



National Fire Protection Association

1 Batterymarch Park, Quincy, MA 02169-7471
Phone: 617-770-3000 • Fax: 617-770-0700 • www.nfpa.org

MEMORANDUM

TO: NFPA Technical Correlating Committee on Protective Clothing & Equipment

FROM: David Trebisacci, Staff Liaison

DATE: October 21, 2011

SUBJECT: NFPA 1989 ROP TCC Letter Ballot (F2012 Cycle)

In accordance with the NFPA Regulations Governing Committee Projects, attached is the Letter Ballot on the Report on Proposals (ROP) for the 2013 Edition of NFPA 1989. Also attached is a copy of the Proposals.

Please note the ballot has two parts:

Part 1 is a Letter Ballot on the Technical Correlating Committee Amendments to the ROP (TCC Notes), and not on the Proposals themselves. Reasons must accompany “Negative” and “Abstaining” votes.

Part 2 is an Informational Letter Ballot Authorizing the Release of the ROP.

Negative votes are limited to subjects within the purview of the TCC. Opposition on a strictly technical basis is not sufficient grounds for substantiating a negative vote. If you have correlation issues please identify and describe your concerns in the area of the ballot form for identification of correlation issues.

Please complete and return your ballot as soon as possible but no later than November 2, 2011. As noted on the ballot form, please return the ballot to Yvonne Smith via e-mail to ysmith@nfpa.org or via fax to 617-984-7056. You may also mail your ballot to the attention of Yvonne Smith at NFPA, 1 Batterymarch Park, Quincy, MA 02169.

The return of ballots is required by the Regulations Governing Committee Projects. As usual, nonvoting members (for example, the nonvoting technical committee chairs) need not return ballots.

Attachments: Ballot Form
NFPA1989 Proposals

1989-1 Log #CP1 FAE-RPE
(Entire Document)

Final Action: Accept

Submitter: Technical Committee on Respiratory Protection Equipment,

Recommendation: Review entire document to: 1) Update any extracted material by preparing separate proposals to do so, and 2) review and update references to other organizations documents, by preparing proposal(s) as required.

Substantiation: To conform to the NFPA Regulations Governing Committee Projects.

Committee Meeting Action: Accept

Committee Statement: The technical committee reviewed the entire document to update any extracted material, and reviewed and update references to other organizations documents. Separate proposals were prepared as required.

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

Comment on Affirmative:

AHLERS, H.: There is a pagination problem with 1989 14 log 7. The committee comment on the first page of log 7 is incomplete and then is followed by the rest of the text of log 7 before the conclusion of the comment appears.

I consider this an editorial comment, not an exception

1989-2 Log #CP5 FAE-RPE
(1.3.2 (New))

Final Action: Accept

TCC Action: The TCC directs the TC to consider the following revised text in the comments stage:

1.3.2 Air supplied pipeline systems with or without a compressor or cascade and designed for fire fighter breathing use shall meet the air quality requirements specified in NFPA 1989.

Submitter: Technical Committee on Respiratory Protection Equipment,

Recommendation: Add a new section after existing paragraph 1.3.1 as shown below, and renumber remaining paragraphs in 1.3.

1.3.2 Where fire fighters encounter an air pipeline with or without a compressor or cascade, they shall take whatever action necessary to ensure the air in this system meets the air quality standards outlined in NFPA 1989.

Substantiation: The technical committee is proposing this new text to ensure that the air in other breathing air systems or components of breathing air systems comply with the requirements of NFPA 1989.

Committee Meeting Action: Accept

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-3 Log #CP3 FAE-RPE
(3.3.13)

Final Action: Accept

Submitter: Technical Committee on Respiratory Protection Equipment,

Recommendation: Revise text to read as follows:

3.3.13 Delete "...also known as an airline respirator..." from the first sentence.

Substantiation: Text is redundant, it appears again at the end of the definition.

Committee Meeting Action: Accept

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-4 Log #8 FAE-RPE
(4.2.3)

Final Action: Accept

Submitter: J. Michael Carlson, TRI Air Testing

Recommendation: Revise text to read as follows:

4.2.3 The accreditation body shall ensure that the laboratory has a written program for calibrating all instruments and devices used for measurement, including colorimetric tubes.

Substantiation: Problem: Remove redundant text about colorimetric tubes.

Substantiation: The section already says "...all instruments and devices..." so calling out one specific testing technique is unnecessary.

Committee Meeting Action: Accept

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-5 Log #1 FAE-RPE
(5.1.3)

Final Action: Accept

Submitter: J. Michael Carlson, TRI Air Testing

Recommendation: Revise text to read as follows:

5.1.3 The accredited testing laboratory shall test the samples for breathing air quality levels as specified in Section ~~5.3~~ 5.6.

Substantiation: Problem: Wrong paragraph referenced.

Substantiation: Air quality is discussed in section 5.6. Section 5.3 is about synthetic air.

Committee Meeting Action: Accept

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-6 Log #2 FAE-RPE
(5.2.2)

Final Action: Accept

Submitter: J. Michael Carlson, TRI Air Testing

Recommendation: Revise text to read as follows:

5.2.2 The accredited testing laboratory shall test the samples for breathing air quality levels as specified in Section ~~5.3~~ 5.6.

Substantiation: Problem: Wrong paragraph referenced.

Substantiation: Air quality is discussed in section 5.6. Section 5.3 is about synthetic air.

Committee Meeting Action: Accept

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-7 Log #3 FAE-RPE
(5.4.2.2)

Final Action: Accept in Part

Submitter: J. Michael Carlson, TRI Air Testing

Recommendation: Add new text to read as follows:

5.4.2.2 All air storage cylinders and receivers must be purged of any stored contaminated air, filled with air from a compressor system with air meeting this standard and tested to the requirements of Section 5.6 prior to being placed back into service.

Substantiation: Problem: Currently there is no mention in any sections of this document specifically requiring the purge, fill and testing of storage cylinders and receivers that have contaminated air.

Substantiation: Adding above text sets a minimum level of storage system maintenance and testing.

Committee Meeting Action: **Accept in Part**

Add new text to read as follows:

5.4.2.1 All air storage cylinders and receivers must be purged of any stored contaminated air, filled with air from a compressor system with air meeting this standard and tested to the requirements of Section 5.6 prior to being placed back into service.

Committee Statement: The technical committee accepted the proposal in part, and added the proposal as a new section 5.4.2.1.

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-8 Log #4 FAE-RPE
(5.5.1 and A.5.5.1)

Final Action: Accept

Submitter: J. Michael Carlson, TRI Air Testing

Recommendation: Revise text to read as follows:

~~5.5.1 Quarterly Breathing air samples required for Section 5.1 Regular Periodic Testing shall be obtained directly at the point of air transfer from the breathing air system. The point of air transfer shall be any connection where breathing air cylinders or receivers are routinely filled: downstream from purification components and prior to or bypassing any storage cylinders or receivers.~~

~~A.5.5.1 The purpose of the air samples take before and after changing the filter is to verify that the compressor is producing compressed breathing that meets this standard. The purpose is not to test the quality of air stored in cascade cylinders or receivers, or to test the air at the point of transfer to SCBAs. Therefore, these samples need to be obtained from a point downstream of the air purification system (but as close to it as possible), and upstream of any air cascade storage cylinders or receivers. The purpose of the air samples taken during periodic quarterly testing is to ensure the compressor is producing compressed breathing air that meets this standard. The cascade systems or receivers that are being filled by the compressor system being tested do not need to be tested during every quarterly periodic testing cycle as long as there are required documented tests showing that the air in the cascade system meets this standard at some point and the compressor system filling the cascade or receivers has continuously met the standards required by sections 5.1 and 5.2. The quarterly samples test the compressed breathing air that is transferred to the SCBA. Therefore, these samples need to be obtained at the point of transfer to the SCBA breathing air cylinders downstream of the cascade storage cylinders or receivers.~~

~~A.5.5.2 The purpose of the air samples taken before and after changing the filter is to verify that the compressor is producing compressed breathing that meets this standard. The purpose is not to test the quality of air stored in cascade cylinders or receivers, or to test the air at the point of transfer to SCBAs. Therefore, these samples need to be obtained from a point downstream of the air purification system (but as close to it as possible), and upstream of any air cascade storage cylinders or receivers. Any time a compressor system fails to meet this standard all cascade systems and receivers supplied by the compressor must be purged, refilled with air from the compressor that has passed this specification and tested to the requirements of this standard before being placed back into service.~~

Substantiation: Problem: As currently written paragraph 5.5.1 periodic quarterly testing may not find all compressors that fail this standard since air is tested at air transfer points not necessarily as produced by the compressor. The air being produced by a failed compressor would mix with residual air in the cascade or receiver and therefore could pass this standard. Also, some components such as oil mist and particulate matter could be captured within the cascade system. Eventually the contamination could become such a load that it makes it out of the air transfer point, but by then the whole system is contaminated.

Substantiation: Performing the air sampling on the compressor system prior to where the air enters a cascade or receiver would find problems at an earlier stage and therefore bring an increased level of safety to users.

Committee Meeting Action: Accept

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-9 Log #5 FAE-RPE
(5.5.2)

Final Action: Accept

Submitter: J. Michael Carlson, TRI Air Testing

Recommendation: Revise text to read as follows:

5.5.2 .When changing the breathing air system's purification components, two air samples shall be taken as required by Section 5.2 Special Testing and Procedures for Maintenance Conditions.

Substantiation: Problem: As currently written it is too easy for users to not understand where to apply the information in section 5.5.2 and its subparagraphs.

Substantiation: Specific reference to the applicable paragraph numbers makes section 5.5.2 clearer to the user.

Committee Meeting Action: Accept

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-10 Log #CP6 FAE-RPE
(5.7 (New))

Final Action: Accept

Submitter: Technical Committee on Respiratory Protection Equipment,

Recommendation: Add a new Section 5.7 and paragraph A.5.7 as follows:

5.7 Posting Requirements.

5.7.1 The accredited testing laboratory shall provide quality assurance signage for all cylinder recharge areas utilized by the AHJ.

5.7.2 All worded portions of the sign shall be at least in English.

5.7.1.1 The quality assurance sign shall bear the following compliance statement legibly printed, and all letters and numbers shall be at least 25 mm (1 in.) in height:

"THIS BREATHING AIR HAS BEEN TESTED TO THE REQUIREMENTS OF NFPA 1989 (2013)"

5.7.3* The sign shall have an expiration date 90 days from date of air quality testing for compressed air systems, and 365 days from the date of purge and refill for storage cylinders independent of a compressed air system, and all letters and numbers shall be at least 6 mm (1/4 in.) in height.

5.7.4 The AHJ shall post the quality assurance signage in a conspicuous location within 6 feet of the compressor and/or any storage cylinders used to recharge emergency services SCBA or as a supplied air source.

A.5.7.3 Stored compressed breathing air should be replaced at least annually.

Substantiation: The technical committee believes that this proposal facilitates quality assurance for end users and alerts them to the condition or status of the breathing air system.

Committee Meeting Action: Accept

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-11 Log #CP4 FAE-RPE
(7.1.6 and 7.1.6.1 (New))

Final Action: Accept

Submitter: Technical Committee on Respiratory Protection Equipment,

Recommendation: Add a new paragraph 7.1.6 as follows:

7.1.6 A breathing air system that uses a flexible line to supply air to an SCBA cylinder outside of containment or to a storage cylinder/cascade system shall have an indicating dessicant dryer installed at the discharge end of that line.

7.1.6.1 The required quarterly air sample (5.1.1) shall not be taken downstream of this extra dryer.

Substantiation: Flexible lines use metal mesh or woven fiber to provide the strength to withstand the high pressure and polymeric material to actually contain the air. All polymeric materials will allow water to permeate to some extent. When air is passed through this flexible line water vapor will be added to the dry air inside the line possibly putting it over the allowed water content. This extra dryer will remove any such water vapor. The required quarterly test should be taken without the help of this extra dryer. The system itself up stream of the flexible line must be capable of producing air that meets the water requirement.

Committee Meeting Action: Accept

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-12 Log #CP2 FAE-RPE
(7.4)

Final Action: Accept

Submitter: Technical Committee on Respiratory Protection Equipment,

Recommendation: Add a new 7.4.1, and renumber the subsequent paragraphs in the current section:

7.4.1 The organization shall require that all air quality test results include the name of the testing labs' accrediting body and the lab's current designation by that body.

Substantiation: Currently fire departments have no method to verify current accreditation.

Committee Meeting Action: Accept

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-13 Log #6 FAE-RPE
(A.5.5.3)

Final Action: Accept in Principle

Submitter: J. Michael Carlson, TRI Air Testing

Recommendation: Add new text to read as follows:

A5.5.3 Allowing compressed breathing air to flow through the fill hose for 1 minute will purge the line of room air and contaminants. Rubber and other polymeric materials will slowly pass water vapor through their structure by the process of permeation. The amount of water vapor that passes through under a given set of conditions is a function of the surface area of the polymeric material involved. This means a longer length of hose will admit more water vapor into the air stream than a shorter length of hose and could result in moisture levels above the requirements of this standard. Therefore, one should try to minimize using long lengths of hose (longer than ten feet). If one does need to use longer lengths of hose the hose should be stored with dry air inside and not open to the atmosphere which contains large amounts of water. Dry air in a stored hose should be under slight positive pressure. High pressure is not required and could be dangerous.

Substantiation: Problem: Some compressed air hoses can be very long such as 100 feet. If open to the atmosphere and then used they can contribute moisture to the compressed air moving through the hose. Users need to be aware that long hoses can lead to out of specification air. Users also need a suggested method to minimize the conditions that could create out of specification air.

Substantiation: In our laboratory we have seen compressed air samples from multiple customers that failed moisture tests where the source of the moisture was attributed to the use of long lengths of hose during the air sampling.

Committee Meeting Action: Accept in Principle

See Committee Action on 1989-11 (Log #CP4)

Committee Statement: The technical committee accepted the proposal in principle, and directs the reader to 1989-11 (Log #CP4)

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

1989-14 Log #7 FAE-RPE
(Chapter X (New))

Final Action: Reject

Submitter: Ronny J. Coleman, FireForceone

Recommendation: Add New Chapter to document – proposed title – Firefighter Breathing Air Replenishment Systems Installed in Structures

I envision this chapter consisting of essentially the following language:

Proposed Language for insertion in NFPA Standard 1989:

Insert Include 1989_L7-here

Substantiation: I am requesting that NFPA Standard 1989 Breathing Air Quality for Fire Emergency Services Respiratory Protection add an additional chapter to deal with the development of firefighter breathing air replenishment systems that are being installed within complex structures for the purpose of replenishing firefighter air under emergency conditions.

The standard currently states that its purpose is “to establish minimum quality requirements for breathing air, including the sampling and testing methods for determining air quality.” Furthermore, section 1.2.2 states “the purpose of this standard shall also be to establish criteria for a safe supply of breathing air for fire and emergency service personnel.”

Firefighter breathing air replenishment systems are permanently installed high pressure breathing air systems designed to allow firefighters to replenish their breathing apparatus at the scene of emergencies within close proximity of the incident. These systems are built directly into the structure as a form of “air standpipe” and contain specific breathing air components that have potential impact on firefighter safety.

The NFPA 1500 standards established for SCBA breathing air replenishment within the fire station were naturally transitioned to the Mobile Air Unit in NFPA 1901, bringing the technology for breathing air replenishment closer to the site of an emergency event. This capability has now moved into the next phase by being able to provide SCBA breathing air replenishment within the complex structures themselves via the installation of a firefighter breathing air replenishment system.

A new chapter in 1989 is required to deal with the natural evolution of this relatively new application for breathing air technology. Over 75 firefighting agencies nationwide have already adopted local ordinances and incorporated these systems into a variety of risks. They include: high-rises, subways, tunnels, and mega structures. There are now over 150 known installations in place with a potential for a significant increase in these installations over the next decade. The lack of direct reference within the NFPA process has been identified as a concern. The concern is that without an adequate nationally recognized installation standard, poorly designed breathing air replenishment systems could be installed. This could compromise the safety of firefighters.

Currently there is a document that does describe these systems. That document is the IAPMO - UPC Plumbing Code, 2009 Edition, Appendix F. However, 2009 UPC Plumbing Code is not widely adopted in all of the states in which the fire service is using breathing air replenishment systems to respond to emergencies. As an example, only 14 out of 50 states adopted the UPC code in 2009. The FBARS is currently incorporated as an appendix rather than a chapter, rendering it even less effective. In many areas where local ordinances for firefighter breathing air replenishment systems (FBARS) have been adopted, Appendix F has not been adopted by the Authority Having Jurisdiction. While breathing apparatus and breathing air systems are mentioned in many NFPA Standards, i.e. 1404, 1500, 1981, 1989 and 1901, UPC Appendix F is not cross-referenced to any of the relevant NFPA Standards. There is no correlation or coordination to the NFPA Standards making process. The IAPMO Process does not have the type of firefighter representation that is present in the NFPA Standards making process. It cannot provide the type of reference that is desirable for a technology that is being installed on such a widespread basis. An NFPA document would be more appropriate to contain these requirements.

Increasing interest in this technology is raising the visibility of this need. As recent as the May-June issue of the NFPA's Journal, there was a column by Kathleen H. Almand, writing for The Fire Protection Research Foundation where she states “One of the major tasks of the NFPA's committees and panels is to integrate new technology into our codes and standards.” This proposal is an opportunity to accomplish that integration.

If it would be beneficial, we are prepared to send a representative to the next meeting of the NFPA 1989 Committee on October 6-8th in San Diego to present documentation to support this recommendation.

Committee Meeting Action: Reject

Committee Statement: The technical committee rejected the proposal because it does not believe it is within the

scope of this standard to specify the minimum requirements for the design, fabrication, engineering, installation, testing, and maintenance of a firefighter breathing air replenishment system installed within a high-rise building or other complex structure for use under emergency conditions. However, the air from these systems shall meet the requirements of NFPA 1989 per NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, paragraph 7.10.

Number Eligible to Vote: 31

Ballot Results: Affirmative: 27

Ballot Not Returned: 4 Dower, N., Johnson, J., Kaller, C., Radtke, T.

Definition: Air Support Vehicle (ASV). See Mask Services Unit.

Definition: FBARS. An acronym for Firefighter Breathing Air Replenishment Systems.

Definition: Firefighter Breathing Air Replenishment System. A complete, self-contained breathing air replenishment system permanently installed within a high-rise building or other complex structure providing a means for fire department personnel to safely and reliably refill empty self-contained breathing apparatus cylinders within close proximity to the location of the incident. FBARS are designed to be utilized under emergency conditions by emergency personnel within that building or structure.

Definition: High-Rise Building. A building where the floor of an occupiable story is greater than 75 ft (23 m) above the lowest level of fire department vehicle access. [5000, 2009]

Definition: Mask Services Unit (MSU). A fire service vehicle that has been designed to provide additional air supplies and/or repair or replacement equipment to support the use of emergency services personnel that are wearing self-contained breathing apparatus. The vehicle shall have a portable compressor capable of providing pressures required to sustain a minimum of 32 field units. May also be designated as an air support vehicle (ASV).

Definition: SCBA. An abbreviation for self-contained breathing apparatus. An atmosphere-supplying respirator that supplies a respirable air atmosphere to the user from a breathing air source that is independent of the ambient environment and designed to be carried by the user. [1981, 2007, 3.3.39; 3.3.40]

New Chapter

X.1 General. This chapter describes the minimum requirements for the design, fabrication, engineering, installation, testing, and maintenance of a firefighter breathing air replenishment system installed within a high-rise building or other complex structure for use under emergency conditions. Where a firefighter breathing air replenishment system is installed within a high-rise building or other complex structure the requirements of this chapter shall apply.

X.1.1 Firefighter Breathing Air Replenishment System (FBARS). Firefighter breathing air replenishment systems may be designed to operate with or without the immediate need of a fire department air support vehicle. An FBARS consists of the following elements:

1. A method for utilizing Mask Services Units/Air Support Vehicles to provide breathing air into an air standpipe system;
2. Piping that connects all of the components together into an assembly that meets the needs of air replenishment for emergency crews;
3. A method of connecting firefighter self-contained breathing apparatus worn by emergency crews into a refilling system staged within a structure;
4. Spacing and location of filling stations to reduce travel time to refill locations;
5. Criterion for onsite air supply storage;
6. Criterion for air monitoring and quality control systems;
7. Criterion for breathing air compressors;
8. Commissioning process to ensure quality control;
9. Test and measurements for ongoing air quality control.

X.1.2 Purpose. To strategically place a breathing air replenishment system in high-rise buildings or other complex structures; to allow firefighters to replenish empty breathing air cylinders within close proximity of the incident; to reduce the amount of travel

distance, time and equipment needed for logistical support; and thus maximize firefighter safety and effectiveness.

X.1.3 Provisions. This system shall be considered a “life safety system” designed to provide a safe and reliable source of breathing air replenishment. Pressurized components of the FBARS shall be listed, approved and certified by a nationally recognized testing and research facility. FBARS shall meet the requirements of Chapter 5 Air Quality Requirements, Chapter 6 Test Methods, and Chapter 7 Compressed Breathing Air Systems; NFPA 70, *National Electrical Code*; NFPA 72 *National Fire Alarm and Signal Code, 2010 Edition*, Chapter 14 and 26; NFPA 1500 *Standard on Fire Department Occupational Safety and Health Program, 2007 Edition*; NFPA 1981 *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, 2007 Edition*; NFPA 1901 *Standard for Automotive Fire Apparatus 2009 Edition*, Chapter 24 Air Systems.

X.1.3.1 Design criteria for all pressure containing components shall be satisfied with a minimum working pressure of 5,000 PSIG at 70° F with a safety factor of 4:1.

X.1.3.2 Compressor and booster supplied systems shall be capable of storage and operation in any ambient temperature between 32°F and 110°F (0°C and 43°C).

X.1.3.3 Cascade and bulk air systems shall be capable of storage and operation in any ambient temperature between 0°F and 110°F (–18°C and 43°C).

X.1.3.4 The air system shall be designed so that it can be operated in environments with relative humidity up to and including 100 percent.

X.1.3.5 All materials used in the air system shall be corrosion resistant or treated to resist corrosion unless the finished product will be in continual contact with a noncorrosive lubricant.

X.2 Assembly and Installation Practices.

X.2.1 All electrical, low voltage and supervisory signal components, equipment, and installation procedures shall conform to NFPA 70, *National Electrical Code*; and NFPA 72 *National Fire Alarm and Signal Code, 2010 Edition*, Chapter 14 and 26;

X.2.2 All screws, pins, bolts, and other fasteners whose failure would create a hazardous condition for personnel or equipment shall be equipped with locking devices.

X.2.3 Safety wire, self-locking nuts, cotter pins, lock washers, and liquid-locking compounds shall be acceptable.

X.2.4 Each part utilized in the fabrication of the FBARS and its components shall be designed for use in compressed breathing air service at pressures, temperatures, and flow rates that will be encountered during actual air system operation.

X.2.5 Discharge air from a compressor shall pass through a purification system prior to distribution.

X.2.6 Prior to the initial air quality test and commissioning, the FBARS shall be purged with pure air until moisture and other contaminants have been removed.

X.3 Maintainability.

X.3.1 The design of the FBARS shall provide for maintainability by including, but not necessarily being limited to, the following maintainability objectives and technical and operational constraints:

X.3.2 The design shall be such that faults can be isolated to allow access to removable assemblies or components.

X.3.3 Breathing air components, mechanical joints, electrical panels and junction boxes shall be readily accessible.

X.3.4 The physical arrangement of components shall be such that they can be inspected, serviced, calibrated, and, if necessary, adjusted without being removed and with minimum disturbance to other components.

X.3.5 The design shall be such that inspection, service, and replacement can be accomplished using a minimum of special tools and support equipment.

X.3.6 Test points shall be provided to facilitate malfunction isolation and the connection of calibration and test instrumentation.

X.3.7 If special tools are required to service or maintain the breathing air system, those tools shall be supplied by the installing contractor or manufacturer.

X.4 Performance Requirements. The FBARS shall be designed to fill at the most remote air cylinder fill station, a minimum of two (2) empty 45 standard cubic foot compressed breathing air cylinders to a maximum pressure of 4,500 PSIG simultaneously in three (3) minutes or less.

–**X.5 Materials of Construction.** All pressurized materials used in the construction shall be suitable for high pressure breathing air at minimum operations of 5,000 PSIG at 70° F with a safety factor of 4:1. All pressurized components shall meet the requirements of ANSI 331 and ASME Section IIIV Codes. The internal service of all components shall be kept free of contamination, especially hydrocarbons, so the air contained within the system meets Chapter 5, Air Quality Requirements.

–**X.6 Isolation.** The FBARS shall be arranged in such a way that when an Air Support Vehicle is supplying air to the system, the supply from the ASV may be isolated from on-site air storage vessels and directed to a main riser by the use of readily accessible selector valves. This will allow breathing air to be supplied directly from the air support vehicle to remote fill stations.

X.7 Components.

X.7.1 Exterior Operator Control Panel.

X.7.1.1 Systems designed for use with a Mask Services Unit (MSU) or Air Support Vehicle (ASV) shall be designed to allow the air support vehicle to interconnect with the system from an accessible exterior panel location, allowing a constant supply of air from the vehicle to the installed FBARS system.

X.7.1.2 The exterior operator control panel shall be attached to the building or on a remote monument.

X.7.1.3 The panel shall be secured inside of a weather-resistant enclosure. The enclosure shall be visible and accessible on approach to the building and shall be maintained with unobstructed view and access.

X.7.1.4 The panel location shall be approved by the AHJ.

X.7.1.5 The panel shall meet the requirements of NFPA 1901 *Standard for Automotive Fire Apparatus 2009 Edition* Chapter 24 Air Systems, Section 24.8.

X.7.2 Interior Air Cylinder Fill Station.

X.7.2.1 Air cylinder fill stations shall be inter-connected directly to the main air supply.

X.7.2.2 Air cylinder fill stations shall be located in a fire resistive enclosure directly accessible to the fire department access paths. Air cylinder fill stations shall be located such that means of egress are not obstructed.

- X.7.2.3** Intermediate air cylinder fill station(s) shall be installed in a location specified by the AHJ.
- X.7.2.4** Each air cylinder fill station shall have the capability of being isolated from the remainder of the system by means of isolation valves.
- X.7.2.5** The interior air cylinder fill stations shall be capable of replenishing a minimum of four (4) empty 45 cubic foot, 4,500 PSIG breathing air cylinders within six (6) minutes or less. The air cylinder fill station shall provide for the refilling of breathing air cylinders in accordance with NFPA 1901, *Standard for Automotive Fire Apparatus, 2009* Edition, Chapter 24, Air Systems Section 24.9.
- X.7.2.6** The design of the air cylinder fill station shall, in a life threatening emergency, provide for the direct refilling of breathing air cylinders by means of a discharge outlet with a minimum of one (1) cylinder filling hose that shall have a female quick connect coupling. The female coupling shall be designed to connect to a male quick connect coupling and be compatible with the fire departments SCBA apparatus, The assembled coupling shall meet the construction, performance and dimensional requirements of NFPA 1981, *Standard on Open Circuit Self-Contained Apparatus for Fire and Emergency Services, 2002* Edition, Chapter 6, Section 6.4. The use of the discharge outlet shall be in accordance with NFPA 1981 *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, 2007* Edition Section 3.3.34.

-X.7.3 Interior Air Cylinder Fill Panel.

- X.7.3.1** Air cylinder fill panels shall be inter-connected directly to the main air supply.
- X.7.3.2** Air cylinder fill panels shall be located in a fire resistive enclosure directly accessible to the fire department access paths. Air fill panels shall be located such that means of egress are not obstructed.
- X.7.3.3** Intermediate air fill panels (s) shall be installed in a location specified by the AHJ.
- X.7.3.4** Each air cylinder fill panel shall have the capability of being isolated from the remainder of the system by means of isolation valves.
- X.7.3.5** The interior air cylinder fill panel shall be capable of replenishing a minimum of two (2) empty 45 cubic feet at 4,500 psig SCBA cylinders simultaneously within three (3) minutes or less.
- X.7.3.6** Each air cylinder fill panel shall be installed in a metal cabinet constructed of minimum 18-gauge carbon steel or equivalent.
- X.7.3.7** With the exception of the shutoff valve, pressure gauges fill hoses and ancillary components all components shall be contained behind a minimum 18-gauge interior panel.
- X.7.3.8** Hinges for the cabinet door shall be located inside of the cabinet.
- X.7.3.9** A minimum of 20% of the door surface area shall be constructed of tempered glass. The thickness of the glass shall not be greater than 1/8-inch.
- X.7.3.10** The design of the cabinet shall provide a means for storing the hose to prevent kinking. When the hose is coiled, the brackets shall be installed so that the hose bend radius is maintained at 4 inches or greater.
- X.7.3.11** The design of the air cylinder fill panel shall, in a life threatening emergency, provide for the direct refilling of breathing air cylinders by means of a discharge outlet with a minimum of two (2) cylinder filling hoses that shall have a female quick connect coupling. The female coupling shall be designed to connect to a male quick connect

coupling and be compatible with the fire departments SCBA apparatus. The assembled coupling shall meet the construction, performance and dimensional requirements of NFPA 1981, *Standard on Open Circuit Self-Contained Apparatus for Fire and Emergency Services*, 2007 Edition, Chapter 6, Section 6.4. The use of the discharge outlet shall be in accordance with NFPA 1981 *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*, 2007 Edition Section 3.3.34.

X.7.3.12 The air cylinder fill panel shall meet the requirements of NFPA 1901 *Standard for Automotive Fire Apparatus*, 2009 Edition Chapter 24 Air Systems.

X.7.4 Air Storage System.

X.7.4.1 FBARS designed with on-site air storage to supply firefighters with air replenishment prior to the arrival of an air support unit shall be capable of refilling a minimum of fifty (50) empty breathing air cylinders of 45 cubic feet at 4,500 PSIG, and shall be capable of replenishing all 50 cylinders at a minimum of two (2) empty 45 cubic feet at 4,500 PSIG SCBA cylinders simultaneously within three (3) minutes or less without fire department supplementation.

X.7.4.2 FBARS designed with on-site air storage shall meet the requirements of Chapter 5 Air Quality Requirements, NFPA 1901 *Standard for Automotive Fire Apparatus*, 2009 Edition, Chapter 24 Air Systems, Section 24.5; and breathing air quality standards of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 2007 Edition.

X.7.5 General Piping and Installation.

X.7.5.1 All pneumatic fittings, tubing, and hose shall be rated for the maximum allowable working pressure that could be encountered, with a test safety factor of not less than 4:1.

X.7.5.2 All pressurized materials used in the construction of the piping distribution system shall be compatible for use with high pressure breathing air equipment and self-contained breathing apparatus.

X.7.5.3 Tubing shall be constructed of stainless steel or other approved materials that are compatible with high pressure breathing air. When stainless steel tubing is used, it shall meet ASTM A-269, Grade 316 or an equal standard.

X.7.5.4 Fittings shall be constructed of stainless steel or other approved materials that are compatible with breathing air. Stainless steel fitting shall be at least Grade 316 and meet the requirements of ASTM A-269 or an equal standard.

X.7.5.5 All pneumatic fittings, tubing, and hose shall be corrosion resistant or treated to resist corrosion.

X.7.5.6 All piping and tubing shall be blown clean with clean, dry air before being installed and shall be free of contamination.

X.7.5.7 Routing of tubing and bends shall be such as to protect the tubing from mechanical damage

X.7.5.8 All rigid tubing shall be clamped to the structure at a minimum of 48 inches, and within 4 inches on either side of a coupling or elbow.

X.7.5.9 Rigid piping shall run in an orderly manner with a minimum of bends and Elbows

X.7.5.10 The piping installation shall provide room for maintenance and repairs with access panels provided where applicable.

- X.7.5.11** When making up threaded piping joints, the sealant shall be applied to the thread in a manner that will prohibit entry of the sealant into the piping system
- X.7.5.12** Air connections on equipment or panels shall be provided with a threaded dust cap on a safety chain or shall be a quick disconnect–type fitting.
- X.7.5.13** All pneumatic fittings, tubing, and hose shall be located within a fire resistive enclosure and be protected from physical damage.
- X.7.5.14** Flexible hose shall be installed in such a manner as to prevent cuts, abrasions, exposure to damage, excessive temperatures and excessive bending.
- X.7.5.15** The hose shall be installed in a manner that permits removal of the hose without removal of major breathing air components or building structure components.
- X.7.5.16** All pressurized components shall meet the requirements of NFPA 1901, *Standard for Automotive Fire Apparatus*, 2009 Edition, Chapter 24 Air Systems and breathing air quality standards of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 2007 Edition; and Chapters 5 Air Quality Requirements.
- X.7.6 Air Monitoring and Quality Control.**
- X.7.6.1** FBARS shall have automatic audible and visual alarms and controls at the Exterior Operator Control Panel and within the Fire Command Center to monitor the systems moisture, carbon monoxide and pressure and shall meet the requirements of NFPA 70, *National Electrical Code*; and NFPA 72 *National Fire Alarm and Signal Code*, 2010 Edition, Chapter 14 and 26.
- X.7.6.2** The monitors shall be connected to the building's fire alarm system as a supervisory alarm and shall meet the requirements of NFPA 70, *National Electrical Code*; and NFPA 72 *National Fire Alarm and Signal Code*, 2010 Edition, Chapter 14 and 26.
- X.7.6.3** The monitors shall transmit a supervisory signal when the levels of moisture exceed 24 ppm or carbon monoxide exceeds 10 ppm for breathing air in accordance with Chapter 5 Air Quality Requirements, or when the pressure of the breathing air system is less than 80% of the operating pressure.
- X.8 Breathing Air Compressor.** FBARS designed with a breathing air compressor shall meet the requirements of NFPA 1901, *Standard for Automotive Fire Apparatus*, 2009 Edition, Chapter 24 Air Systems, Section 24.3.
- X.9 Labels and Plates.** Each component and enclosure shall be identified with a label. The marking of the enclosure shall be immediately visible and accessible to emergency response personnel. Marking shall meet the requirements of NFPA 1901, *Standard for Automotive Fire Apparatus*, 2009 Edition, Chapter 24 Air Systems, Section 24.2.11.
- X.10 Documentation.**
- X.10.1** Two complete sets of plans, specifications and calculations shall be submitted to the AHJ for review and approval. Plans, specifications and calculations shall demonstrate compliance with the requirements of this chapter and shall be stamped by a Registered Design Professional. Documents shall include system calculations, manufacturer mill reports and product data specifications sheets for all components of the FFBARS installation.
- X.10.2** Two complete sets of documentation that cover the operation and maintenance of the system shall be delivered with the FBARS.
- X.10.3** The documentation shall be permitted to be in printed format, electronic format, audiovisual format, or a combination thereof.

X.10.4 Nomenclature for components, controls, and indicators shall be consistent with that used on the diagrams required in X.8 and on equipment nameplates.

X.10.5 The manuals shall include, but not necessarily be limited to, the following:

- (1) An illustrated component list.
- (2) A schedule of maintenance and air quality checks.
- (3) Troubleshooting information to enable a technician to locate trouble and to make repairs or adjustments to the components.
- (4) Step-by-step procedures for operating the FBARS.

X.10.6 Documentation shall meet the requirements of NFPA 1901, *Standard for Automotive Fire Apparatus*, 2009 Edition, Chapter 24 Air Systems, Section 24.2.12.

X.11 Training and Instruction.

X.11.1 If an FBARS without a compressor/ purification system is provided, the system installer shall supply a qualified person to provide operational training to fire department personnel that includes the following:

- (1) A complete system component familiarization/walkaround
- (2) A complete review of the system and its safety features
- (3) A review of all operation, service, and maintenance documentation
- (4) Hands-on familiarization of the safe operation of the air control panel and air cylinder fill station/fill panel, including actual SCBA filling and other pertinent operations of the system.

X.11.2 If an FBARS that includes a compressor/ purification system is provided, a person certified by the breathing air compressor manufacturer in the operation of the specified air compressor system shall provide training to fire department personnel that includes the following:

- (1) A review of the compressor/purification system operations and maintenance, including the operations and maintenance documentation and the name, address, and phone number of the local distributor
- (2) Procedures to change purification cartridges
- (3) Hands-on familiarization of the safe operation of the compressor and purification system

X.11.3 The fire department shall designate one or two individuals to be the resource persons for all the firefighter breathing air replenishment system training and equipment indoctrination.

X.11.4 The fire department shall designate where the training is to take place.

X.11.5 Training shall meet the requirements of NFPA 1901, *Standard for Automotive Fire Apparatus*, 2009 Edition, Chapter 24 Air Systems, and Section 24.2.13.

X.12 FBARS Testing and Commissioning.

X.12.1 Following fabrication, assembly, and installation of the FBARS, the Authority Having Jurisdiction shall witness the pneumatic testing of the complete system at a minimum test pressure of 7,500 PSIG using oil-free dry air, nitrogen or argon. A minimum twenty four (24) hour pneumatic test shall be performed. During this test all fittings, joints and system components shall be inspected for leaks.

X.12.2 The Authority Having Jurisdiction shall witness the filling of two (2) empty 45 cubic foot at 4,500 PSIG capacity SCBA cylinders in three (3) minutes or less using compressed air supplied by fire department mobile air equipment connected to the

exterior fire department connection panel. The SCBA cylinders shall be filled at the Air Fill Panel or Air Fill Station farthest from the exterior fire department connection panel.

X.12.3 The air storage system shall be tested to confirm its ability to meet section X.3.4. This shall be accomplished by replenishing a minimum of fifty (50) empty 45 cubic feet at 4,500 psig SCBA cylinders at the uppermost air cylinder fill panel or air cylinder fill station without fire department mobile air augmentation.

X.12.4 Before the system is placed into service, a minimum of two air samples shall be taken from separate air cylinder fill panels and /or air cylinder fill stations and submitted to an independent certified gas analysis laboratory to verify the system's cleanliness and that the air complies with the requirements for breathing air in accordance with Section 5.3. The written report of the analysis shall be submitted to the Authority Having Jurisdiction documenting that the breathing air complies with this section.

X.12.5 A fire department representative shall be present at all testing.

X.12.6 Testing and Commissioning shall meet the requirements of NFPA 1901, *Standard for Automotive Fire Apparatus*, 2009 Edition, Chapter 24 Air Systems, Section 24.14.

X.13 Security. To prevent unauthorized access to or tampering with the FBARS system, each enclosure shall be maintained locked by a means approved by the fire department. The enclosure shall have a tamper switch connected to the building fire alarm system indicating a supervisory signal when the enclosure is opened and shall meet the requirements of NFPA 70, *National Electrical Code*; and NFPA 72 *National Fire Alarm and Signal Code*, 2010 Edition, Chapter 14 and 26;

X.14 Annual Maintenance – Tests and Measurements.

X.14.1 FBARS installed in accordance with this standard shall be properly inspected, tested and maintained in accordance with this standard to provide at least the same level of performance and protection as initially designed. The owner shall be responsible for maintaining the system and keeping the system in good working order.

X.14.2 The FBARS shall be inspected annually and certified by the installer and/or licensed mechanical engineer specializing in high pressure breathing air systems to be in proper working condition and free of defects. All components of the system shall be included in the inspection.

X.14.3 Air samples shall be taken at least quarterly to ensure the stored air meets or exceeds breathing air quality standards in accordance with Section 5.3. A copy of the report shall be submitted to the fire department.