PROTECTIVE EQUIPMENT AND SCBA

Note Taking Guide

PILOT

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Maryland Fire and Rescue Institute
University of Maryland
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The Maryland Fire and Rescue Institute of the University of Maryland is the State’s comprehensive training and education system for all emergency services.

The Institute plans, researches, develops, and delivers quality programs to enhance the ability of emergency service providers to protect life, the environment, and property.
Lesson 1-2: Personal Protective Equipment

Student Performance Objective

Given information from discussion, handouts, and reading materials, describe fire service respiratory protection.

Introduction

- Two safety components used by fire fighters need special consideration:
  - Personal protective equipment (PPE)
  - Self Contained Breathing Apparatus (SCBA)
Introduction

- PPE protects the body against a limited amount of heat.

Personal Protective Equipment

- PPE is essential to a fire fighter’s safety
  - Must provide full body coverage and protection from a variety of hazards
  - Must be cleaned, maintained, and inspected regularly.

Structural Firefighting Ensemble

- The structural firefighting ensemble
  - Enables fire fighters to work in areas with high temperatures and toxic gases
  - Is designed to be worn with self-contained breathing apparatus (SCBA)
**Structural Firefighting Ensemble**

**TABLE 3-1**

**Protection Furnished by Personal Protective Equipment**

- Provides thermal protection
- Repels water
- Provides impact protection
- Protects against cuts and abrasions
- Furnishes padding against injury
- Provides respiratory protection

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**The Helmet**

- The helmet
  - Must meet the NFPA 1971 Standard
  - Provides impact protection against falling objects
  - Is often color-coded according to rank and function
  - Must have a label permanently attached

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**The Protective Hood**

- The protective hood
  - Covers exposed skin
  - Is constructed of flame-resistant materials
  - Is worn over the facepiece but under the helmet
The Turnout Coat

- The turnout coat
  - Has three layers:
    - Protective outer shell
    - Moisture barrier
    - Thermal barrier
  - Has a flap that provides a secure double seal
  - Comes in two styles—long and short

Bunker Pants

- Bunker pants
  - Are constructed to match the turnout coat.
  - Have a three-layer protective system
  - Should be large enough to don quickly and move in easily

Boots

- Boots
  - Are constructed of rubber or leather
  - Must meet NFPA 1971 requirements
  - Have an outer layer that repels water and is flame- and cut-resistant.
  - Have an inner liner that adds thermal protection.
Gloves

- Gloves
  - Protect from heat, liquid, vapors, cuts, and penetration
  - Must have wristlets to protect skin at the wrist
  - Are usually constructed of heat-resistant leather

The Personal Alert Safety System

- The personal alert safety system
  - Is an electronic device that sounds a loud signal if a firefighter:
    - Is motionless for a set period
    - Activates it
  - Can be separate or integrated into the SCBA unit

Additional PPE

- Approved goggles
- Intercom system
- Flexible ear plugs
- Hand light
- Radio
- Reflective vest
- Drag rescue device
Limitations of the Structural Firefighting Ensemble

- Tasks require energy and strength
- Body heat and perspiration is retained
- Mobility and range of motion is limited
- Normal sensory abilities are decreased

Work Uniforms

- Clothing containing nylon or polyester may melt.
- Synthetic fibers are resistant to high temperature.

Donning and Doffing PPE

- Donning PPE must be done in a specific order to obtain maximum protection.
- To doff PPE, reverse the procedure used in getting dressed.
Care of PPE

• Check the condition of PPE regularly.
• Repair worn or damaged PPE at once.
• Clean PPE when necessary.
  – Badly soiled by exposure
  – Exposed to chemicals or hazardous materials
• Follow the manufacturer’s instructions.

Specialized Protective Clothing

• Vehicle extrication
  – PPE is generally lighter and more flexible than structural firefighting PPE.
  – Latex gloves should be worn when providing patient treatment.
  – Eye protection also should be worn.

Specialized Protective Clothing

• Wildland fires
  – PPE must meet NFPA 1977
  – The gear must be
    • Made of fire-resistant materials
    • Designed for comfort and maneuverability
  – Helmet, eye protection, gloves, and boots are designed for comfort and sure footing
Putting It All Together

- Place the protective hood over your head.
- Put on your bunker pants and boots.
- Put on your turnout coat and secure.

Putting It All Together

- Pull the protective hood up.
- Place your helmet on.
- Turn up your coat collar.

Putting It All Together

- Put gloves on.
- Check your clothing.
- Work safely.
Summary

• Personal protective equipment is essential to a fire fighter.
• Structural firefighting PPE allows fire fighters to work in burning buildings, elevated temperatures, and toxic gases.
• PPE consists of a bunker coat and pants, helmet, protective hood, boots, SCBA, PASS, and additional equipment.
Summary

• Structural PPE adds weight.
• PPE should be checked regularly.
• PPE should be kept clean.
• Gloves and coveralls or jumpsuits are used during vehicle extraction.
Lesson 1-3: Self-Contained Breathing Apparatus

Student Performance Objective

- Given information from discussion, handouts, and reading materials, describe fire service respiratory protection.

Introduction

- Two safety components used by fire fighters need special consideration:
  - Personal Protective Equipment (PPE)
  - Self-Contained Breathing Apparatus (SCBA)
Introduction

- PPE protects the body against a limited amount of heat.
- SCBA allows fire fighters to enter smoky and toxic areas and provides respiratory protection for limited time.

Respiratory Protection

- The interior atmosphere of a burning building is considered immediately dangerous to life and health (IDLH).
- Fire fighters must be proficient in using SCBA before engaging in interior fire-suppression activities.

Respiratory Hazards of Fires: Smoke

- Smoke includes three major components:
  - Smoke particles
  - Smoke vapors
  - Toxic gases
    - Carbon monoxide
    - Hydrogen cyanide
    - Phosgene
Respiratory Hazards of Fires: Oxygen Deficiency

- Oxygen deficiency
  - Occurs in two ways:
    - Fire consumes available oxygen.
    - Fire produces gases that displace oxygen.
  - Can lead to disorientation, inability to control muscles, and irrational thinking

<table>
<thead>
<tr>
<th>Oxygen Concentration</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>21%</td>
<td>Normal breathing air</td>
</tr>
<tr>
<td>17%</td>
<td>Judgment and coordination impaired; lack of muscle control</td>
</tr>
<tr>
<td>12%</td>
<td>Headache, dizziness, nausea, fatigue</td>
</tr>
<tr>
<td>9%</td>
<td>Unconsciousness</td>
</tr>
<tr>
<td>6%</td>
<td>Respiratory arrest, cardiac arrest, death</td>
</tr>
</tbody>
</table>

Respiratory Hazards of Fires: Increased Temperature

- Inhaling the superheated gases produced by a fire can cause severe burns of the respiratory tract.
Other Toxic Environments

- Firefighters may encounter toxic gases or oxygen-deficient atmospheres in other emergency situations
  - At hazardous materials releases
  - In confined-space or below-grade structures where toxic gases are present

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!

Types of Breathing Apparatus

- Open-circuit SCBA
  - Is used for structural firefighting
  - Has a tank of compressed air that provides the air supply
  - Has a one-way valve through which exhaled air is released into the atmosphere
Types of Breathing Apparatus

• Closed-circuit SCBA
  – Closed-circuit SCBA is used for extended operations
  – Air passes through a mechanism that removes carbon dioxide and adds oxygen within a closed system.

Types of Breathing Apparatus

• A supplied-air respirator
  – Uses a hose line connected to a breathing-air compressor or to compressed air cylinders
  – Is sometimes used for specialized operations

SCBA Standards and Regulations

• NIOSH
  – Sets the design, testing, and certification requirements for SCBA
• OSHA and state agencies
  – Are responsible for establishing and enforcing regulations for respiratory protection
SCBA Standards and Regulations

- NFPA standards related to SCBA:
  - NFPA 1500: Basic requirements
  - NFPA 1404: Requirements for SCBA training
  - NFPA 1981: Requirements for design, performance, testing, and certification of open-circuit SCBA

Limitations of SCBA

- Use is limited by the amount of air in the cylinder
- Fire fighters must consider:
  - Time and effort required to reach destination
  - Amount of air available once destination is reached
  - Amount of time needed to complete the task
  - Amount of time needed to reach a safe area

Limitations of SCBA

- Added weight and bulk decrease flexibility and mobility
- The facepiece can limit visibility
- Ability to communicate may be affected
- Hearing may be limited
Physical Limitations of the User

• Moving with the extra weight of SCBA and PPE requires additional energy, which increases air consumption and body temperature.

Psychological Limitations of the User

• Breathing through an SCBA can be very stressful.
  – The surrounding environment is foreign as well.
  – Fire fighters must adjust to these stressful conditions.

Components of SCBA

• Backpack
  – A frame for mounting the other working parts of the SCBA
• Harness
  – Straps and fasteners to attach the SCBA to the fire fighter
Components of SCBA

• The air cylinder
  – Holds breathing air for an SCBA
  – Is equipped with a hand-operated shut-off valve
  – Has a pressure gauge which shows the amount of pressure currently in the cylinder

Components of SCBA

• The regulator assembly
  – Controls the flow of air
  – May have a dual-path pressure reducer
  – Requires, to activate:
    • Opening cylinder valve
    • Donning SCBA
    • Attaching regulator to face piece

Components of SCBA

• The regulator assembly (cont’d)
  – Contains a pressure gauge
  • Requires a second heads-up display.
  • The NFPA requires SCBA to include an end-of-service-time-indicator (EOSTI) or low-air alarm.
Components of SCBA

- The regulator assembly (cont’d)
  - May include a PASS device.
  - Is equipped with a rapid intervention crew/company universal air connection (RIC UAC).

Components of SCBA

- The face piece assembly
  - Delivers breathing air
  - Consists of:
    - Face mask
    - Exhalation valve
    - Regulator
  - Should cover the entire face
  - Must be annually fit-tested

Pathway of Air Through an SCBA

- Air passes through the cylinder shut-off valve into the high-pressure hose that takes it to the regulator.
- The regulator sends air into the face piece and to the user.
Pathway of Air Through an SCBA

- When the user exhales, used air is returned to the face piece.
- Exhaled air is exhausted from the face piece through the exhalation valve.

Skip-Breathing Technique

- Take a short breath, hold, take a second short breath.
  - Do not exhale in between breaths.
- Relax with a long exhale.
- Each breath should take 5 seconds.

Mounting Breathing Apparatus

- The SCBA should be located so that firefighters can don it quickly.
  - Seat-mounted brackets
  - Compartment-mounted brackets
  - Exterior-mounted SCBA
Donning SCBA

• Before beginning, fire fighters must:
  – Check that air cylinder has 90% pressure.
  – Be sure donning/doffing switch is activated.
  – Open the cylinder and listen for alarm.
  – Check the pressure gauges.
  – Check that harness straps are fully extended.
  – Check that valves are in the correct position.

Donning SCBA From an Apparatus Seat Mount

• Don all protective clothing.
• Place arms through the shoulder straps.
• On arriving at the scene, activate bracket release, and exit apparatus.
• Attach waist strap; tighten and adjust shoulder and waist straps.

Donning SCBA From a Compartment Mount

• Slide arms through the shoulder harness straps.
• Release SCBA from mounting bracket.
• Adjust shoulder straps.
• Attach ends of the waist strap and tighten.
Donning SCBA From the Ground, Floor, or Storage Case

• Coat
  – Grasp one shoulder strap close to the back plate and the other farther from the plate.
  – Swing the SCBA over your left shoulder.

Donning the Face Piece

• The face piece must be the correct size, and it must be adjusted to fit the face.
  – There must be no facial hair in the seal area.
  – Eyeglasses that pass through the seal area cannot be worn.
Donning the Face Piece

Safety Precautions for SCBA

- Before entering environment, activate PASS device.
- Properly log into accountability system.
- Work in teams of two.
- Have at least two fire fighters outside.

SCBA Use During Emergency Situations

- Keep calm, stop, and think.
- Control your breathing.
- If SCBA problems are experienced, exit the IDLH area.
- If you are in danger, follow self-survival steps and call a mayday.
Doffing SCBA

- Follow procedures recommended by the manufacturer and your department’s SOPs.
- Reverse the steps for donning the SCBA.

Putting It All Together

- Place the protective hood over your head.
- Put on your bunker pants and boots.
- Put on your turnout coat and secure.
- Open the air-cylinder valve on the SCBA, and check the air pressure.
- Put on your SCBA.
Putting It All Together

• Tighten both shoulder straps.
• Attach the waist belt and tighten it.
• Fit the face piece to your face.
• Pull the protective hood up.
• Place your helmet on.
• Turn up your coat collar.

Putting It All Together

• Put gloves on.
• Check your clothing.
• Be sure your PASS device is turned on.
• Attach your regulator or turn it on.
• Work safely.

SCBA Inspection and Maintenance

• SCBA must be properly serviced each time it is used.
  – The air cylinder must be changed or refilled.
  – The facepiece and regulator must be sanitized.
  – The unit must be cleaned, inspected, and checked for proper operation.
SCBA Inspection and Maintenance

• If inspection reveals any problems that cannot be remedied, remove SCBA from service for repair.
• Only properly trained and certified personnel are authorized to repair SCBA.

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.
Inspection of SCBA

• Annual inspection
  – Must be performed on each SCBA.
  – Must be performed by:
    • A certified manufacturer’s representative or
    • A person who has been trained and certified

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.
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.

Refilling SCBA Cylinders

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

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.
Summary

• Personal protective equipment is essential to a fire fighter.
• Structural firefighting PPE allows fire fighters to work in burning buildings, elevated temperatures, and toxic gases.
• PPE consists of a bunker coat and pants, helmet, protective hood, boots, SCBA, PASS, and additional equipment.

Summary

• The two main types of SCBA are open-circuit and closed-circuit devices.
• SCBA limits the amount of air in the cylinder.
• Breathing through an SCBA is different than breathing normally and can be stressful.

Summary

• SCBA consists of a backpack and harness, air cylinder assembly, regulator assembly, and face piece assembly.
• Air passage through SCBA follows a specific pathway.
Summary

• Skip-breathing conserves air.
• SCBA must be checked regularly.
• SCBA cylinders are refilled via compressors and cascade systems.
• Follow the 18 steps to correctly don PPE.