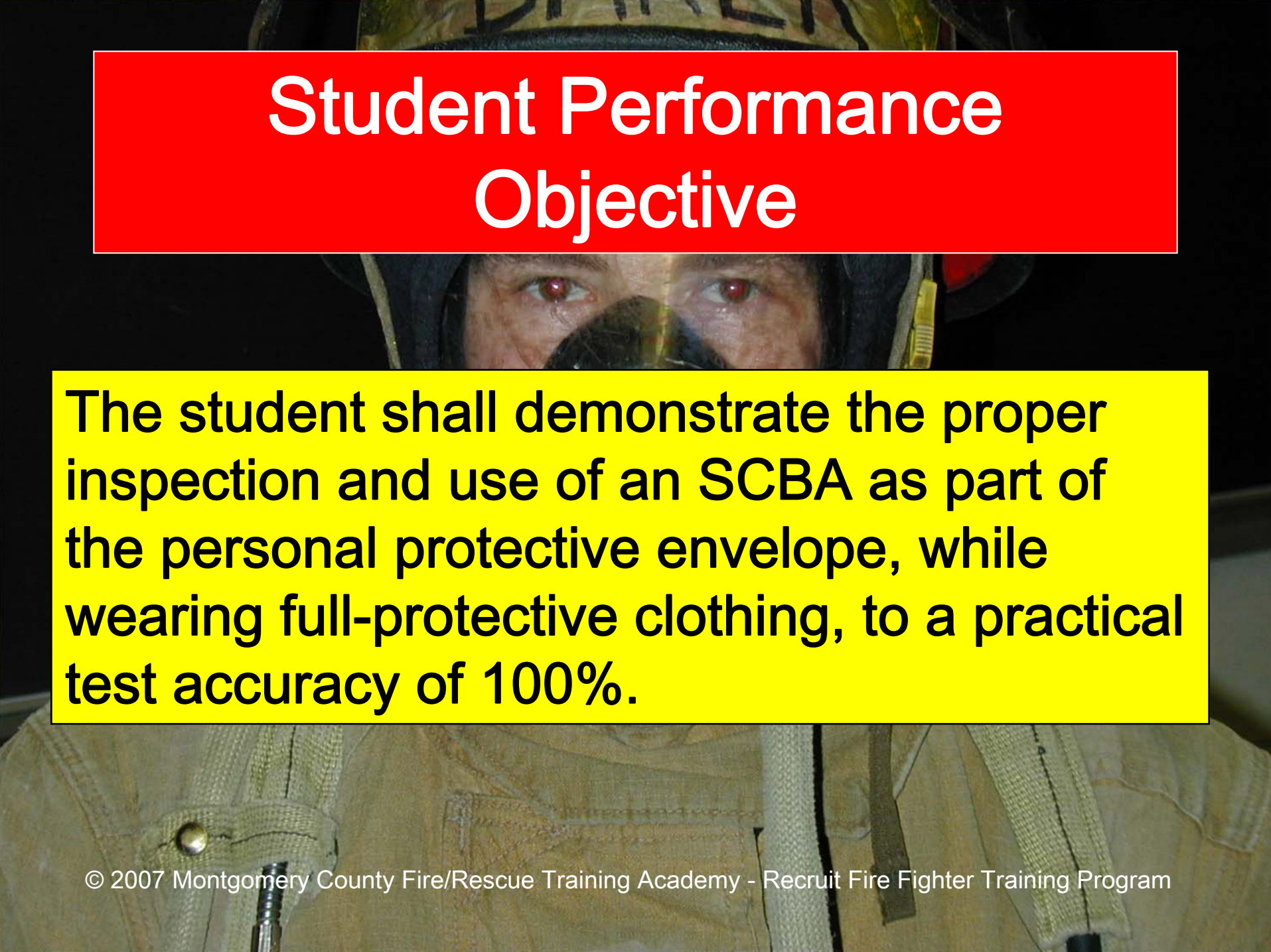
# The Essentials of Fire Fighting

## Self-Contained Breathing Apparatus

Developed by Captain Mark E. Davis & Captain David Polikoff
Edited and updated in 2007 by Lt. Larry Murray



# Student Performance Objective

The student shall demonstrate the proper inspection and use of an SCBA as part of the personal protective envelope, while wearing full-protective clothing, to a practical test accuracy of 100%.

# Overview

- Common Hazardous Atmospheres
- Gas Toxicity
- SCBA Limitations
- Types of Breathing Apparatus
- SCBA Wearer Requirements
- SCBA Parts ID

- Scott 4.5 & Air-Pack Fifty
- Donning & Doffing
- Inspection & Maintenance
- Emergency Procedures
- Cleaning & Refilling

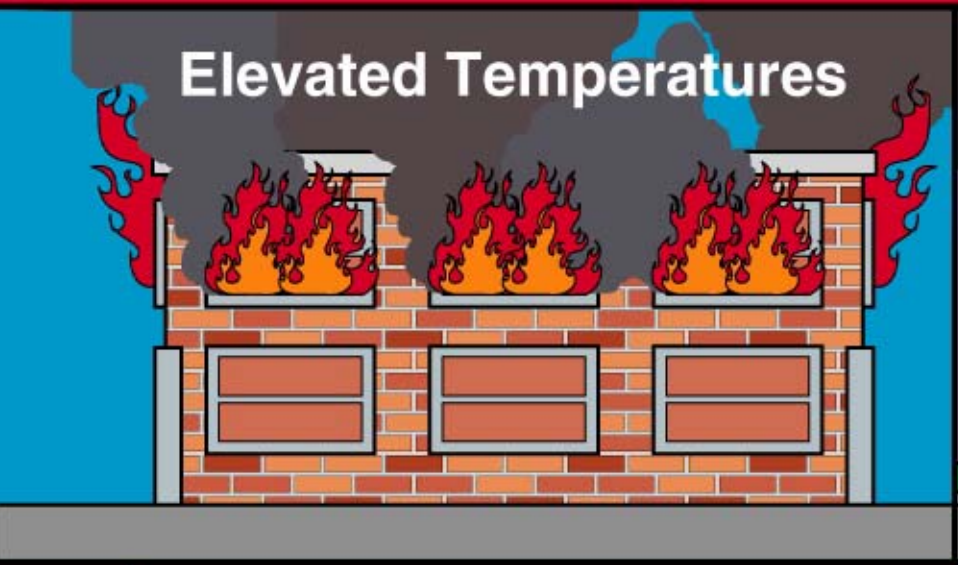
# IDLH



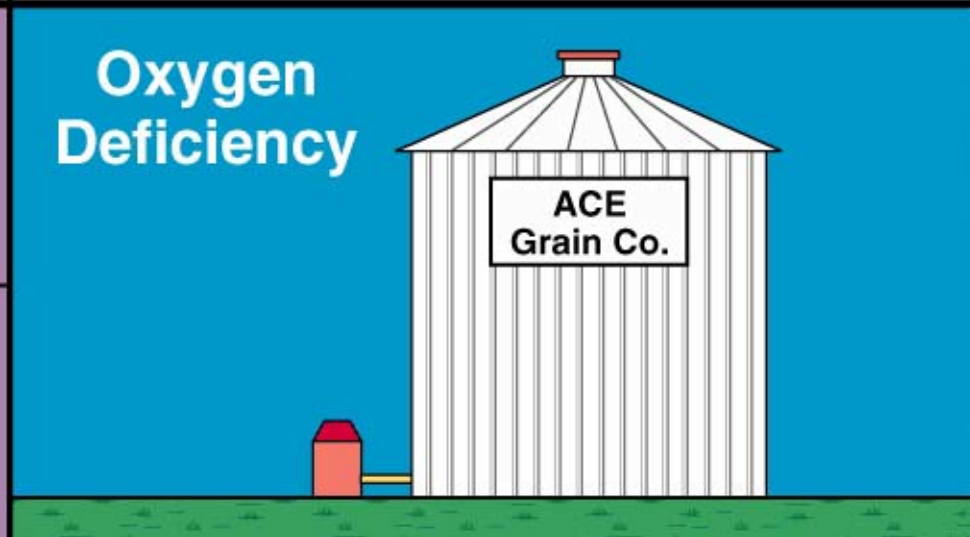
## Immediately Dangerous to Life or Health

A condition "that poses a threat of exposure to contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment."

# THE FOUR HAZARDOUS ATMOSPHERES 4A-2





# Elevated Temperature

- Rapid inhalation of heated air 120 + can cause acute hypotension
- edema in lungs, asphyxiation
- possible pneumonia / death

# Smoke

- Suspended particles of carbon, tar, and dust
- provides location for condensation of gaseous products
- may be simply irritating - possibly fatal
- larger smoke particles filtered by nasal hair and mucous membranes

# Toxic Gases

- direct damage to lungs
- passes into blood stream to impair O2 carrying capacity
- synergistic effect
- severity depends on: nature of combustible, rate of heating, temperature of evolved gases, O2 concentration

# Oxygen Deficiency

- 1st. Noticeable sign is faster breathing
- 17 % muscular impairment
- 12 % dizziness, headache, fatigue
- 9 % unconsciousness
- 6 % death

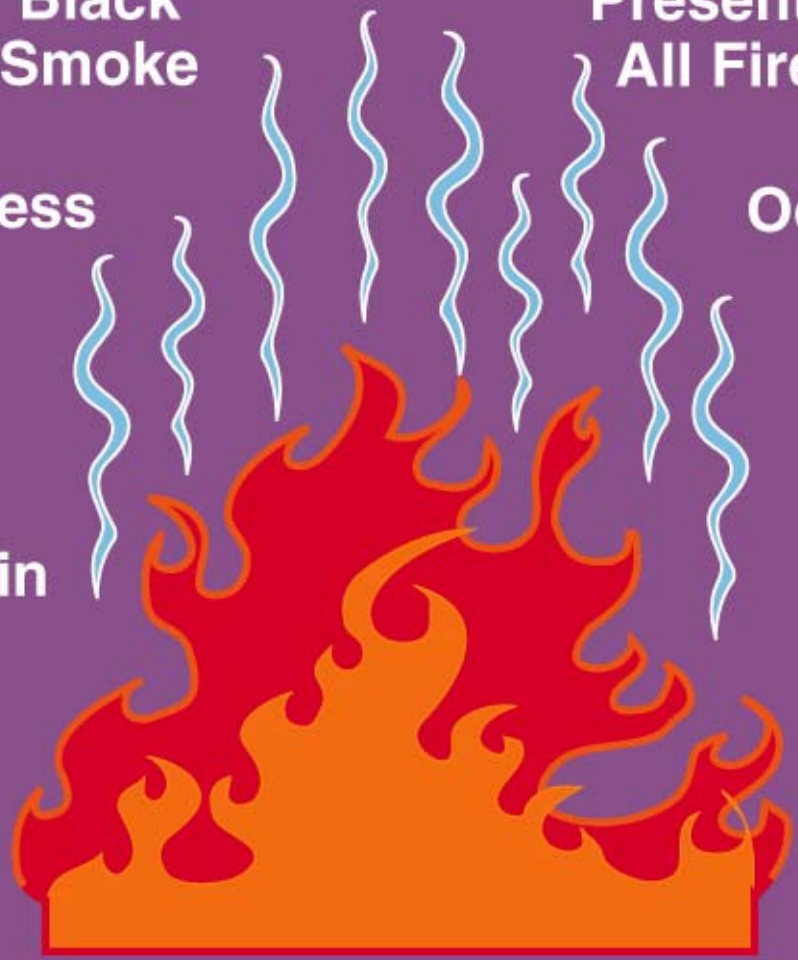
# Gas Toxicity

- Carbon Monoxide
- Carbon Dioxide
- Hydrogen Chloride
- Hydrogen Cyanide

- Nitrogen Dioxide
- Phosgene
- Ammonia
- Chlorine

# CARBON MONOXIDE (CO)

4A-4



Black Smoke

Present at All Fires

Colorless

Odorless

IDLH: 1200 ppm

Oxygen Starvation

Cherry-Red Skin

Flammable

# CARBON DIOXIDE ($CO_2$)

4A-7

Colorless Gas

$CO_2$ Extinguishers

Paralysis of Respiratory Center

Odorless Gas

Frostbite

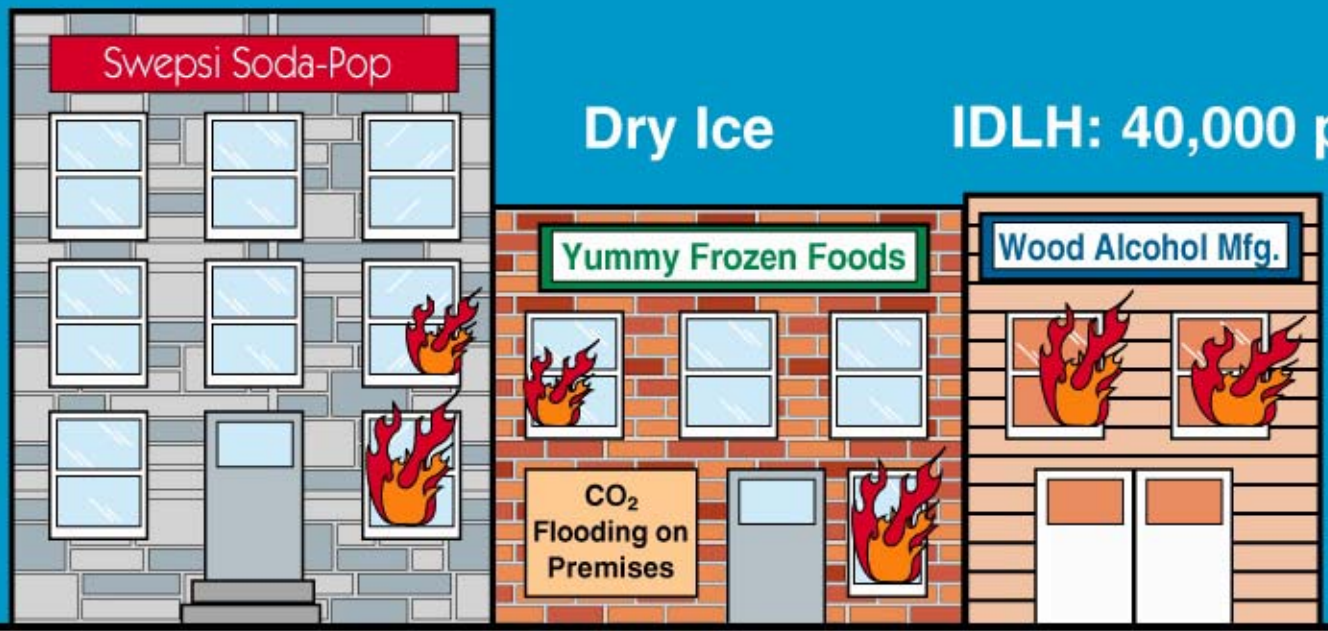
Nonflammable Gas

Product of Combustion

Restlessness

Dry Ice

IDLH: 40,000 ppm



# HYDROGEN CHLORIDE (HCl)

4A-5

Pungent Odor

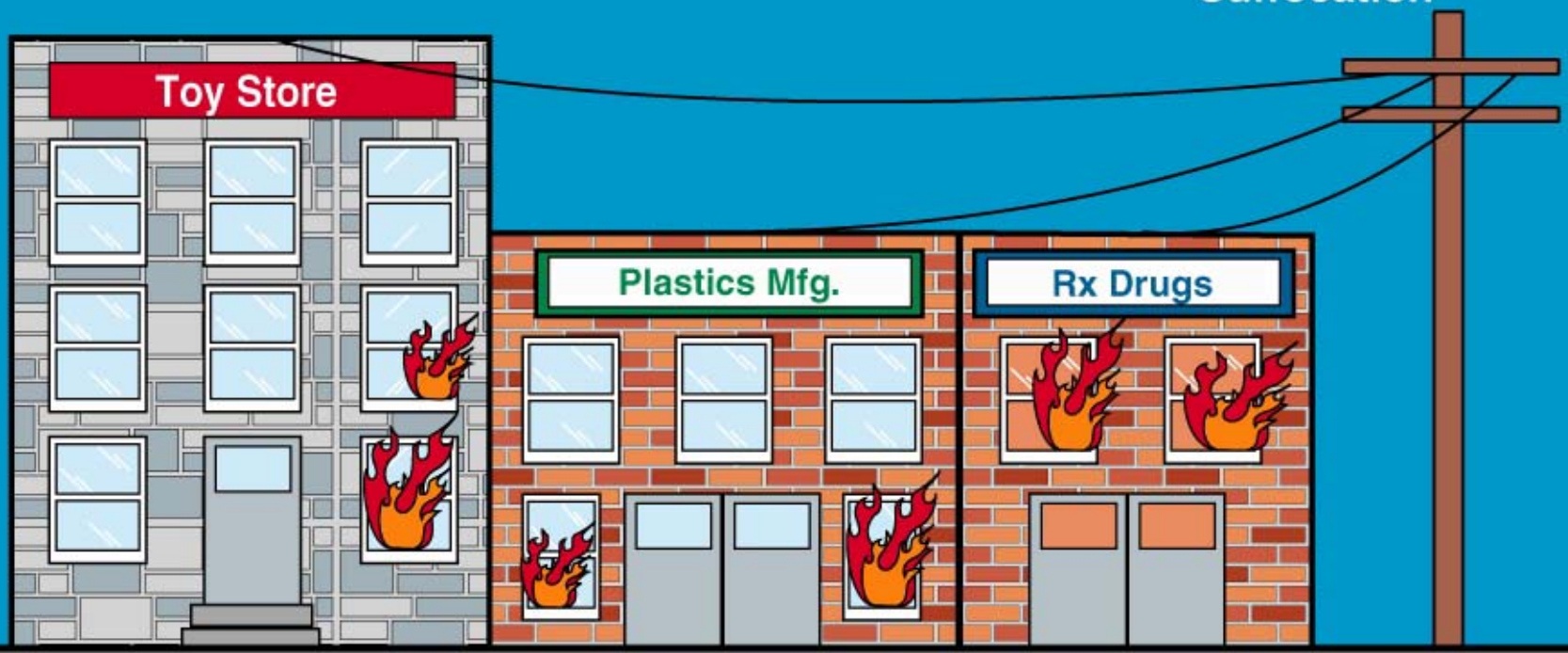
Colorless to Slightly Yellow Gas

PVC Plastics

Telephone & Electrical Cables

IDLH: 50 ppm

Respiratory Tract Swelling: Suffocation



# HYDROGEN CYANIDE (HCN)

4A-6

Colorless or
Pale Blue Gas

Aircraft Cabins

Rubber

IDLH: 50 ppm

Bitter
Almond Odor

Polyurethane

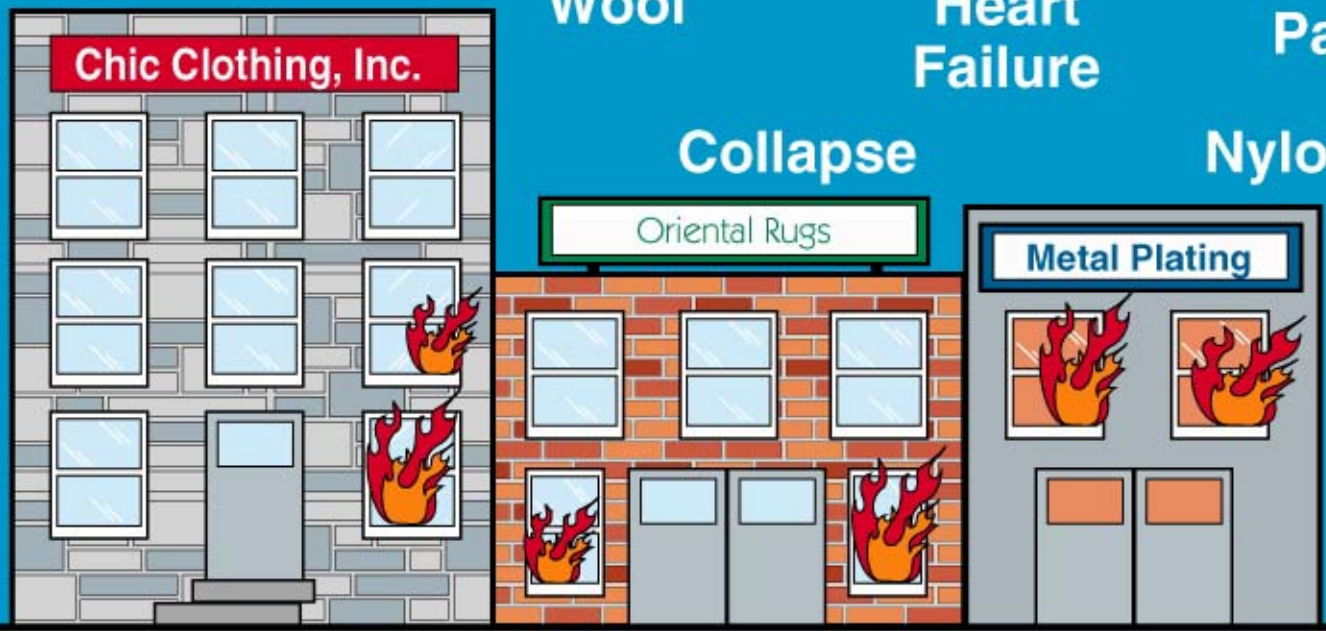
Wool

Heart
Failure

Paper

Collapse

Nylon



# NITROGEN DIOXIDE ($NO_2$)

4A-8

Suffocation

IDLH: 20 ppm

Pyroxylin Plastics

Pulmonary Edema

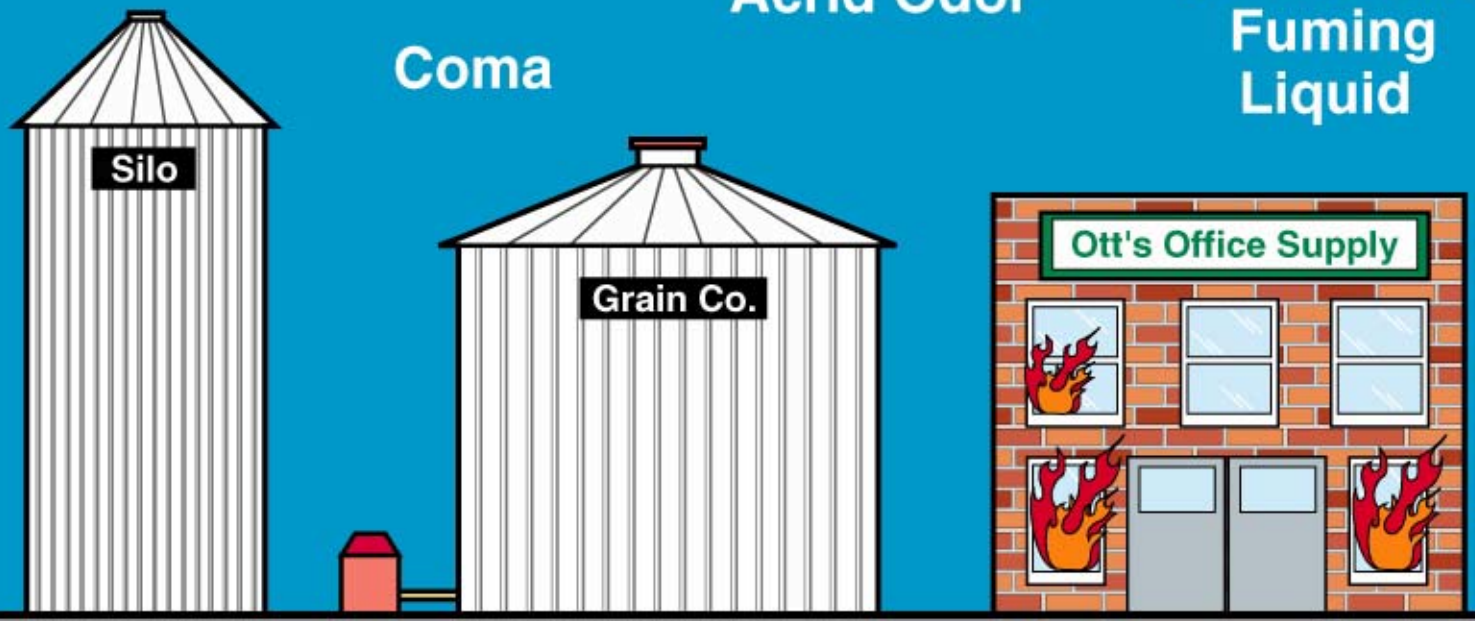
Fermenting Grains

Reddish-Brown Gas

Pungent, Acrid Odor

Dark Brown Fuming Liquid

Coma



# PHOSGENE ($COCl_2$)

4A-9

Colorless Gas

Musty Hay Odor

IDLH: 2 ppm

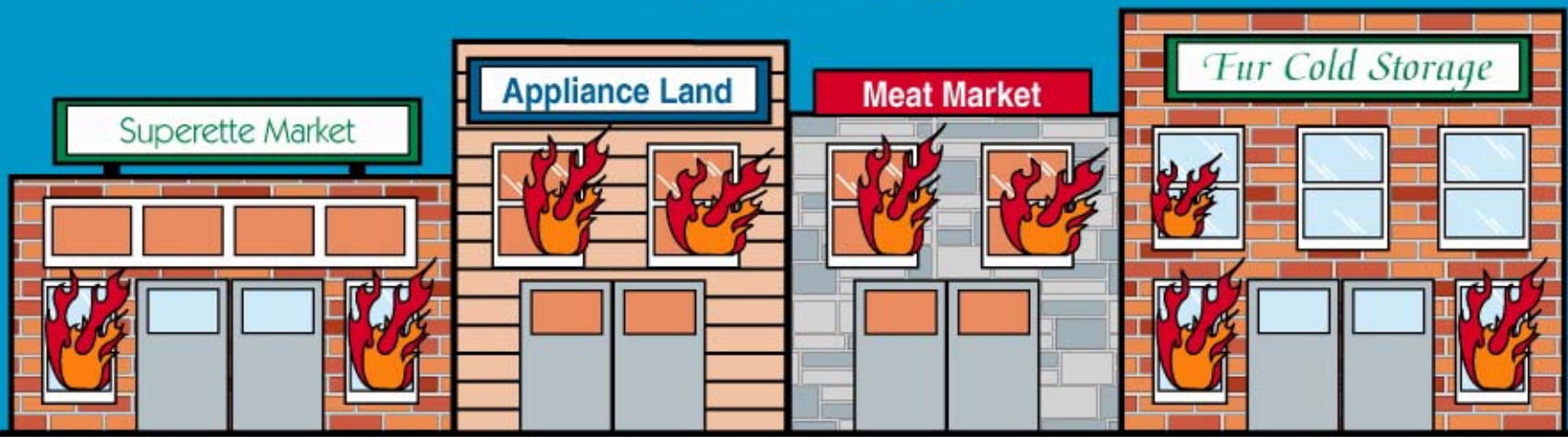
Eye & Skin Irritant

Burning Eyes

Freon

Forms Hydrochloric Acid in Lungs

Refrigerants



# AMMONIA ($NH_3$)

4A-10

Liquid or Colorless Gas

Highly Pungent, Suffocating Odor

Burning Eyes & Throat

Fertilizers

IDLH: 300 ppm

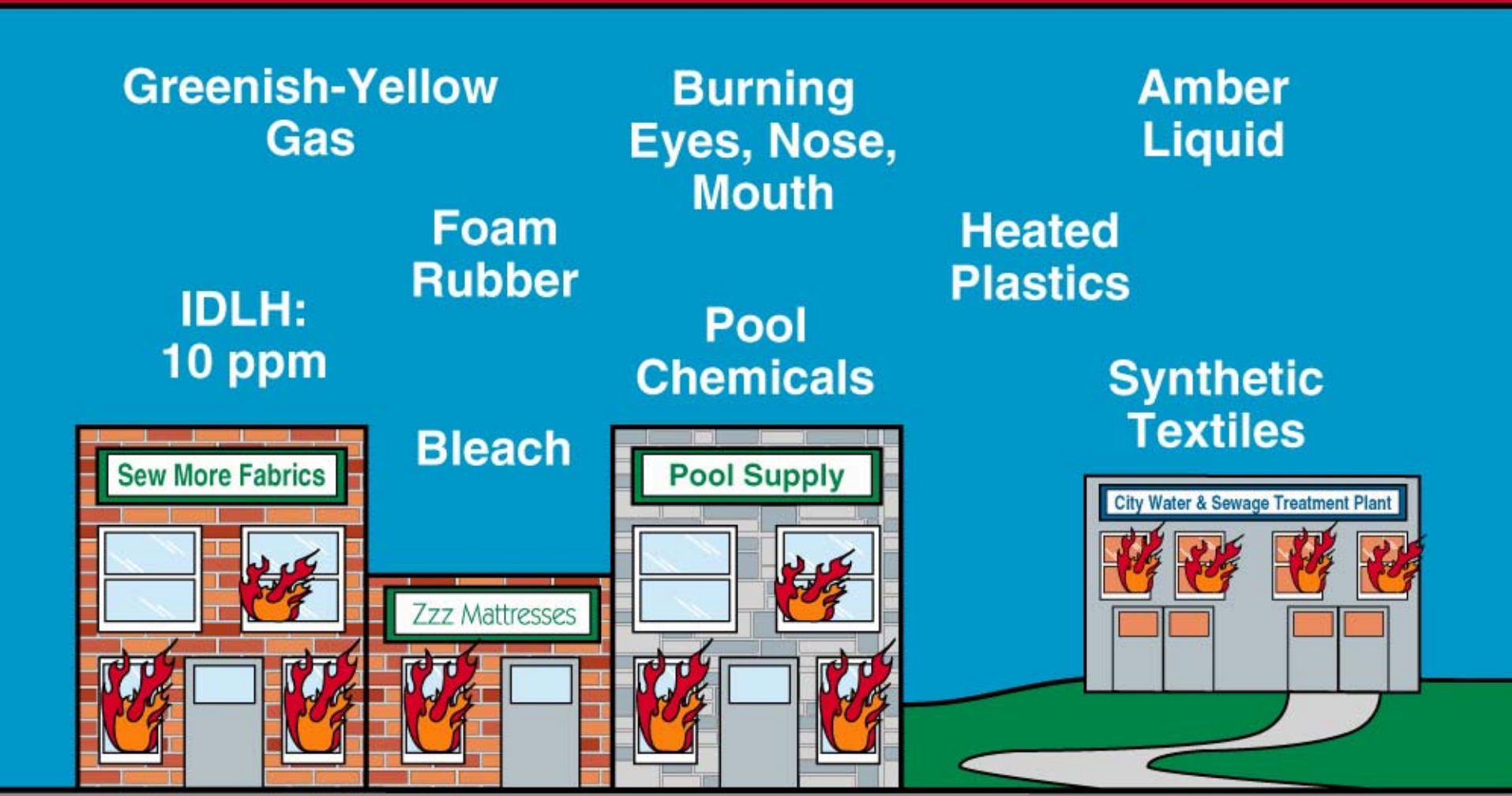
Tearing Eyes

Pulmonary Edema

Refrigerants

# CHLORINE ($CL_2$)

4A-11



# Toxic Atmospheres

| *TOXIC GAS* | *SENSIBILITY* | *IDLH* | *CAUSED BY* | *MISC.* |
|---|---|---|---|---|
| Carbon Dioxide ($CO_2$) | Colorless, Odorless | 40,000 ppm | Free-Burning | End products of complete combustion of carboniferous mat. |
| Carbon Monoxide (CO) | Colorless, Odorless | 1200 ppm | Incomplete Combustion | Cause of most fire related deaths |
| Hydrogen Chloride (HCl) | Colorless to slightly yellowish, pungent odor | 50 ppm | Burning plastics | Irritates eyes and respiratory tract |
| Hydrogen Cyanide (HCN) | Colorless, bitter almond odor | 50 ppm | Burning of wool, nylon, foam rubber | Chemical asphyxiant hampers resp. at the cellular level |
| Nitrogen Dioxide ($NO_2$) | Reddish brown, pungent, acrid odor | 20 ppm | Given off around silos or grain bins | Irritates nose and throat |
| Phosgene ($COCl_2$) | Colorless odor of musty hay, tastless | 2 ppm | Produced when refrigerants such as freon contact flame | Forms Hydrochloric acid in the lungs |

# Types of Breathing Apparatus

- Open -Circuit Self-Contained Breathing Apparatus (SCBA)
- Compressed breathing air is supplied to the user's respiratory system from a cylinder carried on the user's back. Exhaled air is released to the atmosphere.
- SCBA is the most common type of respiratory protection used in the fire service.

# Types of Breathing Apparatus

Open Circuit Self-Contained Breathing Apparatus (SCBA)

SCOTT AVIATION

MSA

DRAEGER

The three brands of SCBA most commonly used in the USA.

# Types of Breathing Apparatus

- Open Circuit Supplied Air Breathing Apparatus (SABA)
- Compressed breathing air is supplied from a remote location using a long air hose, Exhaled air is released to the atmosphere.
- Reserved for special rescue and hazardous materials operations – not used for fire attack.

# Types of Breathing Apparatus

Closed-Circuit Breathing Apparatus (Rebreather)

- A rebreather does not use compressed air. Instead, the user's exhaled air is chemically scrubbed of $CO^2$ and a small amount of $0^2$ is added from a cylinder contained in the unit.
- Rebreather's commonly have long durations of use which are advantageous in extended rescue operations such as mine rescue. Rebreathers are not used for fire attack operations.

# Types of Breathing Apparatus

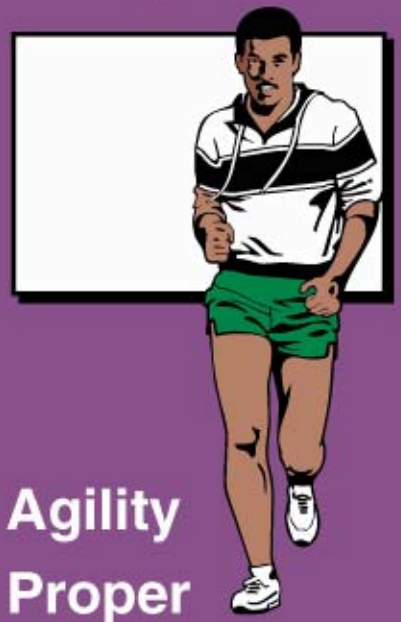
Closed – Circuit Breathing Apparatus

A Bio Marine 240® is one example of a modern, closed-circuit breathing apparatus.
This unit is rated for a 4-hour Use.

# SCBA WEARER REQUIREMENTS

4B-1

## Physical



- Agility
- Proper Conditioning
- Regular Facial Features and Contours

## Medical

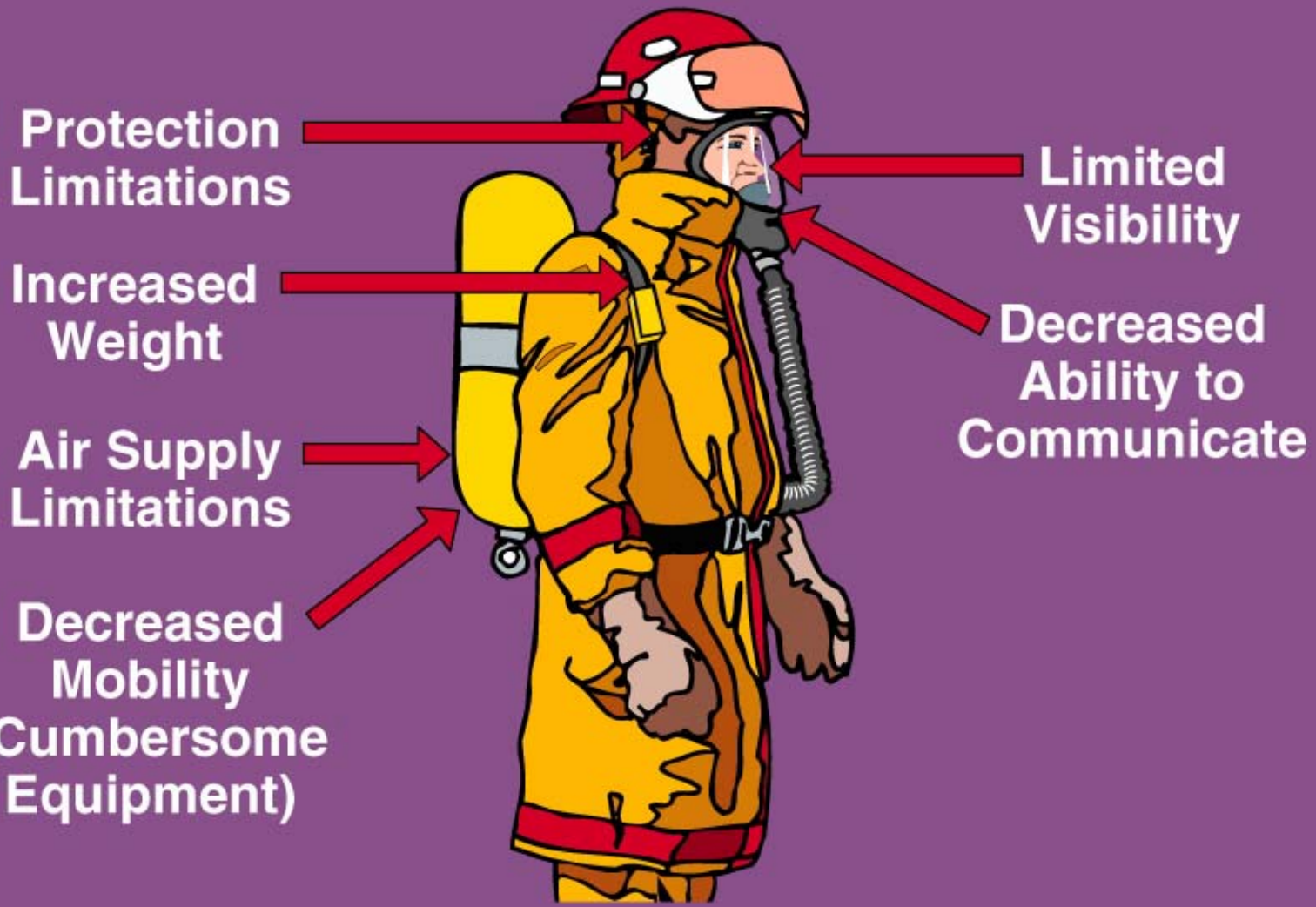
- Neurological Soundness
- Muscular/Skeletal Soundness
- Cardiovascular Soundness
- Respiratory Soundness

## Mental

- Adequate Training in Equipment Use
- Confidence in Self and Equipment
- Emotional Stability
- No Claustrophobia or Other Phobias

# SCBA LIMITATIONS

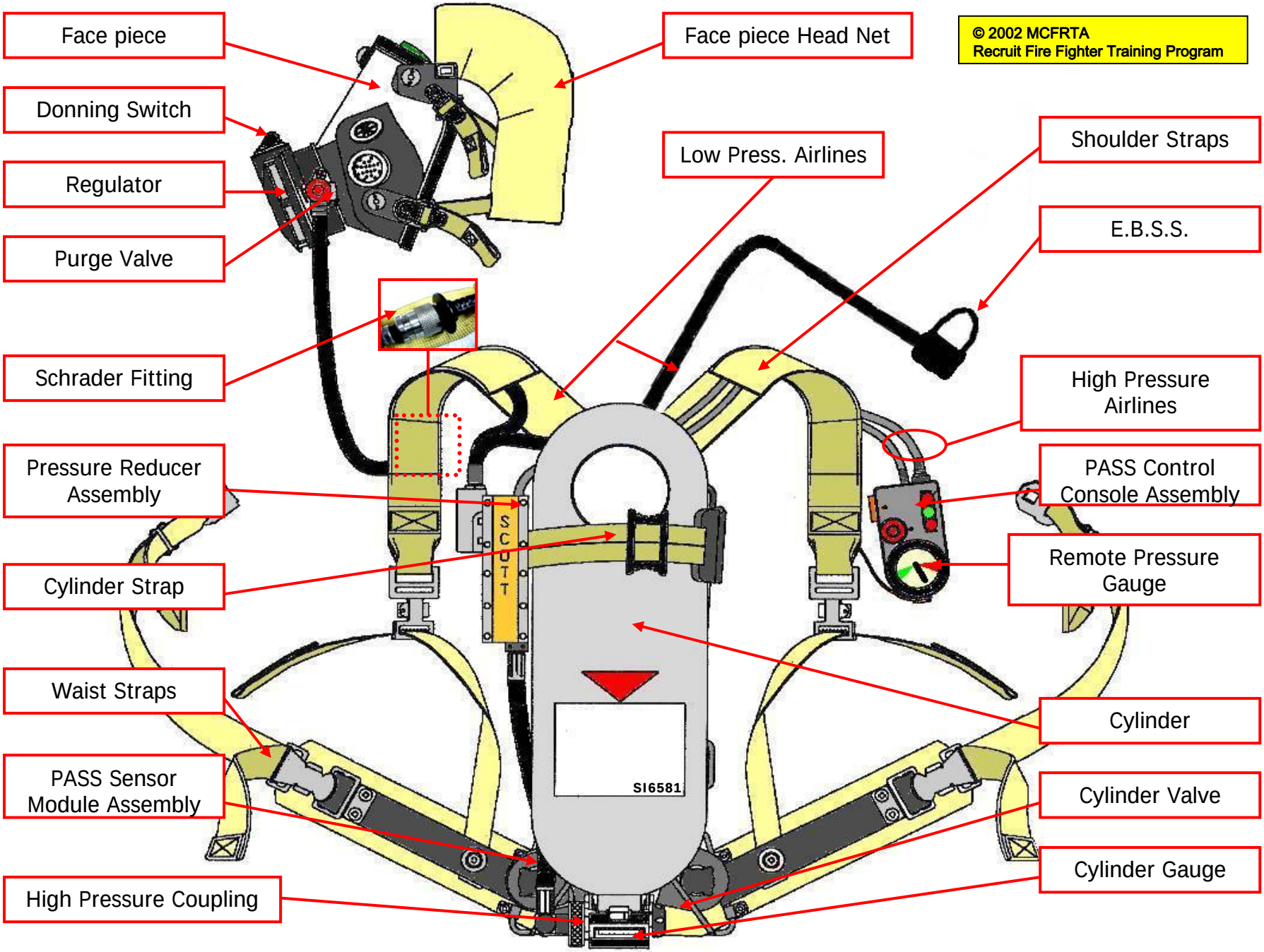
4B-2



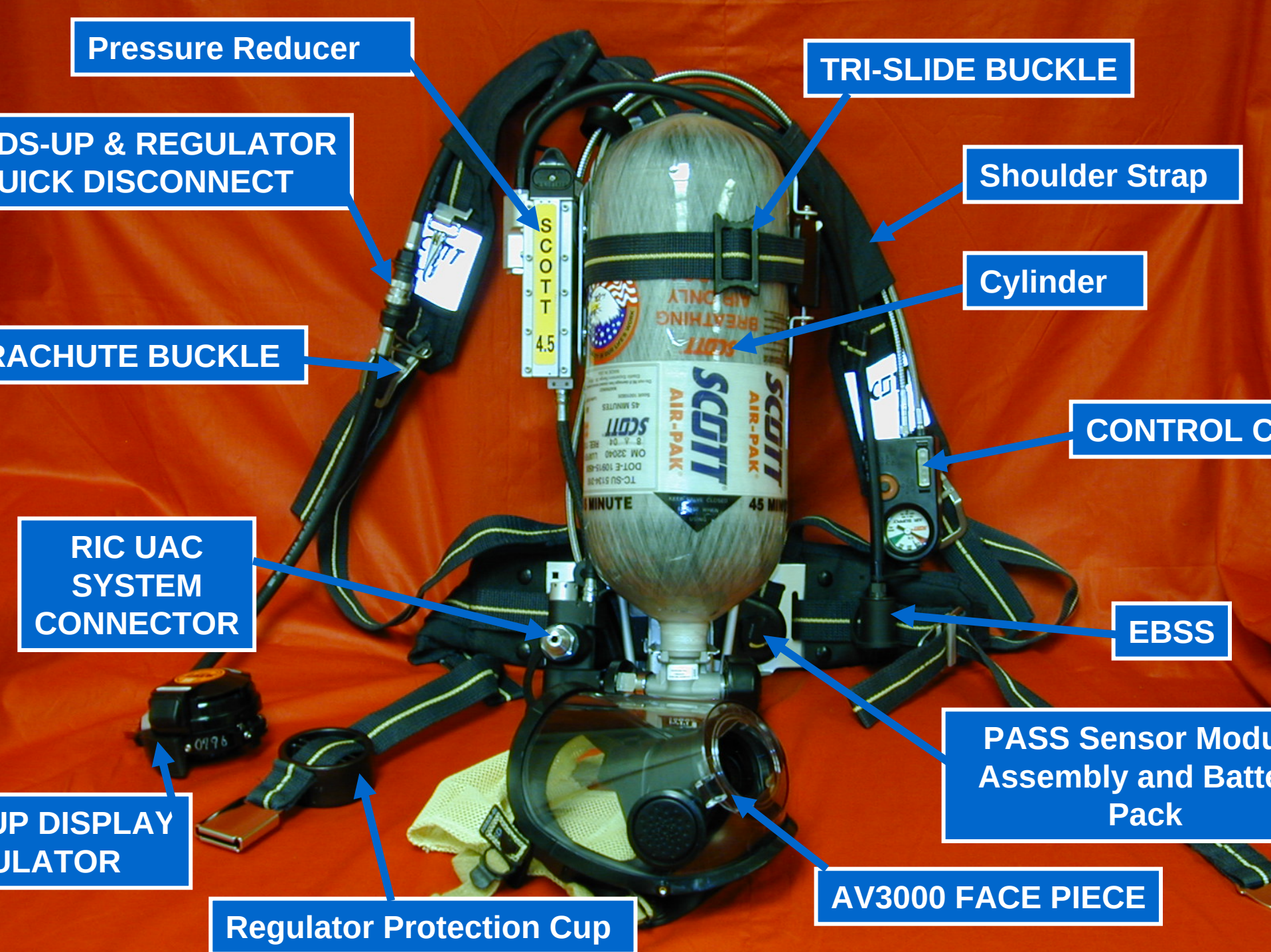
# Montgomery County SCBA

- Bethesda Chevy Chase Rescue Squad - Uses the Cairns SCBA
- All other MCFRS stations use the Scott 4.5 SCBA or the Scott 50 Pak.

# Scott 4.5 SCBA


Face piece
Face piece Head Net
© 2002 MCFRTA
Recruit Fire Fighter Training Program
Donning Switch
Low Press. Airlines
Shoulder Straps
Regulator
E.B.S.S.
Purge Valve
Schrader Fitting
High Pressure Airlines
Pressure Reducer Assembly
PASS Control Console Assembly
Cylinder Strap
Remote Pressure Gauge
Waist Straps
Cylinder
PASS Sensor Module Assembly
Cylinder Valve
Cylinder Gauge
High Pressure Coupling
SCOTT
SI6581


# SCOTT AIR-PACK FIFTY


Pressure Reducer
TRI-SLIDE BUCKLE
DS-UP & REGULATOR
UICK DISCONNECT
Shoulder Strap
Cylinder
RACHUTE BUCKLE
CONTROL C
RIC UAC
SYSTEM
CONNECTOR
EBSS
PASS Sensor Modu
Assembly and Batte
Pack
UP DISPLAY
ULATOR
AV3000 FACE PIECE
Regulator Protection Cup
SCOTT
4.5
SCOTT
AIR-PAK


SCOTT
4.5
SCOTT
AIR-PAK
SCOTT
AIR-PAK
BREATHING AIR ONLY
45 MINUTES
MINUTE
45 MIN

# HARNESS

- Constructed of a lightweight aircraft aluminum alloy, the back frame follows the shape of the user's back.
- The back frame places the bulk of the SCBA's weight on the user's hips, where wrap-around wings provide comfortable hip support.
- Results in a design intended to minimize shoulder fatigue and give the user maximum freedom of movement.

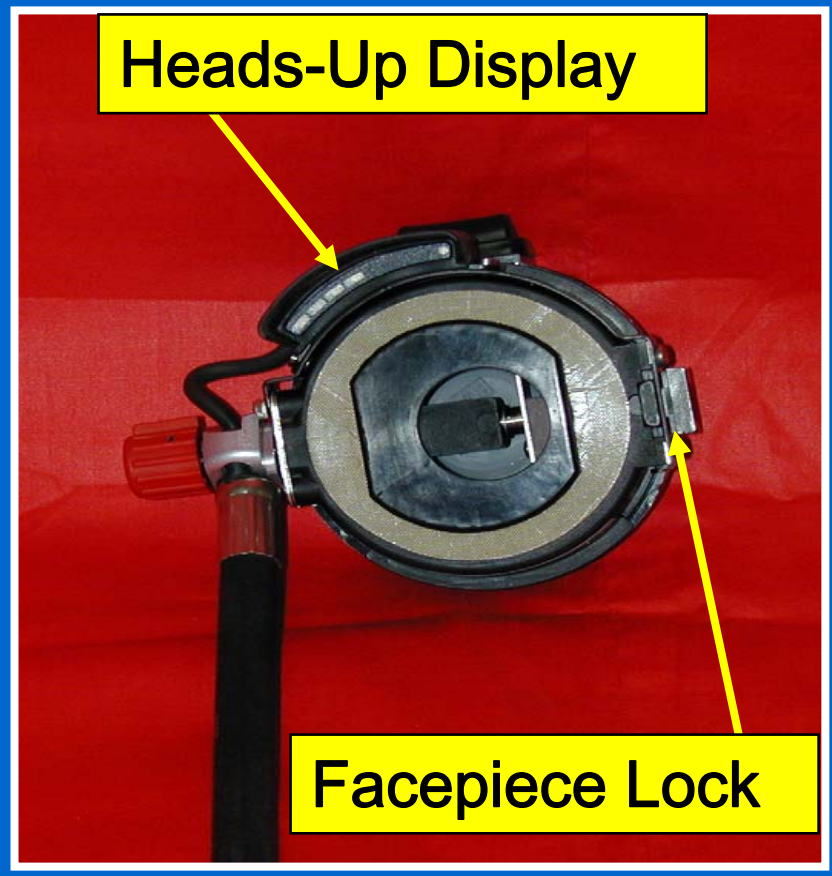
# CONTROL CONSOLE


**Featuring Automatic Activation Of PASS Device**

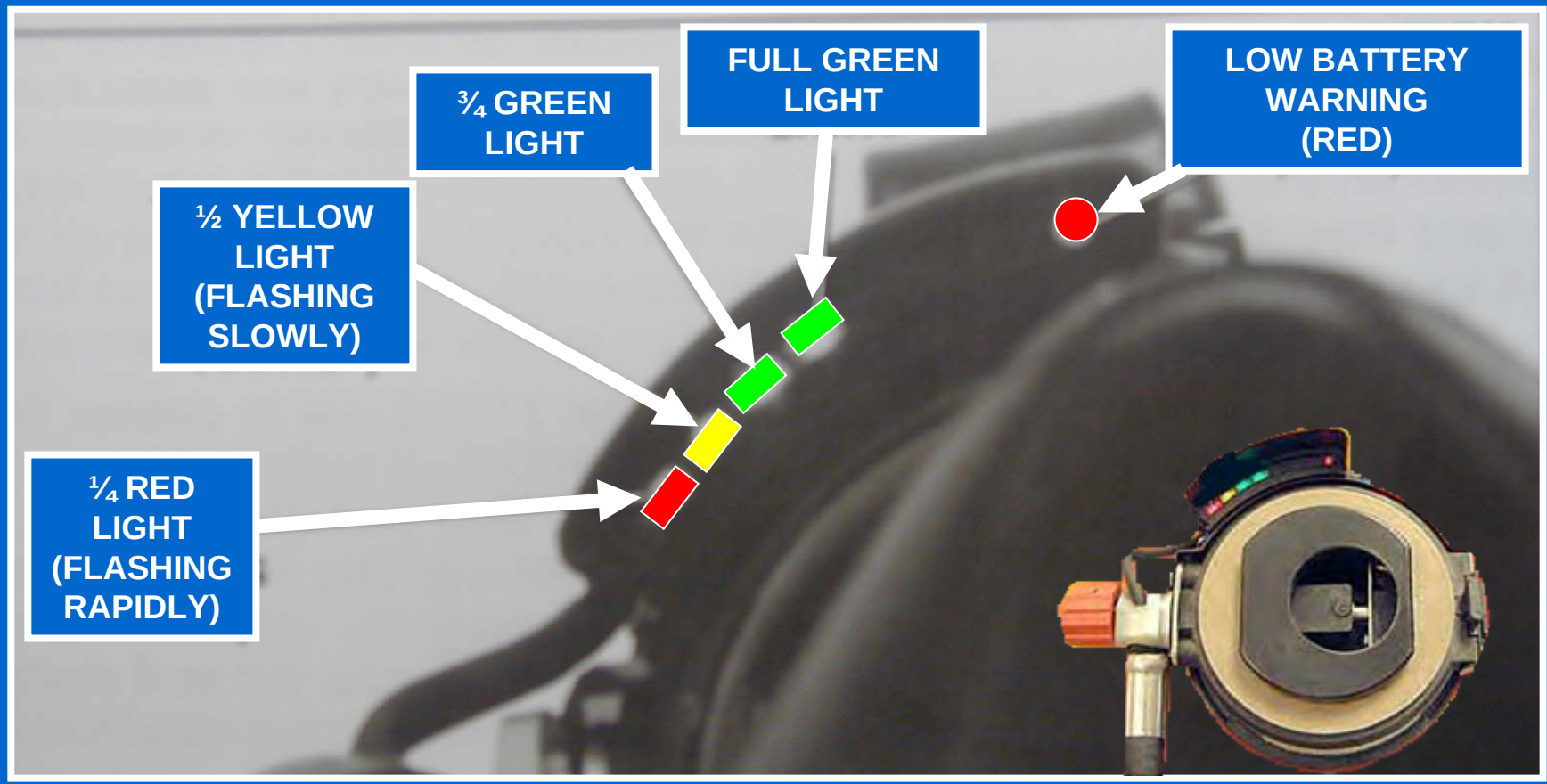
# HEADS-UP REGULATOR QUICK DISCONNECT

**When Reconnecting, Make Sure You Align The HEADS-UP Display Plug With The Mating Connector To Prevent Damage**

# CBRN REGULATOR

# HEADS-UP DISPLAY




2 GREEN LIGHTS = FULL CYLINDER
ONE GREEN LIGHT = 3/4 CYLINDER
ONE FLASHING YELLOW = 1/2 CYLINDER
ONE FLASHING RED = 1/4 CYLINDER

# Scott 4.5 AV2000 Face Piece

Polycarbonate Lens

PBI/Kevlar 4-point Harness

# Scott AV2000® Face Piece

We use three sizes of face pieces:

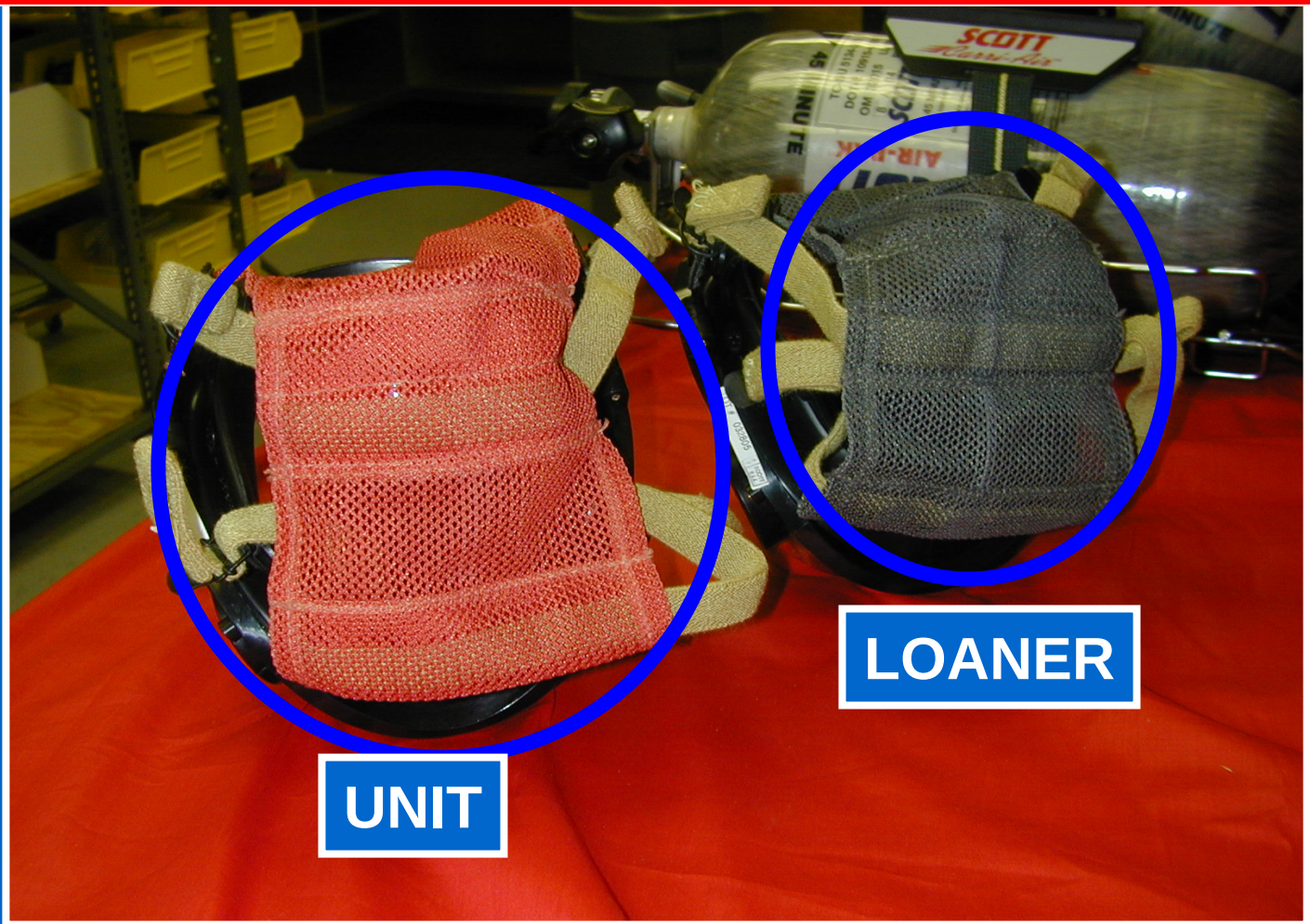
Small has a green rubber seal.

Large has a black rubber seal.

# AV 3000 FACE PIECE

**Sleek Low Profile Improves Downward And Peripheral Vision**
**Six-point Quad Adjustment Head Harness**
**Dual Voicemitters For Clearer Communications**

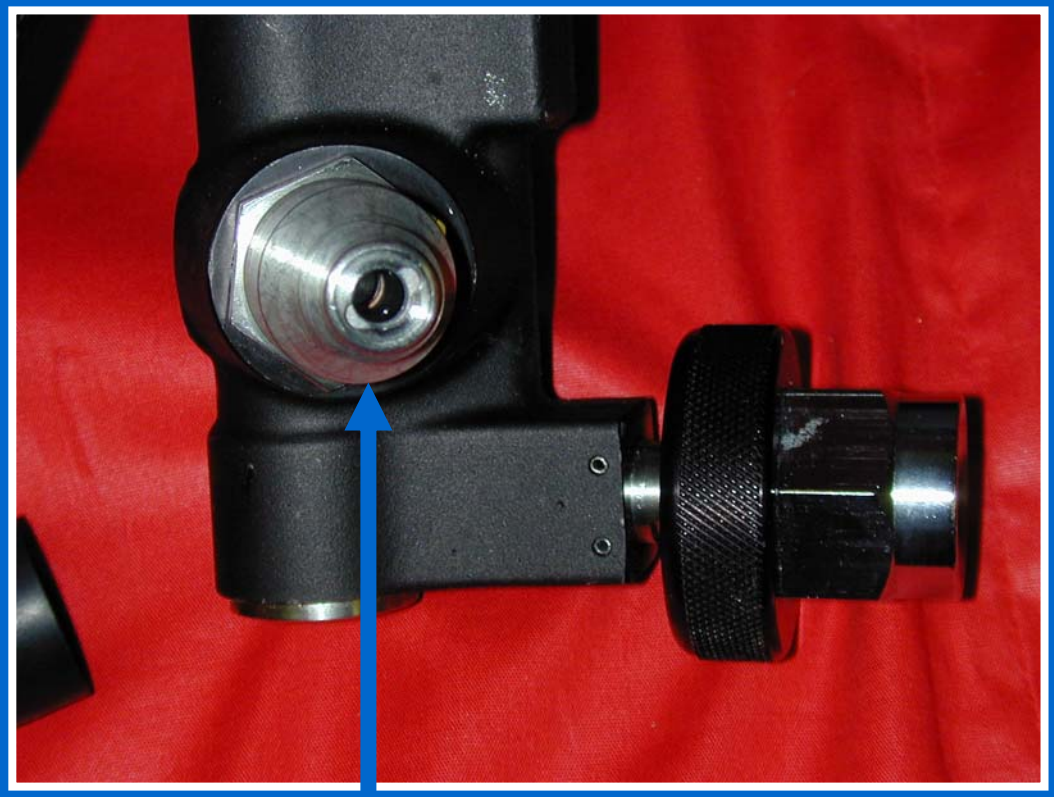
# AV 3000 FACE PIECE




**RED WEBBING INDICATES UNIT FACE PIECE**
**BLUE WEBBING INDICATES LOANER FACE PIECE**

# AV3000 FACEPIECE

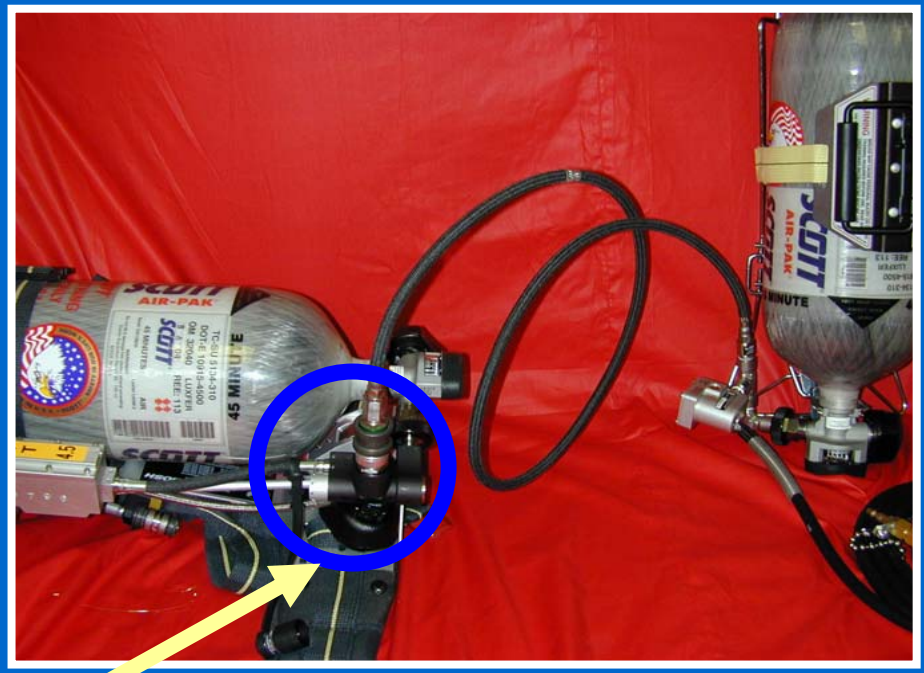
# RIC UAC CONNECTION



**UNIVERAL AIR CONNECTION**

**RIC UAC RELIEF VALVE**

# RIC UAC CONNECTION

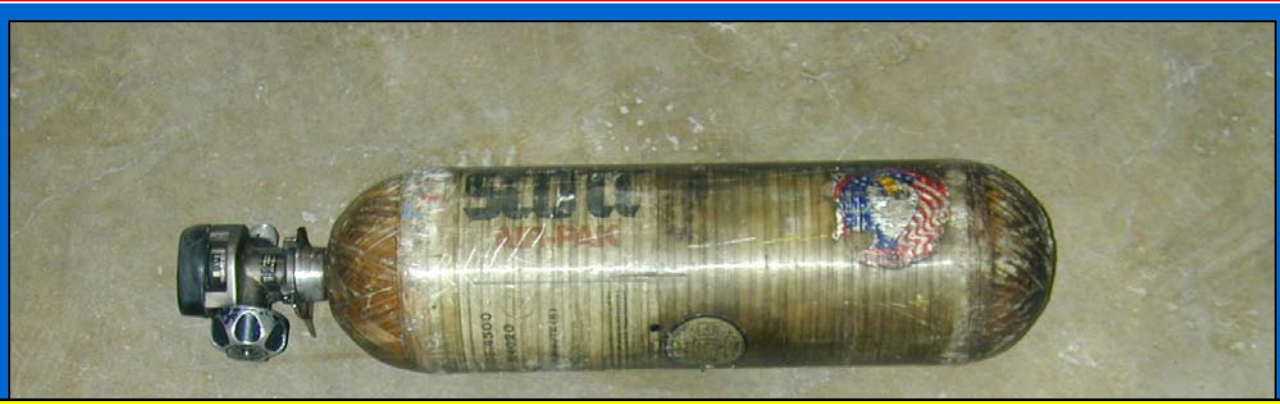



# RIC UAC CONNECTION


AIR-PAK respirators in compliance with NFPA 1981 are fitted with a Rapid Intervention Crew Universal Air Connection System which permits emergency replenishment of an approved SCBA breathing air supply cylinder on a user's respirator from an approved air supply source while in use.

# 45-Minute Cylinder

# SCBA Cylinder



Kevlar Wrapped Aluminum 30-Minute Cylinder

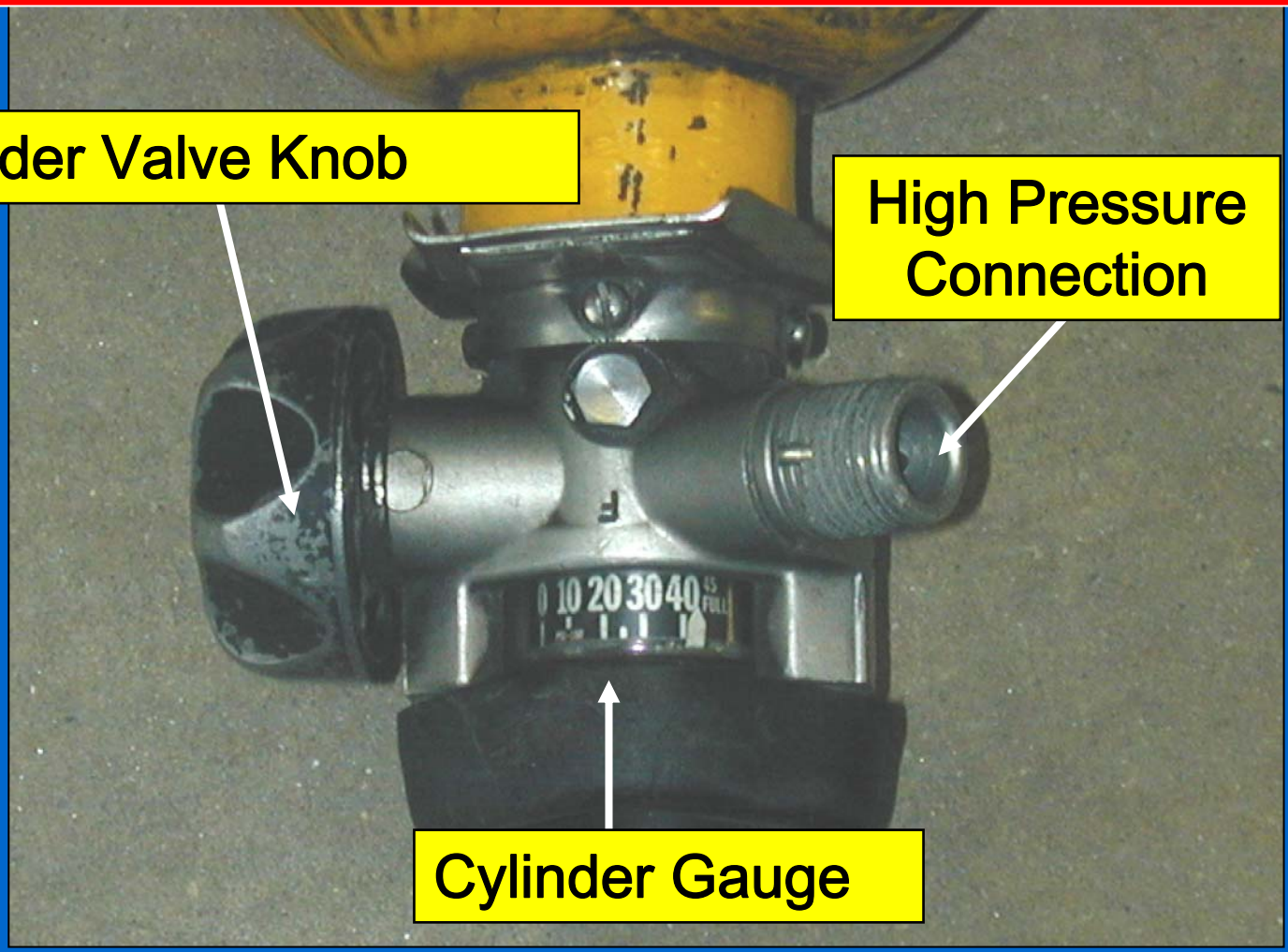
Fiberglass Wrapped Aluminum 30-Minute Cylinder

# SCBA Cylinder


Carbon Fiber/ Kevlar Wrapped Aluminum Cylinder

All MCFRS companies are transitioning to these 45-minute cylinders

# SCBA Cylinder Valve



# SCBA Cylinder Information


Month

Year

Cylinder Pressure

All Cylinders Must Have a Current Hydrostatic Test Label

# Scott SCBA Important Data

- Maximum cylinder pressure is 4500 psi
- SCBA operating pressure is 100 psi
- 30-minute cylinders hold 45 cu ft of air
- 45-minute cylinders hold 66 cu ft of air
- 60-minute cylinders hold 87 cu ft of air
- VibraAlert activates at ¼-cylinder capacity
- Hydrostatic test needed every 3-years on composite cylinders.

# Scott SCBA Important Data

- MOSH NIOSH certified
- Weight 30 min. 21 lbs..
- Weight 45 min. 27 lbs..
- Weight 60 min. 32 lbs..

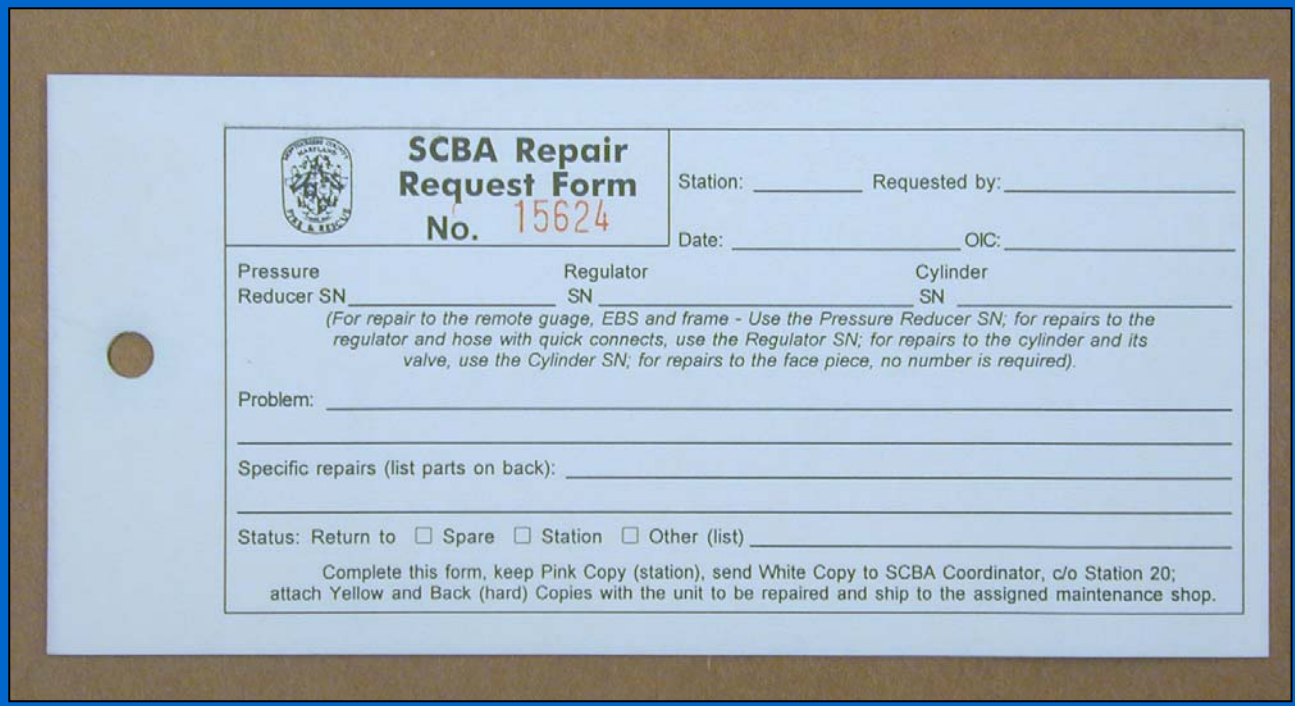
# SCBA Inspection

- Daily Inspection
  - Cylinder is full (>4000psi), VibraAlert® functions, purge valve and donning switch operate properly, face piece is in good condition, PASS device operates properly.
- Monthly Inspection
  - Check all components for deterioration, clean and disinfect the regulator.

# SCBA Maintenance

- Preventive Maintenance & Repair
  - SCBA Repair Shop 240-777-2221
  - SCBA repair technicians are Scott certified and are the **only** personnel authorized to repair MCFRS SCBA.
  - Annual preventive maintenance is performed on all MCFRS
  - SCBA repairs are made on an as needed basis by completing a repair tag and forwarding the item to the repair shop.

# SCBA Repair Request Form



**SCBA Repair Request Form**
**No.** 15624

Station: _____ Requested by: _____

Date: _____ OIC: _____

Pressure Reducer SN _____ Regulator SN _____ Cylinder SN _____

*(For repair to the remote guage, EBS and frame - Use the Pressure Reducer SN; for repairs to the regulator and hose with quick connects, use the Regulator SN; for repairs to the cylinder and its valve, use the Cylinder SN; for repairs to the face piece, no number is required).*

Problem: _____

Specific repairs (list parts on back): _____

Status: Return to ☐ Spare ☐ Station ☐ Other (list) _____

Complete this form, keep Pink Copy (station), send White Copy to SCBA Coordinator, c/o Station 20; attach Yellow and Back (hard) Copies with the unit to be repaired and ship to the assigned maintenance shop.

Must be completed for all SCBA repairs

# SCBA Donning & Doffing

- Donning
  - PPE in-place
  - Check unit
  - Don
- Doffing
  - Face Piece Removal
  - Harness
  - Replace Cylinder

# SCBA Donning




# Donning the Face Piece




# Doffing the SCBA

- When doffing (removing) the SCBA and face piece, simply reverse the donning order.
- Restore the unit to its original condition ensuring that all straps are extended.

# Replacing the Cylinder

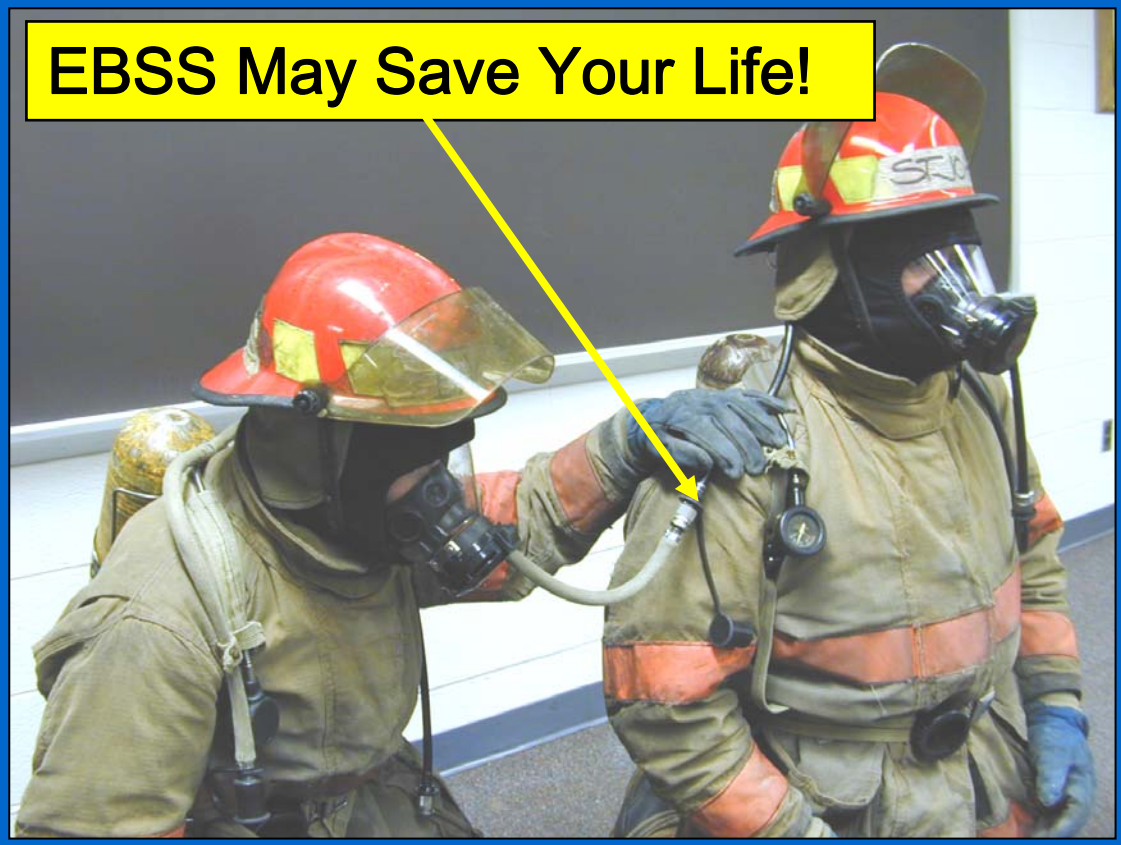



# SCBA Emergency Procedures

- Face Piece Failure
- Breathing Regulator Malfunction
- Pressure Reducer Malfunction
- Air Depletion

You will learn these procedures in the practical sessions.

# Emergency Breathing Support System (EBSS)



# SCBA Cleaning

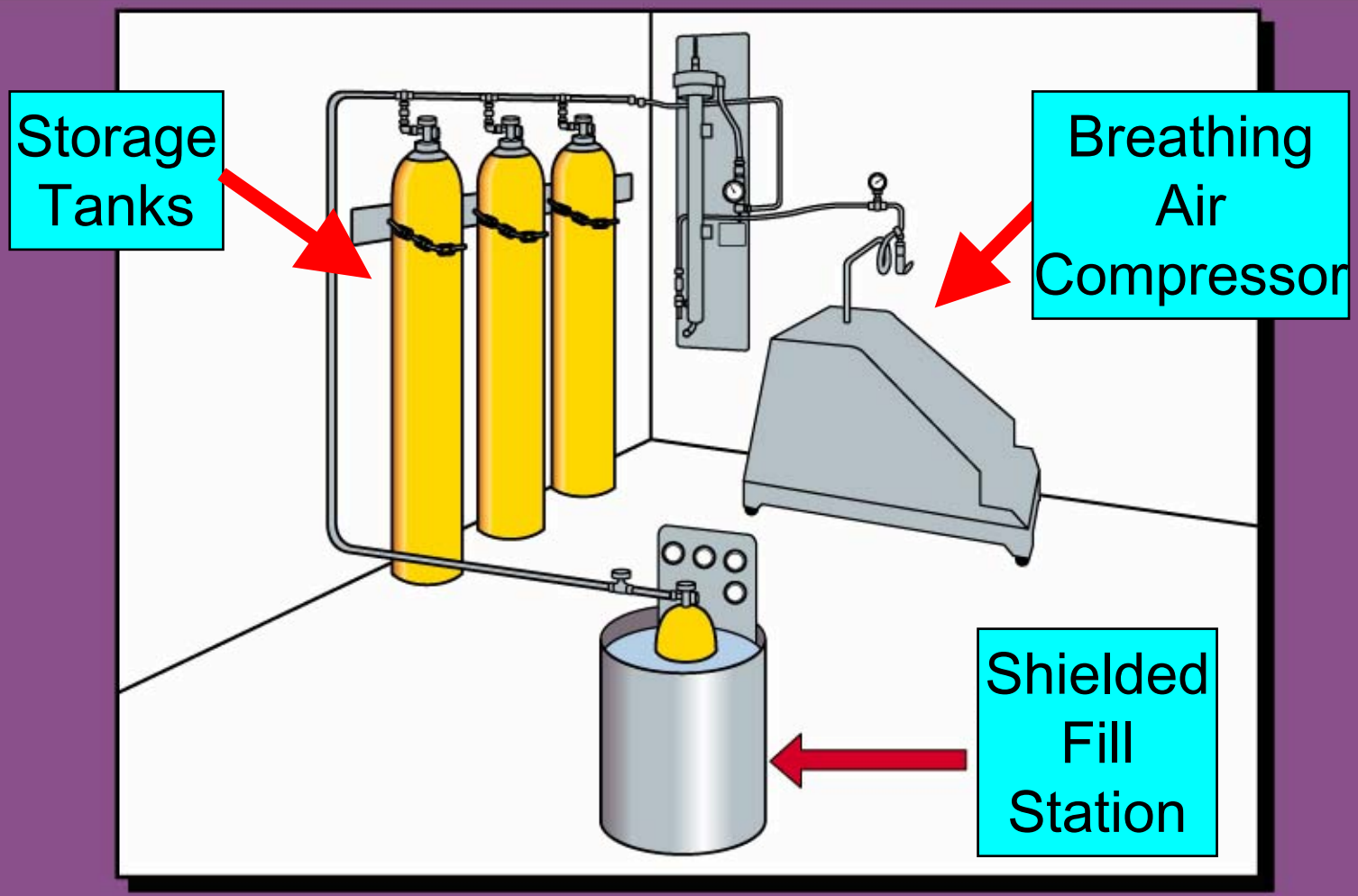
- SCBA unit
  - Mild soap and water using a scrub brush.
  - Do not submerse components in water!
  - Do not submerse an integrated PASS in water!
- Face piece
  - Mild soap and water using a soft cloth.
  - Can use an approved disinfectant if needed.
- Breathing regulator
  - Multi-wash solution
  - 6 sprays, wait 10-minutes,
  - Rinse with spray bottle of clean water

# Refilling SCBA Cylinders

- Cylinders are refilled based upon the principle of air moving from high pressure to low pressure.
- Cylinders are refilled using either a storage bank of larger cylinders (cascade system) or a breathing air compressor system, or a combination of both.
- All safety guidelines must be followed in order to prevent injuries should a cylinder rupture during refilling operations.

# Refilling SCBA Cylinders





# Refilling SCBA Cylinders


A typical fill station

# Refilling SCBA Cylinders


MCFRS operates three, mobile air units capable of refilling SCBA cylinders at the emergency scene.

Air 33 from Station 33, Air 16 from Station 16 and Air 1 from Rescue Co 1

# Review

- Common Hazardous Atmospheres
- Gas Toxicity
- Types of Breathing Apparatus
- SCBA Wearer Requirements
- SCBA Limitations
- Scott 4.5 SCBA
- Inspection & Maintenance
- Donning & Doffing
- Emergency Procedures
- Cleaning & Refilling


*This program was developed by the Montgomery County Fire/Rescue Training Academy*

All of the color drawings for this presentation were developed and:

Published by

**FIRE PROTECTION PUBLICATIONS**

**Oklahoma State University**

**Stillwater, Oklahoma**