APPARATUS & EQUIPMENT TESTING FOR FIRE DEPARTMENTS

Every year, many changes occur in the Fire Service. Promotions in rank occur in the career sector, and new Fire Chiefs are elected and sworn in at Volunteer Fire Departments. Once these celebrations of the profession end, the administrative tasks begin. Formulating and setting budgets, etc. Chief Officers, Commissioners, and Business Administrators are reminded to leave room in the budget for the essential annual testing of Fire Apparatus and Equipment. Budgeting considerations should account for repairs and replacements of equipment that failed testing.

It is essential to note that the New Jersey Public Employee Occupational Safety and Health (NJPEOSH) and manufacturers will rely on the National Fire Protection Association (NFPA) as the industry standard. Although New Jersey is not an "NFPA State," PEOSH can cite fire departments under the General Duty Clause (12:100-10.16) for failing to comply with manufacturers' recommendations or NFPA Standards.

Fire Service Ground Ladder Testing

Testing fire service ladders is governed by NFPA 1932, the *Standard on Use, Maintenance, and Service Testing of In-Service Fire Department Ground Ladders*. These protocols ensure ladders can safely support a 750 lb working load with a 4:1 safety factor.

When to Test

Ladders must be service tested on the following schedule:

- **Annually:** At a minimum once every 12 months.
- **Before Initial Service:** Before being used for the first time.
- **After Incidents:** Following suspected overloading, impact loading, unusual use, or heat exposure.
- **After Repairs:** Whenever a ladder has been repaired (except for simple halyard replacement).
- **Failed Heat Sensor:** If any heat sensor label has changed color (typically turning black), it indicates exposure to temperatures above 300°F.

Core Testing Methods

- **Visual Inspection**
  - Performed monthly and after each use.
  - Inspectors check for structural defects, such as cracks, poor welds, loose bolts, frayed halyards, and inadequate lubrication of slide areas.
  - **Heat Sensors:** Check that the four sensors per section are within their 5-year expiration date and have not been triggered.

- **Horizontal Bend Test**
  - The ladder is extended and placed horizontally on sawhorses 6 inches from each end.
  - A 350 lb pre-load is applied for one minute to "set" the ladder, then removed to establish a baseline measurement.
  - A 500 lb test load is applied to the center for five minutes.
  - Pass/Fail: The ladder fails if there is a permanent "set" (bending) exceeding specific tolerances (e.g., 1/2" for ladders up to 25 ft) after the load is removed.

- Hardware & Hook Tests
    - **Roof Hooks:** Tested with 1,000 lbs of pressure to ensure they do not deform or fail.
    - **Extension Hardware (Pawls/Dogs):** Subjected to 1,000 lbs of pressure to verify the locking mechanisms can hold a weight exceeding their rated capacity.

Maintenance Tips

- **Lubrication:** Use candle wax or paraffin on slide areas to ensure smooth operation.
- **Cleaning:** Use mild soap and water; harsh chemicals can inadvertently damage heat sensor labels.
- **Marking:** Any ladder that fails a test must be immediately marked "Out of Service" and destroyed if it cannot be safely repaired.

Aerial Ladder Testing

NFPA standards for fire department aerial ladder testing primarily fall under NFPA 1914 (Testing Fire Department Aerial Devices). Requiring annual visual/operational tests and less frequent, intensive nondestructive testing (typically every five years) to check for structural integrity, like cracks and fatigue in critical components, supplementing annual checks and ensuring overall safety and compliance.

Testing Frequencies

- **Annual:** Comprehensive visual inspections, operational tests, and load tests are required yearly.
- **Every Five Years (or as needed):** More intensive NDT (such as magnetic particle or ultrasonic testing) is required to detect hidden flaws in metal components.
- **After Stress/Damage:** NDT and thorough testing must be done after unusual stress or damage.

Types of Tests

- **Visual Inspection:** Checking for physical damage, leaks, and wear.
- **Operational Test:** Verifying all movements, outriggers, and controls function correctly.
- **Load Test:** Applying weight to the aerial device to assess its stability and strength.
- **Nondestructive Testing (NDT):** Using methods like ultrasonic, magnetic particle, or dye penetrant to find cracks in structural parts (rails, welds, bolts).
- **Hydraulic Analysis:** Oil analysis and system pressure tests.

Why It Matters

- Ensures firefighter and public safety.
- Prevents unexpected failures.
- Keeps equipment in reliable, operational status.
- Maintains compliance with safety regulations.
- Annual NFPA Ladder Testing Standards

Fire Apparatus Pump Testing

The key NFPA standard for annual fire apparatus pump testing is NFPA 1911, which outlines the procedures for testing fire apparatus pumps. These tests, performed by qualified personnel, verify the pump's ability to deliver water at the required pressures and flows, often involving a series of timed tests (e.g., 20 minutes at 100% of capacity, 5 minutes at 165 psi, etc.).

NFPA 1911 (Standard for Service Testing of Fire Apparatus): Specifically covers the annual performance testing of rated fire pumps on apparatus, detailing test phases such as vacuum, primer, and flow tests at various pressures.

Typical Annual Pump Test Procedures (Based on NFPA 1911)

- **Vacuum Test:** Checks the pump's ability to lift water (e.g., 5 mins).
- **Primer Test:** Measures the time to start pumping (e.g., <30 sec for smaller pumps).
- **Rated Capacity Test:** 20 minutes at 100% rated flow and 150 PSI net pump pressure.
- **Overload Test:** 5 minutes at rated capacity and 165 PSI.
- **70% Capacity Test:** 10 minutes at 70% capacity and 200 PSI.
- **50% Capacity Test:** 10 minutes at 50% capacity and 250 PSI.

Purpose of Testing

- **Verify Performance:** Confirm the pump meets its original rated capacity and performance curve.
- **Identify Deficiencies:** Detect issues early to ensure readiness for emergencies.
- **Documentation:** Create a record for authorities, ISO ratings, and insurance, often requiring a qualified professional to perform and report on the tests.

Fire Hose Testing

Fire Hose Testing involves an annual physical inspection and periodic pressure testing (every 3-5 years) to check for leaks, damage, and coupling integrity, following NFPA standards. The process includes laying out hoses, filling them with water, removing trapped air, pressurizing to a set limit (often 10% above normal operating pressure) for a set time (like 3-5 mins), checking for leaks at couplings and along the length, marking any failures, and then cleaning and drying the hose.

Physical Inspection (Annual)

- **Unroll & Inspect:** Check for cuts, abrasions, chemical damage, mildew, or chemical burns on the hose jacket.
- **Couplings:** Look for missing lugs, loose collars, or signs of wear.
- **Nozzles:** Verify controls function correctly.

Pressure Testing (Service Test)

- **Layout:** Lay hoses straight, up to 300 ft, on a dry surface, away from obstructions.
- **Connect:** Attach to a pump or hose tester, attaching nozzles or caps with bleeder valves.
- **Fill & Purge Air:** Open nozzles/bleeders to fill the hose with water and expel all air; then close them.
- **Pressurize:** Slowly increase the pressure to the required test level (e.g., 250 psi for most sizes, or 10% above the maximum operating pressure).
- **Hold & Check:** Maintain pressure for 3-5 minutes, checking couplings for slippage (mark the coupling/hose junction) and the hose for leaks.
- **Release Pressure & Post-Test:** Slowly reduce the pressure, then clean and dry the hose thoroughly before storing it.

Key Test Pressures (Examples)

- **Attack Hoses (1.5", 1.75", 2.5"):** Often 250 psi.
- **Supply Hoses (4", 5"):** Often 200 psi.
- **General:** 10% above the highest operating pressure, but at least 100 psi.

Why It's Done

- Ensures hose integrity and safety during firefighting operations.
- Detects internal lining issues (delamination)that might not show in static tests.
- Maintains compliance with standards like NFPA 1962

SCBA Maintenance

The NFPA standard for annual SCBA flow testing is NFPA 1852, *Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)*, which mandates annual performance testing using a calibrated breathing machine to ensure the unit delivers correct airflow, pressure, and activates alarms according to manufacturer specifications. This testing verifies regulator function, checks for leaks, and confirms all components meet safety criteria, with documentation required by a certified technician.

NFPA 1852 for Flow Testing

- **Frequency:** At least annually, and before new units are placed in service.
- **Equipment:** Must be performed on a calibrated breathing machine that meets NFPA 1852 specifications.
- **Procedure:** Tests airflow delivery under varying breathing rates and pressures, checks the low-air alarm, and inspects for leaks.
- **Compliance:** Units must meet both NFPA standards and the specific SCBA manufacturer's specifications, whichever is stricter.
- **Documentation:** Requires detailed records of test results and certifications by a qualified technician.

Why It's Important

- **Safety:** Ensures firefighters receive breathable air and warnings in hazardous environments.
- **Compliance:** Meets regulatory requirements for respiratory protection programs.
- **Reliability:** Validates the entire system's integrity, including regulators, hoses, and alarms.

Servicing SCBA Compressors

Servicing SCBA compressors and fill stations requires strict adherence to manufacturer guidelines, NFPA standards (like NFPA 1852, 1851), and OSHA (PEOSH) regulations (1910.134), focusing on clean, Grade D air; regular inspections, cleaning, filter changes, and lubrication; prompt replacement of worn parts; and annual professional servicing, ensuring only certified personnel handle complex maintenance for safe, reliable breathing air.

General Requirements

- **NFPA 1852 & 1851:** These standards guide the care, maintenance, and selection of SCBA and respiratory protection, mandating regular inspections and professional servicing.
- **OSHA 1910.134 (PEOSH):** Requires Grade D breathing air, regular air sampling, and documentation for workplace safety.
- **Manufacturer Manuals:** Always follow specific intervals and procedures outlined in the compressor and SCBA manuals for maintenance and service.

Compressor and Fill Station Maintenance

- **Air Quality:** Must produce Grade D, clean, dry air, free from contaminants and moisture.
- **Moisture Elimination:** Regularly drain condensate from tanks and filtration systems.
- **Filtration:** Change air filters and oil separator elements as scheduled.
- **Lubrication:** Change the compressor oil and filters according to the manufacturer's manual, typically every quarter or every other year.
- **Hoses & Fittings:** Inspect and replace worn or damaged hoses immediately.
- **Heat Exchanger:** Keep the cooling system clean to prevent clogging.
- **Belts & Pulleys:** Check belt tension and pulley nut torque quarterly.

Inspection Frequency

- **Before/After Each Use:** Basic functional checks, cylinder pressure verification (above 90% complete), and cleanliness.
- **Monthly:** Comprehensive inspection for wear, damage, and proper function; check belt tension.
- **Annually (or per manufacturer):** Full servicing, disassembly, cleaning, component replacement, and flow testing by authorized personnel.

Key Personnel and Procedures

- **Certified Technicians:** Annual major servicing and flow tests must be done by certified technicians.
- **Out-of-Service Tagging:** Clearly tag and remove any defective equipment from service.
- **Documentation:** Maintain records of all inspections, maintenance, and air quality tests.

Servicing SCBA Cylinders

Servicing SCBA cylinders involves regular visual checks, annual full servicing by authorized technicians (including flow tests, cleaning, and parts replacement), and periodic hydrostatic testing every 3-5 years (depending on cylinder material) to ensure safety, with strict adherence to manufacturer guidelines and clean air standards (like CGD Grade D) for refilling. Key requirements include documented maintenance, proper cylinder identification, and compliance with DOT regulations.

Regular Inspections (Monthly/Before Each Use)

- **Visual Inspection:** Check for damage, cracks, corrosion, and cleanliness.
- **Functionality:** Verify pressure gauges, valves, and quick-connect fittings work correctly.
- **Air Supply:** Ensure cylinder is fully charged with clean, dry air.

Annual Servicing (By Authorized Technician)

- **Full Disassembly & Cleaning:** Regulator, facepiece, low-air alarm, and other components.
- **Parts Replacement:** Replace all worn or damaged parts, O-rings, and filters.
- **Function & Flow Test:** Test the entire system, including positive pressure tests.
- **Documentation:** Update service log and apply a new service/calibration label.

Periodic Hydrostatic Testing (Every 3-5 Years)

- **Fiberglass/Kevlar Cylinders:** Every 3 years.
- **Carbon Fiber/Aluminum/Steel Cylinders:** Every 5 years.
- **Process:** Performed by certified facilities to check cylinder integrity under pressure, often following DOT 49 CFR 180.205 standards.

  Refilling Requirements
- **Clean Air:** Use only Grade D or better breathing air, free from oil, moisture, and contaminants.
- **Trained Personnel:** Only trained operators should refill cylinders.
- **Checklist:** Follow specific procedures, including checking compressor safety, air intake, and proper valve operation.

Key Regulations & Standards

- Comply with PEOSH, NFPA, DOT, and manufacturer guidelines.
- **Documentation:** Maintain detailed records for each unit.

Maintenance and testing costs can be expensive. However, necessary for operational readiness, community risk reductions, compliance with regulatory agencies such as PEOSH, OSHA, NIOSH, and ISO, and above all else, the safety of firefighters