TOPIC: SELF CONTAINED BREATHING APPARATUS (SCBA) TYPES AND COMPONENTS

TIME FRAME: 1:00

LEVEL OF INSTRUCTION: Level I

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will be familiar with the current types of SCBA used by CAL FIRE and the components of an MSA Self Contained Breathing Apparatus

Standard: With a minimum of 80% accuracy

MATERIALS NEEDED:

- Writing board
- Handouts
- MSA self contained breathing apparatus

REFERENCES:

- IFSTA, Essentials of Fire Fighting, 5th Edition, Chapter 5
- IFSTA, Self Contained Breathing Apparatus, 1st Edition, Chapter 4
- CAL FIRE, Health and Safety Procedures Handbook (1700)
- Mine Safety Appliance Corporation

PREPARATION:

In the fire service, a self contained breathing apparatus (SCBA) is the tool which allows us to operate safely in an oxygen deficient or contaminated atmosphere. To use this tool effectively, it is important that the user understand the intended uses of different types of breathing apparatus and be familiar with the components and operation of these apparatus.

PRESENTATION	APPLICATION

I. TYPES OF SELF CONTAINED BREATHING APPARATUS

What is the primary difference between an open circuit and a closed circuit S.C.B.A.?

A. The determination as to whether a self contained breathing apparatus is open or closed circuit depends upon what happens to the exhaled air

1. Closed circuit - exhaled air in this type apparatus is filtered or scrubbed of carbon dioxide (CO_2), the amount of oxygen used in that last inhalation is replenished from a small compressed oxygen bottle within the self contained breathing apparatus and then the same air is reused or 'rebreathed' by the wearer

   a. This type unit is not widely used in the fire service

2. Open circuit - exhaled air in this type apparatus is exhaled through an exhalation valve to the outside environment

   a. This type unit is the most widely used for fire service applications

II. WHEN TO USE A SELF-CONTAINED BREATHING APPARATUS

A. A SCBA shall be worn whenever an employee is "...working in, or when likely to be exposed to, an oxygen deficient atmosphere or dusts, mists, fumes, vapors, gases, or chemicals of such concentrations or duration as to cause injury..."

B. As a Minimum SCBA Should be Worn During:

PRESENTATION	APPLICATION
	On what emergency incidents should an S.C.B.A. be worn?

1. Structure fires
2. Vehicle fires
3. Dump/dumpster fires
4. Hazardous materials incidents
5. Airplane crashes/fires
6. Confined space operations
7. Below ground operations

C. Self-contained breathing apparatus are not designed for underwater use

III. MINE SAFETY APPLIANCE (MSA) SELF - CONTAINED BREATHING APPARATUS COMPONENTS

NOTE: CAL FIRE employees will have the opportunity to use several brands of breathing apparatus dependant on their individual assignment. Only MSA will be discussed in the remainder of this lesson plan

NOTE: In describing components of the system we will begin with the air source and trace its route to the ultimate user

A. Compressed air cylinders

1. Filled with class D compressed air

a. Extreme caution must be exercised to insure only uncontaminated compressed air is placed in a cylinder

PRESENTATION	APPLICATION
b. Quarterly sampling and analysis of the air supply source is required	
2. Cylinder characteristics	
a. Duration (Rated)	
(1) 15 minute cylinders	
(2) 30 minute cylinders	
(3) 60 minute cylinders	
b. A cylinder's duration is affected by:	What conditions would adversely impact the time an S.C.B.A. cylinder's air will last under emergency conditions?
(1) Physical condition of the user	
(2) Level of activity	
(3) Wearers reaction to stress, fear, etc..	
(4) Amount of training or experience with SCBA	
(5) Cylinder pressure at start of work period	
(6) Condition of SCBA - leaks lessen time	
c. Cylinder types	
(1) Steel cylinders	
(a) Weight - 23 pounds	

PRESENTATION	APPLICATION

(b) Hydrostatic test - 5 year intervals

(c) Full steel construction

(2) Composite cylinders

(a) Fully wound

(b) Weight - 13 pounds

(c) Hydrostatic test 3 year interval

(d) Light weight seamless aluminum liner with fiberglass type material wrapped around circumference and diagonally around long axis of the cylinder

d. Cylinder pressures

(1) High pressure cylinder - 4500 psi

(2) Low pressure cylinder

(a) 3000 psi

(b) 2015 psi

e. Rule of thumb -1 minute working time per 100 psi in the cylinder

f. A steel cylinder may be filled 10% over its rated capacity in the following cases:

NOTE: A steel 2015 psi bottle filled 10% over its rated capacity is 2216 psi. (2015x10% = 201. 201+2015=2216)

PRESENTATION	APPLICATION

(1) Between the date of manufacture and the first required hydrostatic test date

(2) When a "+" is affixed with the hydrostatic test stamp

B. Cylinder valve assembly

1. Cylinder valve handwheel - opens/closes cylinder valve

2. Cylinder valve - must always be fully open when the SCBA is in use

3. Cylinder pressure gauge

a. Will register cylinder pressure without regard as to whether the cylinder valve is open or closed

b. If pressure reading differs + or - 100 psi from reading on regulator pressure gauge, place apparatus out of service

C. High pressure hose and audi-larm

1. High pressure hose assembly

a. Takes air from compressed air cylinder to the regulator at cylinder pressure Consists of:

(1) High pressure hose coupling

(2) High pressure hose

b. Is not designed to be charged while in storage

2. Audi-Larm

PRESENTATION	APPLICATION
	What must a firefighter do, if involved in suppressing a structure fire, when the Audi-Alarm begins to ring? CAL FIRE policy is to notify your "buddy" and both exit the structure immediately

a. Audible low pressure warning device located adjacent to the cylinder valve assembly

b. Piston is armed automatically when cylinder valve is opened, provided the cylinder has at least 850 psi of compressed air

   (1) In the event the audi-larm fails to arm place the unit out of service

   (2) Failure to arm indicates:

      (a) High pressure hose not bled off when last used

      (b) Compressed air cylinder has less than 850 psi

      (c) Audi-larm out of adjustment or inoperative

      (d) Restriction or blockage in cylinder valve or high pressure hose coupling

c. Audi-larm will automatically begin ringing when pressure in the cylinder is approximately 25% of capacity

PRESENTATION	APPLICATION

(1) 4500 psi - 1125

(2) 3000 psi – 750

(3) 2216 psi - 554

(4) Rings continuously down to 200 psi then automatically shuts off.

(a) Normally 2 minutes of air remaining

D. Regulator

1. Regulator reduces the high pressure cylinder air to a breathable pressure

2. A pressure demand regulator is required by law for all Fire Department applications

a. Pressure - A positive pressure, slightly above atmospheric pressure, is supplied continuously to the facepiece when the mainline valve is open

(1) A safety feature, in the event that a leak develops this facepiece pressure forces non-respirable air. toxics, and smoke out

b. Demand - an increased volume of air is supplied to meet the wearers' needs when the wearer inhales

3. Types of regulators

a. Mask mounted (MMR)

(1) Quarter turn placement

(2) Straight placement

b. Belt mounted (BMR)

PRESENTATION	APPLICATION
(1) By-pass valve (a) Red six sided knob (b) Closed during normal operation (c) Opened when needed to unfog facepiece lens (d) Opened when regulator malfunctions (e) Opened when buddy breathing necessary (2) Mainline valve (a) Yellow round knob (b) Open during normal operation (c) Closed whenever bypass valve is being used due to regulator malfunction (d) Closed whenever facepiece is not in use c. Regulator pressure gauge (1) Displays pressure in cylinder only when mainline valve is open (2) Any time the regulator pressure gauge differs from the cylinder pressure gauge by + or - 100 psi the unit is to be placed out of service	What must be done if a difference of + or -

PRESENTATION	APPLICATION
	100 psi is noticed between the cylinder pressure gage reading and the regulator pressure gage reading?

d. Outlet port cover

(1) Reduces the amount of water and debris entering regulator

E. Breathing Tube

1. Belt mount regulator models

2. Breathing tube or low pressure hose

a. Transports air from regulator to the facepiece

b. Corrugated to resist collapse and/or crushing

c. Is subject to cracking at the base of the grooves and should be inspected frequently.

d. Is susceptible to abrasions

F. Facepiece

1. Purpose

a. Protects the wearer from breathing contaminated, toxic, or otherwise non-respirable air present in the environment

b. Supplies wearer with cool respirable air

2. Sizes

a. Face pieces come in three sizes:

PRESENTATION	APPLICATION

(1) Small

(2) Medium

(3) Large

(a) Lens ring may be a different color than the mask indicating an individual size. All masks will have a letter or word indicating size, eg.; S,M,L

3. In order for the facepiece to protect your respiratory tract you must establish and maintain a good face - facepiece seal

NOTE: Fit test should be done on every student to check seal

1. Qualitative test - use isoamyl acetate (Banana oil) or an approved irritant to determine if student can smell the substance which indicates a leak

–or-

2. Quantitative test - actual sample of air in facepiece to determine presence of contaminants. (very expensive)

a. Illegal to wear following:

(1) Glasses where temples break seal

(2) Nomex hood if it interferes with seal

(3) Beards or long sideburns which break seal

b. Face - facepiece seal is checked by both inhaling and exhaling during donning procedure

PRESENTATION	APPLICATION
(1) Upon inhaling the facepiece should collapse against your face (2) Upon exhaling there should be no noticeable escape of air from the face - facepiece seal (3) Exhalation also tests exhalation value (4) In the event of slight leaks the positive pressure within the facepiece should force contaminated air out of the facepiece	Even "slight" leaks reduce working time significantly
c. Facepiece components (1) Head harness or spider (a) Four or five straps to secure facepiece to face (b) When storing DO NOT wrap harness back over the lens. This distorts facepiece and prevents seal (c) When tightening head harness sequence must be chin, temple (if equipped), and forehead (2) Lens (a) Enables wearer to see out (b) Susceptible to scratching	

PRESENTATION	APPLICATION
(c) Field of vision adjusted by top strap (if equipped) (d) Fogging is a problem due to cool lens contacting humid warm breath or humid hot fire environment	Fogging may be inside or outside the facepiece
(3) Exhalation valve (a) Spring loaded so that valve only opens when wearer exhales (i) Keeps non-respirable air from entering (ii) Maintains positive pressure in facepiece	Why is it important to keep exhalation valve clean?
(b) Must be kept clean so it doesn't hang open allowing contaminated air in	
(4) Speaking diaphragm	
(5) Neck strap	
(6) Nose cup (a) Channels air directly to exhalation valve to reduce lens fogging	

PRESENTATION	APPLICATION

(b) Required by law if used at temperature below 32^0 F

(7) Spectacle kit

(a) Enables the wearer to wear glasses without temple piece breaking the face to facepiece seal

G. Harness and carrier assembly

1. Harness components

a. Shoulder straps

(1) Nomex cover

(2) Stainless steel cable interior

b. Chest Strap

(1) Should be used to limit side to side shifting of apparatus on the back

c. Waist strap

(1) Should be drawn as tight as possible across back plate to ensure comfortable fit, reduce fatigue, and to secure unit to user

2. Carrier assembly

a. Components

(1) Back plate

(2) Cylinder locking band

(3) Cylinder clamping lever

IV. MAINTENANCE AND INSPECTION

PRESENTATION	APPLICATION
A. All repairs and part replacement must be done by certified repairperson	Who is allowed to make repairs on a malfunctioning S.C.B.A.?
1. Exceptions:	
a. Cleaning after each use	
b. Exchange of depleted cylinder for new cylinder	
B. Inspections:	
1. The entire SCBA shall be inspected fully when coming on shift	
2. Cylinder pressure shall be checked and recorded daily	
a. Cylinders on an operational SCBA SHALL be exchanged when the pressure falls below 10% of capacity	

SUMMARY:

Self contained breathing apparatus is a crucial piece of personal protective equipment. It is imperative that fire personnel are knowledgeable of respiratory hazards, the requirements for wearing the SCBA, the procedures for donning and doffing the SCBA and care and maintenance of the equipment

EVALUATION:

A written quiz.

ASSIGNMENT:

To be determined by instructor(s).