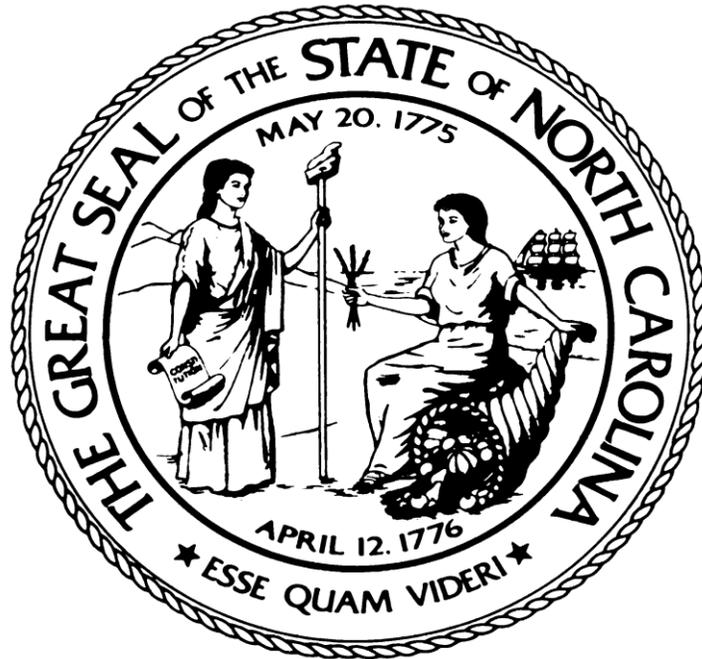


STATE OF NORTH CAROLINA
DEPARTMENT OF ADMINISTRATION
STATE CONSTRUCTION OFFICE



WATER BASED
FIRE PROTECTION SYSTEMS
GUIDELINES AND POLICIES

2020

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APPLICABILITY

The WATER BASED FIRE PROTECTION SYSTEMS GUIDELINES AND POLICIES applies to all projects in which the State Construction Office (SCO) is the designated Authority Having Jurisdiction (AHJ). This includes all State properties as defined in NC GS 425. Note that this does not include community college work. As defined by NC GS 58-31-40, the AHJ for Community College projects over 20,000 square feet is the North Carolina Department of Insurance. The local plan review and inspection department is the AHJ on community college projects under 20,000 square feet.

PURPOSE

The following guidelines and policies are established to aid the design engineer during bid document preparation. This guideline is not intended to repeat requirements from governing NFPA standards and is not intended to be included in the design engineer's specification by reproduction. Rather it is a source of additional requirements, procedures, and clarifications to the design engineer that are to be incorporated in their preliminary design of the fire sprinkler system. Variances of these guidelines and policies shall be discussed with the State Construction Office prior to submitting design to alleviate possible extra work on the designer's part. This office will not entertain a request for deviation from an applicable NFPA requirement.

ADMINISTRATION

- A.** NC Statutes allow sprinkler contractors with a minimum NICET III certification to provide sprinkler designs. A design engineer will typically be contracted to provide a preliminary design within the construction documents that will contain sufficient detail to identify the scope of the work and allow for competitive bidding. The design engineer's responsibilities include but are not limited to:
1. Evaluate the broad range of hazards and fire protection schemes required to develop a workable, integrated fire sprinkler solution.
 2. Provide design documents as outlined in this guideline.
 3. Review shop drawings and submittals to ensure conformance with design documents and applicable codes and standards.
 4. Monitor the installation of fire protection systems and participate in their acceptance and commissioning.
- B.** The current edition of NFPA 13, 14, 20, and 24 as referenced by the NC Building Code is the minimum acceptable. The design to be used by the fire sprinkler contractor shall be clearly stated in the contract documents.
- C.** This document provides rules and procedures that may not be contained in reference NFPA requirements and provides guidance and commentary on Fire Protection Systems subject areas that are frequently points of confusion, contention, or misapplication.

- D. The local fire code official or fire marshal referred to in this document is the Agency's Fire Protection Specialist and/or the local fire code official that will operate the fire apparatus. Although not the AHJ for State Properties, the technical input from these departments is appropriate and should be obtained for issues relating to on-site response.

SCO FIRE SPRINKLER GUIDELINES AND POLICIES

A. Construction Documents:

1. Fire Protection drawings and specifications prepared by the design engineer and included in the bid documents constitute a 'preliminary design' and shall be sealed by the design engineer of record registered in the State of North Carolina. This 'preliminary' design is a basis for bidding and may be referenced to herein as 'construction documents'. A basic understanding of hazard and occupancy classifications; and a working knowledge of fire protection codes and standards is expected from the design engineer of record.
2. Contract Documents shall comply as applicable with NFPA 13, NFPA 14, NFPA 20, NFPA 24, NC Fire Code, NC Building Code, and this guideline. Items to be included but not limited to on Construction Documents are as follows:
 - a) Provide Sprinkler Design Data Summary to include:
 - (1) Project name and address
 - (2) Total building height
 - (3) Type of system
 - (4) Hazard classification
 - (5) Design area
 - (6) Design Density
 - (7) Hose allowance
 - (8) Water supply information
 - b) Identify use of all rooms and areas.
 - c) Symbols and legend.
 - d) Location of alarm valve, check valves, riser check, control valves, etc.
 - e) Electrical equipment locations with schedule listing electrical requirements.
 - f) Piping schematic indicating all tamper/flow switches, valves, etc.
 - g) Main and auxiliary drain locations.
 - h) Fire Department Connection location, type and size.

- i) The plans shall include a general piping layout. The plans need to be of sufficient scale to be clear and concise. (Minimum Scale 1/8"=1'-0").
3. The fire protection work outlined in the contract documents shall not be included on the sheets of other disciplines and shall identify that the fire sprinkler contractor scope of work begins 12" above the finished floor.
4. Details such as piping sizes and head locations are not required to be part of the Construction Documents. Such layouts when provided shall be denoted as being provided for general coordination and information only.
5. Each building story must be a separate sprinkler zone with a dedicated cutoff valve, tamper switch, water flow switch and inspector's test valve; typically referred to as a floor control assembly piped to discharge to exterior. Multiple riser designs requiring the operation of more than one shutoff valve to isolate a portion of the system are not permitted.
6. The Design Team should solicit input from local fire officials or the fire marshal when developing fire protection plans for State-owned facilities.
7. Instructions for sealing penetrations through rated assemblies (such as UL details) shall be on the contract document. The fire sprinkler plans shall identify rated walls consistent with the architectural plans.
8. Working drawings, also referred to as shop drawings, prepared by a licensed fire sprinkler contractor with a minimum NICET III certification shall be complete and submitted and reviewed per the below procedure. A licensed Professional Engineer may also provide sprinkler shop drawings.

B. Review and Approval of Shop Drawings and Hydraulic Calculations:

The following procedure for review and approval of working shop drawings is applicable and should be included in the construction documents as necessary to ensure the fire sprinkler contractor understands their responsibility.

Fire Sprinkler Contractor: The Fire Sprinkler Contractor shall submit working shop drawings, hydraulic calculations, and product data to the design engineer of record – *number of copies as determined by the design engineer*. Shop drawings shall include and be in accordance with working plan requirements of chapter 22 of NFPA 13. Product data shall include and identify all material, equipment, and accessory selections to be installed. A copy of the water flow test shall be included. The hydraulic calculations and shop drawings shall be signed by the fire sprinkler designer and include the NC Fire Sprinkler Contractor (FS) license number. The construction documents are a performance design. The fire sprinkler contractor, as the designer and contractor, shall provide all necessary materials and labor for a system fully compliant with all applicable NFPA requirements and the construction documents. Any discrepancies shall be brought to the attention of the specifying engineer (PE).

Project Engineer: The specifying engineer (PE) has primary responsibility for review and approval of fire suppression system shop drawings and hydraulic calculations. Specifying Engineer review shall determine compliance with applicable codes and standards and the project contract documentation.

After completing this review, the Specifying Engineer sends uploads the following to Interscope for electronic review. All comments made by the designer shall be forwarded to this office with the review package.

- Cover letter with engineers comments
- Drawings
- Hydraulic calculations
- Product data
- Seismic calculations

Once all comments are resolved and approved by SCO, an approval letter releasing this part of project to enter into construction will be sent to the Specifying Engineer. No other reviews are required after the receipt of this approval letter.

C. Water Supply Test Requirements:

1. Water flow and pressure test data within 12 months shall be included with the construction documents to determine if a fire pump may be required. This shall include static pressure, residual pressure, residual flow, date of test, and elevation and location of hydrants used for the test. The water flow test required shall be performed as indicated in NFPA 13 which uses two hydrants; a pressure hydrant and a flow hydrant. The two hydrants shall be as close to the point of connection as possible. If a fire pump is installed the fire pump test can be used instead of a hydrant flow test as basis of design.
2. An updated water flow and pressure test is to be obtained by the fire sprinkler contractor to be used for the working plan design and calculations. A copy of the flow test and test hydrant locations shall be submitted with the shop drawing package.
3. A safety factor to account for fluctuations in water supply, the design calculations shall be based on an available water supply of 10 psi less static pressure, 10 psi less residual pressure and 10% less residual flow than measured.
4. A backflow preventer shall be provided for the fire protection system. If a RPDA type assembly is provided they should be located in a heated enclosure outside of the occupied building. The heated enclosure shall have a low temperature heat detector connected to building fire alarm system. If an exterior heated enclosure is not possible for the site, the RPDA can be installed inside of the building provided it is installed in a room with the floor level of the room above grade with room containing at least 1 exterior wall. An opening in the exterior wall or the mechanical room door with a minimum free area to drain the relief valve to exterior shall be provided. A gravity backdraft damper is recommended in relief opening to limit heat loss in fire protection room. At least 1 floor drain 4" in size shall be provided at backflow preventer. Relief valve of RPDA shall be piped to exterior.

D. Partial Renovation Projects:

For modification of existing sprinkler systems the following applies:

1. If the modification is less than 20 sprinkler heads and does not change the design density and does not add sprinkler coverage area to the existing system, then the existing system may be reworked without hydraulic calculations and without a new water supply test. Shop drawings will still be required to be submitted and approved in accordance with procedure when more than 10 sprinkler heads are affected.
2. If modifications are 20 heads or greater or hazard classification changes or if the area of sprinkler coverage increases, a new water supply test will be required and hydraulic calculations performed and submitted for approval with the shop drawings. Water supply test information from the existing hydraulic nameplate or from the most recent available hydrant may be used for the construction document submittal; a new water flow test will be required for the working drawing submittal.

E. Sprinkler Coverage:

1. Exemptions in the NC Fire Code from 903.3.1.1.1. Note that use of these exemptions does not nullify any credits or exemptions based on a fully sprinklered building. Depending on the hazard of the space, the SCO may require a non-water based fire suppression system to be used.
 - a) Any room where the application of water, or flame and water, constitutes a serious life or fire hazard.
 - b) Any room or space where sprinklers are considered undesirable because of the nature of the contents, when approved by the fire code official.
 - c) Generator and transformer rooms separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire-resistance rating of not less than 2 hours.
 - d) Rooms or areas that are of noncombustible construction with wholly noncombustible contents.
 - e) Fire service access elevator machine rooms and machinery spaces. (*This is a new type of elevator applicable to high rises*)
 - f) Machine rooms, machinery spaces, control rooms and control spaces associated with occupant evacuation elevators designed in accordance with Section 3008 of the International Building Code.

F. Minimum Design Requirements:

1. In accordance with NFPA 13, including occupancy hazard. Design engineer should consider an increase the designated hazard level for unusual or abnormal fuel loading.
2. Residence Halls:
 - a) NFPA 13 shall be the basis of design. The use of NFPA 13R is only for privately funded residential projects as allowed by guidelines found on the SCO website.

3. In Institutional Group I occupants the fire sprinkler zones shall match the fire alarm zones. The designer shall coordinate with owner during the design phase to discuss egress paths, zone locations and “defend in place” strategies.
4. Clearly identify on plans and specification if area reduction can be used on design area.

G. Seismic Requirements:

1. Reference the building code summary for the facility seismic design category. A common omission for a new sprinkler system in an existing building is the lack of a seismic design category. The project must obtain a seismic design category in accordance with the NC Building Code.
2. For seismic design categories A and B, the fire sprinkler drawings should state that “Hanging, bracing, and restraint of fire sprinkler piping shall be in accordance with chapter 9.1 and 9.2 of NFPA13.
3. For seismic category C, the fire sprinkler drawings shall state that “Seismic requirements apply to this project. Hanging, bracing, and restraint of fire sprinkler piping shall be in accordance with section 9.3 of NFPA13. Shop drawings must include details and signify approximate locations of all seismic bracing. Calculations and layout of restraints shall be submitted to this office for approval with shop drawings.

H. Materials:

1. All sprinkler materials and components must be third party listed for sprinkler systems and installed in accordance with their listing. Piping, hanger material, and components that don't affect system performance such as drain valves are generally exempted from this requirement.
2. Piping: The construction document specifications should contain piping and fitting requirements that comply with NFPA 13. SCO guidelines include:
 - a) Black steel piping should be listed as sprinkler piping and include an FM approved MIC inhibiting coating.
 - b) Underground Pipe 3” and larger should be ductile iron with standard cement mortar lining and elastomeric gasket joints.
 - c) Above ground 2-1/2” and larger should be schedule 10 black steel pipe welded or roll grooved for mechanical fittings.
 - d) Above ground 2” and smaller should be schedule 40 black steel pipe threaded, welded, or roll grooved for mechanical fittings.
 - e) CPVC piping may be used in subject to limitations of the manufacturer listing. Penetrations of rated walls will require details applicable to plastic piping. Any fire caulk, spray on fire proofing or acoustic caulk shall be verified that they are compatible to CPVC piping.
3. Sprinkler heads in rooms containing a shower or swimming pool shall have a corrosion resistant coating.

4. Sprinkler heads in janitor's closets should be provided with approved head guard.
5. Sprinkler heads in dormitory closets shall be provided with approved head guard or concealed pendants provided.
6. Sprinkler head armovers shall be installed from side or top of branchline/main. Connecting to bottom of pipe is not allowed. Provide detail on contract documents.
7. Clearly indicate if flexible hose connectors are allowed. Be extra careful with product specification and supervision of the work execution when allowing installation of the flexible connection at sprinkler heads. SCO has experienced many faulty installations of such products on various projects (flexible piping are being crimped, very long taps with two or more sections of hose joined together, numerous bends and turns on a single tap, and others). If allowed, they must meet all of the following:
 - a) FM 1637 or UL 2443 listed.
 - b) Specification for Flexible Connections shall include statement for the product to be mounted in strict accordance with manufacturer written installation instructions.
 - c) Number and radius bends shall be as allowed by the manufacturer. There shall be no twists or kinks. In addition
 - (1) Only UL listed and FM approved 304 stainless steel, corrugated hose with fully braided cover shall be used
 - (2) Hose assembly shall be limited to 5-feet.
 - (3) Head shall be permanently attached to the ceiling using tamper resistant screws
 - (4) Connections shall be seismically qualified where applicable
 - (5) The hydraulic calculations shall be based on actual pressure loss published by the manufacturer.
 - (6) Have 1" true bore internal corrugated hose diameter.
 - (7) Takeoffs shall be from the side or top of the pipe.
 - (8) Plans shall clearly indicate maximum bends allowed to match hydraulic calculations.
8. Floor control valves shall be in accessible and visible location. Accessible locations can be above ceilings as long as a ladder can safely be installed below with labeled ceiling panel or access panel.
9. Manual or automatic air vents at high points are recommended.

I. Dry and Preaction Systems:

1. Wet pipe systems are preferred. Small unheated areas may be protected by systems utilizing listed heat tracing. Heat tracing used for branch lines shall be specifically listed for branch lines. All heat tracing shall be supervised.
2. The use of air in dry systems inevitably contains residual water from testing the system and water from condensation collecting in the system. This leads to greater corrosion problems than

experienced with wet pipe systems and even freezing problems. Consider moisture and corrosion concerns and systems that will address this and employ one of the options below:

- a) A combination air compressor with dryer that is FM or UL approved for sprinkler systems is recommended for base bid.
 - b) If dry pipe system or pre-action system protects an area over 5000sf the use of nitrogen generator with black steel piping is required. The nitrogen generator shall include the following:
 - (1) Sized to maintain NFPA 25 acceptable leak rate (3 psi loss over 2 hours or 36 psi loss over 24 hours).
 - (2) The Nitrogen Generation system shall provide a minimum of 98% nitrogen purity.
 - c) Galvanized steel piping without a nitrogen generator is not recommended.
3. An isolation valve and tamper switch with drain downstream of preaction valve is required to allow piping system to be temporarily turned off to allow forward flow testing of preaction valve. If this valve is not in place the entire piping system will be filled with water for annual testing.

J. Standpipes:

1. Class of standpipes and hose connections are required where dictated by the NC Fire Code.
2. Roofs – Section 7.3.2 (5) of NFPA 14 requires that each required standpipe be extended to the highest landing of stairways with stairway access to a roof, or on roofs with a slope of less than 4 in 12 where stairways do not access the roof. Per annex if a permanent ladder is provided with rood hatch this will result in roof hydrants that are problematic to maintain.
3. Note that NFPA14 allows Class I standpipe systems to be any type described in NFPA14 Section 5.2 in buildings not classified as high-rise buildings. 100 psi is required at top, however the fire department pumper truck can be used as supply. Therefore a Manual Wet Standpipe is allowed in a non-high rise building. 100 psig at the top of the remote standpipes with the use of fire pump is only applicable to high rise buildings.
4. Due to the conflict between NC Fire Code and NFPA 14 in regards to hose connection locations, coordination with fire code official shall be required prior to approval of bid documents.

K. Elevator Hoistways and Machine Rooms:

1. Elevator Hoistways
 - a) Sidewall spray sprinklers shall be installed at the bottom of each elevator hoistway not more than 2 ft above the floor of the pit.
 - b) The sprinkler required at the bottom of the elevator hoistway shall not be required for enclosed, non combustible elevator shafts that do not contain combustible hydraulic fluids.

- c) Ordinary or intermediate temperature rated upright, pendent, or sidewall spray sprinklers shall be installed at the top of elevator hoistways.
 - d) The sprinkler required at the top of the elevator hoistway shall not be required where the hoistway for passenger elevators is noncombustible or limited-combustible and the car enclosure materials meet the requirements of ASME A17.1, *Safety Code for Elevators and Escalators*.
2. Combustible Suspension in Elevators
- a) Sprinklers shall be installed at the top and bottom of elevator hoistways where elevators utilize combustible suspension means such as noncircular elastomeric-coated or polyurethane coated steel belts.
 - b) The sprinklers in the elevator hoistway shall not be required when the suspension means provide not less than an FT-1 rating when tested to the vertical burn test requirements of UL 62, *Flexible Cords and Cables*, and UL 1581, *Reference Standard for Electrical Wires, Cables, and Flexible Cords*.
3. Elevator Machine Rooms
- a) Automatic sprinklers in elevator machine rooms shall be of ordinary- or intermediate temperature rating
 - b) Automatic fire sprinklers shall not be required in elevator machine rooms, elevator machinery spaces, control spaces, or hoistways of traction elevators installed in accordance with the applicable provisions in *NFPA 101*, or the applicable building code, where all of the following conditions are met:
 - (1) The elevator machine room, machinery space, control room, control space, or hoistway of traction elevator is dedicated to elevator equipment only.
 - (2) The elevator machine room, machine room, machinery space, control room, control space, or hoistway of traction elevators are protected by smoke detectors, or other automatic fire detection, installed in accordance with *NFPA 72*.
 - (3) The elevator machinery space, control room, control space, or hoistway of traction elevators is separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire resistance rating of not less than that specified by the applicable building code.
 - (4) No materials unrelated to elevator equipment are permitted to be stored in elevator machine rooms, machinery spaces, control rooms, control spaces, or hoistways of traction elevators.
 - (5) The elevator machinery is not of the hydraulic type.

Power Shutdown

Wherever a sprinkler head is located in an elevator shaft or machine room/control closet, means shall be provided to shutdown elevator power prior to the application of water. The SCO standard method of accomplishing this is:

- Use of an intermediate temperature sprinkler head with a smoke and heat detector adjacent. The smoke detector actuates first and initiates elevator recall. The heat detector with a lower actuation temperature than the sprinkler head, operates a shunt trip breaker provided by the electrical contractor to interrupt power to the elevator.

L. Fire Protection Site Plan:

1. Note that this information may be provided on the civil utility plans. It is a frequent source of comments on construction documents. The fire protection engineer will receive the comments where these items are not properly coordinated.
2. Site plan shall show fire water connection to main. Indicate the location of the Back Flow Preventer (BFP), Post Indicator Valve (PIV), Fire Department Connection (FDC), fire pump test header (if applicable), exterior sprinkler alarm, and adjacent Fire Hydrants (FH). Indicate test hydrant and flow hydrant with flow data on plans.
3. Contract documents for proposed fire apparatus access, location of fire lanes and construction documents and hydraulic calculations for fire hydrant systems should be submitted to the local AHJ for review and approval prior to construction.
4. Unless approved by the local fire marshal, no portion of the facility or building shall be more than 400 feet [600 ft. for sprinklered buildings] from a hydrant on a fire apparatus access road, as measured by an approved route around the exterior of the facility or building. Site plans shall clearly showing apparatus access routes to all buildings on the site within 150 feet of all portions of the first floor. If a fire pump is added, it shall be tested and recorded prior to final inspection. Test shall be included in closeout documents.
5. A detail shall be provided showing restraint of underground joints. Either thrust blocks or restrained joints in accordance with chapter 10 of NFPA 13 are acceptable.
6. Fire protection main piping shall enter the building as close to the exterior as possible. The fire protection main piping shall not be routed through the building. This would include but is not limited to running the fire protection main piping under the slab, through crawl spaces or above the ceiling. In the event that this is technically infeasible a water flow switch and control valve shall be installed where the fire protection main enters the building.
7. The FDC shall be within 100' of a fire hydrant. FDC shall be readily accessible and not located on loading docks or under a building overhang, behind fence or inside enclosed mechanical yard.

M. Fire Pumps:

1. Perform a preliminary hydraulic calculation to determine whether a fire pump is needed.
2. Fire pumps shall be located in dedicated rooms that are 1 hour rated (2 hour rated in high rises). Boilers and other mechanical equipment not related to the fire pump shall not share the room. Domestic water distribution equipment is allowed in the fire pump room.

3. Provide pumps schematic, plan layout and isometric riser and electrical service as required. Electric fire pumps shall have a backup energy source.
4. A recirculating line with a flow meter shall be installed to permit pump testing without discharging.
5. A pump bypass with a normally open valve shall be provided.
6. A suction control valve shall be installed if the incoming water pressure is exceptionally low or where required by the local municipality.
7. If the pump must be sized such that the city pressure plus the churn pressure exceeds 175 psig, account for this with either suitably rated components or suitably located PRV with relief valve.
8. The final NFPA 20 test shall be performed by flowing water through test header not flow meter.

N. Testing:

1. Contractors Material and Test Certificate Forms from the NFPA standards must be used to document testing completed. Waterflow detection devices shall be tested and documented on these forms as well. These tests include:
 - a) Underground pipe flushing and hydrostatic test per NFPA 24.
 - b) Hydrostatic pipe testing per NFPA 13.
 - c) Air pressure test and water test of dry systems per NFPA 13
 - d) Operating test for dry pipe systems per NFPA 13.
 - e) Hydrostatic test and operating test per NFPA 14.
 - f) Fire/Booster Pump Acceptance Test (Performance Test): The fire pump must have a field acceptance test in accordance with NFPA 20. This test shall include a member of the design team, the pump manufacturer, the engine manufacturer (if provided), controller manufacturer, and transfer switch manufacturer (if provided). SCO shall witness a test of the fire pump. It is up to the engineer of record if he wants SCO to witness the official NFPA 20 test or perform secondary test. NFPA 20 requires that the AHJ be given advance notice of the test date, time, and location. Minimum one week advance notice is required.

O. Final inspection

1. At final inspection the following shall be present.
 - a) Engineer of record that has worked on project and is familiar with system.
 - b) A copy of shop drawings.
 - c) A copy of review comments with responses.

- d) All appropriate NFPA forms signed by engineer whom witnessed tests.

P. Closeout:

1. The Specifications shall require the following: The fire sprinkler contractor shall have for review all pertinent NFPA paperwork properly filled out on NFPA forms as applicable (NFPA 13, 14, 20, 24). The shop drawing approval letter from this office shall be available. A set of as-built fire sprinkler shop drawings and hydraulic calculations shall be placed in a white PVC tube marked 'Fire Sprinkler Shop Drawings' and securely fixed in the fire sprinkler riser room.