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Minimum Fire Sprinkler Design Criteria

Instructions

NFPA Standard 13 is to be used as a guide for the design and installation of fire sprinkler systems at BYU. However, NFPA 13 is only a minimum standard. This document will serve as an additional specification for all new or retrofit fire sprinkler installations.

Fire Protection

1. At the completion of the project, the fire sprinkler contractor shall submit to the BYU Construction Department one (1) set of “Mylar” fire sprinkler system as-built drawings or one (1) set of AutoCAD drawing files (.dwg) on a compact disk.

2. The University Insurance Carrier is to be specified as an approval authority. Prior to job bidding, specific detailed rulings can be obtained by contacting the BYU Construction Department, the BYU Risk Management and Safety Department, and/or the University Insurance Carrier.

Submittals

Sprinkler Contractors are to provide the General Contractor with nine (9) copies, and the Provo City Fire Department with two (2) copies of the shop drawings. The General Contractor is to deliver or mail copies of the drawings to the following:

<table>
<thead>
<tr>
<th>Shop Drawings to be Delivered To</th>
<th>Number of Copies</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Contractor</td>
<td>1 Copy</td>
</tr>
<tr>
<td>Architect</td>
<td>1 Copy</td>
</tr>
<tr>
<td>Engineer</td>
<td>2 Copies</td>
</tr>
<tr>
<td>University Construction Coordinator</td>
<td>5 Copies</td>
</tr>
</tbody>
</table>

The University Construction Coordinator will distribute received shop drawings as follows:

<table>
<thead>
<tr>
<th>University Construction Coordinator</th>
<th>1 Copy</th>
<th>(Returns one copy with comments to Contractor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Utility Director</td>
<td>2 Copies</td>
<td>(Returns one copy with comments to Construction Coordinator)</td>
</tr>
<tr>
<td>University Fire Marshal</td>
<td>2 Copies</td>
<td>(Returns two copies with comments to Construction Coordinator)</td>
</tr>
</tbody>
</table>

Final Submittals

Sprinkler contractors shall correct drawings, incorporating comments and shall submit written comments addressing each comment as noted above. Corrected drawings shall be resubmitted, with nine (9) copies being sent out for review as noted above.
The University Fire Marshal will deliver or send copies of the shop drawings to the University Insurance carrier. The University Fire Marshal will correlate with the assigned BYU Construction Coordinator so that plan review comments from the University Insurance Carrier are returned expeditiously.

Approval of shop drawings must be obtained prior to installation. Questions can be forwarded to the University Construction Coordinator and/or the Campus Fire Marshal.

3. All codes and regulations listed pertaining to fire protection shall be complied with. In addition, code(s) adopted by the Utah State Fire Marshals office shall apply.

4. All new installations or retrofit applications required by code where it is necessary to install fire protection systems where commercial cooking is conducted, or cooking areas where grease laden vapors are produced, are to meet the requirements as set forth by the University Insurance carrier, and the BYU Risk Management and Safety Department. Required specifications for the installation of fire suppression equipment designed for the protection of commercial cooking operations can be obtained at the Risk Management and Safety Office. Contact the BYU Campus Fire Marshal for more details.

5. All fire sprinkler designs involving more than 100 sprinkler heads are to be based on a current flow test of the available water supply. The contractor is responsible to conduct the water supply flow tests. Flow tests are to be witnessed by the University Fire Marshal or his designee. Flow test analysis and calculations are to be submitted along with all shop drawings. Where city water provides the sole fire protection water supply, hydraulic calculations should utilize no more than 90% of the supply.

6. For hydraulically calculated or performance specified systems, the most recent State adopted edition of NFPA Standard 13 is to be used, however the additional features listed below shall prevail.

   a) The entire system shall be designed and installed in accordance with the adopted issue of NFPA Standard 13 and these guidelines.

   b) For all hydraulically designed systems the design area shall be the most hydraulically demanding rectangular area having a dimension parallel to the branch lines at least 1.4 times the square root of the area of the sprinkler operation used.

   c) Only schedule 40, ASTM 53, A-135, or A-795 pipe shall be used. No foreign pipe is allowed. Piping with alternative wall thickness to schedule 40 is not allowed.

   d) A simultaneous 250 gpm hose stream demand shall be included in all calculations where Light Hazard Occupancies exist. A 500 gpm hose stream demand shall be included in all calculations for Ordinary Hazard or Higher Hazard occupancy classifications. If more than 1000 square feet of a building is of a higher occupancy classification, then the entire area, including the lesser hazard classification is to receive a 500 gpm hose stream allotment.
e) Design calculations for inside pipe are to include \( C = 100 \) for dry pipe and preaction systems, \( C = 120 \) for wet and deluge systems.

f) The maximum allowable water velocity in pipe shall not exceed 20 feet per second.

g) Construction scheduling should be such that any water supply connection, underground pipe, or fire hydrant(s) installed are to be tested, and in service as soon as practically possible. Sprinkler installation should begin as soon as roof framing or floors are complete and should be in operation to protect as much of the construction as possible. Existing systems that need to be shut down require the contractor to contact the BYU Construction Coordinator prior to any system shut down. All tests are to be witnessed by the owner’s representative. Contact the BYU Construction Department to schedule tests.

h) A Contractor’s Material and Test Certification for Aboveground Piping must be completed in full and submitted to the University Construction Department representative prior to system acceptance. (See Exhibit “A”) Where connection into an underground pipe system occurs, a Contractor’s Material and Test Certificate for Underground Piping must also be submitted. (See Exhibit “B”) The lead-in connection to a fire sprinkler riser shall be completely flushed before connection is made to sprinkler piping. The flushing operation shall be continued for a sufficient time to ensure thorough cleaning. The minimum rate of flow shall be that listed in the most recent edition of NFPA Standard 24.

i) Minimum fire sprinkler head operating pressures shall be seven (7) psi. The design of operating sprinkler pressures in the 30 to 70 psi range is recommended. Fire sprinkler heads shall be frangible bulb type. In areas which have finished ceilings, an adjustable concealed fire sprinkler head shall be used. For tile ceilings, the fire sprinkler head shall be located in the center of the tiles. In areas which have no finished ceilings an upright/pendent fire sprinkler head shall be used. The head shall have a chrome finish in areas with unpainted surroundings, or a white finish in areas with painted surroundings.

Approved manufactures are:

- Reliable
- Central
- Victaulic

All models of fire sprinkler heads are to meet this criteria, the criteria of the University Insurance Carrier, and the adopted edition of NFPA 13.

j) Maximum floor areas to be protected by one fire sprinkler system is not to exceed 52,000 sq. ft. for Light Hazard Occupancies, 52,000 sq. ft. for Ordinary Hazard Occupancies, and 40,000 sq. ft. for Extra Hazard Occupancies. For other than hydraulically calculated systems, contact the BYU Construction Department and the University Fire Marshal for assistance.
k) Use of 17/32-inch orifice sprinklers with ½-inch threaded fittings are not permitted for any system.

l) Sprinkler design densities are to be those specified in Exhibit “C” of this document.

**NOTE: This is a higher standard for design criteria than NFPA 13**

m) OS & Y, indicating, and isolation valves are to be equipped with a tamper switch.

n) In addition to the information required on preliminary or working drawings as indicated in the current edition of NFPA Standard 13, the following data should be provided in the plans:

- Symbol legend
- Scale
- Orifice size of sprinkler should include NPT
- Pipe joining method
- Schedule of pipe used for all branch lines, cross mains, and feed mains
- Seismic bracing depicting both longitudinal and lateral braces
- Type of fittings used, including manufacturer, model and listing authority
- Details of trapeze hanger assemblies using NFPA Tables 6-1.1.3 a, b and c

o) Water control valves shall be located no more than 60 inches above the floor, shall be readily accessible and if concealed, shall have appropriate signage outside the concealed space.
Instructions

Upon completion of work, inspection and tests shall be made by the contractor or his representative. Where indicated with an asterisk (*) the inspection and tests are to be witnessed by a designated University representative. Please consult with the Construction Department to determine who should witness tests where required. It is understood that the owner’s representative’s signature in no way prejudices any claim against the contractor for faulty material, poor workmanship, or failure to comply with approving authority’s requirements or local ordinances.

Fill out all information called for and submit this report to the University Construction Department.

Property/Building Name ________________________________ Date ______________

Name of Person Making This Report ________________________________

Company/Contractor Responsible for Work ________________________________

All applicable specifications and NFPA standards found on this form are to be completed and answered as a “yes”, or “no”. Any “no” answer is to be explained and approved by the University Construction Department prior to system approval.

Plans

As built drawings provided to Construction Department Yes ___ No ______

Installation conforms to plans and equipment meets with design specifications Yes ________ No ___

Pipe, Fittings, and Valves

Type of Pipe ________________________________

Type of Fittings ________________________________

Alarm Valve or Flow Indicator

Type ________________________________

Make ________________________________

Model ________________________________
### Sprinklers

<table>
<thead>
<tr>
<th>Make</th>
<th>Model</th>
<th>Year of Manufacture</th>
<th>Orifice Size</th>
<th>Quantity</th>
<th>Temperature Rating(s) by Location</th>
</tr>
</thead>
</table>

### Dry Pipe Operation Test (Check here if not applicable ____)

**Alarm Device**

<table>
<thead>
<tr>
<th>Type</th>
<th>Make</th>
<th>Model</th>
</tr>
</thead>
</table>

* Trip Test

- Min _______  Sec _______

- Air Pressure PSI _______  Water Pressure PSI _______

* Time Water Reaches Test Outlet _______

* Alarm Operated Properly  Yes ___ No ___

### Deluge and Preaction Valves (Check here if not applicable ____)

**Operation**

- Pneumatic ____  Electric ____  Hydraulic ______

- Piping Supervised  Yes ___ No ___

- Detecting Media Supervised  Yes ___ No ___

- Valve Operates From Manual Trip, Remote, or Both Control Stations  Yes ___ No ___

- Is There an Accessible Facility in Each Circuit for Testing  Yes ___ No ___
MINIMUM FIRE SPRINKLER DESIGN CRITERIA
February 16, 2007

Make __________________________ Model _______________________

Does Each Circuit Operate Supervision Loss Alarm       Yes ___ No ____
Does Each Circuit Operate Valve Release               Yes ___ No ____
Maximum Time to Operate Release                      Minutes _____ Seconds _____

**Pressure Reducing Valve Test**

Location and Floor_____________________________________________________

Make and Model _______________________________________________________

Setting __________ Static Pressure Inlet PSI __________ Outlet PSI __________

Residual Pressure (Flowing) Inlet PSI _______ Outlet PSI _______ Flow GPM _______

**Test Description**

Hydrostatic tests shall be made at not less than 200 psi for 2 hours or 50 psi above static pressure in excess of 150 psi for 2 hours. Differential dry-pipe valve clappers shall be left open during the test to prevent damage. All aboveground piping leakage shall be stopped.

Pneumatic: Establish 40 psi air pressure and measure drop, which shall not exceed 1 ½ psi in 24 hours. Test pressure tanks at normal water level and air pressure. Measure air pressure drop, which shall not exceed 1 ½ psi in 24 hours. ___

**Tests**

* All piping hydrostatically tested at ____ psi for ____ hours

* Dry piping pneumatically tested     Yes _____ No _____ N/A _____

Equipment operates properly     Yes ___ No ___

Do you certify as the sprinkler contractor that additives and corrosive chemicals were not used for testing systems or stopping leaks?     Yes ___ No ___

**Drain Test**

Gauge reading located near water supply test connection ______ psi

Residual gauge pressure, with valve test connection fully open ______ psi
MINIMUM FIRE SPRINKLER DESIGN CRITERIA
February 16, 2007

* Drain test: pass _____ fail ____

Underground water mains and lead in connections to sprinkler system riser flushed before connection made to sprinkler piping. Yes ___ No ___

Welding

Field welded piping Yes ___ No ___
If yes, what location? ____________________________

Do you certify as the sprinkler contractor that any welding procedure complies with the requirements of at least AWS D10.9 level AR-3? Yes ___ No ___

Do you certify that welding quality control procedures were used to ensure that all discs are retrieved, that openings in piping are smooth, that slag and other welding residues are removed, and that the internal diameters for piping are not penetrated? Yes ___ No ___

Hydraulic Data Nameplate

Nameplate provided at main riser location? Yes ___ No ___

Signatures

Name of Installing Contractor ____________________________

Date ____________________

Certification of Completion Approved by ____________________________

Date ____________________

Additional Explanation and Notes

________________________________________________________________________

________________________________________________________________________
Instructions

Upon completion of work, inspections and tests shall be made by the contractor or his representative. Where indicated with an asterisk (*) the inspection and tests are to be witnessed by a designated University representative. Please consult with the Construction Department to determine who should witness tests where required. It is understood that the owner’s representative’s signature in no way prejudices any claim against the contractor for faulty material, poor workmanship, or failure to comply with approving authority’s requirements or local ordinances.

Fill out all information called for, and submit this report to the University Construction Department.

Property Name

Date

Name of Person Making This Report

Company/Contractor Responsible for Work

All applicable specifications and NFPA standards found on the form are to be completed and answered as a “yes” or “no”. Any “no” answer is to be explained and approved by the University Construction Department prior to system approval.

Plans

Installation Conforms to Accepted Plans and Specifications Yes ___ No ___

If No, State Deviations

Underground Pipes and Joints

Pipe Types and Class

Type Joint(s)

Test Description

**Flushing:** Flow the required rate until water is clear as indicated by no collection of foreign material.

**Hydrostatic:** Hydrostatic tests shall be made at not less than 200 psi for two hours or 50 psi
above static pressure in excess of 150 psi for two hours.

Flushing Tests

* New Underground Piping Flushed According to Instructions Above
  If No, Explain

Hydrostatic Test

* All New Underground Piping Hydrostatically Tested Per Instructions Above
  If No, Explain

Hydrants

Number Installed, Type and Make
  All Operate Satisfactorily

Water Control Valves

Water Control Valves Left Wide Open
  If No, State Reason

Signatures

Name of Installing Contractor
  Date:
  Certification of Completion Approved by
  Date:

Additional Explanation and Notes
1. Fire sprinkler design densities shall comply with the following:

<table>
<thead>
<tr>
<th>Hazard Classification</th>
<th>Design Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Hazard</td>
<td>0.10 - 0.15 gpm/sq. ft. over the most remote 1500 - 2000 sq. ft. Spacing to be</td>
</tr>
<tr>
<td></td>
<td>in the range of 130 - 225 sq. ft. using quick response fire sprinkler heads with</td>
</tr>
<tr>
<td></td>
<td>head temperatures complying with NFPA 13, Table 3-2.5.1.</td>
</tr>
<tr>
<td>Ordinary Hazard Group I</td>
<td>0.15 - 0.20 gpm/sq. ft. over the most remote 3,000 - 4,000 sq. ft. Fire sprinkler</td>
</tr>
<tr>
<td></td>
<td>heads with head temperatures complying with NFPA 13, Table 3-2.5.1 shall be</td>
</tr>
<tr>
<td></td>
<td>used.</td>
</tr>
<tr>
<td>Ordinary Hazard Group II</td>
<td>0.20 - 0.25 gpm/sq. ft. over the most remote 3,000 - 4,000 sq. ft. Fire</td>
</tr>
<tr>
<td></td>
<td>sprinkler heads with head temperatures complying with NFPA 13, Table 3-2.5.1</td>
</tr>
<tr>
<td>Extra Hazards Group I &amp; II</td>
<td>These areas are to be determined separately on an individual basis along</td>
</tr>
<tr>
<td></td>
<td>with the assistance of the University Insurance Carrier, and the BYU Risk</td>
</tr>
<tr>
<td></td>
<td>Management and Safety Department. Designs should anticipate criteria for Extra</td>
</tr>
<tr>
<td></td>
<td>Hazard Group I at 0.30 - 0.35 gpm/sq. ft. over the most remote 3,000 - 5000 sq.</td>
</tr>
<tr>
<td></td>
<td>ft.</td>
</tr>
</tbody>
</table>

2. The following examples shall serve to assist in calculations of fire sprinkler design for BYU. This sample only represents a small portion of the University. The design criteria for miscellaneous storage, library stack rooms, and hazardous material storage areas will require additional consultation with the Insurance Carrier, and University Risk Management and Safety Department.

<table>
<thead>
<tr>
<th>Light Hazard</th>
<th>Individual Areas in a Building as an Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theaters and auditoriums, excluding stages and prosceniums</td>
<td>Wilkinson Center</td>
</tr>
<tr>
<td>Art galleries, museums</td>
<td>Museum of Art</td>
</tr>
<tr>
<td>Restaurants and cafeteria seating areas</td>
<td>Morris Center</td>
</tr>
<tr>
<td>Stadiums</td>
<td>Cougar Stadium</td>
</tr>
<tr>
<td>Hospitals (other than laboratories, service and storage areas)</td>
<td>Student Health Ctr.</td>
</tr>
<tr>
<td>Apartments</td>
<td>Wyview</td>
</tr>
<tr>
<td>Dormitories</td>
<td>Heleman Halls</td>
</tr>
<tr>
<td>Electronic data processing center</td>
<td>Talmage Building</td>
</tr>
<tr>
<td>Offices</td>
<td>Abraham Smoot Admin Bldg</td>
</tr>
<tr>
<td>Post offices (excluding mail processing plants)</td>
<td>Wilkinson Center</td>
</tr>
</tbody>
</table>
The design criteria for Light Hazard Occupancies would be 0.10 - 0.15 gpm/sq. ft. over the most remote 1500 - 2000 sq. ft. with spacing in the range of 130 - 225 sq. ft. using quick response fire sprinklers with head temperatures proportional to predicted maximum ceiling temperatures.  

**NOTE: This is a higher standard for design criteria than NFPA 13**

**Ordinary Hazard Group I**

Service areas for cafeterias and restaurants  
Electrical rooms  
Mechanical rooms  
Parking garages

**Individual Areas in a Building as an Example**

Docks, delivery/storage areas  
All buildings  
Lee Library Tunnel

The design criteria for Ordinary Hazard Group I Occupancies would be 0.15 - 0.20 gpm/sq. ft. over the most remote 3,000 - 4000 sq. ft.  

**NOTE: This is a higher standard for design criteria than NFPA 13**

**Ordinary Hazard Group II**

Arenas which may be used for exhibition purposes  
Exhibition halls  
Stages  
Post Offices, bulk mail centers  
Wood shops, metal shops, machine shops, workshops  
Boutiques  
Retail stores  
Grain/dust elevators  
Laboratories (flammable liquids not in excess of allowable quantities)  
Printing & publishing  
Repair garage  
Dry Cleaners  
Horse Stables

**Individual Areas in a Building as an Example**

Wilkinson Center Ball Room  
Wilkinson Center Ball Room  
Wilkinson Center  
Student Auxiliary Services  
Campus Craft Sales Areas  
Bookstore  
Bag room, heating plant  
Photo developing rooms  
Press Building  
Auto Shops  
Auxiliary Services Laundry  
Ellsworth Building

The design criteria for Ordinary Hazard Occupancies Group II would be 0.20 - 0.25 gpm/sq. ft. over the most remote 3,000 - 4000 sq. ft.  

**NOTE: This is a higher standard for design criteria than NFPA 13**

**Extra Hazard Group I**

Printing (using inks having flash points below 100 degree f.)  
Upholstering shops  
Chip bins, paper shredding areas  
Chemistry laboratories

**Individual Areas in a Building as an Example**

University Press Building  
Upholstery shop  
University Press Building  
Benson Building

The design criteria for Extra Hazard Group I Occupancies would be 0.30 - 0.35 gpm/sq. ft. over the most
remote 3,000 - 5000 sq. ft. NOTE: This is a higher standard for design criteria than NFPA 13.

<table>
<thead>
<tr>
<th>Extra Hazard Group II</th>
<th>Individual Areas in a Building as an Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flammable liquids spraying</td>
<td>Auto Shop, Auxiliary Services</td>
</tr>
<tr>
<td>Open oil quenching, dip tanks</td>
<td>Paint Shop</td>
</tr>
<tr>
<td>Solvent cleaning</td>
<td>Paint Shop</td>
</tr>
</tbody>
</table>

The design criteria for Extra Hazard Group II Occupancies would be 0.40 gpm/sq. ft. over the most remote 3,000 - 5000 sq. ft. NOTE: This is a higher standard for design criteria than NFPA 13