

NITROGEN-GENERATING SPRINKLER CORROSION INHIBITING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This section outlines the requirements for the nitrogen-generating sprinkler corrosion inhibiting system. The work described in this section includes all engineering, labor, materials, equipment, and service required to design, supply, install, test, and commission the nitrogen generating corrosion inhibiting system.
- B. Section includes:
 - 1. Pipe, fittings, and specialties.
 - 2. Sprinkler corrosion inhibiting system.
 - 3. Related sections:
 - a. 01 43 00 Quality Control.
 - b. 21 05 00 Common Work Results for Fire Suppression.
 - c. 21 06 00 Schedules for Fire Suppression.
 - d. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. A53 / A53M – Standard Specification for Pipe, Steel, Black, Welded and Seamless.
 - 2. A135 / A135M – Standard Specification for Electric-Resistance-Welded Steel Pipe.
 - 3. A234 / A234M – Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 4. A733 – Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
 - 5. A865 – Standard Specification for Threaded Couplings, Steel, Black, Welded or Seamless, for Use in Steel Pipe Joints.
- B. American National Standards Institute (ANSI):
 - 1. B2.1 – Basic Standards for Steel Pipe Threads.
 - 2. B16.3 – Malleable Iron Threaded Fittings.
 - 3. B16.39 – Malleable Iron Threaded Pipe Unions.
 - 4. B1.20.1 – Pipe Threads, General Purpose (Inch).

1.3 SYSTEM DESCRIPTION. Furnish and install a sprinkler corrosion inhibiting system that fills the sprinkler piping with 98% nitrogen at required supervisory pressure. The system shall be NITROGEN-PAC™ SC Series, manufactured by UNITED Fire Systems (908-688-0300, x222) and shall consist of:

- A. A self-contained, factory-assembled nitrogen generator unit with:
 - 1. UL Listed oilless compressor.
 - 2. UL Listed refrigerated dryer.
 - 3. Particle and coalescing filters.
 - 4. Nitrogen membrane separator.
 - 5. Nitrogen receiver.
 - 6. Manual bypass valves.
 - 7. Digital compressor runtime monitor.
 - 8. Visual indicators for normal and bypass modes.
 - 9. Single-point connection for 115 VAC single-phase power.
 - 10. Leveling feet.
 - 11. Single drain connection point for all required drains.
- B. Purge vent assemblies.
- C. Corrosion monitor assemblies.
- D. Nitrogen analyzer.
- E. Steel pipe or approved tubing to connect the self-contained unit to the sprinkler system.

1.4 PERFORMANCE REQUIREMENTS

- A. Design and performance of systems, components, and methods specified herein shall comply with all applicable referenced codes and standards.
- B. Contract drawings indicate the general arrangement of the system and are a guide for intent only. Contractor is responsible for providing and installing all equipment necessary to complete the installation in compliance with all applicable requirements.
- C. Contractor shall design, furnish, and install the sprinkler corrosion inhibiting system(s) per this specification, and shall provide Professional Engineering services needed to assume Engineering responsibility.
- D. Pipe sizing indicated on contract drawings is based on preliminary hydraulic estimates for routing indicated. Contractor is responsible for final pipe sizing based on as-installed locations.
- E. All piping system components shall be approved for at least 175 PSIG (1200 kPa gage) working pressure.
- F. All equipment and materials shall be new and unused.

1.5 QUALITY ASSURANCE

- A. Perform a level of Quality Control in accordance with Section 01 43 00.
- B. Furnish a Quality Work Plan per Section 01 43 00 for this work.
- C. Pipe shall bear label, stamp, or other markings indicating material specification.
- D. Shop drawings and design calculations shall include a seal and signature by a qualified Licensed Professional Engineer, registered in the State where jobsite is located.

1.6 SUBMITTALS

- A. General Requirements. The Engineer shall review all submittals for conformance to the contract drawings and specifications. The contractor shall be required to resubmit any materials, with appropriate modifications, that are found to be in non-conformance with the requirements of the contract drawings and these specifications after review by the Engineer. Approval of the submittals by the Engineer shall not relieve the Contractor of their responsibility to meet the requirements of the drawings and specifications.
- B. Action Submittals.
 - 1. Product Data. For each type of product indicated, include, as applicable, product rated capacities, operational characteristics, electrical characteristics, materials of construction, standards of construction, and approvals. Manufacturer data sheets of each component shall indicate dimensions, mounting details, weight, voltage and current requirements, and manufacturer part number.
 - a. Self-contained nitrogen generating assembly.
 - b. Purge vent assembly.
 - c. Air maintenance device.
 - d. Nitrogen analyzer,
 - e. Corrosion monitor assembly.
 - f. Pipe, fittings, and pipe hanging devices.
 - 2. Shop Drawings. Include all pertinent information such as structural members, ceiling construction, partitions, lighting fixtures, air diffusers and registers, speakers, and piping runs.
 - a. Plan views of all rooms where nitrogen generating assemblies are located.
 - b. Plan views of all areas where intermediate pipe runs are located.
 - c. Normal pressure values (in PSIG) to be expected on all system pressure gages.
 - d. All details necessary for proper evaluation and installation of design, including:
 - i. Provisions for commissioning, inspecting, and testing.
 - ii. Pipe hanger locations and assembly.

3. Calculation. Include the sprinkler system size (in gallons) and a calculation to substantiate nitrogen generator system size selection. The system sizing calculation shall take into account the volume of all piping networks, the largest single piping network, the system piping allowable leakage rate permitted by NFPA 13, and the purging sequence that establishes and maintains 98% nitrogen throughout the piping network.
- C. Delegated-Design Submittals. Include performance requirements and design criteria analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Information Submittals.
 1. Qualification data for installing contractor.
 2. Qualification data for professional engineer.
- E. Commissioning Submittal: Field Test Plan.
- F. Closeout Submittals. Provide six (6) sets of:
 1. As-built drawings.
 2. Operation and maintenance instructions for self-contained nitrogen generating system, including instructions for:
 - a. Refrigerated dryer.
 - b. Float drains.
 - c. Particle and coalescing filters.
 - d. Purge vent assembly.
 - e. Nitrogen analyzer.
 - f. Air maintenance device.
 3. Final commissioning report, including pressure gage readings as indicated in this specification, and written verification of 98% or more nitrogen purity at each purge valve assembly.

PART 2 - PRODUCTS

2.1 SPRINKLER CORROSION INHIBITING SYSTEM. Furnish and install a nitrogen generating sprinkler corrosion inhibiting system. This system shall provide nitrogen for supervisory pressure of the preaction sprinkler system pipe instead of air. The system shall be NITROGEN-PAC™ SC Series, manufactured by UNITED Fire Systems (908-688-0300, x222).

- A. General Requirements.
 1. The nitrogen generating system shall provide a minimum of 98% purity nitrogen within the sprinkler pipe after a reasonable time allowed for purging.
 2. An AC circuit, of the proper phase and current and voltage rating, shall be provided by the Electrical Contractor for the self-contained system assembly.
- B. Specific Product Requirements.
 1. Self-Contained System Assembly. A self-contained, factory-assembled system assembly for delivering 98% dry nitrogen shall be provided. All parts of the self-contained system assembly shall work together as a system. The assembly shall be properly sized to deliver the proper volume of fast-fill air and 98% nitrogen to the preaction and / or dry-pipe sprinkler system(s) to be protected. The self-contained system shall be UNITED Fire Systems NITROGEN-PAC™ SC Series or approved equal. The self-contained system shall consist of the following parts:
 - a. Compressor. The compressor shall be a single unit equipped with an oilless pump, electric motor, and start capacitor. The compressor shall be factory-assembled to the self-contained system assembly. The compressor shall use single-phase 115 VAC power.

- b. Refrigerated Dryer. A refrigerated dryer shall be supplied to remove condensation moisture from the air supplied by the compressor. Systems using only an aftercooler shall not be acceptable. The refrigerated dryer shall be factory-assembled to the self-contained system assembly. The dryer shall produce air with a -40 degree Fahrenheit dew point at the maximum SCFM operating mode of the compressor. The dryer shall be based on motor-driven evaporative cooling, with moisture removed through a separator and automatic condensate drain. A heat exchanger shall re-warm the cooled, dry air. The refrigerant shall be R-134A or other zero-ozone-depletion refrigerant.
 - c. Nitrogen Generator Cabinet. The system nitrogen generator cabinet shall:
 - i. Produce minimum 98% nitrogen using membrane separator technology.
 - ii. Be factory-assembled to the self-contained system assembly.
 - iii. Be contained in 14 gage steel enclosure, powder coated red inside and out, with door attached by heavy gage continuous hinge.
 - iv. Use a nitrogen separator membrane to supply sufficient 98% purity nitrogen generation rate in SCFM to maintain 98% nitrogen within the sprinkler system piping.
 - v. Be equipped with a two-stage (particulate and coalescing) filtration system that protects the nitrogen separator membrane to facilitate long service life.
 - vi. Be equipped with valves to facilitate bypassing the nitrogen generation components, allowing fast-fill (30 minute maximum) of the sprinkler piping with air, as required by NFPA 13.
 - vii. Contain a metering valve, two (2) pressure gauges, a drain valve and all required connections for testing and maintenance.
 - d. Nitrogen Receiver. The system shall be equipped with a nitrogen receiver with a capacity of 22 gallons. The nitrogen receiver shall be ASME code compliant, rated for 200 PSIG, and shall be equipped with a safety relief valve. The receiver shall be factory-assembled to the self-contained system assembly.
 - e. Control Cabinet. A control cabinet shall be part of the self-contained system assembly. User access to the interior of the cabinet shall be restricted by using screws to fasten the cover to the control cabinet. The cover of the control cabinet shall have a digital runtime monitor displaying, in hours and minutes, the cumulative run time of the compressor motor. The cover shall also have two (2) visual indicators: one (1) red indicating the system is in bypass (providing air) mode, and one (1) green indicating the system is in normal (providing nitrogen) mode.
2. Air Maintenance Device. Each sprinkler riser shall be equipped with an air maintenance device, to properly regulate the nitrogen and air pressure to suit the valve installed in the riser. The device shall be equipped with an adjustable regulator, adjusted at system commissioning to the pressure required by the preaction / dry sprinkler valve. The device shall also be equipped with bypass valving for fast-fill in 30 minutes or less as required by NFPA 13. The air maintenance device shall be a UNITED Fire Systems Model AMD-1, or approved equal.
 3. Purge Vent Assembly. The sprinkler system piping shall be equipped with at least one purge vent assembly. The purge vent assembly shall be equipped with a manually-operated isolation ball valve, strainer, float valve that closes when sprinkler water reaches the device, fixed restriction orifice, and nitrogen purity analyzer port. The purge vent assembly shall permit purging of the sprinkler system piping per manufacturer recommendations, and monitoring of the nitrogen purity within the piping. At least one (1) purge vent assembly shall be provided per sprinkler system riser. The purge vent assembly shall be a UNITED Fire Systems Model PVA-3, or approved equal.

4. Corrosion Monitor Assembly, The sprinkler system piping shall be equipped with a corrosion monitor assembly, consisting of a precision-manufactured corrosion coupon, a pressure switch that will sense supervisory pressure when the corrosion coupon is perforated by corrosion, a shutoff ball valve, and a bleed valve. The corrosion monitor assembly shall be UNITED Fire Systems Model CMA-1, or approved equal.
5. Nitrogen Purity Analyzer. The system shall be supplied with a hand-held portable battery-operated nitrogen purity analyzer. The analyzer shall have a digital display, showing the nitrogen purity in percent (measurement range 0 to 99.9%) with a 0.1% resolution. Flexible tubing shall connect the body of the analyzer to a female quick-connect fitting, compatible with the male quick-connect fittings located in the nitrogen generator cabinet and each purge vent assembly. Proper performance of the nitrogen generation system shall be established with readings taken with the analyzer. The nitrogen purity analyzer shall be a UNITED Fire Systems Model NA-1, or approved equal.

2.2 PIPE, FITTINGS, AND SPECIALTY

- A. General Requirements. Comply with requirements in "Piping Schedule" article and on contract drawings for applications of pipe and fitting materials and joining methods. For applicable standards, refer to 1.2.
- B. Pipe.
 1. All pipe shall be black. Galvanized pipe shall not be permitted.
 2. All pipe shall be minimum Schedule 40. Schedule 10 pipe shall not be permitted.
 3. All threads shall be NPT.
- C. Fittings and Couplings.
 1. All fittings and couplings shall be black or factory-painted. Galvanized fittings shall not be permitted.
 2. Fittings and couplings shall be minimum Class 150.
- D. Unions.
 1. Unions shall be black. Galvanized unions shall not be permitted.
 2. Unions shall be malleable or ductile iron.
 3. Unions shall be used only as necessary where joining pipe is impossible or impractical without them.
- E. Hangers.
 1. Design, provide, fabricate, and install all hangers and supports adequate to support pipe, allow for imposed forces, satisfy structural requirements, and maintain proper clearances to adjacent piping, equipment, and structural elements.
 2. Hangers and supports shall keep piping in alignment without sagging or interference.

PART 3 – EXECUTION

3.1 PIPING INSTALLATION

- A. Location and Arrangement. Contract drawings, plans, schematics, and diagrams indicate general location and arrangement of piping. Working drawings shall indicate actual piping installation layout. Install piping per working drawings.
- B. Deviations. Installation deviations from approved working drawings require written approval from the Engineer. During installation, do not deviate from approved working drawings without written approval from the Engineer.
- C. Fittings. Use listed fittings to make changes in direction and pipe size reductions.
- D. Pipe Ends. Ream ends of pipe to remove burrs. Bevel plain ends of pipe.
- E. Examination. Examine all pipe and fittings thoroughly before installation. Do not install damaged or defective pipe or fittings.
- F. Cleaning. Remove scale, slag, dirt, oil, cutting and threading shavings, and debris from inside and outside of pipe after fabrication and before assembly. Use a non-toxic solvent to ensure pipe is clean. Pipe shall be free of solvent and water when installed.

3.2 ELECTRICAL INSTALLATION

- A. Location and Arrangement. Contract drawings, plans, schematics, and diagrams indicate general location and arrangement of electrical devices. Working drawings shall indicate actual device installation layout. Install devices per working drawings.
- B. Deviations. Installation deviations from approved working drawings require written approval from the Engineer. During installation, do not deviate from approved working drawings without written approval from the Engineer.
- C. Wiring.
 - 1. All wiring shall be of the proper size to conduct the circuit current, but shall not be smaller than #18 AWG unless permitted by the local electrical code.
 - 2. Wire that has scrapes, nicks, gouges, or crushed insulation shall not be used.
 - 3. The manufacturer's minimum wire-bending radii shall be observed in all enclosures, raceways, and conduits.
 - 4. Aluminum wire shall not be used.
 - 5. Splicing of circuits shall be kept to a minimum, and is only permitted in an electrical box suitable for the purpose. Appropriate hardware shall be used to make the wire splices. Wires that are spliced together shall have the same color insulation.
 - 6. Wire with white insulation shall be used exclusively for the identification of the neutral conductor of AC circuits. Wire with green insulation shall be used exclusively for the identification of the earth-ground conductor of AC or DC circuits. Appropriate color-coding shall be utilized for all other field wiring.
 - 7. All electrical circuits shall be numerically tagged with suitable markings at each terminal point. All circuits shall correspond with the installation drawings.
- D. Raceways.
 - 1. Wiring to be installed in a minimum $\frac{3}{4}$ inch EMT using steel compression fittings.
 - 2. All electrical enclosures, raceways, and conduits shall be provided and installed in accordance with applicable codes and intended use, and shall contain only those electrical circuits associated with the fire detection and control system. No circuit or circuits that are unrelated to the fire detection system shall be routed through the enclosures, raceways, and conduits dedicated to the fire detection system.

3.3 MECHANICAL TESTING

- A. Testing to be performed by the installing licensed sprinkler contractor in accordance with manufacturer's commissioning instructions.
- B. Test Plan.
 - 1. The Contractor shall submit a test plan that describes how the system shall be tested. This shall include a step-by-step description of all tests and shall indicate type and location of test apparatus to be used. At a minimum, the tests to be conducted shall be per the relevant referenced codes and any additional supplemental tests required by the authority having jurisdiction.
 - 2. Tests shall not be scheduled or conducted until the Engineer approves the test plan.
- C. Execution. All tests shall be performed in the presence of the Engineer and the authority having jurisdiction. The Contractor shall record all equipment, tests and system configurations in a format approved by the Engineer and the authority having jurisdiction. A copy of the commissioning tests and results shall be provided to the Engineer, the authority having jurisdiction, and the end user.
- D. Commissioning. The system shall be commissioned by a representative from the manufacturer, or a representative from the installing contractor trained by the manufacturer. The Engineer, at his / her option, may observe the commissioning process. The process shall include at least the following steps.

1. Verify that all aspects of the installation have been completed, including mechanical interconnection and electrical power installation.
2. Perform fast-fill of each sprinkler piping network with air from compressor with nitrogen system in bypass mode. Each network shall fill in 30 minutes or less. Examine each piping network for excessive leakage. If any network fails to fill in 30 minutes, or excessive leakage is found, the contractor shall correct leaks before proceeding.
3. Perform fast-fill of each sprinkler piping network with air from the compressor with nitrogen system in bypass mode. Each network shall fill in 30 minutes or less. Examine each piping network for excessive leakage. If any network fails to fill in 30 minutes, or excessive leakage is found, the contractor shall correct the leaks before proceeding
4. Restore all valves to normal (not fast-fill or bypass) status.
5. Adjust regulators on each air maintenance device to indicate normal value (from shop drawings) on pressure gages.
6. Open valves on each purge vent assembly to purge each sprinkler piping network in a pre-determined sequence
7. Record values shown on each pressure gage, including:
 - a. Two (2) gages in nitrogen generator cabinet (upstream and downstream of separator membrane).
 - b. Gage(s) indicating pressure at each air maintenance device.
8. Use N2 purity analyzer to verify that sprinkler piping network(s) with open purge valve assemblies are beginning to register a rise in nitrogen purity.
9. The contractor shall return at regular, agreed-to intervals to continue the purging process until all sprinkler piping networks register at least 98% nitrogen purity at all purge vent assemblies.

3.4 ELECTRICAL CHECKOUT AND TESTING

- A. Electrical checkout and testing shall be performed by the Contractor. Contractor personnel shall be competent fire alarm technicians with a current training certificate from United Fire Systems or approved equal.
- B. Test Plan.
 1. The Contractor shall submit a test plan that describes how the system shall be tested. This shall include a step-by-step description of all tests and shall indicate type and location of test apparatus to be used. At a minimum, the tests to be conducted shall be per the relevant referenced codes and any additional supplemental tests required by the authority having jurisdiction.
 2. Tests shall not be scheduled or conducted until the Engineer approves the test plan.
- C. Execution. All tests shall be performed in the presence of the Engineer and the authority having jurisdiction. The Contractor shall record all equipment, tests and system configurations in a format approved by the Engineer and the authority having jurisdiction. A copy of the commissioning tests and results shall be provided to the Engineer, the authority having jurisdiction, and the end user.

3.5 WARRANTY

- A. All equipment and installation to be warranted against defects for 12 months starting upon the date of system acceptance by all authorities having jurisdiction.