

## INSTRUCTOR GUIDE

COURSE: FIREFIGHTER PRE-BASIC

SESSION REFERENCE: 2

TOPIC: PROTECTIVE CLOTHING AND EQUIPMENT

LEVEL OF INSTRUCTION: 3.0

TIME REQUIRED: 3 HOURS

MATERIALS: Personal Protective Clothing  
Self-Contained Breathing Apparatus

REFERENCES: ESSENTIALS OF FIRE FIGHTING, FOURTH EDITION,  
IFSTA, CHAPTER 4  
MINIMUM PRE-BASIC TRAINING PROGRAM FOR  
FIREFIGHTER TRAINEES IN MARYLAND, MARYLAND  
FIRE-RESCUE EDUCATION AND TRAINING COMMISSION

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### PREPARATION:

**MOTIVATION:** Instructor should stress the need for safety in all aspects of emergency service duties and impress upon the students the roles of attitude, training, and awareness. Proper knowledge and use of personal protective clothing and self-contained breathing apparatus is necessary to help provide a safe working environment for the emergency service provider.

**OBJECTIVE (SPO):** The student will be able to describe the importance of safety in the fire department, the various items of personal protective clothing, the parts of a self-contained breathing, and demonstrate the proper method for donning them.

### OVERVIEW:

#### Protective Clothing and Equipment

- \* Safety
- \* Protective clothing
- \* Self-contained breathing apparatus

Session 2

PROTECTIVE EQUIPMENT

- SPO            The student will be able to describe the importance of safety in the fire department, the various items of personal protective clothing, the parts of a self-contained breathing, and demonstrate the proper method for donning them.
- 2-1    Describe some of the safety practices that can reduce or prevent death and injury in the fire service.
- 2-2    Describe the items of personal protective clothing and demonstrate how to don and doff them.
- 2-3    Describe the components of a self-contained breathing apparatus and demonstrate putting a unit into operation.

The protective clothing and self-contained breathing apparatus portions of this lesson should be delivered as a combination of demonstration and student practice with the minimum amount of time spent on lecture. This material is designed to give the student some basic information on protective clothing and self-contained breathing apparatus. It is not intended to replace a Firefighter I program nor make the individuals fully-functional firefighters. It includes some basic information that any new firefighter should know to assist in an exterior mode on the fireground.

## I. SAFETY (2-1)

### A. NFPA 1500 - Standard on Fire Department Occupational Safety and Health Program

1. Specifies minimum requirements for an occupational health program, and safety procedures for those individuals involved in fire suppression, rescue, and related activities
2. Outlines general requirements for
  - a. Training and education
  - b. Vehicles and equipment
  - c. Protective clothing and equipment
  - d. Emergency operations
  - e. Facility safety
  - f. Medical requirements and responsibilities for both members and departments
  - g. Member assistance programs

### B. Emergency Services Deaths and Injuries

1. Annual injuries
  - a. More than 100,000
  - b. 1 of every 7 firefighters
  - c. Cumulative injuries over long-term due to inhalation of toxic products is significant but difficult to measure

- d. Deaths by cause
  - 1) Stress
  - 2) Struck by/contact with objects
  - 3) Caught/trapped
  - 4) Falls

- e. Deaths by nature of injury
  - 1) Heart attack
  - 2) Internal trauma
  - 3) Asphyxiation
  - 4) Burns
  - 5) Crushing
  - 6) Stroke
  - 7) Electric shock
  - 8) Pneumonia

## 2. Causes of injuries

- a. Excessive heat
  - 1) Superheated atmospheres
  - 2) Radiated energy
  - 3) Direct contact with flame and hot objects or surfaces
- b. Sharp objects
  - 1) Nails
  - 2) Broken glass
  - 3) Jagged steel

- 4) Sharp cutting points of tools
  - c. Blunt objects or surfaces
    - 1) Falling objects
    - 2) Impact from tools
  - d. Electrical current - contact with energized electric wire
  - e. Falls
  - f. Unbreathable atmospheres
3. Other considerations
- a. Hearing loss
  - b. Toxic substance exposure (hazmat)
  - c. Disease
    - 1) Studies show that all fire suppression personnel are at some degree of risk to bloodborne pathogens
    - 2) General precautions
      - a) Assume all patients have a communicable disease
      - b) Use quality latex or vinyl gloves when handling patients
      - c) Use facial/eye protection and liquid impervious gowns or aprons when appropriate
      - d) Use a waterless antimicrobial hand cleaner after handling patients

4. Locations

- a. Responding to and returning from alarms
- b. At scene
- c. In-station
- d. Inspections
- e. Training

5. Personal safety

- a. Safety procedures while riding apparatus
  - 1) Ride in proper place
  - 2) Remain seated
  - 3) Use safety equipment such as seat belts, safety bars and hearing protection
  - 4) Do not dress during apparatus movement
- b. Safety when mounting, dismounting, and operating around apparatus
  - 1) Never attempt to mount or dismount moving apparatus
  - 2) Use handrails when mounting and dismounting
  - 3) If it is suspected that the apparatus is in contact with electrical lines stay where you are or jump clear of the apparatus to exit if necessary
  - 4) Look before dismounting apparatus so that you know where you are stepping or what you are stepping into (power lines, ditches, etc.). If dismounting on traffic side be sure to check for on-coming vehicles

5) When operating around apparatus remember that headlights can blind on-coming motorists and that their vision may not return to normal until they are past the apparatus

c. Safety in the station

1) Use proper lifting techniques

2) Good housekeeping

a) Keep aisles and walkways clear and free from slipping hazards

b) Keep stairs clear and well lighted

c) Floors, aisles, stairs, handrails, slide poles, and slides maintained in safe condition

3) Control horseplay

C. Basic Guidelines

1. Maintain good wellness and physical condition

2. Use appropriate personal protective equipment for operation being performed

3. Follow departmental SOPs

4. Attitude

II. PROTECTIVE CLOTHING (2-2)

A. Helmet

1. Shell protects head from impact, heat and cold - designed to fail on impact to reduce shock to the head and neck

2. Shield protects eyes and face from foreign objects

3. Adjustable suspension system to absorb shock to head and neck

4. Ear flaps protect ears and neck from heat and cold

5. Chin strap ensures that the helmet stays in place during normal wear and upon impact
  6. All parts need to be used to ensure proper protection
  7. Do not use open area in the top of helmet for storage. This area must stay open to absorb shock and act as an insulator
  8. Should be a comfortable fit, square to the head, with hood and facepiece on
- B. Hearing Protection - earplugs or earmuffs should be provided for all activities with high noise levels.
- C. Eye Protection
1. Acceptable eye protection
    - a. Absorbs impact without shattering
    - b. Not be subject to scratching
    - c. Not melt at high temperatures
  2. Common types of eye protection
    - a. Helmet faceshield
    - b. SCBA facepiece
    - c. Safety glasses
    - d. Safety goggles
- D. Protective Hoods
1. Protects neck, ears, and face from extreme heat
  2. Used in conjunction with SCBA facepiece
- E. Boots
1. Rubber or leather
  2. Insulating qualities

3. Puncture resistant insole
4. Steel toe
5. Ribbed sole for traction
6. Water resistant

F. Gloves

1. Protect from heat
2. Protect from sharp objects
3. Gloves must breathe
  - a. Allow moisture out
  - b. Prevent moisture from coming in
4. Proper fit - should provide good manual dexterity
5. Wrists need to be covered

G. Coat

1. Protects from
  - a. Heat/cold
  - b. Sharp objects
  - c. Blunt objects
  - d. Water repellent
2. Multiple layers (all must be in place when coat is in use)
  - a. Provides air space for added insulation
  - b. Outer shell
    - 1) Light color with reflective striping recommended
      - a) Reflects heat

- b) Shows dirt (indicates need for cleaning)
      - c) Good visibility
    - 2) Fire resistant fabric
      - a) Does not mean "fireproof" and is not intended for use as an entry suit
      - b) Material can burn, but is self-extinguishing when removed from flame or ignition source
  - c. Moisture barrier
    - 1) Allows moisture from body to escape
    - 2) Prevents outside moisture or liquids from getting in
    - 3) Helps protect from steam burns
    - 4) Not a chemical barrier
  - d. Thermal barrier
    - 1) Additional thermal protection
    - 2) Quilted liners provide additional air pockets for insulation
- 3. Proper fit
- 4. Reinforced wear points
- H. Pants - same features as coat
- I. Care and Maintenance
  - 1. Helmets
    - a. Shell
      - 1) Remove dirt and chemicals
      - 2) Check for damage - repair or replace
    - b. Suspension - inspect

- c. Replace helmets that do not fit or are damaged beyond repair
- 2. Coats/pants/hoods/gloves
  - a. Machine or hand wash according to manufacturer's directions  
  
NOTE: Have students check labels for cleaning instructions
  - b. Check for rips, tears - repair or replace  
  
NOTE: Protective clothing should only be repaired by authorized personnel and only with like threads or fabric
- 3. Boots
  - a. Wash oil, grease, chemicals, debris from bottom
  - b. Store in cool, dark place
  - c. Replace damaged boots

J. Donning/Doffing

- 1. Proper procedure for donning protective clothing
  - a. Boots/pants pulled up
    - 1) All fasteners closed
    - 2) Suspenders/straps in place
  - b. Hood on - if SCBA is being donned, hood will need to be folded back after coat is donned so that facepiece can be donned
  - c. Coat on
    - 1) All fasteners closed
    - 2) Collar up/closed

- d. Helmet on - if SCBA is being donned, helmet will be donned after facepiece is donned and hood is pulled back up
    - 1) Ear flaps down
    - 2) Chin strap in place
    - 3) Eye protection in place
  - e. Gloves on - glove and coat wristlets should overlap
- 2. Doffing - the procedure above in reverse
  - 3. Walk students through, step-by-step
  - 4. Allow students to practice
  - 5. Time all students for complete and proper donning

NOTE: This segment presents a good opportunity for the instructor to inspect student protective clothing. Note any deficiency that may be considered to be a safety hazard. Work with student to try and make appropriate corrections.

### III. SELF-CONTAINED BREATHING APPARATUS (2-3)

#### A. Respiratory Hazards

- 1. Oxygen deficiency
  - a. Normal air contains 21% oxygen
  - b. At least 16% needed to sustain life
- 2. Toxic gases
  - a. May be present from normal processes taking place (certain levels are permitted in the workplace)
  - b. May be result of accidental release
  - c. Normal by-product of combustion
  - d. Most taken into body through inhalation

- e. May not be visible
- 3. Superheated gases
  - a. Normal by-product of combustion
  - b. Can cause temporary or permanent damage to respiratory system
- 4. Smoke
  - a. Normal by-product of combustion, especially incomplete combustion
  - b. Can affect body functions
- 5. SCBA protects firefighter from most respiratory hazards encountered in a fire

B. General Safety Precautions

- 1. Vision standards
  - a. Use of standard eyeglass frames not recommended
    - 1) Prevent facepiece seal at temples
    - 2) Special lens mounts available from manufacturers
  - b. Use of contact lenses - Recent studies involving soft and extended wear contact lenses have shown no significant problem
- 2. Hair standards - facial hair interfering with facepiece seal is prohibited including beards, sideburns, mustaches, and long hairlines or bangs

C. Method of Operation

- 1. Compressed air from cylinder is supplied to wearer
  - a. Inhalation opens valve in regulator
  - b. Regulator allows air to flow to facepiece

- c. Exhalation closes valve in regulator, stopping flow and opens exhalation valve in facepiece to atmosphere
- 2. Air from cylinder is allowed to pass through regulator. Upon inhalation, pressure is reduced in facepiece. Regulator supplies more air to compensate for pressure drops. Exhalation valve forced closed by spring tension causing slight pressure buildup inside facepiece
  - a. Maintains slightly higher than atmosphere pressure
  - b. Prevents leaks from outside into facepiece

#### D. SCBA Components

##### 1. Cylinder

###### a. Types

###### 1) 30 minute high pressure

a) Volume - 45 cu. ft. at 4,500 psi

c) Average unit weight - 23 lbs.

###### 2) 60 minute high pressure

a) Volume - 88 cu. ft. at 4,500 psi

c) Average unit weight - 30 lbs.

###### b. Cylinder valve and gauge

c. Markings - serial number, hydrostatic test date (tested every 3 years), DOT markings, fill pressure

d. Safety or over-pressure plug - if, during filling, the cylinder is over filled, a small metal disc will rupture and the air will escape to the outside

e. A full cylinder rated at 30 minutes by the NIOSH/MSHA (Federal non-fire service agencies) will last about 15 to 20 minutes depending on

###### 1) Physical condition

- 2) Psychological stability or make-up
- 3) Ability to control breathing
- 4) Training and experience
- 5) Work activity
- 6) Other factors

2. Harness - a device to hold and carry the breathing apparatus assembly on the back
  - a. Backplate - holds the cylinder in place with a cylinder strap; equipped with adjustable band for 30- and 60-minute cylinders
  - b. Shoulder strap - straps to carry the assembly on the back
  - c. Chest strap - holds the shoulder straps in position
  - d. Waist strap - holds the harness on the back and prevents the assembly from sliding
  - e. Approval label - NIOSH/MSHA
3. Low pressure warning device
  - a. Device to warn that your air supply is running low
  - b. Activates at approximately 25% of rated working pressure (3 to 5 minutes) of air left in the cylinder, depending on
    - 1) Physical condition
    - 2) Psychological stability or make-up
    - 3) Ability to control breathing
    - 4) Training and experience
    - 5) Work activity
    - 6) Other factors
  - c. Location and type of device

4. High pressure hose
  - a. Carries air, at cylinder pressure, from cylinder to first and second stage regulators
  - b. Connection from high pressure hose - Should be finger tight. If the connection still leaks, snug up with hand. If it still leaks, check "O" ring. Never over tighten. It will damage "O" ring
5. Regulator assembly - a device which reduces the high pressure air from the cylinder to a lower pressure
  - a. First stage mounted on side of backpack
  - b. Gauge - tells how much air is remaining in the cylinder
    - 1) Connected to high pressure hose and fastened to left shoulder strap
    - 2) Shows pressure reading whenever pressure on system
    - 3) Have student compare cylinder and gauge near shoulder strap, go by lowest pressure
    - 4) Should never be more than 100 psi difference. If so, have checked by service personnel
  - c. Facepiece mount regulators
    - 1) No mainline valve - system is activated by inhaling
    - 2) Does not have by-pass valve - system is designed to fail in the open position
    - 3) Purge valve - for purging contaminants from the facepiece
    - 4) Doffing control - shuts off air to facepiece prior to doffing
    - 5) Locking device - to assure regulator to facepiece connection

6) Gasket - sealing regulator to facepiece

6. Personal Alert Safety System (PASS)

- a. Purpose - to alert others of a downed or lost firefighter
- b. Integrated into breathing apparatus and turned on automatically when SCBA cylinder turned on
- c. Function
  - a) Detects lack of motion for 30 second time period
  - b) Sounds pre-alert signal at 18 seconds
  - 3) May be de-activated by tapping or by movement
  - 4) Without de-activation pre-alert goes to full alert. Can only be de-activated by resetting

7. Facepiece assembly

- a. Facepiece - covers/protects the face and provides for inhalation and exhalation of low pressure air
- b. Exhalation valve - allows exhaled air to leave the facepiece and stops smoke and toxic gases from entering facepiece on inhalation
  - 1) Can sometimes become stuck, preventing exhaled air leaving by way of the exhalation valve; causes air to blow out around the face seal
  - 2) To correct, try blowing out hard while holding facepiece tight to face
  - 3) Positive pressure - exhalation valve on the facepiece is equipped with a pressure balancing mechanism - air does not continuously flow, but does maintain a positive pressure inside the facepiece
- c. Speaking diaphragm - allows wearer to communicate more clearly
- d. Nose cup - deflects exhalation away from lens to prevent fogging

- e. Spider or facepiece harness - strap which holds the facepiece firmly against the face. Be sure straps are fully extended when putting away (check for wear and tear)

E. After Use Maintenance

1. Recharge/replace cylinder if at 90% capacity or less
2. Inspect "O" ring and gasket
3. Inspect facepiece
4. Clean facepiece
  - a. Submerge in approved cleaner/disinfectant with warm water
  - b. Rinse in warm water
  - c. Air dry - do not connect facepiece regulator to facepiece when regulator is wet
5. Inspect and clean harness
6. Check operation of all gauges and valves
7. Defective units should be removed from service, tagged, and sent for repair or replacement

F. Operational Rules for SCBA

1. Use only when in good health and physical condition
2. Do not use when overexerted, or if already suffering from smoke inhalation
3. Check operation of apparatus before entering the fire area
4. Work in pairs - apparatus can malfunction; two people are more than twice as effective as one
5. When possible, stay in contact with hoseline or use a lifeline to speed escape if necessary. If disoriented, locate a wall and follow it to a window or door. Feel the floor for cracks between floor boards or tiles to avoid crawling in circles

6. Conserve air - make every movement count
7. Be familiar with apparatus used, through training and practice
8. Be able to work using touch and hearing only
9. Know limitations of breathing apparatus - what it can and cannot do
10. Know your own limitations and do not exceed them
11. Allow enough time for exit when low pressure alarm sounds. You may have to move quickly since you are more than a half bottle time into the fire area
12. Always extend all straps fully when removing the breathing apparatus

G. Donning and Doffing Procedures and Safety Checks

1. Student preparation
  - a. Harness and facepiece - all should be the same
    - 1) Cylinder down and backpack up
    - 2) Cylinder valve at feet
    - 3) Straighten and extend all straps
    - 4) Facepiece on right of cylinder
  - b. Check apparatus to see if the cylinder valve is off and system bled
2. Pre-donning inspection
  - a. All straps (harness and facepiece)
    - 1) Take out twists
    - 2) Fully loosened
  - b. Valves - all connections hand tight

- c. Read cylinder gauge (out loud during drills)
  - d. Open cylinder valve
    - 1) Listen for low pressure warning device
      - a) Will not activate if regulator has not been bled from previous use
      - b) Remind students not to use SCBA if warning device does not activate
    - 2) Read gauge near shoulder strap and compare to cylinder gauge
3. Donning (two suggested methods)
- a. Coat method
    - 1) Stand or kneel at valve end of cylinder
    - 2) With left hand, cross over backplate and grasp shoulder strap that will be worn on left shoulder
    - 3) Control the regulator (if applicable) with right hand
    - 4) Lift harness assembly and swing so that grasped shoulder strap is resting on left shoulder while right shoulder strap comes across the back to rest on right shoulder
    - 5) Secure all straps
  - b. Over the head
    - 1) Kneel at the end opposite the cylinder valve
    - 2) Grasp backplate/cylinder with both hands
    - 3) Lift harness assembly overhead - let straps hang free, they will fall into place over the elbows
    - 4) Slide harness onto back in proper position
    - 5) Secure all straps

- c. Don facepiece
  - 1) Chin first
  - 2) Place webbing over head and slide down on back of head with hand
  - 3) Secure straps (in order)
    - a) Neck
    - b) Temple (if equipped and needed)
    - c) Top (if equipped and needed)
  - 4) Helmet chin straps must be used

- d. Safety check

- 1) Facepiece seal
  - a) Hold hand over regulator connection on facepiece
  - b) Inhale slightly and hold your breath momentarily (10 seconds)
  - c) Facepiece should slightly collapse and there should not be any leakage or air. If leak is suspected - readjust facepiece and head straps and retry
- 2) Exhalation valve check
  - a) With hose in the regulator coupling, inhale and exhale to assure function
  - b) Foreign matter may lodge in spring assembly

- 4. Operation

- a. Connect regulator to facepiece according to manufacturer's procedure

- b. Inhale to check regulator gauge function. Gauge reading should be equal to or within 100 psi. Believe the lessor of the two
  - c. Positive pressure check - break seal with two fingers; check for outward rush of air
  - d. Open purge valve to check for function
5. SCBA doffing
- a. Facepiece doffing
    - 1) Remove regulator from facepiece and secure in holder on waist strap
    - 2) Loosen facepiece spider straps by pulling forward the buckles provided
    - 3) Pull facepiece down so as to allow the chin to be removed, then lift facepiece over head. Finish loosening spider straps as in "ready position"
    - 4) Place in a clean area so as to protect the lens from scratching and the inside of facepiece and breathing tube from becoming wet or contaminated from dirt, dust, grit, or liquids
    - 5) Clean facepiece before stowing
  - b. Doffing the harness
    - 1) Unbuckle waist and chest straps
    - 2) Fully extend all straps using appropriate buckles. Loosen and let out shoulder straps all the way. Remove right shoulder strap from shoulder
    - 3) Reach to left shoulder strap with left hand
    - 4) Slide harness off left shoulder
    - 5) Place harness on floor with cylinder towards floor
    - 6) Extend all straps on the harness assembly

- 7) Lay out straps and check to see that they are not tangled or twisted; straighten as necessary
  - 8) Shut off cylinder and bleed with purge valve
  - 9) Shut off PASS device
6. Donning drill
- a. Have students spread out in a large circle
  - b. While in full protective clothing, each student shall don and place their SCBA in full operation with 1 minutes, using the four-step method
7. Quick fill procedure
- a. Remove quick fill hose from pouch
  - b. Remove protective caps and connect quick fill hose to male connection near regulator on left shoulder strap of donor unit
    - 1) Female connection should snap in place
    - 2) Green ring should appear near female connection
  - c. Remove protective caps and connect quick fill hose to male connection on receiver unit pressure of two cylinders will equalize within one minute
  - d. Disconnect hose, replace all protective caps, and bleed hose by pressing against solid surface, and replace in pouch with connections downward
8. Changing cylinders
- a. Spread apparatus on floor with cylinder up
  - b. Point cylinder valve at feet
  - c. Extend and straighten all straps
  - d. Turn cylinder valve off
  - e. Bleed air off regulator by slowly opening purge valve

- f. Disconnect H/P hose from cylinder (check "O" ring in H/P connector)
- g. Loosen cylinder strap or holding device
- h. Remove cylinder from backplate
- i. Insert new cylinder to cylinder stop
- j. Tighten cylinder holding device; securing cylinder to backplate
- k. Check "O" ring in H/P connector before connecting high pressure hose
- l. Check proper position of regulator and straps by donning apparatus
- m. Turn cylinder valve on to check for leaks
- n. Bleed system by turning the cylinder valve off and bleed the air off regulator by slowly opening purge valve

9. Practical exercises

NOTE: Before beginning this portion of the class, discuss hose couplings so that the students can use them to determine proper direction of travel during the obscured vision exercise.

- a. Obscured Vision Practical Exercise
  - 1) Students are to follow a hoseline going from one end (nozzle to water source or water source to nozzle) without losing contact with hoseline or becoming disoriented.
  - 2) Nomex hoods should be turned backwards so as to obscure vision taking care to not dislodge the facepiece.
  - 3) Students will be spread on the hoseline at sufficient intervals to avoid working as a team.
- b. Wrap-Up - Clean facepieces, fill cylinders, and stow units

REVIEW:

Protective Clothing and Equipment

- \* Safety
- \* Protective clothing
- \* Self-contained breathing apparatus

REMOTIVATION:

ASSIGNMENT:



EVALUATION: