Homeland Security
Science and Technology

# TechNote

U.S. Department of Homeland Security
SAVER
System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions. Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercially available equipment and systems, and develops knowledge products that provide relevant equipment information to the emergency responder community.

SAVER Program knowledge products provide information on equipment that falls under the categories listed in the DHS Authorized Equipment List (AEL), focusing primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?" These knowledge products are shared nationally with the responder community, providing a life- and cost-saving asset to DHS, as well as to Federal, state, and local responders.

The SAVER Program is supported by a network of Technical Agents who perform assessment and validation activities.
This TechNote was prepared for the SAVER Program by the National Urban Security Technology Laboratory.

NUSTL

For more information on this and other technologies, contact the SAVER Program by e-mail or visit the SAVER website.

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## Air-Line Supplied Air Respirators

*Supplied air respirators (SARs) are designed to provide long-term respiratory protection. They are used when air-purifying respirators, which filter contaminants from the ambient air, cannot provide adequate protection for a sufficient duration or for the anticipated level of airborne contaminants. SARs must be used when unknown chemicals may be present and in immediately dangerous to life and health (IDLH) environments, such as oxygen-deficient atmospheres. SARs provide clean breathing air from an uncontaminated source. There are two types of SARs that differ in the way air is supplied to the facepiece. In the self-contained breathing apparatus (SCBA), the user carries an air cylinder, and in the air-line SAR, the user is attached to the air source by a long hose. Air-line SARs may limit the user's mobility; SCBAs allow the user to be mobile but have a limited air supply. This TechNote focuses on air-line SARs. Previous TechNotes addressed SCBAs (July 2014, September 2014).*

### Technology and Applications

Air-line SARs are positive-pressure devices that can deliver air to a variety of facepieces. Positive-pressure respirators maintain positive pressure during both inhalation and exhalation and can be operated in either continuous flow or pressure-demand mode. In continuous-flow mode, a steady stream of air is sent to the facepiece at all times, preventing the entry of contaminants even if there is a leak. Because they consume air rapidly, continuous flow respirators must use an air compressor rather than air cylinders as the air source. Pressure-demand respirators use a pressure regulator and an exhalation valve to release air to the user during inhalation. If a leak develops in a pressure-demand respirator, the regulator sends a flow of clean air into the facepiece, preventing the entry of contaminants. Loose-fitting facepieces must always be operated in continuous-flow mode, while tight-fitting facepieces can be operated in either mode.

The facepiece can be a tight fitting full-facepiece or half-mask respirator, or a loose-fitting hood, helmet, or air-fed suit. Tight fitting full- and half-mask facepieces are used in the chemical industry for confined space

**Tight-fitting full-facepiece, loose-fitting hood, helmet, and air-fed suit**
*Photos courtesy of OSHA*

entry, firefighting operations, and when hazardous materials are present. Loose-fitting hoods are often more comfortable and can be used with facial hair. Loose-fitting hoods are usually made of Tyvek® or polypropylene-type materials and can be either disposable or reusable. They are used to protect against splashes of chemicals and dust sprays in the auto, healthcare, pharmaceutical, and manufacturing industries. Helmets provide protection against airborne objects and contaminants and are generally used for grinding, painting, sanding, and blasting applications. Air-fed suits isolate the whole body from the surrounding atmosphere. The suits do not have a breathing apparatus inside the suit; instead, breathing air is connected to the suit via an external air line. They are used to protect workers in chemical and pharmaceutical manufacturing, remediation of hazardous materials sites, against highly infectious biological agents, and for protection of workers from radioactive particles at nuclear facilities.

### *Breathing Air Sources*

Breathing air can be obtained from an air compressor, plant compressed-air supply, or a bank of air cylinders. Any compressed air intake should be located in an area of clean, fresh air and should not be close to vehicle exhaust when at ground level and not near process exhaust stacks when at roof level. Portable ambient-air pumps that deliver filtered low-pressure air can be used in the absence of an air compressor. They are generally limited to air-line lengths between 100 and 150 feet and provide air for a few workers. When a long air line, up to 300 feet, is required, or the air used by the facepiece must be heated or cooled, a high-pressure compressor must be used. High-pressure compressors can be either gasoline fueled or electric. They require moisture traps, dust filters, and hydrocarbon absorbents. If oil-lubricated compressors are used, carbon monoxide or high-temperature alarms, or both, must be used.

### *Fittings*

The types of quick-connect couplers or fittings used for hoses and connection points depend on the respirator manufacturer. OBAC, Hansen, Schrader, and Industrial Exchange fittings are commonly used and come in sizes such as ¼, ⅜, and ½ inch. It is very important for respirator user safety that respirator air-line couplings be incompatible with outlets of other gas systems to prevent inadvertent filling of air-line respirators with nonrespirable gases or oxygen. If inert gases, such as helium, argon, or nitrogen, which are extensively used in industrial applications, are accidentally supplied to a SAR, the results can be fatal. Couplings of nonbreathing air systems must be replaced with a different, incompatible type of coupling.

## IDLH Applications

**Full-facepiece SAR with escape SCBA**
*Photo courtesy of OSHA*

If SARs are used in IDLH conditions, a small emergency escape SCBA must be worn at the waist to protect the wearer in case the air-supply hose becomes severed or crimped or the air-compressor fails. The escape SCBA usually contains less than 15 minutes of air and should never be used to enter an IDLH environment. IDLH conditions can occur in confined spaces such as tanks that contain chemicals or fuel, in sewers, and in enclosed spaces with little or no ventilation. Responding to a terrorist attack or a hazardous materials incident would also be considered an IDLH condition.

## Standards

The Occupational Safety and Health Administration's (OSHA's) respiratory protection standard, 29 CFR 1910.134, covers various types of respirators, including SARs, and includes information on respirator selection for both IDLH and non-IDLH atmospheres, fit testing and seal protection, and respirator training and use. Breathing air quality is also addressed, namely that breathing air shall meet at least the requirements for Grade D breathing air described in American National Standards Institute/Compressed Gas Association Commodity Specification for Air, G-7.1-1989. These requirements address oxygen content and limits on hydrocarbons, carbon dioxide, and carbon monoxide. The Centers for Disease Control and Prevention, National Institute of Occupational Safety and Health also issues standards and recommendations for respirator use and lists approved models.