



# FIRE & EMS BULLETIN

## CASCADE SYSTEM TRAINING REQUIREMENTS

New Jersey PEOSH Standard N.J.A.C. 12:100-10.14(a) states, “air cylinders for respiratory equipment shall be filled only by trained personnel”. To assist fire agencies who use cascade systems to refill SCBA cylinders, we provide the following lesson plan.

### Learning Objectives

By the end of this training, participants will be able to:

- Describe the purpose and components of a multiple-cylinder SCBA cascade system.
- Explain the cascade filling sequence (lowest pressure to highest).
- Safely connect and disconnect SCBA cylinders to the cascade system.
- Perform a pre-use inspection of the cascade system.
- Identify and respond to common malfunctions and emergency procedures.

### Lesson Outline

#### Module 1: Introduction & Theory

- System components: high-pressure cylinders, manifold, fill hoses, check valves, pressure gauges, relief valves, fill station
- Pressure ratings and cylinder markings (DOT specifications, hydrostatic test dates)
- Regulatory overview: OSHA 29 CFR 1910.134, NFPA 1500, NFPA 1404, and manufacturer guidelines

#### Module 2: System Inspection & Setup

- Pre-use inspection checklist walkthrough
  - Cylinder inspection: visual damage, hydrostatic test date, valve condition
  - Manifold and hose inspection: connections, O-rings, leaks
  - Pressure gauge verification
  - Identifying cylinder pressure levels and cascade order
  - Securing cylinders properly (chained or strapped per manufacturer requirements)

#### Module 3: Cascade Filling Operations

- When refilling an SCBA cylinder using a cascade system, start with the lowest pressure storage cylinder (or bank) first. You then progress sequentially to higher-pressure cylinders to finish or top off the bottle.
- Step-by-step cascade filling procedure.
  - Connecting fill hose to SCBA cylinder — verify thread compatibility and O-ring condition
  - Slow, controlled valve opening to prevent pressure surge
  - Monitoring fill pressure — do not overfill beyond rated cylinder pressure
  - Switching to the next cascade cylinder when pressures equalize
  - Disconnecting fill hose safely — bleed pressure before disconnect
- Documenting fills: cylinder pressures before/after, date, time, and operator name

#### Module 4: Malfunctions & Emergency Procedures

- Overpressure conditions and relief valve activation — evacuate area, notify supervisor
- Leaking connections — isolate valve, shut down system, do not attempt repair under pressure
- Damaged cylinder — do not use, tag out of service, notify supervisor immediately
- Cylinder valve failure — close adjacent valves, depressurize safely
- Emergency shutdown procedure — step-by-step sequence

## Module 5: Hands-On Practical

- Instructor demonstration of full cascade fill procedure
- Participants perform pre-use inspection (supervised)
- Participants perform cascade fill sequence (supervised, one at a time)
- Participants practice emergency shutdown procedure
- Q&A and debrief

## Module 6: Knowledge Check & Wrap-Up

- Written or verbal knowledge check
- Review of key points and common errors observed during practical
- Documentation of training completion

### Suggested Knowledge Check Questions

The following questions may be administered verbally or as a written quiz. A score of 80% or higher is required.

1. What is the primary purpose of a multiple-cylinder SCBA cascade system?

*Answer: To provide a continuous, extended supply of breathing air for SCBA refilling without requiring a compressor on-site.*

2. In what order should cascade cylinders be used during a fill operation?

*Answer: Always begin with the lowest-pressure cylinder and work up to the highest-pressure cylinder.*

3. What two items must be verified on a cascade cylinder before placing it in service?

*Answer: The hydrostatic test date (must be current) and a visual inspection for physical damage.*

4. What must be done before disconnecting a fill hose from an SCBA cylinder?

*Answer: Bleed (depressurize) the fill hose before disconnecting to prevent sudden pressure release.*

5. What action should be taken if a cascade cylinder is found to be physically damaged?

*Answer: Remove it from service immediately, tag it out, and notify the supervisor. Do not use it.*

6. What is the minimum pressure that should be maintained in cascade cylinders before they are removed from service for refilling?

*Answer: Typically, 200 psi (or per manufacturer specification) to prevent contamination of the cylinder.*

7. Which OSHA standard governs the use of SCBA and respiratory protection in the workplace?

*Answer: OSHA 29 CFR 1910.134 — Respiratory Protection.*

8. What is the function of a relief valve on a cascade system?

*Answer: To automatically release excess pressure if the system pressure exceeds the rated safe limit, preventing overpressure failure.*

9. How often must high-pressure cascade cylinders undergo hydrostatic testing?

*Answer: Every 5 years for most DOT-specification cylinders (verify with cylinder markings and applicable DOT regulations).*

10. What is the correct response if a connection begins leaking during a cascade fill operation?

*Answer: Stop the fill immediately, close the cylinder valve, bleed the hose pressure, and inspect/replace the O-ring or fitting before resuming.*