.
      c. Follow the manufacturer’s cleaning and drying instructions (on a tag attached to the inside of the PPE).
F. Specialized Protective Clothing

1. Vehicle extrication
   a. Most members of the emergency team will wear full turnout gear.
   b. Some protective clothing, such as special gloves and coveralls or jumpsuits, is specifically designed for vehicle extrication and is generally lighter in weight and more flexible than structural firefighting PPE.
   c. Latex gloves should be worn when providing patient treatment.
   d. Eye protection also should be worn because of the possibilities of breaking glass, contact with body fluids, metal debris, and incidents with tools.

2. Wildland fires
   a. Firefighting gear designed specially for fighting wildland or brush fires must meet NFPA 1977, Standard on Protective Clothing and Equipment for Wildland Fire Fighting.
   b. The jacket and pants are made of fire-resistant materials, such as Nomex or specially treated cotton, which are designed for comfort and maneuverability while working in the wilderness.
   c. Wildland fire fighters wear a helmet of thermoresistant plastic, eye protection, pigskin or leather gloves, and boots designed for comfort and sure footing while hiking.
   d. Structural gear is not designed for extended wildland firefighting.

III. Respiratory Protection

Time: 49.5 Minutes
Slides: 29-61
Level: Fire Fighter I
Lecture/Discussion/Demonstration

A. Introduction to Respiratory Protection
   1. The interior atmosphere of a burning building is considered to be immediately dangerous to life and health (IDLH).
   2. Fire fighters must be proficient in using SCBA before engaging in interior fire-suppression activities.
   3. An SCBA is both expensive and complicated; using one confidently requires practice.

B. Respiratory Hazards of Fires
   1. Visible smoke contains many different substances, some of which are dangerous if inhaled.
   2. Smoke also contains invisible, highly toxic products of combustion.
   3. Combustion consumes oxygen and can lower the oxygen concentration in the atmosphere below the level necessary to support life.
   4. Smoke
      a. Smoke has three major components: particles, vapors, and gases.
      b. Smoke particles
         i. Consist of unburned, partially burned, and completely burned substances
         ii. Can be toxic or irritating
         iii. Many smoke particles are so small that they can pass through the natural protective mechanisms of the respiratory system and enter the lungs.
      c. Smoke vapors
         i. Small droplets of liquids
         ii. Can be toxic or irritating
      d. Toxic gases
         i. Many of the gases commonly produced by residential or commercial fires are very toxic.
         ii. Carbon monoxide, which preferentially binds with hemoglobin, displacing oxygen from the bloodstream
         iii. Hydrogen cyanide, which is a narcotic gas formed when plastic products burn, can render a person unconscious.
         iv. Phosgene, which is an irritant gas formed when common household products burn incompletely, can cause fluid retention in the lungs and death.
5. Oxygen deficiency
   a. Normal outside or room air contains approximately 21 percent oxygen.
   b. Oxygen deficiency in an enclosed area occurs in two ways:
      i. The fire consumes large quantities of the available oxygen, decreasing the concentration of oxygen.
      ii. The fire produces large quantities of other gases, which decrease the oxygen concentration by displacing the oxygen that would otherwise be present.
   c. Atmosphere with an oxygen concentration of 19.5 percent or less is considered oxygen deficient.
   d. If the oxygen level decreases below 17 percent, people can experience disorientation, an inability to control their muscles, and irrational thinking, which can make escaping a fire much more difficult.

6. Increased temperature
   a. Heat is a respiratory hazard.
   b. Inhaling the superheated gases produced by a fire can cause severe burns of the respiratory tract.

**C. Other Toxic Environments**

- Fire fighters will encounter toxic gases or oxygen-deficient atmospheres in many emergency situations, including:
  - Hazardous materials releases
  - Confined-space or below-grade structures

**D. Conditions that Require Respiratory Protection**

- SCBA must be used:
  - In enclosed areas where there is smoke
  - During overhaul until the air has been tested
  - Whenever toxic gases or an oxygen-deficient atmosphere is possible

- Golden rule: Always assume that the atmosphere is hazardous!

**E. Types of Breathing Apparatus**

- The two main types of SCBAs are open-circuit breathing apparatus and closed-circuit breathing apparatus.

   a. Open-circuit breathing apparatus
      i. Open-circuit apparatus is usually used for structural firefighting.
      ii. A tank of compressed air provides the breathing air supply for the user.
      iii. Exhaled air is released into the atmosphere through a one-way valve.

   b. Closed-circuit breathing apparatus
      i. Closed-circuit apparatus is more often used for extended operations, such as mine rescue work, where breathing apparatus must be worn for a long time.
      ii. The air passes through a mechanism that removes carbon dioxide and adds oxygen within a closed system.
2. A supplied-air respirator uses a hose line that is connected to a breathing-air compressor or to compressed air cylinders located outside the hazardous area.
   a. Supplied-air respirators are not used by fire fighters for structural firefighting.
   b. Hazardous materials teams and confined space rescue teams sometimes use supplied-air respirators for specialized operations.

F. SCBA Standards and Regulations
1. The National Institute for Occupational Safety and Health (NIOSH) sets the design, testing, and certification requirements for SCBA.
2. The Occupational Safety and Health Administration (OSHA) and state agencies are responsible for establishing and enforcing regulations for respiratory protection programs.
3. The NFPA has developed three standards directly related to SCBA:
   a. NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, includes the basic requirements for SCBA use and program management.
   b. NFPA 1404, Standard for Fire Service Respiratory Protection Training, sets requirements for an SCBA training program within a fire department.
   c. NFPA 1981, Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services, includes requirements for the design, performance, testing, and certification of open-circuit SCBA for the fire service.

G. Uses and Limitations of SCBA
1. Limitations of the equipment
   a. Because an SCBA carries its own air supply in a pressurized cylinder, its use is limited by the amount of air in the cylinder.
      i. An SCBA for structural firefighting must carry enough air for a minimum of 30 minutes. Cylinders rated for 45 minutes and 60 minutes are also available.
      ii. Duration ratings are based on ideal laboratory conditions.
      iii. An SCBA cylinder will generally have a realistic useful life of 50 percent of its rated time.
   b. Fire fighters must manage their time while using an SCBA and consider important factors:
      i. Time and effort required to reach destination
      ii. Amount of air available once destination is reached
      iii. Amount of time needed to complete task and air required for that time
      iv. Amount of time to reach a safe area
   c. An SCBA provides a limited window of time for firefighting and safe exit.
   d. Build a margin of safety for safe exit
   e. Generally, an SCBA weighs at least 25 lb.
   f. The size of the unit also makes it more difficult for the user to fit into small places.
   g. Added weight and bulk decrease the user’s flexibility and mobility and shift the user’s center of gravity.
   h. The SCBA face piece can limit visibility, particularly peripheral vision.
   i. The face piece may fog up under some conditions.
   j. An SCBA also may affect the user’s ability to communicate.
   k. An SCBA is noisy during inhalation and exhalation, which may limit the user’s hearing.
2. Physical limitations of the user
   a. The weight and bulk of the complete PPE ensemble limit a fire fighter’s ability to walk, climb ladders, lift weight, and crawl through restricted spaces.
   b. Moving with this extra weight requires additional energy, which increases air consumption and body temperature.

3. Psychological limitations of the user
   a. Breathing through an SCBA is different from normal breathing and can be very stressful.
   b. The surrounding environment, which is often dark and filled with smoke, is foreign as well.
   c. Fire fighters must adjust to these stressful conditions.

H. Components of SCBAs
1. The backpack provides the frame for mounting the other working parts of the SCBA.
2. The harness consists of the straps and fasteners used to attach the SCBA to the fire fighter. Most harnesses have two adjustable straps.
3. The air cylinder holds the breathing air for an SCBA.
   a. Air pressure ranges from 2200 to 4500 pounds per square inch (psi).
   b. The neck of an air cylinder is equipped with a hand-operated shut-off valve.
   c. The pressure gauge is located near the shut-off valve and shows the amount of pressure currently in the cylinder.
4. The regulator assembly controls the flow of air to the user.
   a. Inhaling decreases the air pressure in the face piece, which opens the regulator and releases air from the cylinder into the face piece.
   b. Exhaling opens the exhalation valve, which exhausts used air into the atmosphere.
   c. Some units have a dual-path pressure reducer.
      i. Automatically provides backup method for air supply if primary malfunctions
   d. SCBA regulators will maintain a slightly positive air pressure in the face piece.
      i. If there is any leakage around the face piece, the positive pressure will let breathing air seep out and prevent contaminated air from leaking in.
   e. Activation requires opening the air cylinder valve, donning the SCBA, attaching the regulator to the face piece, and breathing.
      i. Some require users to turn a valve for activation.
   f. If activation is cut off during use, the purge valve can be opened.
      i. Creates a constant air flow
      ii. Rapidly depletes remaining air supply
      iii. Can release condensed air from the face piece
   g. Contains a gauge indicating the pressure of the air remaining in the cylinder
      i. Reading should be within 100 psi or each other.
   h. An SCBA requires a second heads-up air pressure display.
      i. Must be visible in the face piece
      ii. Some contain four light-emitting diode displays, indicating the level of the air cylinder.
   i. NFPA requires SCBAs that include an end-of-service-time-indicator (EOSTI) or low-air alarm.
      i. Indicates low breathing air supply
      ii. Most fire departments require fire fighters to exit the IDLH area before the EOSTI alarm.
Some SCBAs include PASS devices.
  i. Helps colleagues locate a downed fire fighter with an audible signal
  ii. Can be automatically activated
  iii. Turning on air supply activates PASS device.

Communication while wearing an SCBA is difficult.
  i. SCBAs are equipped with voice communication systems.
  
SCBAs are equipped with rapid intervention crew/company universal air connection (RIC UAC).
  i. Connected to an SCBA and refills a cylinder if it is running out of air
  ii. A rapid intervention team refills the cylinder.

SCBAs are required to be certified for protection against:
  i. Chemical
  ii. Biological
  iii. Radiologic
  iv. Nuclear agents

Accessories are available to enhance SCBA use.
  i. Tracking devices can help the fire fighter exit a hazardous environment.
  ii. Fire fighters must know how to use extra devices.

Fire fighters must learn how to operate the SCBA model used in their department.
  i. Competent operation in the dark and with gloves on is essential.

The face piece delivers breathing air to the fire fighter.
  a. The face piece assembly consists of:
     i. A face mask with a clear lens
     ii. An exhalation valve
     iii. A regulator
  b. On models with a harness-mounted regulator, face pieces have a flexible low-pressure hose.
  c. Later models will have the regulator attached directly to the face piece.
  d. The face piece should cover the entire face.
  e. Some models have a voice amplification device to improve communications.
  f. Several factors may prohibit face masks from sealing properly:
     i. Facial hair, sideburns, beard
     ii. A low hair line
     iii. Ponytails or buns
     iv. A skull cap that projects under the face piece or temple pieces
     v. Missing teeth
     vi. Improper size face mask
  g. Face pieces are manufactured in several sizes.
  h. NFPA 1500 requires that all fire fighters must have their face pieces fit-tested annually to ensure that they are wearing the proper size.

Pathway of Air Through an SCBA
  1. Breathing air is stored under pressure in the cylinder.
  2. Air passes through the cylinder shut-off valve into the high-pressure hose that takes it to the regulator.
  3. The regulator reduces the high pressure air to low pressure.
  4. Next the air goes directly into the face piece.
  5. From the face piece, the air is inhaled through the user’s air passages and into the lungs.
  6. When the user exhales, used air is returned to the face piece.
  7. Exhaled air is exhausted from the face piece through the exhalation valve.
J. Skip-Breathing Technique
1. The skip-breathing technique helps conserve air while using an SCBA in a firefighting situation.
2. Take a short breath, hold, take a second short breath (do not exhale in between breaths).
3. Relax with a long exhale.
4. Each breath should take 5 seconds.

K. Mounting Breathing Apparatus
1. SCBA should be located so that fire fighters can don it quickly when they arrive at the scene of a fire.
2. Seat-mounted brackets enable fire fighters to don SCBA en route to an emergency scene, without unfastening their seat belts or otherwise endangering themselves.
3. Compartment-mounted SCBA brackets should be positioned high enough for easy donning of SCBA units.
4. An exterior-mounted SCBA should be protected from weather and dirt by a secure cover.
5. Keeping SCBA in a storage case is most appropriate for transporting extra SCBA units but not for transporting SCBA that will be used during the initial phase of operations at a fire scene.

L. Donning SCBA
1. Fire fighters must be able to don and activate SCBA in 1 minute.
2. Fire fighters must be wearing full PPE before donning SCBA.
3. Before beginning the actual donning process, fire fighters must carefully check the SCBA to ensure it is ready for operation.
   a. Check to be sure the air cylinder has at least 90 percent of its rated pressure.
   b. If the SCBA has a donning/doffing switch, be sure that it is activated.
   c. Open the cylinder valve two or three turns, listen for the low-air alarm to sound, and then open the valve fully.
   d. Check the pressure gauges on the regulator and on the cylinder. Both gauges should read within 100 psi of each other.
   e. Check all harness straps to be sure they are fully extended.
   f. Check all valves to be sure they are in the correct position. (An open bypass valve will waste air.)
4. Donning SCBA from an apparatus seat mount
   a. Don all protective clothing before mounting the apparatus.
   b. Place arms through the shoulder straps while sitting down, and then fasten the seat belt.
   c. Or fasten the seat belt first and then slide one arm at a time through the shoulder straps of the SCBA harness.
   d. Partially tighten the shoulder straps while seated.
   e. On arriving at the emergency scene, release seat belt, activate bracket release, and exit apparatus.
   f. Be sure to take a face piece.
   g. After exiting the apparatus, attach the waist strap, and then tighten and adjust the shoulder and waist straps.
   h. Donning SCBA from a seat-mounted bracket will be practiced in Skill Drill 3-3.
5. Donning SCBA from a compartment mount
   a. Slide one arm through the shoulder harness strap then slide the other arm through the other shoulder strap.
   b. Release the SCBA from the mounting bracket.
   c. Adjust the shoulder straps to carry the SCBA fairly high on the back.
   d. Attach the ends of the waist strap and tighten the waist strap.
   e. Donning SCBA from a side-mounted compartment or bracket will be practiced in Skill Drill 3-4.
6. Donning SCBA from the ground, the floor, or a storage case
   a. Fire fighters must sometimes don an SCBA that is stored in a case or on the ground.
   b. Either of two methods can be used—the over-the-head method or the coat method.
   c. Over-the-head method
      i. Place the SCBA on the ground or on the floor with the cylinder valve facing away from you.
      ii. Lay the shoulder straps out to each side of the backpack.
      iii. Grasp the back plate with both hands and lift the SCBA over your head.
      iv. Let the backpack slide down your back.
      v. The straps will slide down your arms.
      vi. Balance the unit on your back.
      vii. Attach and tighten the waist strap and then tighten the shoulder straps.
   d. Coat method
      i. Place the SCBA on the ground or on the floor with the cylinder valve facing toward you.
      ii. Spread out and extend the shoulder straps.
      iii. Use your left hand to grasp the left shoulder strap close to the back plate.
      iv. Use your right hand to grasp the right shoulder strap farther away from the back plate.
      v. Swing the SCBA over your left shoulder.
      vi. Release your right arm and slide it through the right shoulder harness strap.
      vii. Tighten both shoulder straps.
      viii. Attach and tighten the waist belt.
   e. Donning SCBA using the over-the-head method will be practiced in Skill Drill 3-5.
   f. Donning SCBA using the coat method will be practiced in Skill Drill 3-6.

e. Donning SCBA from a seat-mounted position with a safety latch will be practiced in Skill Drill 3-7.

7. Donning the face piece
   a. To perform correctly, the face piece must be the correct size and it must be adjusted to fit your face.
   b. NFPA 1500 describes requirements for face piece fit testing.
   c. There must be no facial hair in the seal area.
   d. Eyeglasses that pass through the seal area cannot be worn.
   e. Donning a face piece will be practiced in Skill Drill 3-8.

M. Safety Precautions for SCBA
   1. Before entering a hazardous environment, activate your PASS device.
   2. Be sure you are properly logged into your accountability system.
   3. Always work in teams of two in hostile environments.
   4. Always have at least two fire fighters outside at the ready whenever two fire fighters are working in a hostile environment.

N. SCBA Use During Emergency Operations
   1. Fire fighters must be prepared to react if an emergency situation occurs while they are using SCBA.
   2. Keep calm, stop, and think.
   3. Control your breathing by maintaining steady respiration.
   4. If there are SCBA problems, exit the IDLH area.
   5. If no air is released from the regulator, open the purge valve.
      a. This rapidly empties your cylinder.
      b. Immediately exit the hazardous environment.
   6. If you are in danger, follow self-survival steps and call a mayday.
   7. The SCBA is used in a variety of conditions.
      a. You must learn to master a number of firefighting skills in good and poor areas of visibility.
      b. Practice all skills while wearing the SCBA.
Chapter 3  ■  Personal Protective Equipment and Self-Contained Breathing Apparatus

O. Doffing SCBA
1. Follow the procedures recommended by the manufacturer and your department’s standard operating procedures (SOPs).
2. In general, you should reverse the steps used to don an SCBA.
3. Doffing the SCBA will be practiced in Skill Drill 3-9.

IV. Putting it All Together: Donning the Entire PPE Ensemble

Time: 7.5 Minutes
Slides: 62-66
Level: Fire Fighter I
Lecture/Discussion

A. Putting it All Together
1. Although donning personal protective clothing and donning and operating an SCBA can be learned and practiced separately, you must be able to integrate these skills to have a complete PPE ensemble.
   a. Place the protective hood over your head.
   b. Put on your bunker pants and boots. Adjust the suspenders and secure the front flap of the pants.
   c. Put on your turnout coat and secure the front.
   d. Open the air-cylinder valve on your SCBA, and check the air pressure.
   e. Put on your SCBA.
   f. Tighten both shoulder straps.
   g. Attach the waist belt and tighten it.
   h. Fit the face piece to your face.
   i. Tighten the straps, beginning with the lowest straps.
   j. Check the face piece for a proper seal.
   k. Pull the protective hood up so that it covers all bare skin but does not obscure vision.
   l. Place your helmet on your head with the ear tabs extended and secure the chin strap.
   m. Turn up your coat collar and secure it in front.
   n. Put on your gloves.
   o. Check your clothing to be sure it is properly secured.
   p. Be sure your PASS device is turned on.
   q. Attach your regulator or turn it on to start the flow of breathing air.
   r. Work safely.

B. SCBA Inspection and Maintenance
1. SCBA must be properly serviced and prepared for the next use each time it is used, whether it is an actual emergency incident or a training exercise.
2. The air cylinder must be changed or refilled.
3. The face piece and regulator must be sanitized according to the manufacturer’s instructions.
4. The unit must be cleaned, inspected, and checked for proper operation.
5. It is the user’s responsibility to ensure that the SCBA is in ready condition before it is returned to the fire apparatus.
6. The daily inspection procedure should be used when restoring a unit to service after it has been used.
7. If an SCBA inspection reveals any problems that cannot be remedied by routine maintenance, the SCBA must be removed from service for repair.
8. Only properly trained and certified personnel are authorized to repair SCBA.
Cleaning and Sanitizing SCBA

Slide 67
Inspection of SCBA
- SCBA should be inspected to identify parts that are damaged or need repair.
- Operational testing checks the functioning parts of SCBA.
  - Should be done after each use and at the beginning of each shift or on a set schedule.

Slide 68
Inspection of SCBA
- Annual inspection
  - Must be performed on each SCBA.
  - Must be performed by:
    - Certified manufacturer’s representative or
    - Person who has been trained and certified

Slide 69
Servicing SCBA Cylinders
- Cylinders must be visually inspected during daily and monthly inspections.
- Federal law requires periodic hydrostatic testing and limits the number of years a cylinder can be used.

Slide 70
Replacing SCBA Cylinders
- A single fire fighter must doff an SCBA to replace the air cylinder.
- Two fire fighters working together can change cylinders without removing the SCBA.
- A fire fighter should be able to change cylinders in the dark and while wearing gloves.

Slide 71
Refilling SCBA Cylinders
- Compressors and cascade systems are used to refill SCBA cylinders.
- Proper training is required to fill SCBA cylinders.

Slide 72
Cleaning and Sanitizing SCBA
- Follow manufacturers’ instructions.
- Rinse the unit with clean water.
- Clean the harness assembly and cylinder with mild soap and water.
- Clean the face pieces and regulators with mild soap and water or a disinfectant solution.

V. Inspection of SCBA

Time: 9 Minutes
Slides: 67-72
Level: Fire Fighter I
Lecture/Discussion/Demonstration

A. SCBA should be inspected to identify parts that are damaged or need to be repaired or replaced.
   1. Operational testing can be followed in Skill Drill 3-10.

B. Operational testing checks the functioning parts of SCBA.
   1. Concentrates on the working parts
   2. Should be done after each use and at the beginning of each shift or on a set schedule
   3. Follow the steps in Skill Drill 3-11 for operational testing.

C. Annual Inspection
   1. A complete annual inspection and maintenance must be performed on each SCBA.
   2. The annual inspection must be performed by a certified manufacturer’s representative or a person who has been trained and certified to perform this work.

D. Servicing SCBA Cylinders
   1. Cylinders must be regularly inspected and tested to ensure they are safe.
   2. Cylinders must be visually inspected during daily and monthly inspections.
   3. More detailed inspection is required if a cylinder has been exposed to excessive heat, came into contact with flame, was exposed to chemicals, or dropped.
   4. The US Department of Transportation requires hydrostatic testing for SCBA cylinders on a periodic basis and limits the number of years that a cylinder can be used.
   5. Hydrostatic testing identifies defects or damage that render the cylinder unsafe.

E. Replacing SCBA Cylinders
   1. A single fire fighter must doff an SCBA to replace the air cylinder.
   2. Two fire fighters working together can change cylinders without removing the SCBA.
   3. A fire fighter should be able to change cylinders in the dark and while wearing gloves.
   4. Follow the procedures recommended by the manufacturer and by department SOPs.
   5. Replacing an SCBA cylinder will be practiced in Skill Drill 3-12.

F. Replacing an SCBA Cylinder on Another Fire Fighter
   1. To rapidly reenter the fire scene, have another person replace your SCBA.
   2. Replacing an SCBA cylinder on another firefighter will be practiced in Skill Drill 3-13.

G. Refilling SCBA Cylinders
   1. Compressors and cascade systems are used to refill SCBA cylinders.
   2. Compressor systems filter atmospheric air, compress it to a high pressure, and transfer it to the SCBA cylinders.
   3. Cascade systems use several large storage cylinders of compressed breathing air connected by a high-pressure manifold system to transfer air from the storage tanks to the cylinder.
   4. Proper training is required to fill SCBA cylinders.
   5. Refilling and SCBA cylinder from a cascade system will be practiced in Skill Drill 3-14.

H. Cleaning and Sanitizing SCBA
   1. Follow manufacturers’ specific instructions for the care and cleaning of SCBA.
   2. Rinse the entire unit using a hose with clean water.
   3. The harness assembly and cylinder can be cleaned with a mild soap and water solution.
   4. Face pieces and regulators can be cleaned with a mild soap and warm water or a disinfectant cleaning solution.
      a. The face piece should be fully submerged in the cleaning solution.
      b. The regulator can be cleaned with the same solution but should not be submerged.
      c. The face piece and regulator should then be rinsed with clean water.
      d. Cleaning and sanitizing SCBA will be practiced in Skill Drill 3-15.
VI. Summary

Time: 7.5 Minutes
Slides: 73-77
Level: Fire Fighter I
Lecture/Discussion

A. Personal protective equipment is essential to a fire fighter.
B. Structural firefighting PPE allows fire fighters to enter burning buildings and work in elevated temperatures and toxic gases.
C. PPE consists of a bunker coat and pants, helmet, protective hood, gloves, boots, work uniform, SCBA, PASS, and additional equipment.
D. Structural PPE adds weight, can create overheating, and decreases mobility.
E. Fire fighters should be able to don PPE in 1 minute or less.
F. The condition of PPE should be checked regularly.
G. PPE should be kept clean.
H. Follow the manufacturer's cleaning and drying instructions for PPE.
I. Gloves and coveralls or jumpsuits are part of specialized equipment used during vehicle extraction.
J. PPE for wildland fires includes a jacket and pants made of fire-resistant materials, helmet, eye protection, and pigskin or leather gloves.
K. Respiratory hazards associated with fires include smoke, smoke particles, smoke vapors, toxic gases, oxygen deficiency, and increased temperatures.
L. The two main types of SCBA are open-circuit and closed-circuit devices.
M. The SCBA limits the amount of air in the cylinder.
N. Physical conditioning is important for all SCBA users.
O. Breathing through SCBA is different than breathing normally and can be stressful.
P. SCBA consists of four parts: backpack and harness, air cylinder assembly, regulator assembly, and face piece assembly.
Q. Air passage through SCBA begins in the cylinder, through the shut-off valve into the high-pressure air line, into the regulator. In an SCBA with a face piece-mounted regulator, the air goes into the face mask. In a harness-mounted regulator, air flows from the regulator through a low-pressure hose into the face mask. From the face piece, air is inhaled. Exhaled air passes through the exhalation valve.
R. Skip-breathing conserves air while using an SCBA in a firefighting situation.
S. SCBA must be checked regularly to ensure readiness for use.
T. SCBA cylinders are refilled using compressors and cascade systems.
U. Follow 18 steps to correctly don PPE:
   1. Place the protective hood over your head and down around your neck.
   2. Put on your bunker pants and boots.
   3. Put on your turnout coat.
   4. Open the air-cylinder valve on your SCBA and check the air pressure.
   5. Put on your SCBA.
   6. Tighten the shoulder straps of the SCBA harness.
   7. Attach the waist belt of the harness.
   8. Fit the face piece to your face.
   9. Tighten the face piece straps.
   10. Check the face piece for a proper seal.
   11. Pull the protective hood up so that it covers all bare skin.
   12. Place your helmet on your head and secure the chin strap.
   13. Turn up your coat collar.
   14. Put on your gloves.
   15. Check your clothing to be sure it is secured.
   16. Make sure your PASS device is on.
   17. Attach your regulator or turn it on.
   18. Work safely!
POST-LECTURE

I. Wrap-Up Activities

Time: 40 Minutes
Level: Fire Fighter I and II
Small Group Activity/Individual Activity/Discussion

Fire Fighter in Action and/or Fire Fighter II

This activity is designed to assist the student in gaining a further understanding of SCBA maintenance.

Purpose
This activity allows students an opportunity to understand SCBA cleaning schedules, refilling, required specifications, and testing.

Instructor Directions
1. Direct students to read the “Fire Fighter in Action” and/or “Fire Fighter II in Action” scenario located in the Wrap-Up section at the end of Chapter 3.
2. Direct students to read and individually answer the quiz questions at the end of the scenario. Allow approximately 10 minutes for this part of the activity. Facilitate a class review and dialogue of the answers, allowing students to correct responses as needed. Use the answers noted below to assist in building this review. Allow approximately 10 minutes for this part of the activity.
3. You may also assign these as individual activities and ask students to turn in their comments on a separate piece of paper.

Answers to Multiple Choice Questions
1. A
2. A
3. D
4. D
5. C
6. C

Technology Resources

This activity requires students to have access to the Internet. This may be accomplished through personal access, employer access, or a local educational institution. Some community colleges, universities, or adult education centers may have classrooms with Internet capability that will allow for this activity to be completed in class. Check out local access points and encourage students to complete this activity as part of their ongoing reinforcement of firefighting knowledge and skills.

Purpose
To provide students an opportunity to reinforce chapter material through use of online Internet activities.

Instructor Directions
1. Use the Internet and go to www.FireFighter.jbpub.com. Follow the directions on the Web site to access the exercises for Chapter 3.
2. Review the chapter activities and take note of desired or correct student responses.
3. As time allows, conduct an in-class review of the Internet activities and provide feedback to students as needed.
4. Be sure to check the Web site before assigning these activities because specific chapter-related activities may change from time to time.
II. Lesson Review

Time: 15 Minutes
Level: Fire Fighter I

Discussion

Note: Facilitate the review of this lesson’s major topics using the review questions as direct questions or overhead transparencies. Answers are found throughout this lesson plan.

Fire Fighter I

A. In what type of atmosphere is the SCBA required?
B. Describe the different components that make up turnout gear.
C. List and describe the two different types of PASS devices.
D. What is the oxygen concentration of normal room air?
E. What are some of the toxic gases that are normally produced by residential or commercial fires?
F. What are the different types of breathing apparatuses, and which one is normally used by the fire service?
G. What are the different components of the SCBA?
H. Describe the “skip-breathing” technique.
I. How often should SCBA be inspected?
J. Describe the differences between compressors and cascade systems.

III. Assignments

Time: 5 Minutes
Level: Fire Fighter I and II

Lecture

A. Advise students to review materials for a quiz (determine date/time)
B. Direct students to read the next chapter in Fundamentals of Fire Fighter Skills as listed in your syllabus (or reading assignment sheet) to prepare for the next class session.