



COLORADO SPRINGS FIRE DEPARTMENT
Division of the Fire Marshal
Administrative Ruling



Number:	2022-1		
Subject:	Firefighter Air Replenishment Systems (FARS)		
Reference:	2015 International Fire Code Appendix L		
Effective Date:	4/15/22	Issued By:	Mark Trudell, Captain
Revision Date:		Revised By:	
Approval Date:	5/1/22	Approved By:	

PURPOSE: To establish design parameters for the most reasonable firefighter air replenishment system that must be installed in this jurisdiction.

SCOPE: This policy applies to all new FARS designs submitted for review and approval as of the effective date of this ruling.

DESCRIPTION OF ISSUE: Rapidly changing technology has rendered the current code requirements obsolete, cumbersome and more costly, the way they are currently written.

DECISION: The following updated criteria may be used for design, testing, installation and maintenance of FARS until such time it is formally adopted into code.

L101
GENERAL

L101.1 Scope. The design, installation and maintenance of fire fighter air replenishment systems (FARS) shall be in accordance with this section.

L101.2 Required installations. A fire fighter air replenishment system shall be installed in the following buildings:

1. Buildings classified as high-rise in accordance with the International Building Code.
2. Basements or subfloors of high-rise buildings, and underground structures having normally occupied floors that are three or more floors below grade with a per floor area greater than 25,000 square feet (2,322.6 m²).
3. Underground parking structures having three or more levels below grade.

4. Any new building 500,000 square feet or more in size.
5. Transportation tunnels constructed in accordance with NFPA 130 or 502 that exceed 700 feet in length.

SECTION L102 DEFINITIONS

L102.1 Definitions. For the purpose of this appendix, certain terms are defined as follows:

FIRE FIGHTER AIR REPLENISHMENT SYSTEM (FARS). A permanently installed arrangement of piping, valves, fittings and equipment to facilitate the replenishment of breathing air in self-contained breathing apparatus (SCBA) for fire fighters engaged in emergency operations.

INTERIOR FILL STATION. A station designed for the safe, simultaneous filling of breathing air cylinders utilizing universal air connections (UAC) without having to remove the bottle from the self-contained breathing apparatus (SCBA) harness assembly.

SECTION L103 PERMITS

L103.1 Permits. Permits shall be required to install and maintain a FARS. Permits shall be in accordance with Section L103.2.

L103.2 Construction permit. A construction permit in accordance with 105.7.23 is required for installation of or modification to a FARS. The construction permit application shall include documentation of an acceptance and testing plan as specified in Section L105.

L103.3 Plans. Prior to the installation of a FARS, plans and specifications shall be submitted to the *fire code official* for review and approval. Plans shall demonstrate compliance with the requirements of this section and shall include calculations prepared by a registered design professional demonstrating that the design criteria for all pressure containing components is satisfied plus a minimum safety factor of 25 percent. Plans and specifications shall conform to guidance documents provided by the Division of the Fire Marshal

L103.3.1 Quality assurance. Plans, specifications, equipment and product data sheets, and system calculations for the FARS shall be reviewed and stamped by a qualified State of Colorado licensed design professional, who is knowledgeable in high pressure breathing air replenishment systems and can demonstrate previous experience with such systems.

SECTION L104 DESIGN AND INSTALLATION

L104.1 Design and installation. A FARS shall be designed and installed in accordance with Sections L104.2 through L104.15.

L104.1.1 Contractor qualification. The FARS shall be installed by a manufacturer approved vendor.

L104.1.2 Prevention of contamination. The installing contractor shall ensure that, at all times, the system components are not exposed to contaminants, including, but not limited to, oils, solvents, dirt and construction materials. When contamination of the system components has occurred, the effected component shall not be installed in the system.

L104.1.3 Internal surfaces. The internal surfaces of all pressurized materials shall be free of contamination.

L104.2 Standards. Fire fighter air replenishment systems shall be in accordance with Sections L104.2.1 and L104.2.2.

L104.2.1 Pressurized system components. Pressurized system components shall be designed and installed in accordance with ASME B31.3.

L104.2.2 Air quality. The system shall be designed to convey breathing air complying with NFPA 1989.

L104.3 Design and operating pressure. The minimum design pressure shall be 110 percent of the fire department's normal SCBA fill pressure. The systems design pressure shall be marked in an approved manner at the supply connections, and adjacent to the pressure gauges on any fixed air supply components. Pressure shall be maintained in the system within 5 percent of the design pressure.

L104.4 Cylinder refill rate. The FARS shall be capable of refilling breathing air cylinders of a size and pressure used by the fire department at a rate of not less than two empty cylinders in 2 minutes at the most remote cylinder filling panel.

L104.5 Breathing air supply. Where a fire department mobile air unit is available, the FARS shall be supplied by an external mobile air connection in accordance with Section L104.14.

L104.5.1 Stored pressure air supply. Stored pressure air supply shall be designed based on Chapter 24 of NFPA 1901 except that provisions applicable only to mobile apparatus or not applicable to system design shall not apply. A stored pressure air supply shall be capable of refilling not less than 25 empty breathing air cylinders of a size and pressure used by the fire department, or as approved by the *fire code official*.

L104.5.2 Retrofit of external mobile air connection. A FARS not initially provided with an external mobile air connection due to the lack of a mobile air unit shall be retrofitted with an external mobile air connection where a mobile air unit becomes available. Where an external mobile air connection is provided, a means to bypass the stored pressure air supply shall be located at the external mobile air connection. The retrofit shall be completed not more than 12 months after notification by the *fire code official*.

L104.6 Isolation valves. System isolation valves that are accessible to the fire department shall be installed on the system riser to allow piping beyond any air cylinder refill panel to be blocked.

L104.7 Pressure relief valve. Pressure relief valves shall be installed at each point of supply and at the top or end of every riser. The relief valve shall meet the requirements of CGFA S-1.3 and shall not be field adjustable. Pressure relief valves shall discharge in a manner that does not endanger personnel who are in the area. Valves, plugs or caps shall not be installed in the discharge of a pressure relief valve. Where discharge piping is used the end shall not be threaded.

L104.8 Materials and equipment. Pressurized system components shall be *listed* or *approved* for their intended use and rated for the maximum allowable design pressure in the system. Piping and fittings shall be stainless steel meeting the requirements of ASTM A269, Grade 316 or equivalent.

L104.8.1 Prohibited materials. The use of carbon steel, iron pipe, malleable iron, high-strength gray iron or alloy steel is prohibited.

L104.8.2 Marking. System piping, gauges, valves, fill stations, external mobile air connection, air storage enclosure and air storage cylinders shall be clearly marked by means of permanent signage indicating their function. Marking for specific equipment shall be as follows:

1. Markings used for distribution piping shall contain content's name and direction of flow arrow and shall be located as follows:
 - a) At each valve
 - b) At wall, floor or ceiling penetrations
 - c) At each change of direction
 - d) At a minimum of every 20 feet of fraction thereof throughout the piping system.
 - e) At external mobile air connection
 - f) At interior fill stations
 - g) At entrance to air storage enclosure
2. The front of each fill station access panel, the external mobile air connection, the air storage system room, and the air storage system shall be marked "FIRE FIGHTER AIR REPLENISHMENT SYSTEM." The

lettering shall be in a color that contrasts with the background and a minimum 2 inches high with a 3/8 inch stroke.

L104.9 Welded connections. Piping connections that are concealed shall be welded.

L104.10 Protection of piping. System piping shall be protected by a minimum two (2)-hour fire-resistive construction and shall be protected from physical damage in an *approved* manner.

L104.11 Compatibility. Fittings and connections intended to be used by the fire department shall be compatible with the fire department's equipment.

L104.12 Security. Connections to a FARS shall be safeguarded from unauthorized access or tampering in an *approved* manner. A tamper switch monitored by an approved supervising station shall be provided.

L104.13 Interior Fill stations. Fire fighter air replenishment fill stations shall comply with Section L104.13.1 through L104.13.3.

L104.13.1 Location. Fill stations for refilling breathing air cylinders shall be located as follows:

1. **Aboveground structures.** A fill station shall be installed on floor landings in all stairwells, commencing on the third-floor landing above grade, and every other floor thereafter.
2. **Basements, Subfloors and/or Underground structures.** A fill station shall be installed on floor landings in all stairwells, commencing on the second floor below grade and every other below-grade level thereafter.
3. **Large horizontal structure.** A fill station shall be located at each standpipe hose connection and no more than 150 feet travel distance.
4. **Transportation and pedestrian tunnels.** A fill station shall be located within 200-feet of the tunnel entrance and at intervals not exceeding 400 feet thereafter as approved by the fire code official.
5. The fill station panel shall be located a minimum of 36 inches (914 mm) but not more than 60 inches (1524 mm) above the finished floor or stairway landing.

L104.13.2 Design. Fill stations for breathing air cylinders shall be designed to meet the following requirements:

1. A pressure gauge and pressure-regulating devices and controls shall be provided to allow the operator to control the fill pressure and fill rate on each cylinder fill hose.
2. Valves controlling cylinder fill hoses shall be slow-operating valves.

3. A separate flow restriction device shall be provided on each fill hose.
4. A method shall be provided to bleed each cylinder fill hose.
5. Provide for the direct refilling of the fire fighter's breathing air cylinders using Rapid Intervention Crew/Company Universal Air Connection (RIC/UAC) fittings.

L104.13.3 Cylinder refill rate. Fill stations shall be capable of simultaneously filling two or more empty breathing air cylinders equivalent to those used by the fire department to the cylinders' design pressure within 2 minutes.

L104.13.4 Cabinet requirements. Each fill station shall be installed in a cabinet constructed of minimum 18-gauge carbon steel. The depth of the cabinet shall not create an exit obstruction when installed in building stairways. All components with the exception of the shutoff valve, pressure gauges, fill hoses and ancillary components shall be contained behind a minimum 18-gauge access panel.

L104.13.4.1 Door. Hinges for the cabinet door shall be located inside of the cabinet. The door shall be arranged such that when the door is open, it does not reduce the required exit width or create an obstruction in the path of egress. A minimum of 20 percent of the door surface area shall be constructed of tempered glass.

L104.13.4.2 Components. The cabinet shall be of sufficient size to allow for the installation of all the necessary components as may be required to allow authorized personnel to safely and reliably replenish a minimum of two (2) breathing air cylinders connecting directly to firefighters self-contained breathing apparatus equipment by means of quick fill adapters, hose and RIC/UAC fittings.

L104.13.4.3 Cylinder filling hose. 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 (102 mm) or greater.

The discharge outlet of each cylinder filling hose shall have a female RIC UAC. The female fitting shall be designed to connect to a male RIC UAC. The assembled RIC UAC shall meet the construction, performance and dimensional requirements of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services*.

L104.14. External mobile air connection. A minimum of one external mobile air connection shall be provided for fire department mobile air apparatus where required by Section L104.5 to supply the system with breathing air.

L104.14.1 Location. The location of the external mobile air connection shall be within 40 feet of *approved* fire department vehicle access and *approved* by the *fire code official*.

L104.14.2 Protection from vehicles. A means of vehicle impact protection in accordance with Section 312 shall be provided to protect mobile air connections that are subject to vehicular impact.

L104.14.3 Clear space around connections. A working space of not less than 36 inches (914 mm) in width, 36 inches (914 mm) in depth and 78 inches (1981 mm) in height shall be provided and maintained in front of and to the sides of external mobile air connections.

L104.14.4 Construction. The external mobile air connection panel shall be installed in a cabinet constructed of minimum 18-gauge carbon steel, provided with corrosion preventive coating or equivalent, and comply with NEMA 4 weather resistance requirements.

L104.14.5 Enclosure components. The external mobile air connection panel shall consist of the necessary components to provide air to the air fill stations located on the upper or lower building levels, or both. The external mobile air connection shall be designed to allow connection from the mobile air unit.

L104.15 Air Storage System. The air storage system shall be installed in buildings and structures at locations approved by the *fire code official*.

L104.15.1 Room Design. The air storage system shall be located in rooms that are separated from all other areas of the building by a minimum of 2-hour fire-rated construction in accordance with the *International Building Code*.

L104.15.1.1 Storage. Rooms containing air storage systems shall be free from storage, equipment and penetrations not essential to the operation of the air storage system and related components.

L104.15.1.2 Size. Rooms containing air storage systems shall be designed with adequate space for all equipment necessary for the installation, as defined by the manufacturer, with sufficient working room around the stationary equipment. Clearances around equipment to elements of permanent construction, including other installed equipment and appliances, shall be sufficient to allow inspection, service, repair or replacement, without removing such elements of permanent construction or disabling the function of a required fire-resistive-rated assembly. Air storage rooms shall be provided with a door(s) and unobstructed passageway large enough to allow removal of the largest piece of equipment.

L104.15.1.3 Freeze protection. The room shall be conditioned so that the temperature is no less than 40 F (4 C) and no more than 80 F (26.7 C).

L104.15.1.4 Lighting. Artificial and emergency lighting shall be provided and shall have a minimum intensity of illumination of 3.0 ft-candles, unless otherwise specified.

L104.15.2 Pipe, tube and fittings. Pipe, tube, and fittings shall be constructed of stainless-steel materials that are compatible with high pressure breathing air and shall meet all of the following:

1. ASTM A269 Grade 316 or equivalent
2. Minimum 0.375-inch outside diameter x 0.065-inch wall fully annealed seamless.
3. ASTM A276 Grade 316 or equivalent or ASTM A182 for forged fittings.

L104.15.2.1 Securement. Piping and tubing shall be supported at a minimum of five (5) feet intervals. Individual clamps and mounting components shall be mechanically secured to the building support members in accordance with the manufacturer's recommendations.

L104.15.2.2 Design flow. The distribution piping shall have a minimum calculated design flow using one (1) interior fill panel, and four (4) breathing air cylinders operating simultaneously at the furthest point from the fire department access.

L104.16 Air Monitoring system. An approved air monitoring system shall be provided. The system shall automatically monitor air quality, moisture and pressure on a continual basis. The air monitoring system shall be equipped with not less than two content analyzers capable of detecting carbon monoxide, carbon dioxide, nitrogen, oxygen, moisture and hydrocarbons.

L104.16.1 Alarm conditions. The air monitoring system shall transmit a supervisory signal when any of the following levels are detected:

1. Carbon monoxide exceeds 5 ppm.
2. Carbon dioxide exceeds 1,000 ppm.
3. An oxygen level below 19.5 percent or above 23.5 percent.
4. A nitrogen level below 75 percent or above 81 percent.
5. Hydrocarbon (condensed) content exceeds 5 milligrams per cubic meter of air.
6. The moisture concentration exceeds 24 ppm by volume.
7. The pressure falls below 90 percent of the maintenance pressure specified in Section L104.3

L104.16.2 Alarm supervision, monitoring and notification. The air monitoring system shall be connected to the building's fire alarm system and monitored by an approved supervising station. Audible and visual supervisory signals shall be annunciated at a constantly attended location and the fire command center.

L104.16.2.1 Reporting. The building owner or authorized agent shall notify the fire department of any alarm signaling a rise in moisture or carbon monoxide levels within the system, as well as the locally available service provider.

L104.16.3 Air quality status display. Air quality status shall be digitally displayed at the external mobile air connection required by Section L104.14 and the fire command center.

L104.16.4 Pressure monitoring switch. An electric low-pressure monitoring switch shall be installed in the piping system to monitor the air pressure. The pressure switch shall initiate a supervisory signal when the pressure of the breathing-air system is less than 4,950 psig (20,685 kPa) at 70 F (21 C) + 100 psig (690 kPa).

SECTION L105 ACCEPTANCE TESTS

L105.1 Acceptance tests. Upon completion of the installation, a FARS shall be acceptance tested to verify compliance with equipment manufacturers' instructions and design documents. Oversight of the acceptance tests shall be provided by the registered design professional who reviewed the stamped the plans. Acceptance testing shall include all of the following:

1. A pneumatic test in accordance with ASME B31.3 of the complete system at a minimum test pressure of 110 percent of the system design pressure using oil free dry air, nitrogen or argon shall be conducted. Test pressure shall be maintained for not less than 24 hours. During this test, all fittings, joints and system components shall be inspected for leaks. Any defects in the system or leaks detected shall be documented on an inspection report and repaired or replaced.
2. A cylinder-filling performance test shall be conducted to verify compliance with the required breathing air cylinder refill rate from the exterior mobile air connection and where provided, a stored air pressure supply system.
3. The air quality monitoring system shall be testing to verify both of the following conditions:
 - 3.1. Visual indicators required by Section L104.16.1 function properly.

- 3.2. Supervisory signals are transmitted as required by Section L104.16.2 for each sensor based on a sensor function test.
4. Connections intended for fire department use shall be confirmed as compatible with the fire department's mobile air unit, SCBA cylinders and, where provided RIC/UAC connections.
5. Air samples shall be taken from not less than two fill stations and submitted to an approved gas analysis laboratory to verify compliance with NFPA 1989. The FARS shall not be placed into service until a written report verifying compliance with NFPA 1989 has been provided to the *fire code official*.
 - 5.1 During the period of air quality analysis, the air fill panel inlet shall be secured so that no air can be introduced into the system and each air fill panel shall be provided with a sign stating "AIR QUALITY ANALYSIS IN PROGRESS, DO NOT FILL OR USE ANY AIR FROM THIS SYSTEM." This sign shall be a minimum of 8-1/2 by 11 inches with a minimum of 1-inch lettering.
6. A functional test of the low-pressure monitoring switch shall be performed to verify compliance with L104.16.
7. Internal surfaces of all pressurized materials shall be certified as free of contamination.

L105.2 System certification. Prior to final acceptance, the building owner shall provide the *fire code official* with written verification of a testing and certification contract. Upon satisfactory completion of all tests and verification of air quality, the system shall be considered complete.

L105.2.1 Commissioning report. The registered design professional shall certify the entire FARS has been installed, tested and commissioned in accordance with this section and the *approved* plans through a sealed commissioning report, provided to the *fire code official*.

SECTION L106 INSPECTION, TESTING AND MAINTENANCE

L106.1 Periodic inspection, testing and maintenance. A FARS shall be continuously maintained in an operative condition and shall be inspected and certified not less than annually. Not less than quarterly, an air sample shall be taken from the system and tested to verify compliance with NFPA 1989. The laboratory test results shall be maintained on site and readily available for review by the *fire code official*.

L106.2 Modifications. FARS shall be extended, altered, or augmented as necessary to maintain and continue protection where the building is altered, remodeled or added to. Alterations to FARS shall be done in accordance with applicable standards. Upon

completion of necessary alterations, the system shall undergo certification requirements of Section L105.

**SECTION L107
REFERENCED STANDARDS**

ASME B31.3 – 2012 Process Piping L104.2.1, L105.1

CGA S-1.3 – 2008 Pressure Relief Device Standards – Part 3 Stationary Storage
Containers for Compressed Gases L104.7

NFPA 1901 – 09 Standard for Automotive Fire Apparatus L104.5.1

NFPA 1989 – 13 Breathing Air Quality for Fire Emergency Services Respiratory
Protection L104.2.2, L105.1; L16.”

