

COLORADO SPRINGS FIRE DEPARTMENT

Firefighter Air Replenishment

General requirements for design and installation of FARS.



CONSTRUCTION SERVICES

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PURPOSE

This guidance document has been developed in an effort to provide the highest level of service to the customers of the Colorado Springs Fire Department. Firefighter air replenishment systems allow firefighters and other first responders to replenish empty breathing air cylinders within close proximity of the incident, reducing the amount of travel distance, time and personnel needed for logistical support, thus maximizing firefighter safety and effectiveness.

SCOPE

This document outlines the requirements set forth in the adopted International Fire Code, local amendments, and department policies as they relate to the installation and maintenance of a firefighter air replenishment system. This document is not intended to provide an all-inclusive listing of submittal and inspection requirements, as it would be virtually impossible to cover all situations.

DEFINITIONS

CSFD	Colorado Springs Fire Department
EMAC	External Mobile Air Connections
FARS	Firefighter Air Replenishment System
IFC	International Fire Code
PSI	Pounds per Square Inch
RIC/UAC	Rapid Intervention Crew/Universal Air Connection
SCBA	Self-Contained Breathing Apparatus

GUIDELINES

I. INTRODUCTION

The FARS system shall provide a safe and reliable source of clean breathable air to firefighters and other first responders performing fire suppression, evacuation, search and rescue and other types of emergency response tasks at incidents requiring the use of self-contained breathing apparatus. Nothing within this document shall be reduced in quality in any manner, including but not limited to; system design criteria, system performance criteria, components, materials, installation procedures, testing procedures, commissioning requirements and certification.

A. APPLICABLE CODES AND STANDARDS.

1. 2021 International Fire Code and local Amendments.
2. 2019 NFPA 1989 Standard on Breathing Air Quality for Emergency Services Respiratory Protection.

B. WHEN REQUIRED. Approved FARS shall be installed in new buildings meeting the following criteria:

1. Any building classified as a high-rise, including basement and sub-floors.
2. Underground structures having occupied floors three or more floors below grade and having a per floor area greater than 25,000 square feet.
3. Underground parking structures having three or more levels below grade (no area restriction).
4. Any building having a footprint 500,000 square feet in area or larger.
5. Transportation tunnels exceeding 700 feet in length.

C. ADMINISTRATIVE REQUIREMENTS.

- 1. Approved Contractors.** Contractors who intend to design and install a FARS system shall be approved or certified by the manufacturer of the FARS system. Colorado Springs Fire Department is not seeking to create a new license for this system at this time.
- 2. NFPA Standards.** FARS shall meet the criteria of the adopted codes as amended and all applicable requirements of the most recent edition of the NFPA standards. NFPA standards are effective on January 1st of the year following the effective date printed in the standard.
- 3. Permits/Inspections.** Approved plans and associated permits shall be secured through CSFD prior to the start of any work. All permitted work shall be inspected by CSFD.
- 4. Pre-Plan Submittal Meeting.** Plans will not be reviewed if a pre-plan submittal meeting has not been conducted. The intent of this meeting is to finalize the location and number of EMACs for the building in question.
- 5. Technical Specifications.**
 - CSFD uses Scott brand air packs.
 - SCBA's 66 cubic foot breathing air cylinders at 5,500 PSI.
 - The minimum design pressure for the distribution piping shall be 110% of the SCBA pressure of 5,500 PSI or 6,050 PSI.
 - There is also a required safety factor of 25% of the design pressure.
 - Cylinder refill rate of not less than two (2) empty SCBA cylinders in two (2) minutes simultaneously at interior fill stations.
 - Stored air supply shall be capable of refilling not less than 25 empty SCBA cylinders.
 - Distribution piping shall have a minimum design flow using one (1) interior fill station and four (4) SCBA cylinders operating simultaneously at furthest point from the EMAC.

II. SUBMITTAL INFORMATION

A. CONSTRUCTION DOCUMENTS.

Prior to the installation of a FARS, construction documents shall be submitted to CSFD for review and approval. Plans and supporting documentation shall be prepared and sealed by a registered design professional, licensed in the State of Colorado, who is knowledgeable in high pressure breathing air replenishment systems. The submittal shall demonstrate compliance with the requirements of Appendix L of the adopted fire code.

Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show it conforms to the provisions of the adopted code, standards, relevant laws, ordinances, rules and regulations adopted by the City of Colorado Springs.

Electronic plans are required as of January 1, 2023 and hard copy plans are no longer accepted. Electronic plans may utilize color coding for various components. Copies of all submittals are retained by CSFD for permanent record.

B. MINIMUM REQUIREMENTS OF SUBMITTAL

1. **Plan Review Number.** Submittals associated with a construction project shall be provided with the CSFD Plan Review Number. This number is an eight-digit number code located on the plan approval label for the building permit set.
2. **Drawings.** All plan sheets shall be signed/sealed by a registered design professional of an approved vendor. Plans shall be submitted through the CSFD customer portal.
 - a. **Floor plans.** A floor plan shall be provided showing, at a minimum, locations of:
 - i. Interior fill stations and clear space around interior fill stations.
 - ii. Stored air supply.
 - iii. Piping, valves, fittings, low pressure switches.
 - iv. Air monitoring display.
 - v. Fire command center.
 - vi. Address where the installation is occurring.
 - vii. Installing contractor.
 - viii. Designing contractor (if different from installing contractor).
 - ix. Vendor certification for contractors involved
 - b. **Site Plan.** The site plans shall provide the following information:
 - i. Location of fire department vehicle access roads.
 - ii. Location of EMAC and clear space around EMAC.
 - iii. Vehicle impact protection (if required) around EMAC.
3. **Cut Sheets/Specifications.** One set of manufacturer's product information shall be provided for all piping, valves, hangers/methods of supporting/mounting equipment, conduit, switches, fittings, cabinets, etc. Where multiple models/types are shown, the specific item(s) being installed shall be highlighted.
 - a. **Manufacturer mill report.** The manufacturer mill report for tubing, fittings, valves, pressure regulators, pressure relief devices, pressure gauges, cylinder filling hoses and all other components that may be required by the manufacturer for a complete installation.
4. **Calculations.** One set of calculations shall be submitted to CSFD and shall contain the information and/or details indicated in Appendix L of 2021 IFC. Calculations shall show design criteria for all pressure containing components is

satisfied. Minimum design pressure of 110% of the SCBA operating pressure plus a 25% safety factor is required.

5. **Equipment Schedules/Legends.** Equipment schedules and/or legends shall identify the make/model of the items being used

III. INSTALLATION.

A. EXTERIOR MOBILE AIR CONNECTION.

The exterior fire department connection panel shall provide the fire department's mobile air operator access to the FARS and shall be compatible with the mobile air unit (MAU).

When air supplementation becomes available by the fire department mobile air unit, the EMAC will allow the MAU operator to connect and begin augmentation of the system, providing for a constant source of breathing air replenishment to all interior fill panels. The EMAC is interconnected to the air monitoring system, air storage system and interior fill panels.

1. **Required Components.** The following components shall be installed in the external mobile air connection enclosure:
 - a. One male rapid intervention crew (RIC) universal air connection (UAC) filling. When connected to a female fitting, the assembled 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*.
 - b. One downstream shutoff valve.
 - c. One pressure gauge to check pressure of the piping distribution to air filling stations located on upper and lower building levels.
 - d. One pressure relief valve designed for 1.25 times the design discharge of the fire department air supply or air supply trucks. All fittings, hoses, and hard piping in the external mobile air connection panel and distribution piping to air filling station supply panels, shall be designed for an air pressure of 1.5 times the pressure of the fire department air delivery system.
 - e. External mobile air connections can be designed for an air pressure supply piping system for supply of air-to-air filling stations. The air supply lines will require an intermediate regulator to provide air pressure for a 6,000 psi (34,473 kPa) for a 5.5 air pack system. The air supply lines will be fitted with separate pressure relief valves set at 1.25 times the working pressure of the air supply line and the operating pressure of the pressurized lines.
 - f. The relief valve, fittings and connection hose shall meet the requirement of the ASME *Boiler and Pressure Vessel Code*, 7 Section VIII, *Unified Pressure Vessel Code*. The installation of the piping system, as a minimum, will be based on ASME B31.3-2012.
 - g. Mechanical supports for piping, hoses, gauges and pressure components, shall be designed and built to provide a solid rigid structure.

- h. Pressure display.
- i. Air monitoring system display.

2. Installation requirements.

- a. The EMAC shall be located within 40 feet of a fire department access road.
- b. A clear space of 36-inches wide, by 36-inches deep and 78-inches tall shall be maintained around an EMAC.
- c. The mounting height shall be such that the top of the cabinet is no more than 72 inches above grade and the bottom is no more than 48-inches above grade.
- d. Where necessary due to the location, vehicle impact protection in accordance with IFC 312 may be required.

- B. AIR STORAGE SYSTEM.** The air storage system along with interior air fill panels shall provide firefighters and other first responders the ability to safely and reliably replenish empty breathing air cylinders prior to the fire departments mobile air unit arriving on scene.

The air storage system shall be installed within a minimum of a 2-hour rated enclosure free from storage, equipment and penetrations not essential to the operation of the air storage system. The room shall be adequately sized such that there is sufficient clearance around equipment and cylinders to conduct routine inspections, service, repair or replacement of any elements without removing any permanent construction or damaging or removal of any elements of a fire-resistive rated assembly. Three feet clearance is a good rule of thumb. Doors shall be sized to allow the removal of the largest piece of equipment. Adequate heat and light shall also be provided in the room.

- C. INTERCONNECTED PIPING DISTRIBUTION SYSTEM.** The interconnected piping distribution system shall be designed so that the exterior fire department connection panel may be isolated from the air storage system and routed directly to the interior air fill panels via the systems main distribution line. This shall be accomplished through the means of check valves and actuator selector valves readily accessible by fire department personnel, thus allowing breathing air to be supplied directly from the fire department MAU to the interior fill panels.

1. Installation requirements.

- a. Piping or tubing shall be installed within 2-hour fire-resistive rated construction and shall also be protected from physical damage in an approved manner. Piping run within a rated stairwell, must be protected from physical damage.
- b. Piping or tubing shall be of stainless steel. The use of any other material, including but not limited to carbon steel, iron pipe, malleable iron, high strength grey iron or steel alloy is prohibited.
- c. Internal surfaces shall be free from contamination.

- D. INTERIOR FILL STATIONS.** Interior fill stations provide firefighters and other first responders the ability to safely and reliably replenish empty breathing air cylinders during an emergency incident. The panel for the interior fill station shall contain all

the necessary gauges, valves, tubing, fittings, supports, connectors, adapters, tamper switches and other necessary components to allow firefighters to safely and reliably replenish SCBA cylinders.

1. Required Components.

- a. Pressure gauge and pressure-regulating devices and controls to allow the operator control fill pressure and rate on each cylinder fill hose.
- b. Valves shall be slow-operating valves.
- c. Separate flow restriction device shall be provided on each fill hose.
- d. A method to bleed each cylinder fill hose.
- e. RIC/UAC connections for direct refilling of SCBA cylinders.

2. Installation requirements.

- a. Interior fill station cabinet shall be installed such that the bottom of the cabinet is no more than 48-inches above the floor.
- b. Adequate clearance around the cabinet shall be provided to allow the free operation of the door to the fully open position and does not pose an obstruction to required exit width or egress path.

E. AIR MONITORING SYSTEM. The air monitoring system continually monitors the air quality, moisture and pressure to ensure safety and effectiveness of the FARS. The air monitoring system shall be connected to the fire alarm system and monitored by an approved supervising station. A display indicating the required information shall be provided at both the EMAC and the fire command center. A minimum of two content analyzers shall be provided and shall monitor the following:

- a. Carbon monoxide.
- b. Carbon dioxide.
- c. Oxygen.
- d. Nitrogen.
- e. Hydrocarbons.
- f. Moisture content.
- g. Pressures.

IV. MATERIALS.

When mechanical high-pressure tube fittings are used, they shall be listed for the type of materials to be joined and rated for the maximum pressure of the system, to include safety factors. When mechanical tube fittings are used, prior approval by the authority having jurisdiction must be obtained. All concealed mechanical fittings for tubing and valves shall be made accessible by means of fire rated, self-closing, access door with fire department approved locking system. When tubing passes through a fire rated or solid material, it shall be protected by a sleeve at least three (3) times the tube diameter. Both ends of the sleeve shall be filled with and approved fire stop material.

Prior to and during the welding of sections of tubing, a continuous, regulated dry nitrogen or argon purge at 3 psig (20.68 kPa) shall be maintained to eliminate contamination with

products of the oxidation or welding flux. The purge shall commence a minimum of 2 minutes prior to welding operations and continue until the welded joint is at an ambient temperature between 60 F and 80 F (15.5 C to 26.6 C).

V. INSPECTIONS AND ACCEPTANCE TESTING.

It shall be the duty of the person authorized by the permit to notify CSFD the work is ready for inspection. It shall also be the responsibility of the person requesting the inspection to provide access to and means for proper inspection of the work. The registered design profession who stamped the drawings shall oversee the acceptance tests.

- A. VISUAL INSPECTION.** A visual inspection shall be conducted to verify the installation is in compliance with the manufacturer's instructions and the design documents.
- B. PNEUMATIC PRESSURE TEST.** All piping, joints, and pressurized components shall be pressure tested at 110% of the system design pressure for a period of not less than 24 hours. Oil free dry air, nitrogen or argon shall be used. All fittings, joints and components shall be inspected for leaks, and any defects found shall be documented and the component repaired or replaced.
- C. LOW PRESSURE SWITCH CALIBRATION.** Upon successful completion of the pneumatic pressure test, the low-pressure switch shall be calibrated to not less than 4,950 psi descending and tested to verify alarm signals are annunciated at the fire alarm control panel, the EMAC and the air monitoring display in the fire command center.
- D. CYLINDER FILL TEST.** Cylinder filling performance test shall be conducted to verify compliance with the required cylinder refill rate from both the EMAC and the stored air supply.
- E. AIR MONITORING SYSTEM.** Air monitoring system shall be tested to verify the alarm and supervisory conditions are reporting correctly to the supervising station.
- F. AIR SAMPLING.** Air samples shall be taken from no less than two interior fill stations and sent to an approved gas analysis laboratory to verify compliance with the parameters of NFPA 1989.
- G. CONNECTION COMPATIBILITY.** Connections shall be verified to be compatible with the mobile air unit and the SCBA cylinders used by the fire department.
- H. FINAL COMMISSIONING.**
 - 1. The installing contractor shall provide training for the fire department upon the successful conclusion of all inspections, testing and commissioning procedures. This training shall be accomplished in three (3) separate shifts of not more than three (3) hours per session. The fire department may request additional training when the regular testing and certification contractor performs testing and certification procedures. Training sessions shall be by mutual consent with the building owner or authorized agent.
 - 2. Internal surfaces of all pressurized materials and components shall be certified as free of contamination.
 - 3. The building owner shall provide the fire department with written verification of a testing and certification contact for the FARS system.

4. Commissioning report. The registered design professional shall certify the entire FARS has been installed, tested and commissioned in accordance with the adopted fire code and the approved plans through submission of a sealed commissioning report, provided to CSFD.
- I. MAINTENANCE.** The FARS shall be continuously maintained in an operative condition and shall be inspected and certified as per the following schedule:
1. Quarterly air samples shall be taken and submitted to an accredited testing laboratory. Samples shall be taken within 90 days of each other, ± 5 days.
 2. Annually the FARS system shall be inspected and re-certified in accordance with the acceptance testing procedures listed previously.
 3. Modifications. Breathing air samples shall be taken after any event including but not limited to, alteration, repairs, replacement or relocation of any FARS or a component of the FARS. Passing test results shall be received before returning the system to service.

ANNEX A: INSPECTION AND TESTING CHECKLIST

Air Storage System, distribution pipe, tube and fittings

Code Section	Requirement	Contractor	Fire Inspector
L104.8	Stainless steel tubing meeting ASTM-269 and is grade 316 or equivalent	X	
L104.15.2	Stainless steel fittings meet ASTM-479 and is grade 316 or equivalent	X	
	Review manufacturer mill report	X	
	Confirm welding procedures and weld samples are in conformance with ASME B31.1	X	
L104.10	Piping/tubing and fittings protected from mechanical damage – 2-hour rating		X
L104.15.2.1	Tubing supports installed max 5-ft spacing and properly secured to structure		X
L104.8.2	Marking – piping/tubing identified at each valves, wall/floor/ceiling penetrations, changes of direction and at least every 20-feet.		X
L104.15.1.2	Room provides sufficient clearance around equipment	X	

Interior Fill Stations

L104.13.1	Confirm locations are per approved plans		X
L104.13.4	Confirm cabinet minimum 18-gauge carbon steel	X	
L104.13.4.1	Confirm cabinet door hinges are internal		X
	Confirm minimum of 20% of cabinet door is tempered break-through glass		X
L104.8.2	Confirm cabinet markings		X
L104.12	Confirm cabinet enclosure secured form unauthorized tampering		X
L104.13.4.3	Confirm discharge outlet of each cylinder filling hose is provided with female RIC/UAC designed to connect to a male RIC/UAC.		X

	Cylinder filling hose shall not be kinked, if coiled, the minimum bend radius of 4-inches.		X
L104.13.2	Valves controlling cylinder fill hoses are slow-operating valves		X
External Mobile Air Connection (EMAC)			
L104.14.4	Panel is within NEMA 4 18-gauge carbon steel cabinet	X	
L104.14.1	Location per approved plans – there may be multiple EMACs.		X
L104.14.3	Working space of no less than 36 inches x 36 inches x 78 inches tall is provided in front of and to the sides of the EMAC		X
L104.14.2	Vehicle impact protection is provided where subject to vehicular impact		X
L104.8.2	Confirm required cabinet markings		X
L104.12	Confirm cabinet is secured from authorized access/tampering		X
L104.14.5	Confirm internal components in compliance with code	X	
Air Monitoring System			
L104.13.1	Confirm display panel, pressure maintenance cylinder and content analyzer location are in accordance with approved plans		X
L104.16.3	Confirm minimum two display panels, one at EMAC and one in FCC		X
L104.16	Minimum of two 6-point content analyzers		X
L104.16.2	Verify fire alarm signals, annunciation at EMAC and FCC or other constantly attended location		X
L104.16.4	Verify operation of low-pressure monitoring switch		X
L104.12	Verify air monitoring system is secured form unauthorized access or tampering		X

Acceptance Testing			
L105.1	Pneumatic Test at 6,050 psi for 24 hours	X	X
	Cylinder filling performance	X	
	Air monitoring system provides required visual indicators	X	X
	Supervisory signals transmitted as required: tamper switches, air monitoring system	X	X
	Connections for FD use verified to be compatible with MAU, SCBA	X	X
	Air Samples from minimum 2 fill stations and sent to lab for analyzing – provide report to fire inspector	X	X
	Verify system is secured during air quality analysis	X	X
	Functional test of low-pressure monitoring switch, 4,950 psi	X	X
	Internal surfaces of all pressurized materials shall be certified as free of contamination	X	
	Verify system filled to operating pressure 5,500 psi, all control valves placed in normal operating position all doors are secured and locked	X	X
	Testing and certification contract in place		X
	Registered design professional shall provide their sealed commissioning report		X