

American Fire Services

1982

*Analyses, Alternatives, Innovations,
Solutions*

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Evaluating Fire Protection Systems

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A Matter of Performance

**Specifications
versus
Performance**

Specification Codes

- Precise
- Detailed
- Inflexible
- Required

Specification Code Examples

- 6.8.1 Unless the requirements of 6.8.1.1, 6.8.1.2, and 6.8.1.3 are met, the fire department connection(s) shall consist of two 2 ½ inch connections using NH internal threaded swivel fittings(s) with “2.5-7.5 NH standard thread,” as specified in NFPA 1963.
- Components shall be listed
- Branch lines shall be Schedule 40 steel
- Upright sprinklers shall be installed with the frame arms parallel to the branch line.
- Clamps supporting pipe by means of set screws shall not be used.
- Circuit disconnecting means shall have a red marking, shall be accessible only to authorized personnel, and shall be identified as “FIRE ALARM CIRCUIT.”

Performance Codes

- Expected outcomes
- Combined functions leading to desired results
- Flexible approaches
- Boundary conditions
- Measurable Results

Performance Code Examples

- Deliver water within 60 seconds of activation
- Initiate alarm signal within 300 seconds
- Provide 250 gpm at 100 psi residual pressure

- It is possible to comply with specifications and still fail performance
- No code violations does not assure successful performance

Design versus Layout

- NICET III Layout is specification driven
- Engineering design is performance and objective driven

Performance Influences External Factors

- Conditions Independent of System
 - Water supply
 - Weather
 - Temperature

Performance Influences External Factors

- Conditions Independent of System
 - Ownership
 - Changes
 - Use/Occupancy
 - Reconfigurations / Renovations

Performance Influences External Factors

- Conditions Independent of System
- Usage
- Damage
- Deterioration / Wear & Tear

Performance Influences External Factors

- Conditions Independent of System
- Maintenance
- Testing
- Inspection

Performance Influences Internal Factors

- Design
- Quality
- Experience
- Excess / Reserve capacity

Performance Influences Internal Factors

- Flexibility to adapt to change
- System add-ons / reconfigurations
- Ability to upgrade

Performance Fundamentals

- Assumptions
- Owner Requirements
- Code, Standards, Statutes, Regulations
- Building Description

Performance Fundamentals

- Design Approach
- Objectives & Decisions
- Alternative Means & Methods
- Methodology

Performance Fundamentals

- Testing Criteria
- Equipment & Tools

Performance Fundamentals

- Technology Application
- Bells & Whistles
- Simple & Straight Forward
- Reliability

Acceptance Fundamentals

- Procedure
- Thoroughness

Acceptance Fundamentals

- Testing
 - Under normal operating conditions
 - Under unusual conditions
 - Emergency power
 - Circuits in trouble
 - Fire, water damage

Acceptance Fundamentals

- Installation Quality
 - Workmanship
 - Attention to detail
 - Accessibility for maintenance, inspection, repair

System Lifetime Fundamentals

- Maintenance
- Compatibility / Availability of Parts
- Periodic Testing
 - Component
 - Performance
- Changing External conditions
- Inspections and review

Role of the Inspector Performance

- Concurrence with design assumptions
- Compliance with installation standards
- Consideration of local conditions and requirements
 - FD access
 - Water supply

Role of the Inspector Acceptance

- Installation details and quality
- Functional testing
- Preparation, Maintenance, and Availability of Documentation
- Satisfactory Performance

Role of the Inspector Lifetime

- Assurance of Maintenance and Replacement
- Periodic testing and actual usages
- Documentation

Role of the Inspector Lifetime

- Inspections
 - Awareness of changed conditions
 - Relocated partitions
 - Uses
 - Occupancy
 - Water supply
 - Hazards
- Visual Inspection
- Witnessing functional periodic testing
- Review and recording of documentation

Role of the Inspector Impairments

- Notification Time Frame
- Alternative Safeguards
- Fire Watch

Reference Codes Performance

- Design Documents
- As Built Drawings
- Installation Standards

Reference Codes Acceptance

- Commissioning Tests
- System Documentation
- Exceptions, Limitations

Reference Codes Lifetime

- Maintenance Records
- Repair Orders
- Impairments
 - 4 hour impairment notification
- Inspections
- Periodic Testing & Comparison of results

Role of Codes SBC

- When to install
- What to install (type of system)
- Where to install
- Extent to install (complete, partial)
- Accepted standards

- Note: All systems, required and non-required (901.2)

Role of Codes CSFSC – IFC / LSC 101

- When to install
- What to install (type of system)
- Where to install
- Extent to install (complete, partial)
- Accepted standards
- Life Safety

Role of Codes CSFPC – NFPA 1

- Maintenance, Inspection Testing
- NFPA 25, NFPA 20, NFPA 72

CSFPC NFPA 1



CSFPC NFPA 1

- Standpipe Systems (13.2, NFPA 25)
- Automatic Sprinklers (13.3, NFPA 25)
- Fire Pumps (13.4, NFPA 25)
- Water Supply (13.5, NFPA 25)
- Portable Fire Extinguishers (13.6, NFPA 10)
- Detection, Alarm, and Communication Systems (13.7, NFPA 72)
- Other Fire Protection Systems (13.9)

Automatic Sprinkler Systems



Automatic Sprinkler Systems Purpose

The purpose of this standard shall be to provide a reasonable degree of protection for life and property from fire through standardization of design, installation, and testing requirements for sprinkler systems, including private fire service mains, based on sound engineering principles, test data, and field experience. (1.1.2)

Automatic Sprinkler Systems Performance

- Project Specifications
- Design Documents
- Assumptions
- As Built Drawings
- SBC
- CFSC
- NFPA 13

Automatic Sprinkler Systems Performance

- For dry pipe systems protecting dwelling unit portions of any occupancy, the sprinklers in the dwelling unit shall have a maximum water delivery time of 15 seconds to the single most remote sprinkler (7.2.3.1.1 and 7.2.3.6.3) TABLE 7.2.3.6.1
- Note: The calculation program and method shall be listed by a nationally recognized testing laboratory. (7.2.3.6.2)
- The air supply shall have a capacity capable of restoring normal air pressure in the system within 30 minutes. (7.2.6.3.2)
- Sprinklers shall be installed throughout the premises. (8.1.1 (1))
- System valves and gauges shall be accessible for operation, tests, and maintenance. (8.1.2)
- Performance Objective. Sprinklers shall be so located so as to minimize obstructions to discharge as defined in 8.5.5.2 (Obstructions to Sprinkler Discharge Pattern Development) and 8.5.5.3 (Obstructions that Prevent Sprinkler Discharge from Reaching Hazard) , or additional sprinklers shall be provided to ensure adequate coverage of the hazard
- The water demand for sprinklers shall be determined only from one of the following, at the discretion of the designer:
Density / area curves if Figure 11.2.3.1.1 in accordance with the density / area method of 11.2.3.2. (11.2.3.1.1) Figure 11.2.3.1.1

Automatic Sprinkler Systems



Automatic Sprinkler Systems Acceptance

- NFPA 13 Procedures
- Certificates
 - Underground Pipe
 - Aboveground Pipe
 - Welding
 - Hydrostatic Testing
 - Pneumatic Testing (if applicable)
 - Operation Times
 - Flow calculations and measurements
 - Water Supply Tests

Automatic Sprinkler Systems Acceptance

- Listing of Components (Field Verification)
 - Material
 - Application
 - Installation
- Water Supply
 - Demand (11.1.4)
 - Duration (11.1.5)
 - Occupancy Classification (11.2.1.2)
- Flushing
 - Flushing Rate and Duration (10.10.2.1)
 - Hydrostatic Test (10.10.2.2)
 - Hydrant Operating Test (10.10.2.4)
 - Backflow Prevention Assemblies (10.10.2.5)
- Underground Piping Test Certificate

Automatic Sprinkler Systems



Automatic Sprinkler Systems Acceptance

- System Piping
 - Hydrostatic Test (25.2.1.1)
 - Pneumatic Test (25.2.2.1)
 - System Operational Test (25.2.3)
 - Waterflow Devices (25.2.3.1)
 - Alarm Valves (25.2.3.2)
 - Main Drain Valves (25.2.3.4)
 - Control Valves (25.2.3.5)
 - Pressure Reducing Valves (25.2.4)
 - Backflow Prevention assemblies (25.2.5)
- Inspectors Test
 - Alarms and Supervisory Signals

Automatic Sprinkler Systems



Automatic Sprinkler Systems Lifetime

- Omissions
- Obstructions
- Clearance to storage *(8.6.6)
- Reconfigurations
- Changes in Hazards / Commodities
- Pressure Gauges (history)
- Inspection Tags (Falsification)
- Inspection Reports
- Compressor Cycling
- Backflow Prevention Devices (8.17.4.6.2)
- Care & Maintenance of 13D (13.3.3.2.1)
- NFPA 25 Chapters 3, 4, 5, 7, 9, 13, 14

Automatic Sprinkler Systems Lifetime

- CSFPC NFPA 1
- NFPA 25

Standpipe Systems



Standpipe Systems Performance

- Flow & Pressure (7.8 and 7.10)
- FDC locations (6.4.5.1.1)

Standpipe Systems Performance

- Project Specifications
- Design Documents
- Assumptions
- As Built Drawings
- SBC
- CFSC
- NFPA 14

Standpipe Systems Acceptance

- NFPA 14 Procedures
- Certificates
- Underground Pipe
- Aboveground Pipe
- Welding
- Hydrostatic Testing
- Flow Testing
- Flow calculations and measurements
- Water Supply Tests

Standpipe Systems



Standpipe Systems Acceptance

- Water Supply Evaluation (10.1)
- Procedure & Timeliness (12 months) (10.2)
- Flushing (11.2)
- Hose Thread Verification (11.3)
- Hydrostatic Test (11.4)
- Flow Test (11.5)
- Pressure Regulating Devices (11.5.5)
- Manual Valves (11.6)
- Alarms & Supervision (11.7)
- Timing of water supply installation (12.8)

Standpipe Systems Lifetime

- CSFPC NFPA 1
- NFPA 25

Standpipe Systems Lifetime

- Witnessing Flow & Pressure Testing
- Pressure Reducing Valve Testing
- Documentation & Inspection Review
- NFPA 25 Chapters 3, 4, 6, 9, 14

Fire Pumps



Fire Pumps Performance

- Project Specifications
- Design Documents
- NFPA 20

Fire Pumps Performance

- As designed

Fire Pumps



Fire Pumps Acceptance

- NFPA 20 Procedures
- Certificates
- Factory Performance Data & Curves
- Commissioning Test Data
- Pump Manufacturer Acceptance
- Drive Engine Manufacturer Acceptance
- Fire Alarm System Coordination

Fire Pumps Acceptance

- Water Supply Evaluation (4.6.1.1)
- Procedure & Timeliness (12 months) (4.6.1.2)
- Variable Speed Pressure Control Limiting Pumps
- Flushing (14.1.1)
- Hydrostatic (14.1.2)
- Field Acceptance (14.2)
 - Pump Manufacturer
 - Engine Manufacturer
 - Controller Manufacturer
 - Transfer Switch Manufacturer
 - Fire Alarm Contractor

Fire Pumps Lifetime

- NFPA 20
- NFPA 25

Fire Pumps Lifetime

- NFPA 25 Chapter 3, 4, 8, 9, 13

Fire Alarm Systems Purpose

- The purpose of fire alarm and signaling systems shall be primarily to provide notification of alarm, supervisory and trouble conditions, to alert the occupants, to summon aid, and to control emergency functions.

Fire Alarm Systems Performance

- Project Specifications
- Design Documents
- As Built Drawings
- SBC
- CFSC
- NFPA 72

Fire Alarm Systems Performance

- By Initiation function

Fire Alarm Systems Performance



Fire Alarm Systems Performance

- By Notification function

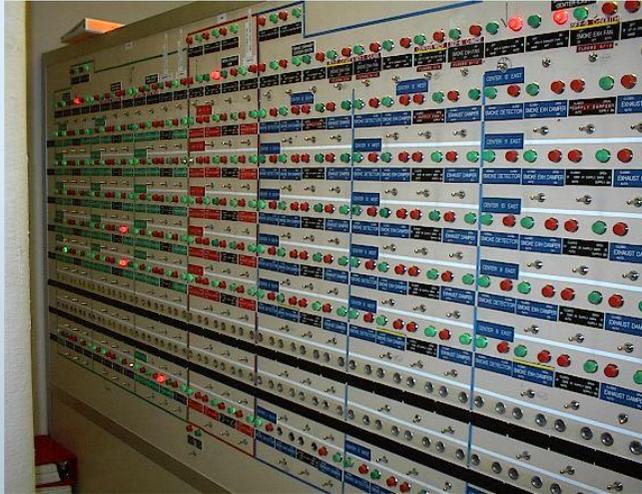
Fire Alarm Systems Performance



Fire Alarm Systems Performance

- By Control function

Fire Alarm Systems Performance



Fire Alarm Systems Acceptance

- NFPA 72 Procedures
- Certificates
- Commissioning Data

Fire Alarm Systems Acceptance

- Approval and Acceptance (10.18.1)
- Documentation (10.18.2)
- Records (10.18.3)

Fire Alarm Systems Lifetime

- NFPA 72

Fire Alarm Systems Lifetime

- Impairments (10.19)
- Inspection Testing & Maintenance (Chapter 14)
- Initiating Devices (Chapter 17)
- Notification Devices (Chapter 18)
- Emergency Control Functions & Interfaces (Chapter 21)

NFPA 3 & NFPA 4

- NFPA 3 (2012)
 - Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems
- NFPA 4 (2015)
 - Standard for Integrated Fire Protection and Life Safety System Testing
 - Chapter 7 of NFPA 3

NFPA 3

- Qualifications of Commissioning Personnel (Chapter 4)
- Fire Commissioning Agent (4.2.1)
- Installation Contractor (4.2.2)
- Registered Design Professional (4.2.3)
- Construction Manager and General Contractor (4.2.4)
- Facilities Management Personnel (4.2.5)
- Third Party Test Entity (4.2.6)
- Authority Having Jurisdiction (4.2.7)
- Integrated Testing Agent (4.2.8)
- Insurance Representative (4.2.9)

NFPA 3

- Commissioning (Chapter 5)
- Activities of Personnel
- Planning Phase (5.2)
- Design Phase (5.3)
- Construction Phase (5.4)
- Occupancy Phase (5.5)
- Training (5.5.4)

NFPA 4

- General (Chapter 4)
- Fundamental Principles (4.1)
- Testing Team (4.2)
- Qualifications (4.3)
- Responsibilities (4.4)
- Test Plan (4.5)
- Test Methods (Chapter 5)
- Test Frequencies
- Initial (6.2)
- Periodic (6.3)
- Post Modification (6.4)
- Documentation (Chapter 7)

Exceptional Tree Performance

