SCBA self contained breathing apparatus quiz
Hazardous environments that require respiratory protection (1)

• Oxygen deficiency
  – Combustion process consumes oxygen
  – Production of toxic gases may displace oxygen
  – Oxygen concentration diluted by other gases during combustion process
  – Physiological effects of reduced oxygen (hypoxia)
    • Normal – 21% oxygen in air
    • 17% oxygen in air
      – Some muscular impairment
      – Increase in respiratory rate
    • 12% oxygen in air
      – Dizziness, headache, rapid fatigue
    • 9% oxygen in air
      – Unconsciousness
    • 6% or less oxygen in air
      – Death occurs in minutes from respiratory failure and concurrent heart failure
Hazardous environments that require respiratory protection (2)

- Elevated temperatures
  - Heated air can damage respiratory tract
    - Excessive heat (120-130 degrees)
      - Blood pressure drop
      - Circulatory failure
    - Inhalation of heated gases
      - Pulmonary edema
      - Death from asphyxiation
    - Respiratory tissue is not immediately reversible with the introduction of fresh, cool air

- Smoke
  - Smoke is a suspension of fine particles of tar, carbon and dust
    - Tar
    - Carbon
    - Dust
    - Provides a means for the condensation of some of the gaseous products of combustion such as aldehydes and organic acids
    - Some of these particles are lethal; some are irritating
    - Size of particles determine how deeply they will penetrate into the lung
Hazardous environments that require respiratory protection (3)

- Toxic gases
  - During fires, a firefighter will be exposed to combinations of irritants and toxicants
    - Each fire will present different products of combustion
    - Combinations may have a synergistic effect
  - Harmful effects of inhaled toxic gases
    - Disease of the lung tissue
  - Impair the oxygen carrying capacity of red blood cells
- Type of toxic gases given off are dependent upon:
  - Nature of the combustion
  - Rate of heating
  - Temperature of involved gases
  - Oxygen concentration at time of combustion
List commonly found fire gases (1)

- Carbon monoxide (CO)
  - More fire deaths occur from exposure to carbon monoxide than any other product of combustion
  - Colorless
  - Odorless
  - Present at every fire
  - Results from incomplete combustion
  - Carbon monoxide combines with the blood’s hemoglobin about 200 times more readily than oxygen causing oxygen to be excluded and eventually hypoxia will result.
  - Concentrations of carbon monoxide above five hundredths of one percent (0.05%) (500 PPM) can be dangerous
  - Symptoms include:
    - Headache
    - Dizziness
    - Nausea
    - Vomiting
    - Cherry-red skin coloration
  - Administering pure oxygen is the most important element in first aid care
  - Brain injuries may appear up to three weeks after a severe exposure
List commonly found fire gases (2)

- Hydrogen chloride
  - Colorless gas
  - Pungent odor
  - Causes swelling of upper respiratory tract
    - Labored breathing
    - Suffocation can result
  - Due to the increased use of plastics, PVC is commonly found at fires
    - Polyvinyl chloride
- Hydrogen chloride
  - Overhaul stage is especially dangerous
    - Latent heat can still decompose plastics
    - Electrical cables may continue to decompose after fire is extinguished
- Hydrogen cyanide
  - Interferes with respiration at the cellular and tissue level
  - Classified as a chemical asphyxiate
  - Colorless gas
  - Noticeable almond odor
  - Materials that emit hydrogen cyanide include:
    - Wool, nylon, polyurethane foam, rubber, paper
  - Concentrations above 270 PPM are almost immediately fatal
List commonly found fire gases (3)

- **Carbon dioxide**
  - Non-flammable
  - Colorless
  - Odorless
  - Concentrations of greater than 10%-12% cause death within a few minutes from paralysis of the brain’s respiratory center
  - Use caution when working around a total Carbon Dioxide (CO$_2$) total flooding system

- **Nitrogen oxides**
  - Nitrogen dioxide
  - Nitric oxide

- **Nitrogen dioxide** is a pulmonary irritant
  - Reddish brown in color
  - Commonly called silo gas
  - Released from pyroxylin plastics
  - Causes pulmonary edema
  - Reacts with water and oxygen to form nitric and nitrous acids
  - Causes arterial dilation, blood pressure variations, dizziness and headache
  - Irritating effects can be tolerated while a lethal dose is being inhaled

- **Phosgene**
  - Colorless, tasteless gas
  - Disagreeable odor
  - Produced when Freon comes into contact with flame
  - When in contact with water, it decomposes into hydrochloric acid
PHYSICAL REQUIREMENTS OF SCBA USER

• Physical
  – Sound physical condition
  – Maximize amount of work that can be performed
  – Maximize available air supply

• Agility
  – Must be agile as the unit will restrict wearer’s movements
  – Will affect balance

• Facial features
  – Need good face piece seal
  – Presence of facial hair may not permit a proper seal including as little as a 24-hour growth

• Medical
  – Good motor coordination needed
  – Must have good physical strength and size
  – Good cardiovascular system
  – Healthy respiratory system

• Mental
  • Adequate training in use of equipment
  • Self-confidence
  • Emotional stability
LIMITATIONS OF SCBA

- Limited visibility
- Decreased ability to communicate
- Increased weight
- Decreased mobility
Basic components of open-circuit SCBA

– Backpack and harness assembly
  • Designed to hold the air cylinder on the firefighter’s back
  • Adjustable harness straps provide a secure fit
  • Waist strap is designed to properly distribute weight of cylinder pack

– Air cylinder assembly
  • Many different sizes available
  • Main weight of the breathing apparatus
  • Cylinder pressures and capacities:
    – Low pressure: 2216 PSI, 45 cubic feet of air
      » Rated to be 30-minute cylinder
      » Expected use of time 12 to 18 minutes
    – Low pressure: 3000 PSI, 66 cubic feet of air
      » Rated as a 45-minute cylinder
    – High pressure: 4500 PSI, 45 cubic feet of air
      » Rated as a 30-minute cylinder
    – High pressure: 4500 PSI, 88 or 90 cubic feet of air
      » Rated as a one hour cylinder
Basic components of open-circuit SCBA

- Regulator
  - Regulator reduces the pressure from the cylinder to slightly above atmospheric pressure and controls the flow to meet the needs of the wearer
  - Bypass valve or purge valve is used as an emergency valve should the regulator fail
  - Pressure gauges are sometimes located on the regulator or in close proximity to the facepiece
    - Should read within 100 PSI of the cylinder gauge
  - All units are required to have an audible low pressure/quarter service alarm

- Facepiece assembly
  - Lens
  - Exhalation valve-one way valve
  - Possibly a low pressure hose
  - Adjustable straps or webbing
  - Speaking diaphragm
Inspection procedure of SCBA

• NFPA 1404 and NFPA 1500 require all SCBA to be inspected:
  – After each use
  – Weekly
  – Monthly
  – Annually

• Periodic inspection and care
  – Check the face piece
  – Check the low pressure hose (if applicable)
  – Check the exhalation valve by inhaling slowly with the thumb or palm over the end of the hose connection and then exhaling slowly
  – Connect the low-pressure hose to the regulator and check the performance of the regulator, by inhaling deeply and quickly, checking to make sure that the regulator supplies a full flow
Inspection procedure of SCBA

– Cleaning and sanitizing of SCBA components
  • Immediately after each use

– Daily inspection procedures
  • Check for full cylinder (minimum 90%)
  • Check all gauges for proper operation (should register within 100 psi of each other)
  • Check low-pressure, quarter service alarm for function
  • Check all hose connections (tight, not leaking)
  • Face piece is clean and operational
  • Straps and harness in good condition and is fully extended
  • Operate bypass and mainline valves
    – Bypass must be returned to closed position after testing