PROPER HANGING OF FIRE SPRINKLER SYSTEMS
Historical developments and basic concepts
Hangers
Hanger installation
Special listed pipe
Hangers in earthquake areas
Trapeze hangers
Ends of lines and armovers
Riser support
U-type hangers made of round wrought iron or malleable cast iron, ring clips or approved adjustable hangers. Flat U-type hangers permitted if at least 3/16-inch thick.

Hangers required to be at least 12 inches from sprinklers to avoid interference, except round hangers were permitted as close as 3 inches.

For concrete construction, cast iron inserts recommended, but expansion bolts could be used in existing buildings, preferably in a horizontal position.
NFPA 13 – 2010 contains Section 9.1 on Hangers and 9.2 on Installation of Pipe Hangers

NFPA 13 basis for other NFPA standards for water-based systems: 13R, 14, 15, 16, 750

NFPA 13D requires support methods comparable to those of local plumbing codes.

Exception: listed piping must be supported per listing limitations
Hangers must meet the requirements of Section 9.1 unless certified by a professional engineer as capable of:

- supporting five times the weight of the water-filled pipe plus 250 lbs (114 kg) at each point of support
- the points of support are adequate
- the spacing limitations for the piping material are not exceeded
- the hanger components are ferrous

Detailed calculations to be submitted to AHJ as required
The components of hanger assemblies that directly attach to the pipe or to the building structure must be listed.

- Exception: Mild steel hangers formed from rods.
- Exception: Fasteners (screws and bolts) per 9.1.3 to 9.1.5.

UL 203 listing based on 5 times weight of water-filled pipe plus 250 lbs (114 kg). Not intended as building design dead load per hanger.
HANGERS - COMPONENTS

- Hangers and their components must be ferrous.

- Exceptions:
  - Nonferrous components proven by fire tests to be adequate for the hazard, listed for the purpose, and in compliance with the requirements of the standard
  - Holes through structural members permitted to serve as hangers if permitted by applicable building codes
HANGERS - TYPES

Defined by how they attach to the structure and the sprinkler piping
ATTACHMENT TO STRUCTURE

- Ceiling Flanges
- Side Beam Attachments
- Beam and C-clamps
- Concrete Inserts and Expansion Shields
- Straps and U-hooks
- Lag Screws and Coach Screw Rods
- Powder-driven Studs and Welding Studs
As part of listing, C-clamps are tested in each possible mounting position unless otherwise marked.

Some structural engineers prefer attachment of hanging loads to top flanges.
ATTACHMENT TO PIPE

- Riser Clamps
- Adjustable Swivel Rings or Loops
- J-hangers
- Clevis Hangers
- Straps and U-hooks (straps must be listed)
CONCRETE INSERTS AND EXPANSION SHIELDS

- Listed inserts permitted
- Listed expansion shields permitted except:
  - With cinder concrete, permitted only for branch lines where alternated with through bolts or beam hangers
  - Only in side of concrete beams (above centerline or above reinforcing steel) or vertically under Section 9.1.3.7
Studs and installation tools must be listed

- Steel should not be less than 3/16-inch (4.2 mm) thick for powder-driven studs

- Representative samples of concrete must be tested for minimum loads per 9.1.3.9.3

- Steel must be not less than US standard 12 gauge (2.78 mm) for welded attachment of welding studs or other hanger parts

- Increaser couplings must be directly attached to powder-driven studs or welding studs
RODS AND U-HOOKS

- Hanger rod, U-hook rod and eye rod diameters depend on the pipe size being supported, with minimum 3/8-inch (10 mm) diameter (5/16-inch (7.9 mm) for U-hooks) unless part of listed hanger assembly
  - Table 9.1.2.1 – Hanger rods
  - Table 9.1.2.4 – U-hook rods
  - Table 9.1.2.5.1 – Eye rods
- Threaded sections of rods shall not be bent or formed
SCREWS AND BOLTS

- For ceiling flanges and U-hooks, minimum screw options and dimensions provided in Table 9.1.5.2.1

- For coach screw rods, minimum plank thickness and beam or joist face width provided in Table 9.1.5.7.2

  - Example: for 3-inch pipe, minimum nominal $t$ is 4 inches (102 mm), minimum nominal $w$ is 3 inches (76 mm)
Nails are not acceptable for fastening hangers.

Holes for lag screws and coach screw rods must be pre-drilled 1/8-inch (3.2 mm) less in diameter than screw thread maximum root diameter.

Bolts must be provided with a flat washer and nut, and holes for bolts must not be more than 1/16-inch (1.6 mm) larger in diameter than the bolt.

Eye rods must be secured with lock washers to prevent lateral movement, with flat washer also provided for wood structural members.
Hang branch lines perpendicular to close-spaced building members such as joists or purlins
INSTALLATION OF HANGERS

- Piping must be supported independently of ceiling sheathing
  - Exception: Toggle hangers permitted under hollow tile or metal lath and plaster for pipe 1-½ inch (40 mm) or smaller

- Piping in racks must be supported from rack

- Structure must support weight of the water-filled piping plus 250 lbs (114 kg)
  - Exception: 1-inch (25 mm) and smaller branch lines under metal decks

- Piping under ducts can be supported by common hangers per 9.2.1.5
DISTANCE BETWEEN HANGERS

Table 9.2.2.1 based on type and nominal size of pipe

- Steel pipe maximum 15 ft (4.6 m) spacing, but 12 ft (3.7 m) maximum up to 1-¼ inch (32 mm) and for threaded light wall
- Other maximums assigned for copper, CPVC, and ductile iron

- Not less than one hanger for each section of pipe
  - Exception: Lengths less than 6 ft (1.8 m)

- At least one hanger on cross mains between each two branch lines
  - Exception: Steel mains in bays
EXCEPTIONS FOR STEEL MAINS

- Where hangers are attached to purlins on all branch lines as near to the cross main as possible, intermediate hangers are permitted to be omitted from steel cross mains in bays:
  - For 2 or 3 branch lines per bay, 1 omitted
  - For 4 or more branch lines per bay, 2 omitted
 Beam strength of special listed pipe a consideration during listing

 Special hangers now available to avoid harm to nonmetallic piping, usually with flared edges.
HANGERS IN EARTHQUAKE AREAS

- Section 9.3.7

- Retaining strap required for all C-type clamps (including beam and large flange clamps). Strap to be listed or meet minimum dimensions. In absence of adequate lip, strap to be secured with bolt or screw.

- Powder-driven fasteners not permitted where systems are required to be protected against earthquake accelerations greater than 0.5g unless specially listed.
Considered an extension of the building structure; used to transfer loads to appropriate structural members.
Minimum required section modulus from Table 9.1.1.6.1(a) must be less than or equal to the minimum available section modulus of proposed trapeze member from Table 9.1.1.6.1(b).

Criteria based on simple center-loaded steel beam supporting 15 ft (4.6 m) of water-filled pipe plus 250 lbs (114 kg) with maximum allowable bending stress of 15 ksi (1034.2 bar).
It is desired to support 8-inch Schedule 10 pipe with a trapeze hanger with a span of 5 ft 8 in (1.7 m).

- Table 9.1.1.6.1(a) requires 0.97 section modulus for 6 ft (1.8 m) span
- Table 9.1.1.6.1(b) provides 1.04 section modulus for 3-inch Schedule 10 pipe
Section 9.1.1.6.5 requires “All components of each hanger assembly that attach to a trapeze member shall conform to 9.1.1.4 and be sized to support the suspended sprinkler pipe.”
Formula for effective length of trapeze supporting pipe to one side of span:

\[ L = \frac{4ab}{(a + b)} \]

This can allow smaller trapeze member
For a 6-ft (1.8 m) span with 8-inch Schedule 10 pipe at center of trapeze the required section modulus is 0.97.

If pipe is 1 ft (0.3 m) from one support, what is the new section modulus?

\[
a = 1 \text{ ft} \quad b = 5 \text{ ft} \quad a = 0.3 \text{ m} \quad b = 1.5 \text{ m}
\]

\[
L = \frac{4(1)(5)}{1+5} = \frac{20}{6} = 3.33 \text{ ft} \quad L = \frac{4(0.3)(1.5)}{0.3+1.5} = \frac{1.8}{1.8} = 1.0 \text{ m}
\]

With an effective length of 3.33 ft (1.0 m) the required section modulus becomes 0.64
Unsupported length at end of branch lines limited to 36 in. (0.9 m) for 1-inch (25 mm) pipe, 48 in. (1.2 m) for 1-1/4-inch (32 mm) pipe or 60 in. (1.5 m) for 1-1/2-inch (40 mm) and larger pipe.
Exception: For pendent sprinklers at 100 psi (7 bar) or higher under ceilings, closest hanger must prevent upward movement, and unsupported length limited to 12 in. (305 mm) for steel or 6 in. (152 mm) for copper.
SUPPORT OF ENDS OF LINES

- Special restraint against upward movement for high pressure lines applies only to pendent sprinklers through ceilings.

- Criteria based on 1985 NFSA tests for Texas State Board of Insurance.
Cumulative horizontal length of unsupported armover must not exceed 24 in. (610 mm) for steel or 12 in. (305 mm) for copper.

Exception: For pendent sprinklers at 100 psi (7 bar) or higher under ceilings, length limited to 12 in. (305 mm) for steel or 6 in. (152 mm) for copper, and closest hanger must prevent upward movement.

Note: The pendent sprinkler can be installed either directly in the fitting at the end of the armover or in a fitting at the bottom of a drop nipple.
SPECIAL LISTED HANGERS
RISER SUPPORT

- Risers to be supported by riser clamps or by hangers on horizontal pipe within 24 inches (610 mm) of riser
- In multi-story buildings, riser supports to be provided at the lowest level, at each alternate level above, above and below offsets, and at the top of riser
- In high vertical shafts or bays, distance between supports must not exceed 25 ft (7.6 m)
8.15.3.2.3 – Where corrosive conditions are known to exist due to moisture or fumes, hangers that resist corrosion must be used or a protective coating applied.

A-9.2.2 – Where copper tube is used in moist areas or other environments conducive to galvanic corrosion, copper hangers or ferrous hangers with an insulating material should be used.
QUESTIONS?

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