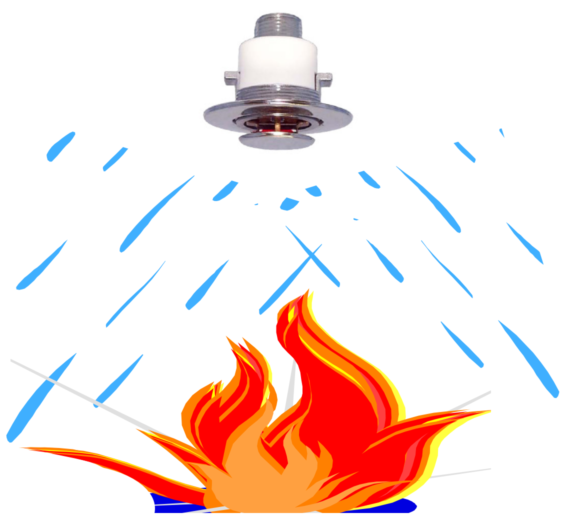
Safety & Buildings

Plumbing

Multipurpose Piping Systems



Design Manual

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Introduction

- Most deaths caused by fire in homes occur at night. The occupants are generally sleeping and there may or may not be a smoke alarm present. If a smoke alarm is close to the source of the fire it will possibly activate early enough to provide the waking residents time enough to exit the dwelling. But if the smoke is trapped in a room without an alarm, the fire may be too far along to permit exit of the dwelling by the time the alarm sounds. Over 85% of fire deaths occur in the home. Fire protection is a life safety issue.

- Smoke detectors have shown to increase survival rates by 50%, while sprinklers plus smoke detectors are estimated to increase survival rates by 97%.

- In April 2000 a new paragraph (s. Comm 82.40(3)(f)) *Multipurpose piping systems*) was included in the Wisconsin Administrative Code. This was the result of Wisconsin adopting most of NFPA-13D. As of March 1, 2009, the definition of a multipurpose system was revised to mean a water distribution system conveying water to plumbing fixtures and appliances and to automatic fire sprinklers with the intention of serving both domestic and fire protection needs.

- The subsequent chapters in this manual are intended to familiarize the reader with the materials, design method and sizing of a multipurpose piping system. This manual assumes that the reader has a basic knowledge of the pressure available for uniform loss method of sizing the water distribution system. For an in depth explanation of that method, the department has available another manual titled, ***Sizing the Water Supply System.***

- There are three different types of piping systems used in the design of a multipurpose piping system. They are:
  - The tree type system.
  - The looped system.
  - The network system.

- The looped system, network type system and any system served by a municipal water main less than 4-inches in diameter require hydraulic calculations as per

NFPA 13. The water calculation worksheets designed for sizing plumbing piping and the fire-water calculation worksheets designed for sizing residential sprinkler demand and the friction loss tables on type of materials in SPS 382.40 – 4-11, use the same formulas such as the Hazen & Williams and velocity formulas required in NFPA 13. Proper use of the design manual worksheets will meet the hydraulic calculation procedures in accordance with NFPA 13.

- The Wisconsin Plumbing Code by definition states that a Multipurpose piping system is a water distribution system (SPS 381.01(156)) and is that portion of a water supply system from the building control valve to the connection of a plumbing fixture or fixture supply connector, plumbing appliance, water using equipment, or other piping systems to be served. Any piping intended to serve residential sprinklers on a multipurpose system shall be connected to the water distribution system (downstream of the building control valve).

- How do Multipurpose Systems (MPP) save lives?
  By incorporating a sprinkler system with a plumbing water distribution system, the cost of installing a high degree of fire protection in a dwelling is brought within reach of the average homeowner, current estimates are at $ 1.61 per square ft. The design of a MPP system is intended to keep the fire contained, allow enough time to escape, and prevent the fire from going to flashover. In approximately 93% of the time, the fire is completely extinguished. Of great importance is addressing the time of a fire event. A fire can grow from first flame to flash over in less than 5 minutes, completely trapping any occupants who may be unaware of the developing disaster. Toxic smoke and extreme heat reaching over 1100 degrees F. can quickly overcome a life in just a few breaths. It is in this volatile arena of smoke, heat, flame, and initial 5 minutes of time that the MPP system is designed for, a fire department as good as they are, cannot address this initial period of time.

- Multipurpose piping systems are allowed not required in the State of Wisconsin for one and two family dwellings since May 1, 2000.

- MPP systems for public buildings are allowed with restrictions in accordance with SPS 362.0903(6) since March 1, 2008.

- MPP systems for public buildings will be one option to meet the sprinklering requirements mandated after December 31, 2010 for public buildings as identified in SPS 362.0903(6). For further information refer to Chapter 11 in this manual.

- A Multipurpose piping system is defined as plumbing and as such can only be installed by a Master Plumber responsible and the Journeyman and Apprentice Plumbers under the Master Plumber's responsibility. A Master Plumber Restricted Licensed person may perform modifications to an existing system only.

Multipurpose Piping Systems

Chapter **Page**

Department of Safety & Professional Services
Division of Industry Services

MPP Design Manual

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Questions?

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Chapter 1
Definitions and Materials

Definitions

- **Authority Having Jurisdiction.** The organization, office, or individual responsible for approving equipment, materials, an installation or a procedure (3.2.2).

- **Automatic Sprinkler System.** An integrated system of piping connected to a water supply, with listed sprinklers that automatically initiate water discharge over a fire area. Where required, the sprinkler system also includes a control valve and a device for actuating an alarm when the system operates (3.9.9).

- **Control Valve.** An indicating valve (such as plug valves, ball valves, butterfly valves, or OS & Y gate valves) used to control or shut a supply of water to a sprinkler system (3.3.10.2).

- **Design Discharge.** The rate at which water is discharged from an automatic sprinkler in gpm (3.3.2).

- **Labeled.** Materials or equipment with an accompanying identifying mark of an organization such as a label or symbol attached thereto that is recognized and accepted by the authority having jurisdiction and having a concern with product approval. By such label the manufacturer expresses compliance with the appropriate standards and / or performance specifications (3.2.3).

- **Listed.** Equipment or materials included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose (3.2.4).

- **Manufactured Home.** Has the meaning specified under s.101.91 (2), Stats. Note: A structure that is designed to be used as a dwelling with or without a permanent foundation and that is certified by the federal department of housing and urban development as complying with the standards established under 42 USC 5401 to 5425. (c) A mobile home, unless a mobile home is specifically excluded under the applicable statute.

- **Multipurpose Piping System.** Means a type of water distribution system conveying water to plumbing fixtures and appliances and automatic fire sprinklers with the intention of serving both domestic and fire-protection needs (SPS 381.01(156).

- **Network System.** A type of multipurpose system utilizing a common pipe system supplying domestic fixtures and fire sprinklers where each sprinkler is served by a minimum of three separate paths (3.3.9.4).

- **Residential Sprinkler.** A type of sprinkler that meets the definition of fast response as defined by NFPA 13D, *Standard for the Installation of Sprinkler Systems in One – Two Family Dwellings and Manufactured Homes 2007 Edition,* and that has been specifically investigated for its ability to enhance survivability in the room of fire origin and that is listed for use in the protection of dwelling units (3.3.8.2).

- **Sprinkler, Automatic.** A device that will control or suppress a fire event when it is exposed to heat equal to or above its thermal rating and the heat actuated element opens to allow water to discharge over a specific area.(3.3.8.1).

Materials

Piping.

- The pipe or tubing which conveys the water to the sprinklers shall conform to both SPS 384.30 table 384.30-8 and NFPA 13D. This means that as long as the water in the pipe is on its way to a sprinkler, it shall conform to both. Piping that is serving only domestic plumbing fixtures or appliances need conform to only table SPS 384.30-8, (5.2.1, A.5.2.1).

- The table below is taken from s. SPS 384.30.

Table 384.30–8
WATER DISTRIBUTION PIPE AND TUBING

Material	Standard
Brass	ASTM B43
Cast iron	AWWA C115
Chlorinated Poly (Vinyl Chloride) (CPVC)[a]	ASTM D2846; ASTM F441/441[c]; ASTM F442/442M[d]
Copper[b,e]	ASTM B42; ASTM B88
Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene	CAN/CSA B137.10, ASTM F1281
Crosslinked polyethylene (PEX)[a]	ASTM F876; ASTM F877
Ductile iron	AWWA C115; AWWA C151
Galvanized steel	ASTM A53
Polyethylene/Aluminum/Polyethylene	CAN/CSA B137.9
Polyethylene/Aluminum/Polyethylene (PE−AL−PE) Composite Pressure Pipe	ASTM F1282
Stainless Steel	ASME B36.19M; ASTM A270; ASTM A450

[a] Plastic pipe and tubing installed underground shall be in accordance with ASTM D2774.
[b] Copper tubing, type M, may not be installed underground.
[c] Use is limited to pipe $2^1/_2$ inches or less in diameter for sch 80 and 1 inch or less in diameter for sch 40.
[d] Use is limited to pipe with a SDR 11 or less.
[e] Copper pipe or tubing shall not be installed if the pH of the water to be conveyed is 6.5 or less.

- All of the materials in the table are approved for water distribution piping serving fixtures and appliances with the stipulations in the footnotes, but not all the pipe is approved for multipurpose piping in a one or two family residence. There are 4 materials currently in this table that are acceptable to NFPA 13D for use as multipurpose piping to sprinklers.
- They are:
  Chlorinated Poly Vinyl Chloride (CPVC) ASTM F442.
  Copper ASTM B88.
  Galvanized Steel ASTM A53.
  Cross linked polyethylene (PEX) ASTM F876

- All non-metallic pipe must be listed as well as meet the standard. Some nonmetallic tubing is listed for use with ordinary temperature-rated sprinklers only.

- Galvanized Steel has a minimum diameter of 1-inch. Cross linked polyethylene (PEX) ASTM F876 tubing is approved in network systems that are ½ -inch diameter. The minimum size for the rest of the material is ¾-inch diameter. (8.4.3)

Pipe Fittings and Valves

- Pipe fittings in the multipurpose piping system serving sprinklers shall conform to the pipe material standards listed in s. SPS 384 or Table 384.30-10 Wis. Adm. Code and NFPA 13D. The joints shall be made in conformance with s. SPS 384.40 Wis. Adm. Code and NFPA 13D.

- Valves on the piping which serve sprinklers shall conform to s. SPS 384.30(5) Wis. Adm. Code and NFPA 13D.

Hangers and Supports

- Hangers and supports shall conform to s. SPS 382.60 Wis. Adm. Code. This includes the spacing requirements in Table 382.60.
- Additionally, *listed piping shall be supported in accordance with any listing limitations.* An example is CPVC ASTM F442 tubing is listed for use with galvanized steel straps.

- When a sprinkler discharges, the velocity in the pipe or tubing may be 8-feet per second. This velocity can cause the movement of the tube or pipe if it is not supported properly. Piping laid on rafters or joists shall be secured to prevent lateral movement. The sprinklers should be secured as close to the sprinkler as possible to assure the sprinkler will discharge over its intended coverage area (7.4.3, 7.4.4).

Sprinklers

- Only listed residential sprinklers shall be used. These sprinkler listings are based on tests to establish the ability of the sprinklers to control residential fires under standardized fire test conditions. The criteria used for such tests are found in UL 1626, Standard for Residential Sprinklers for Fire-Protection Service.

- **Temperature Ratings.** Where the maximum ambient ceiling temperatures do not exceed 100^{o} F (38^{o} C), ordinary temperature-rated residential sprinklers shall be installed. These are designed to operate at 135^{o} F to 170^{o} F (57^{o} C to 77^{o} C).
- Sprinklers installed under glass or plastic skylights exposed to the direct rays of the sun shall be the intermediate temperature-rated sprinklers designed to operate at 175^{o}F to 225^{o}F (79^{o}C to 107^{o}C). (7.5.5)

- Sprinklers installed in an unventilated concealed space under an uninsulated roof or in an unventilated attic shall be intermediate temperature-rated sprinklers. (7.5.5.3)

- Sprinklers installed near other heat sources or obstructions, shall meet the requirements of NFPA 13D Table 7.5.5.3 and 8.2 Position of Sprinklers.

- Sprinklers that have operated or have been damaged shall be replaced with sprinklers having the same performance characteristics as the original equipment (4.2.2).

- A sprinkler shall not be permitted to have ornamental finishes or paint applied to its surface by an individual other than the manufacturer of the sprinkler and shall be part of the listing (7.5.6).

- **Wisconsinisms**

- Sections 7.6, 6.3(4), 8.1.3, and 8.6 of the NFPA 13D 2007 Standard do not apply.

- Section 7.6 covers water flow alarms, and the requirement for such an alarm on a water distribution system is exempted.

- Section 6.3(4) covers one of the conditions to meet acceptability for a MPP system in that it must be permitted by the local plumbing or health authority. This is not the case, the authority having jurisdiction is the Department of Safety & Professional Services.

- Section 8.1.3 refers to Sprinkler Coverage; sprinklers shall be installed according to their listing.
  Section 8.1.3.2. Non residential sprinklers are not allowed.

- Section 8.6 Location of Sprinklers, applies only on a full 13 D system, not a partial system.

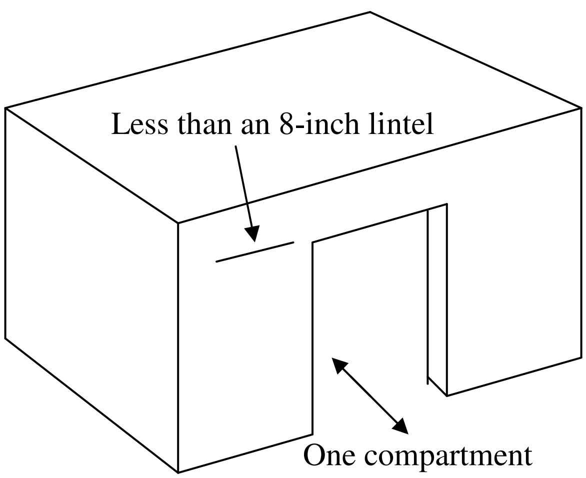
Chapter 2
MPP System Requirements

- Multipurpose piping systems are dependent upon installation criteria supplied by the manufacturer of the sprinklers and NFPA 13D to function properly when discharging. Failing to install the sprinklers and piping per the requirements of the manufacturer and NFPA 13D could result in the system failing to control a fire.

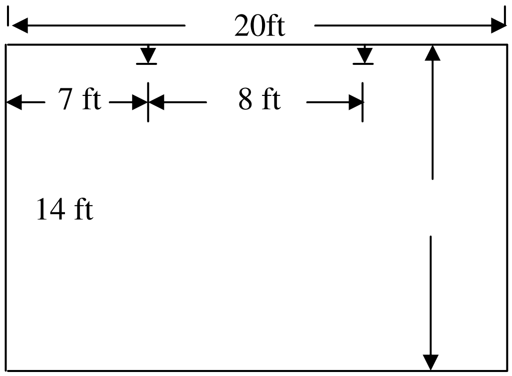
- The system shall be designed to provide a discharge of at least 18 gpm to any single sprinkler and at least 13 gpm per sprinkler for compartments with multiple sprinklers, to a maximum of two sprinklers **or** the system shall provide at minimum the flow required to produce a discharge density of 0.05 gpm/ ft^2 to the design sprinklers, in accordance with the manufacturers sprinkler listing specifications (8.1.1.2.2) You can have more than two sprinklers in a compartment, but for design purpose, the two most remote or demanding sprinklers in a compartment under a flat, smooth horizontal ceiling, shall be used in the design of the system. (8.1.1)

- Where there are multiple sprinklers in a compartment, calculations shall be provided for the single sprinkler criteria and the multiple sprinkler criteria. (8.1.1.2.1)

- A compartment is an area that is enclosed on all sides by walls and a ceiling. The compartment can include doorways or openings to adjacent rooms, provided the lintel depth is less than 8 inches from the ceiling.



- The demand of the fire sprinkler and water distribution system shall be calculated by determining the greater controlling demand of a sprinkler(s) or plumbing fixture on the system. (8.1.2)
- **Example;** The sprinklers used in a compartment are listed in a table by the manufacturer. The room you want to protect is 14 ft by 20 ft. In the manufacturers literature, the sidewall sprinkler being considered to use has a coverage area of 14 ft by 14 ft at 10.2 psi., 14 gpm demand (2 sprinklers, 28 gpm demand) What that means is that with a pressure available at the sprinkler of at least 10.2 psi, the discharge would cover an area out away from the sprinkler to 14 ft and 7 ft on each side of the sprinkler.



- One sprinkler could not cover the entire room, therefore 2 sprinklers would have to be installed.

- In order to prevent one sprinkler from keeping the other from discharging, sprinklers shall be installed in accordance with their listing where the type of ceiling configuration is referenced in the manufacturer's listing. Sloped ceilings do have a minimum distance of 8 ft between sprinklers. Without a minimum distance between sprinklers discharge spray from the first sprinkler could cover the sprinkler next to it. This is called cold soldering. The spray from the first sprinkler that discharges would keep the fire from heating the frangible bulb on the sprinkler next to it.

- A maximum distance from a sprinkler to a side wall of 7 feet would have to be maintained when using the criteria for the 14 ft x 14 ft coverage area. If the distance would exceed 7 feet, you must use the next higher coverage area criteria in your calculations. That would probably take it up to a 16 ft x 16 ft coverage area. But the amount of water pressure required to cover the larger area would increase. The higher flow rate would then cause a greater pressure loss from flow friction in the pipe.

- There is no volume control on sprinklers. As a result, if the sprinklers are placed within the limits for the 14 ft x 14 ft coverage and there is more pressure available than required for that coverage, more water will discharge than called for.

- The minimum 18 gpm for a single sprinkler and 13 gpm for multiple sprinklers do not apply to all sprinklers. Lower flow rates are allowed but the manufacturer of the sprinkler shall have sprinklers tested and approved by a listing agency. The minimum operating pressure of any sprinkler shall be the higher of the minimum operating pressure specified by the manufacturer's listing **or** 7 psi. (8.1.4)

Water Supply Requirements

- Multipurpose piping systems are dependent upon a reliable source of water. The following sources are considered to be reliable. (6.2)

- Water supplied from a municipal water main (reliable waterworks system).
- Water supplied by a private well is a reliable water source if the pressure tank meets the standards of the American Society of Mechanical Engineers and has a pressure source such as a well pump or booster pump.

- A stored water supply shall have a minimum quantity equal to the water demand rate times 10 minutes. A one story dwelling or manufactured dwelling with less than 2000 square feet is permitted to have a 7 minute water supply.
- A stored water source with an automatically operated pump.

- Water demand rates for multipurpose piping;
- Systems are determined by the most demanding sprinkler or sprinklers in gallons per minute. That could be a single sprinkler or multiple sprinklers. If there is no compartment in the dwelling containing more than one sprinkler, the highest gallon per minute demand from any sprinkler in the dwelling determines the 10 minute supply. If the sprinkler demands 17 gallons per minute for its coverage area, the stored water shall equal 170 gallons. If there are multiple sprinklers in a compartment, the total gpm demand from both could equal 28 gpm. 28 gpm times 10 minutes equals 280 gallons of storage.

- Two family dwellings require an additional flow of 5 gallons per minute added to the sprinkler system demand when determining the pressure loss in the water service, water meter and any piping which serves both dwelling units. The additional domestic design demand shall not be required where provisions are made to prevent flow in the domestic water system upon the operation of a sprinkler. (6.3 (1))

- A sign shall be affixed adjacent to the building control valve that states with the following text in ¼-inch high letters; " Warning, the water system for this home supplies a fire sprinkler system that depends on certain flows and pressures being available to fight a fire. Devices that restrict the flow or decrease the pressure such as water softeners shall not be added to this system without a review of the fire sprinkler system by a fire protection specialist. Do not remove this sign." (6.3 (5)) With the code changes for March 1, 2009, additional wording is required.
- Identification of the type of MPP system installed is required, whether it conforms to a full 13D system, or whether it does not conform to a full 13D system. The State of Wisconsin allows partial systems regarding the number and location of sprinklers on one and two family dwellings as long as they are identified as such.

- In subsequent chapters, you will learn how to perform calculations and size a multipurpose piping system for a single family home. Hydraulic calculation procedures in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems,* shall be used for straight run (tree) type systems, grid-type systems, looped-type systems and systems connected to city water mains of less than 4 inch in diameter (8.4.4). <u>Segmented loss calculations</u> using the 'tree type' straight run system are allowed only on MPP systems connected to a 4" or larger municipal main. Grid-type systems shall be permitted to be ½-inch diameter tube.

- Sprinklers are not required in bathroom areas of 55 ft^2 or less. (8.6.2)

- Linen closets, pantries and clothes closets do not require a sprinkler if the area of space does not exceed 24 ft2, and the least dimension does not exceed 3 feet, **and** the walls and ceilings are covered with noncombustible or limited combustible materials that are defined in NFPA 220, Standard of Types of Building Construction. (8.6.3)

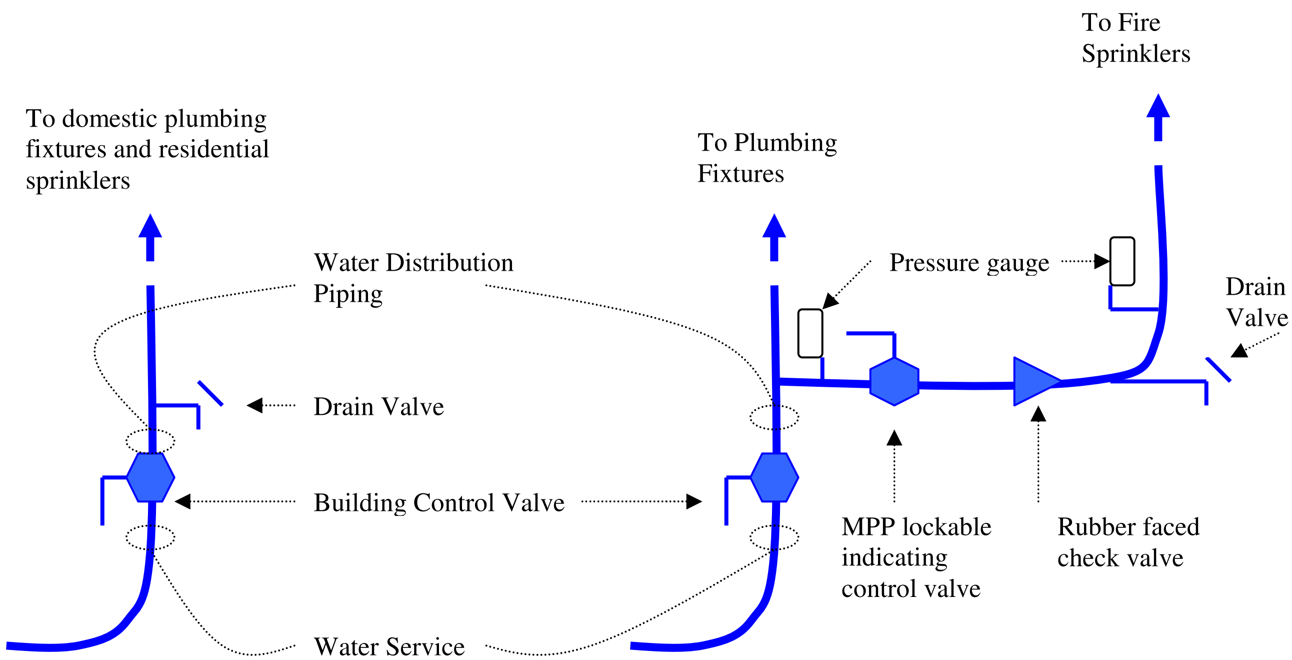
- Sprinklers are not required in garages, carports, and similar structures. Unheated entry areas and porches do not require sprinklers when another means of exit is available. (8.6.5)

- There is no sprinkler requirement for attics or crawl spaces or concealed spaces that are not used or intended for living purposes **and** do not contain fuel fired equipment. (8.6.5)

- Obstructions such as ceiling fans and lights require a minimum distance of 3 feet center to center from a pendant sprinkler, and 5 feet to center from a sidewall sprinkler. If these distances cannot be maintained, then an additional sprinkler shall be located on the other side of the obstruction. (8.2)

- Unfinished basement ceilings are allowed when protection of piping is not required according to listed manufacturer's specifications, or where galvanized or copper tubing is installed. Residential sprinklers shall be permitted to be installed with the anticipation of a future installation of a finished ceiling. (8.2.4)

- <u>The building control valve is required to shut off both the domestic water distribution system and the sprinkler(s). A separate valve branching off the water distribution piping immediately downstream of the building control valve serving sprinkler(s) may be installed in the locked open position only. (7.1.1)</u>



- Pressure gauges are required when a pressure tank is used for the water supply. (7.3.2)

- For testing and maintenance and repairs, a drain valve shall be installed downstream of the building control valve. (7.2.1)

Chapter 3
Sprinkler Design and Location

- The preceding chapters have explained the definitions, listed materials, and the some of the limits of installation. The subsequent chapters will show some of ways the multipurpose piping system can be installed so as to meet the requirements of NFPA 13D. Partial 13D systems are allowed in Wisconsin, and the location requirements in NFPA 13D 8.6, Location of Sprinklers, only apply when installing what can be described as a “full” 13D system.

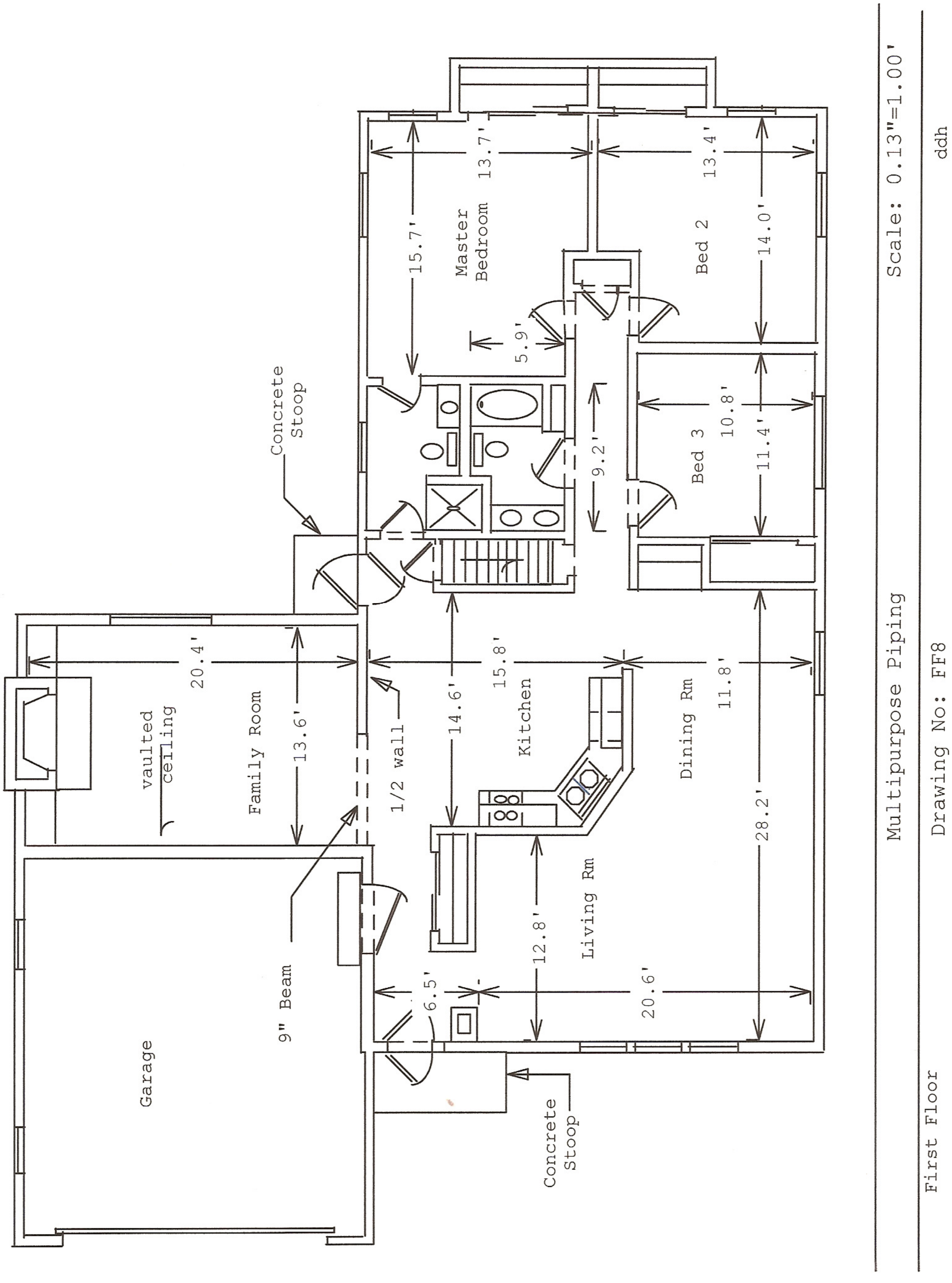
- Figure 3-1 on page 3-2 displays the first floor plan and Figure 3-2 on page 3-3 displays the basement plan of a popular style three bedroom ranch home. This manual will concentrate on the design of a complete or full NFPA 13D multipurpose piping system for this dwelling.

- Examine the first floor plan in figure 3-1. Note that the room sizes are listed for each room other than the powder room and rear foyer. For reasons explained later in this manual, those areas are not included in the coverage (8.6). The dashed lines indicate shelves, appliances under cabinets and the headers above doorways. Some of the doorways and entrances from one room to another do not have a header or a lintel. You must remember that if the lintel is less than 8 inches, the compartment continues into the next room (4.1, 4.1.1, 4.1.2). In other words, the kitchen/dinette and the dining room are one compartment. And expanding it further the compartment will also include the living room, foyer, rear foyer and the center hall. The family room has a vaulted ceiling, and there is a beam in the kitchen ceiling to separate the rooms therefore the family room is not included.

- The main bathroom is just under 54 ft^2. 8.6.2 of NFPA 13D, stipulates that sprinklers shall not be required in bathrooms of 55 ft^2 or less. Therefore a sprinkler will not be installed in the main bath.

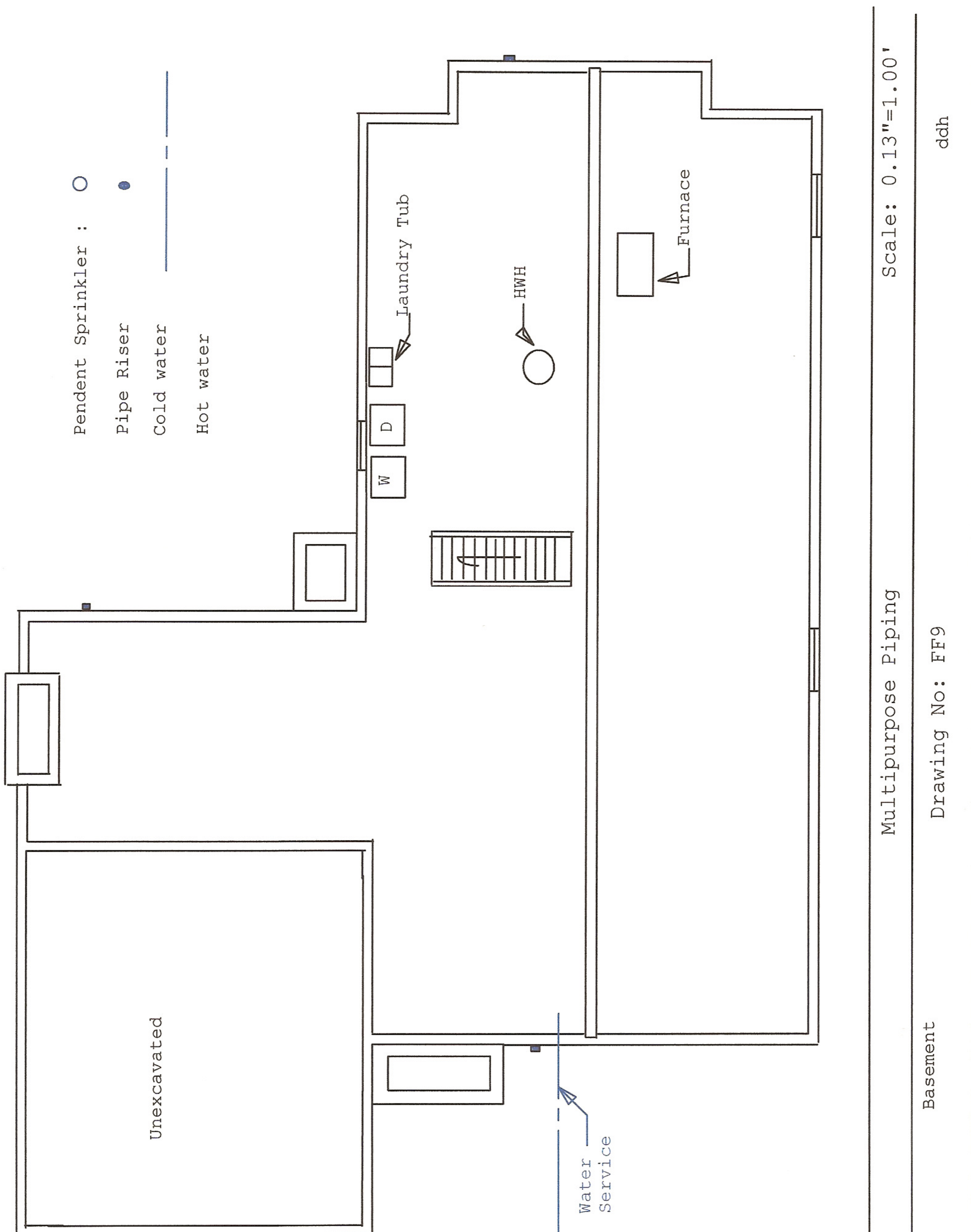
- None of the closets are large enough to meet or exceed 24 ft^2 or have the least dimension of 3 feet or more (8.6.3). Therefore the closets, garage and the powder room will not be included in the compartments to be protected by fire sprinklers (8.6.4).

Figure 3 - 1



Master Bedroom
13.7'
15.7'
5.9'
Bed 2
13.4'
14.0'
Bed 3
10.8'
11.4'
9.2'
Concrete Stoop
Family Room
vaulted ceiling
20.4'
13.6'
1/2 wall
Kitchen
15.8'
14.6'
Dining Rm
11.8'
28.2'
Living Rm
12.8'
6.5'
20.6'
9" Beam
Garage
Concrete Stoop
Scale: 0.13"=1.00'
ddh
Multipurpose Piping
Drawing No: FF8
First Floor

Figure 3-2


Pendent Sprinkler :
Pipe Riser
Cold water
Hot water
Laundry Tub
HWH
Furnace
D
W
Unexcavated
Water Service
Scale: 0.13"=1.00'
ddh
Multipurpose Piping
Drawing No: FF9
Basement

Locating the Sprinklers

- Figure 3-3 on page 3-6 is the first floor plan with the location of the sprinklers displayed. The sprinklers used are sidewall sprinklers.

- Sprinkler location is dependent upon the sprinkler selected and its flow capacities. The manufacturer specifications are readily available by contacting or downloading on the Web the sprinkler companies detailed specs. Reliable, Viking, Globe, are just a few sprinkler companies that have a selection of residential sprinklers to choose from.

  Master Bedroom 1 – 16' X 16'
  Bedroom 2 1 – 14' X 14'
  (Note that in these two compartments, the inner wall adjacent to the sprinkler head location has an offset where a small corner of the floor space would not receive spray. Two options need to be considered; one is to install ceiling pendents in these two rooms to cover the floor area in question, the other is to have the carpenter wall in the uncovered area. Keep in mind, with ceiling pendents installed and piping running through a cold ceiling attic space, insulation and / or a source of heat will be required to prevent freezing.)

  Bedroom 3………………..1 – 12' X 12'
  Main Bath……………… None
  Hallway…………………. 2 – 12' X 12'
  Stairway……………….. 1 – 12' X 12'
  Back door foyer………… 1 – 12' X 12'
  Kitchen…………………… 1 – 16' X 16'
  Dining……………………. 1 – 12' X 12'
  Living Room………………1 – 16' X 20'
  Living Room 1 – 16' X 16'
  Front Entry Foyer…………1 – 12' X 12'
  Family Room………………2 – 14' X 14'

- Spacing between sprinklers shall be installed in accordance with their listing where the type of ceiling configuration is referenced in the listing (8.1.3.1.1).

- The family room requires 2 sprinklers and the ceiling also is vaulted towards the common wall with the garage. Therefore the sprinklers must be placed within 4-6 inches of the peak of the ceiling (8.2.2.1). The sprinkler deflectors shall also be parallel to the ceiling slope.
- The area that each sprinkler covers must be taken into consideration when locating the sprinklers. In Figure 3-3 on page 3-6, (the living room and dining room area) note the dashed lines. These lines depict the limit of the living room sprinkler when sizing at a 16 ft x 20 ft coverage area. The distance coverage between each sprinkler in the living and dining room area must overlap so that all areas are included.
- Odd shaped rooms can present some challenges to the designer when locating the sprinklers. All areas must be included in the coverage, but sprinklers must not be placed too close to each other or cold soldering can occur.

- Also note on this print layout the compartment areas that consist of two or more sprinklers. As long as there are no lintels between rooms 8” or greater, multiple rooms will be considered to be one compartment. In this case the living room, dining room, kitchen, main entry foyer, hallway, and rear entry foyer, is one compartment (4.1.4, 4.1.2). The family room is another compartment.

- Sprinklers are designed to be installed in compartments with smooth flat ceilings. If sprinklers are installed in areas with open joists spaces or open truss joists, the heat from a fire may be diverted from or travel above the sprinkler. NFPA 13D does permit sprinklers in basements where ceilings are not required, but they shall be positioned in a manner that anticipates the future installation of a finished ceiling (8.2.4).

- The drawing in Figure 3-4 on page 3-7 illustrates the location of sprinklers in the basement. It is assumed that the entire basement is going to have a finished ceiling. The width of the basement is less than 28 feet.

- Note the sprinklers are all pendants. In the front to rear direction of the basement, the sprinklers are placed so that a 16 ft x 16 ft coverage area can be used for all the sprinklers. Even though there are more than 2 sprinklers in the basement, the whole basement can be considered 1 compartment. This is assuming that the ceiling will be dropped far enough that the beam will not create an 8 inch or greater change in elevation.

- Note that a sprinkler was placed behind the stairs. The area under the stairs would then be included in the coverage. Another option would be to enclose the area under the stairs and the additional sprinkler would not be necessary (8.6.5).

- The area of basement behind the garage and under the family room is included because it is a full height area of the basement (8.6.5).
- Basement pendent sprinklers………………..11 – 16’ X 16’

- Provide a specification sheet on the sprinklers selected and make a list showing the manufacturer, model no, coverage areas, flow requirements in GPM, and pressure requirements to obtain the flow rate.
- The sprinklers have now all been located in the compartments of the first floor and the basement. The next step is to make a drawing of the water distribution system.

- Sidewall Reliable F1 RES 44 SWC
  7……12’ X 12’……..13 gpm…...8.7psi
  3…....14’ X 14’……..14 gpm.....10.2psi
  3...….16’ X 16’……..17 gpm….15 psi
  1…….16’ X 20’…….23 gpm….27.4psi

- Pendant Reliable RFC 43 CCP
  11…..16’ X 16’……..13 gpm…..9.1 psi

Figure 3-3

Sprinkler:

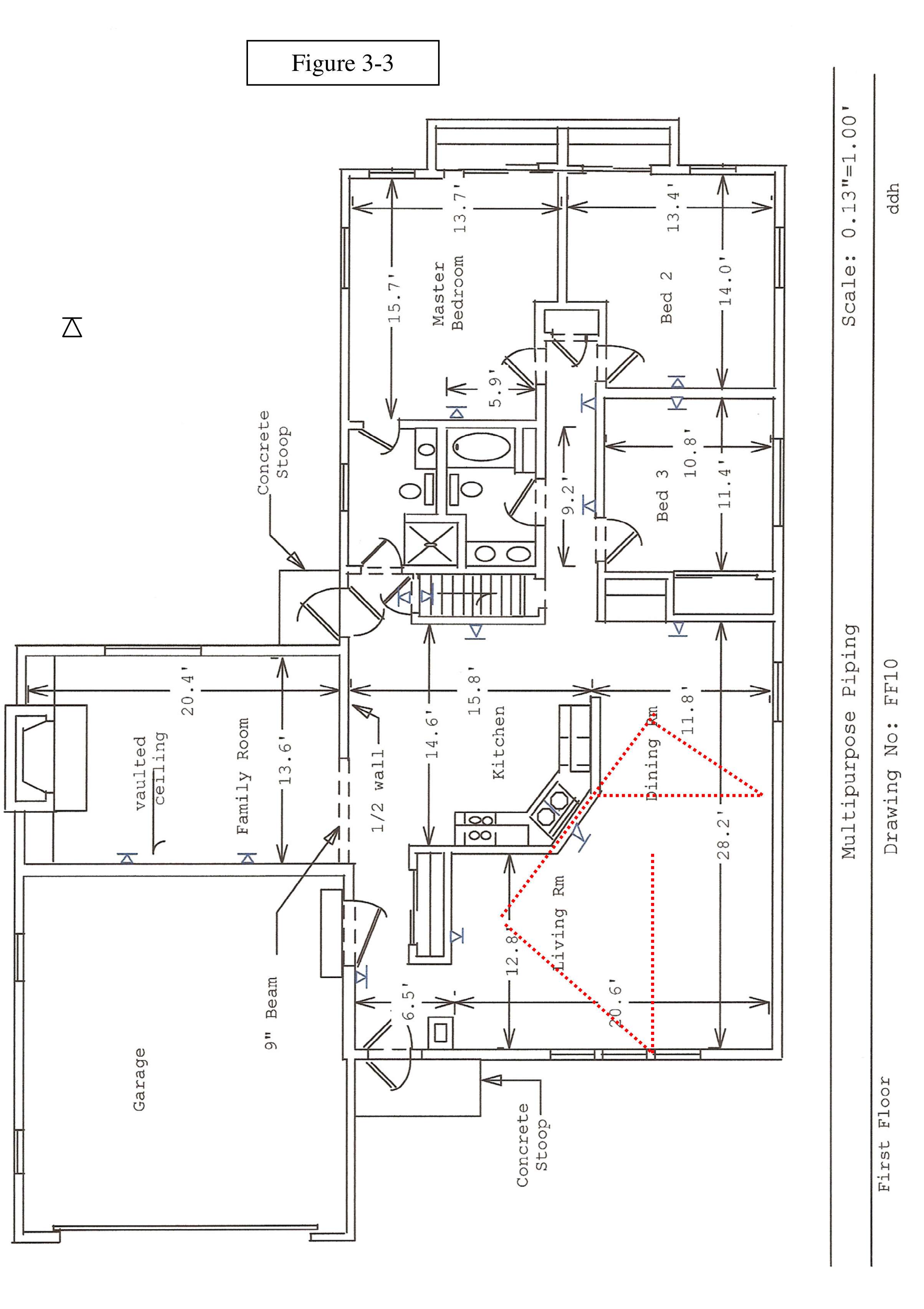
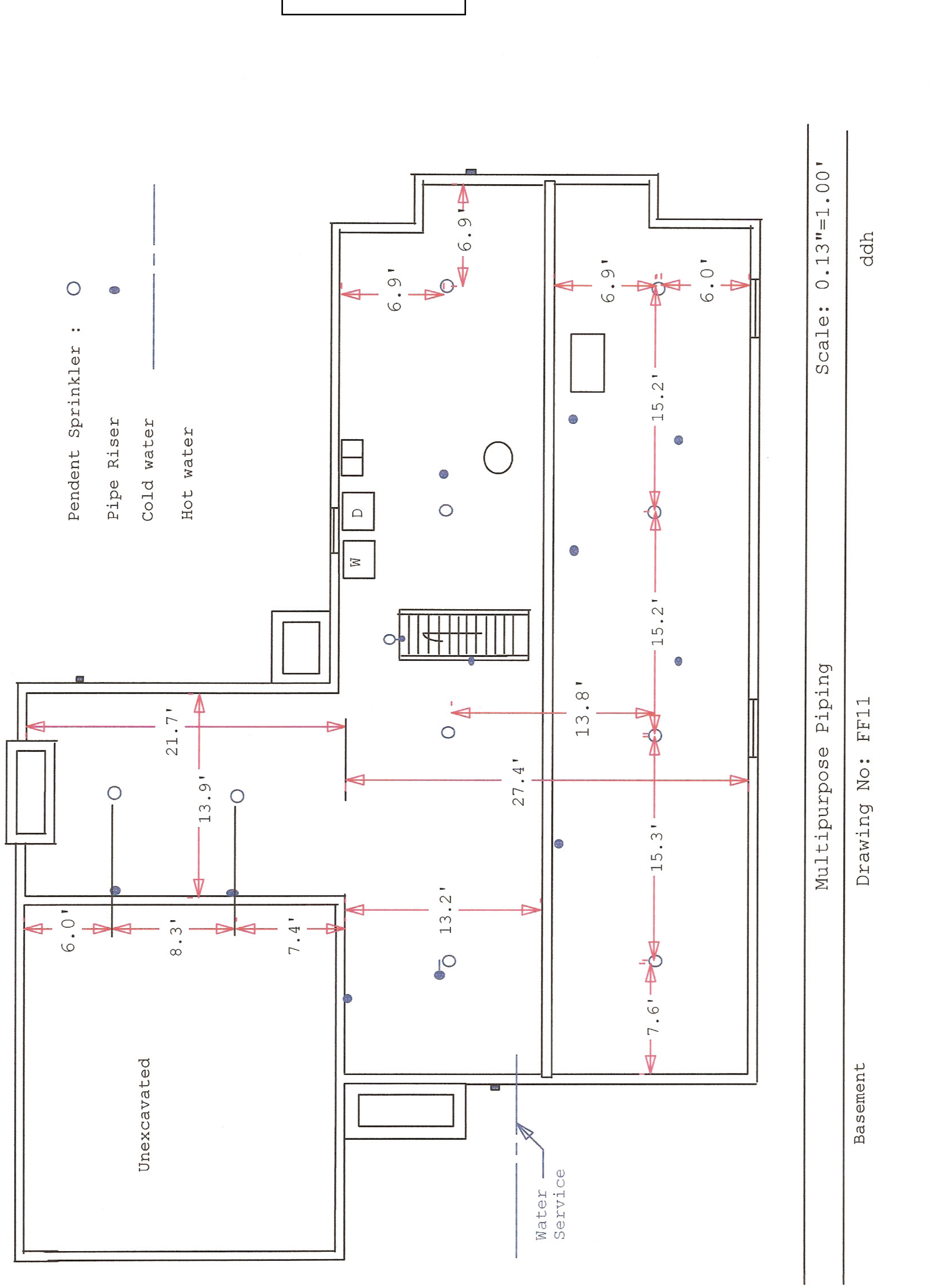


Figure 3-4


Pendent Sprinkler :
Pipe Riser
Cold water
Hot water
W
D
Unexcavated
Water Service
6.9'
6.9'
6.9'
6.0'
15.2'
15.2'
13.8'
21.7'
13.9'
27.4'
15.3'
6.0'
8.3'
7.4'
13.2'
7.6'
Scale: 0.13"=1.00'
ddh
Multipurpose Piping
Drawing No: FF11
Basement

Chapter 4
Designing the Multipurpose Piping System

- Now that the position of the sprinklers is known, the piping diagram can be drawn. There is a plan view of the first floor with the sprinklers shown in Figure 4-1 on the next page, and the basement in Figure 4-2 on page 4-3. Figure 4-2 shows the piping layout on the basement ceiling. Hot and cold water lines are both drawn. The water service is located just to the right of the front stoop.

- The water supply piping system serves the following fixtures and appliances:

  2 bathrooms
  A kitchen sink and dishwasher on the first floor
  3 outside wall hydrants
  In the basement, a laundry tray, automatic washer and water heater

- Because it also serves sprinklers, the entire system is called a multipurpose piping system.

- Page 4-4, Figure 4-3 displays an isometric view of the entire multipurpose piping system. If you study this drawing and compare it to the floor plans supplied in Figures 4-1 and 4-2, the areas the sprinklers are located and covering should become identified. This drawing will be used throughout the rest of this manual. Multipurpose piping serving the sprinklers is drawn in a heavier line weight.

- Sizing the system for a domestic supply to only plumbing fixtures and appliances does not require an isometric drawing. As long as you are sure of the distance to the controlling fixture and calculate the "A" value correctly, it can be sized as you are installing it.

- It is much more difficult to correctly size a multipurpose piping system without a drawing or a very good idea of the type of fittings and how many will be installed. It is critical that the system will work properly if the sprinklers are subjected to a situation where they will discharge.

- Chapter 5 illustrates how the system is sized for the domestic water supply to the plumbing fixtures and appliances. Chapter 6 and the rest of the chapters are devoted to the multipurpose piping system design for the sprinklers in the dwelling.

Figure 4-1

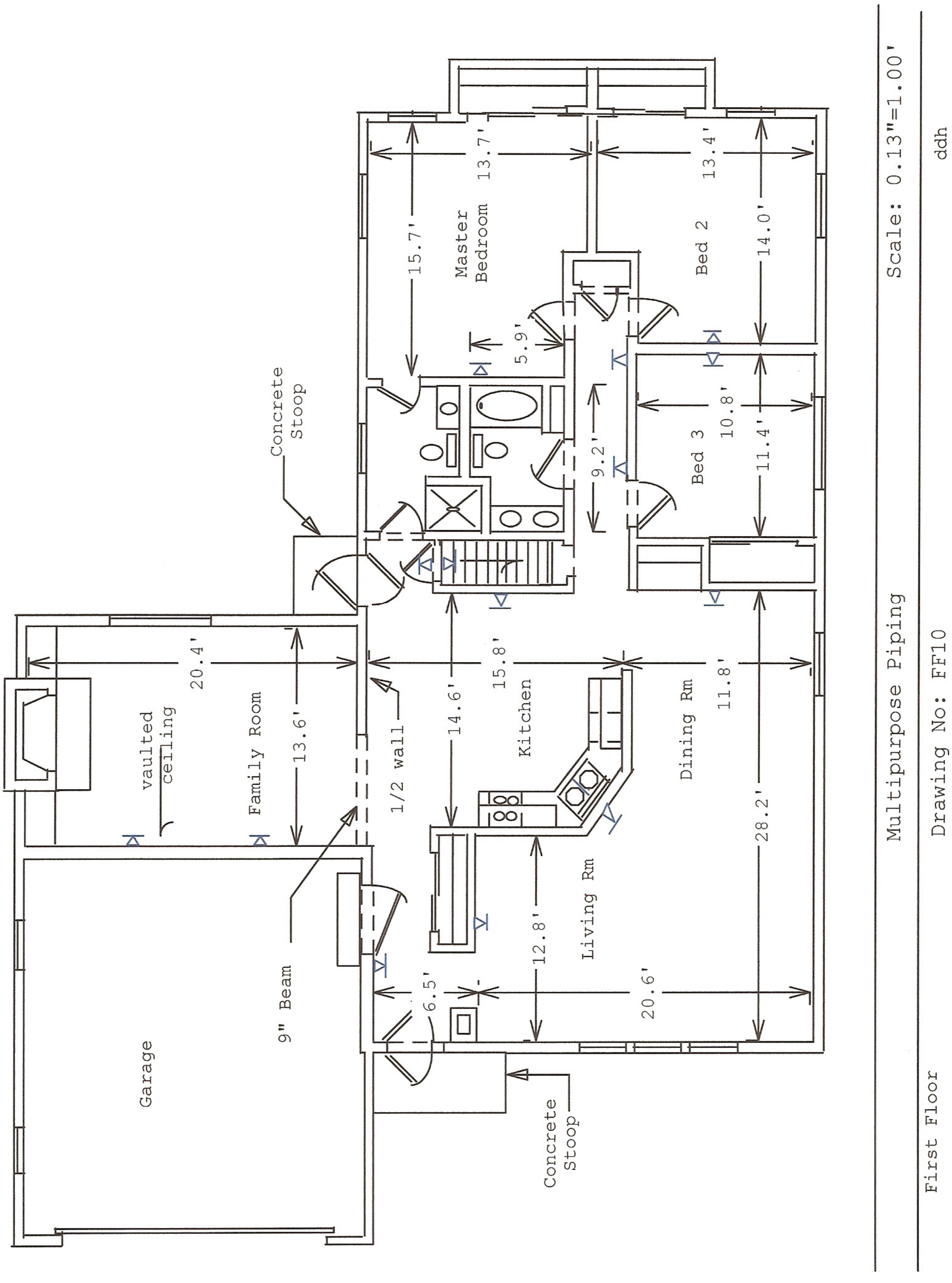
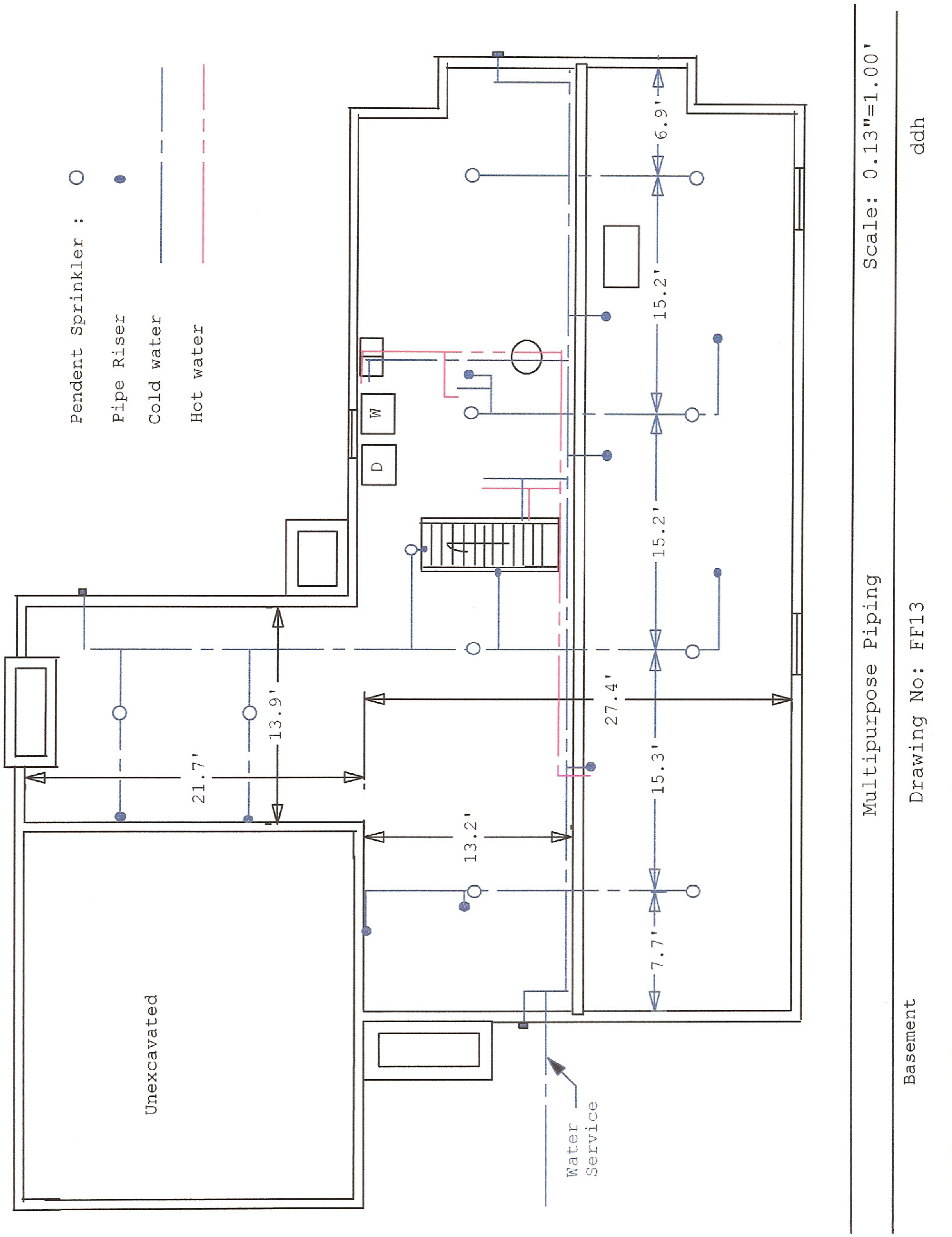
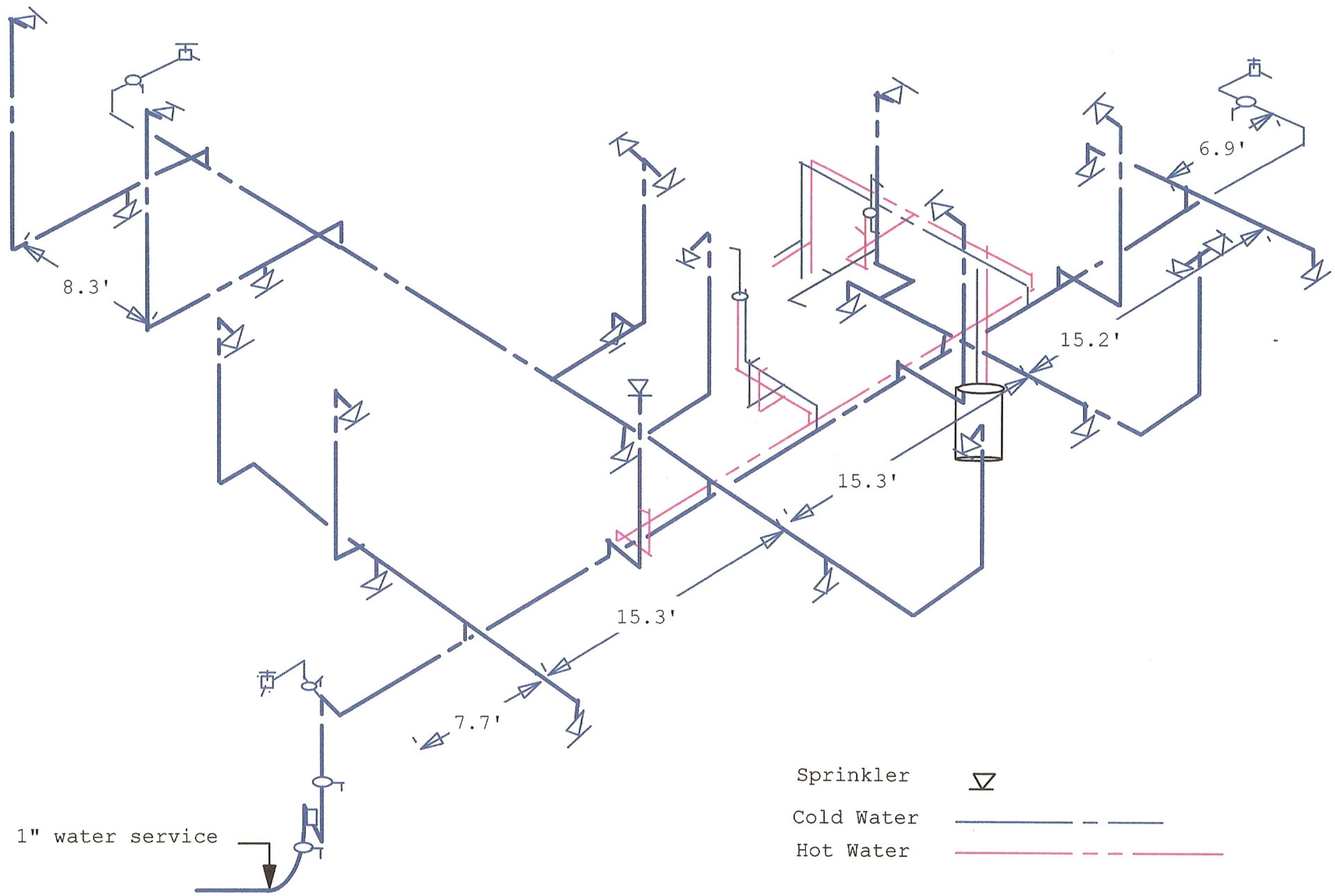

Master Bedroom
Bed 2
Bed 3
Kitchen
Dining Rm
Living Rm
Family Room
vaulted ceiling
Garage
9" Beam
1/2 wall
Concrete Stoop
Concrete Stoop
13.7'
13.4'
15.7'
14.0'
5.9'
9.2'
10.8'
11.4'
20.4'
13.6'
14.6'
15.8'
11.8'
28.2'
12.8'
6.5'
20.6'
Multipurpose Piping
Scale: 0.13"=1.00'
Drawing No: FF10
First Floor
ddh

Figure 4-2



Pendent Sprinkler :
Pipe Riser
Cold water
Hot water
W
D
6.9'
15.2'
15.2'
15.3'
7.7'
27.4'
21.7'
13.9'
13.2'
Unexcavated
Water Service
Scale: 0.13"=1.00'
ddh
Multipurpose Piping
Drawing No: FF13
Basement



Multipurpose Piping

Isometric | Drawing No: FF14 | ddh

Chapter 5
Sizing the Domestic Supply

- When all of the sprinklers have been located and a design for the water distribution piping has been established, the sizing of the multipurpose piping system can be accomplished. Piping to the plumbing fixtures and appliances shall be sized and piping to sprinklers shall be sized. Which ever is the most demanding and requires the larger diameter pipe shall take precedence.

- The first step in sizing is determining the gpm from the plumbing fixtures and appliances.

1 Automatic Clothes Washer	1.5
1 Dishwashing Machine	1.0
3 Hose Bibbs, ½ inch	9.0
1 Kitchen Sink	1.5
1 Laundry Tray	1.5
1 Bath. Group; BT, Lav, and WC	4.0
1 Bath. Group; SH, Lav, and WC	3.5
TOTAL WSFU	22.0

- The total water supply fixture units in the dwelling are 22. Table 382.40-3 in the Wisconsin Administrative Code is used for converting water supply fixture units to gallons per minute. The fixture units are flush tank type, so the right side column is the side to use.

- The total number of wsfu's is 22 and that is not in the Water Supply Fixture Units column, so you must interpolate. To do this, look at the next higher number in the wsfu column. The next number is 30. It is 10 higher than the 20 listed above it. Then look at the next number in the Flush Tank Type gpm column. The number is 20. 20 is 6 higher than 14.

- 20 wsfu's converts to 14 gpm. You need to find out how much gpm to add to 14 gpm by adding 2 wsfu's. To do this divide 6 gpm by the difference in the water supply fixture units, which is 10. 6 divided by 10 equals .6.

- That means that .6 gpm must be added for every 1 wsfu over 20 and up to 30. There are 2 more than 20 wsfu's so 1.2 gpm is added to the 14 gpm. 22 wsfu's converts to 15.2 gpm.

- Figure 5-1 on pages 5-4, 5-5 illustrates the completed water calculation worksheet. After lines 1 to 5 are filled in, the loss in the water service and water meter can be calculated. The next section of the water calculation worksheet can now be completed. The next step is to determine which graph to use in calculating the loss in the service.
- The water service is 1-inch diameter and the material is Copper Type K. Graph A-382.40(7)-2 in the Wis. Administrative Code is the graph to use. Look at Figure 5-2 on page 5-5. The flow rate of 15.2 gpm is located on the left side of the graph, and the junction with a 1-inch water service line has been circled. The point of intersection is at 6.6 psig per 100 feet of pipe.

	GALLONS PER MINUTE	
Water Supply Fixture Units	Predominately Flushometer Type Water Closets or Syphon Jet Urinals	Predominately Flush Tank Type Water Closets or Washdown Urinals
20	35	14
30	40	20

- That pressure loss is for a Copper Type K tube 100 feet in length.

- The water service is not 100 feet in length, it is 65 feet. You must find the loss in 65 feet of this tube at 15.2 gpm flow rate. 65 feet is .65 of 100 feet. Therefore multiply 6.6 x .65.

  - 6.6 x .65 = 4.355 or 4.3

- The calculations in lines 6 through 9 determine the pressure available at the building control valve. The rest of the calculations in the worksheet will determine the pressure available for uniform loss.

- A water meter will be installed in the water supply system. The meter is a standard ¾ inch cold water displacement type. Graph A-382.40(7)-1, which is the pressure loss graph in cold water meters, is Figure 5-3 and located on page 5-6. The loss has been determined to be 3.5 psig and is entered on line C.

- The remainder of the calculations in the worksheet have determined the "A" value to be 23. When the "A" value surpasses a whole number, it is rounded up to the next whole number.

- The "A" value of 23 is now used to find the maximum allowable load on each pipe size in the system for the domestic supply.

- Table 382.40-6 is the maximum allowable load for copper tubing type M. This table is Figure 5-4 and located on page 5-7. Since 23 is greater than the highest "A" value shown, the maximum for each pipe size in this table will apply.

- The table is based on a maximum of 8 feet per second velocity in the pipe. "NP" on the bottom of each column means that by adding more wsfu or gpm listed in the row above, the velocity would be greater than 8 feet per second and that is "NOT PERMITTED".

- The maximum allowable load on each size pipe in the copper type M table is shown below.

Size	FT units
½	7.5
¾	18.0
1	34.0

- The dwelling has a total of 22 wsfu's. 18 is the maximum on a ¾ inch diameter pipe. That means there are 4 more wsfu's than allowed on that ¾ inch diameter pipe. There is a ½ inch hose bibb just downstream of the building control valve. The hose bibb demands 3 wsfu's. The load on the pipe downstream from the connection of that hose bibb is now 19 wsfu's. As soon as 1 more wsfu is served, the pipe diameter downstream of that connection can be reduced to ¾ inch.
- Figure 5-5 on page 5-8, is an isometric view of the multipurpose piping system. 1-inch diameter pipe will have to be supplied downstream of the building control valve to the connection of the cold water supply piping serving the kitchen sink. This is the minimum pipe size for the multipurpose piping system when sized for plumbing fixtures.
- <u>Now that the minimum sizing for the domestic supply to the plumbing fixtures has been established, you must determine the size for the piping to the sprinklers. The pipe diameters can be larger, but not smaller.</u>

Figure 5-1

Water Calc. Worksheet Multipurpose piping, Drawing No. FF8
Name of Project

INFORMATION REQUIRED TO SIZE WATER SERVICE AND WATER DISTRIBUTION:

1-	Demand of building in water supply fixture units (WSFU); (WSFU)	22
1.a.	Demand of building in WSFU converted to Gallons Per Minute: (GPM) (Table 82.40-3)	15.2
2-	Elevation difference from main or external pressure tank to building control valve; (feet)	5
3-	Size of water meter (when required) 5/8"____ 3/4" X ____ 1" ____ other ____	3/4
4-	Developed length from main or external pressure tank to building control valve; (feet)	65
5-	Low pressure at main in street or external pressure tank. (psi)	60

CALCULATE WATER SERVICE PRESSURE LOSS
(unnecessary for internal pressure tanks)

6-	Low pressure at main in street or external pressure tank. (value of # 5 above)		60
7-	Determine pressure loss due to friction in 1 inch diameter water service. Water service piping material is Type K copper. Pressure loss per 100 ft. = 6.6 X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65)	**Subtract value of "7"**	4.3
		Subtotal	55.7
8-	Determine pressure loss or gain due to elevation, (multiply the value of # 2 above by .434)	**Subtract value of "8"**	2.2
9-	Available pressure after the bldg. control valve.	Subtotal	53.5

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B.	Available pressure after the bldg. control valve. (from "9" above)	Value of "B"	53.5
C.	Pressure loss of water meter (when meter is required)	**Subtract value of "C"**	3.5
		Subtotal	50
D.	Pressure at controlling fixture*. (Controlling fixture is: Pr. Bal. Shower valve).	**Subtract value of "D"**	20
	(*Contolling fixture is the fixture with the most demanding pressure to operate properly which includes the following when determining fixture performance; loss due to instantaneous water heaters, water treatment devices, and backflow preventers which serve the controlling fixture.)	Subtotal	30
E.	Difference in elevation between building control valve and the controlling fixture in feet; 12 X .434 psi/ft.	**Subtract value of "E"**	5.2
		Subtotal	24.8

Water Calc Worksheet Multipurpose piping, Drawing No. FF8
Name of Project

F. Pressure loss due to water treatment devices and backflow preventers which serve the controlling fixture. (Water softeners, filters, etc.)

(Pressure loss due to; none).

F1. WSFU Downstream of Water Treatment Device; ______

F2. Convert wsfu to GPM using Table 382.40-3 ______
or
F3. Convert wsfu to GPM using Table 382.40-3e ______
(For individual dwellings only)

F4. Refer to manuf. graph to obtain pressure loss: ______
(If no water treatment device enter "0")

Subtract value of F4 0

Subtotal 24.8

G. Pressure loss through tankless water heaters, combination boiler / hot water heaters, heat exchangers which serve the controlling fixture;

Hot water WSFU's; ______ convert to; GPM = ______ (Table 382.40-3)
Refer to manufacturer's pressure loss graph to determine loss at the required GPM;

0 pressure loss. **Subtract value of "G"** 0

Subtotal 24.8

H. Developed length from building control valve to controlling fixture in feet 72 X 1.5 **Divide by value "H"** 108

Subtotal 0.23

Multiply by: 100

A. Pressure available for uniform loss **"A" =** 23

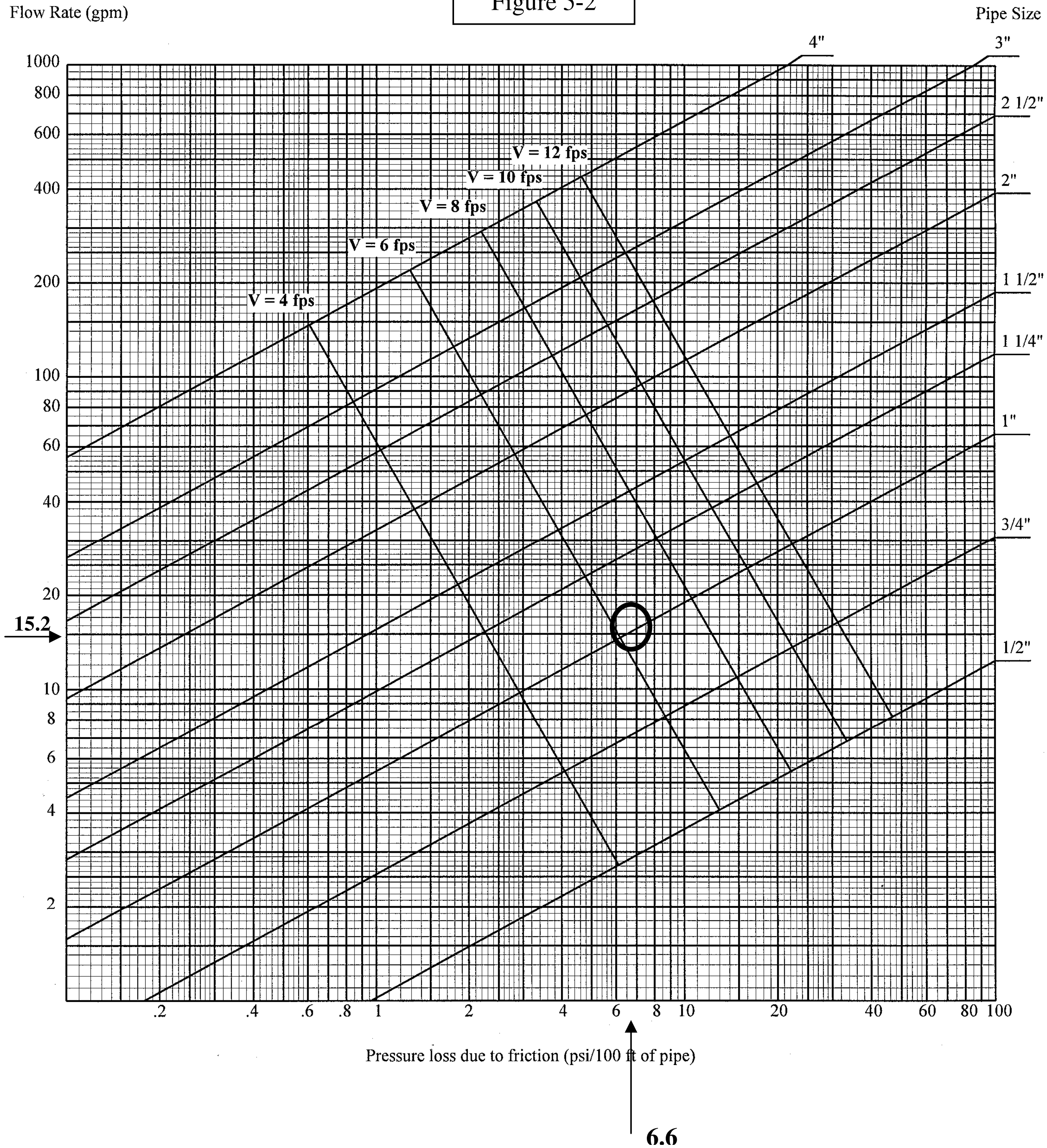
Water distribution piping is: Type M Copper Tubing

*Note: The "A" value obtained by using Table 82.40-3e can only be used for an individual dwelling when sizing the water treatment device (water softeners, etc) and no hose bibbs, hydrants, or high flow fixtures are being served by the water treatment device.

Note: High flow fixtures are defined as fixtures that exceed a flow rate of 4 gpm @ 80 psi, and water veloities not exceeding 8 ft. per second.

- **Graph A-382.40 (7)-2**
- Pressure losses due to flow friction
- Material: Copper Tube-Type K, ASTM B88; (C = 150)

Figure 5-2



Graph A-382.40(7)-1

PRESSURE LOSS IN COLD-WATER METERS, DISPLACEMENT TYPE

Figure 5-3

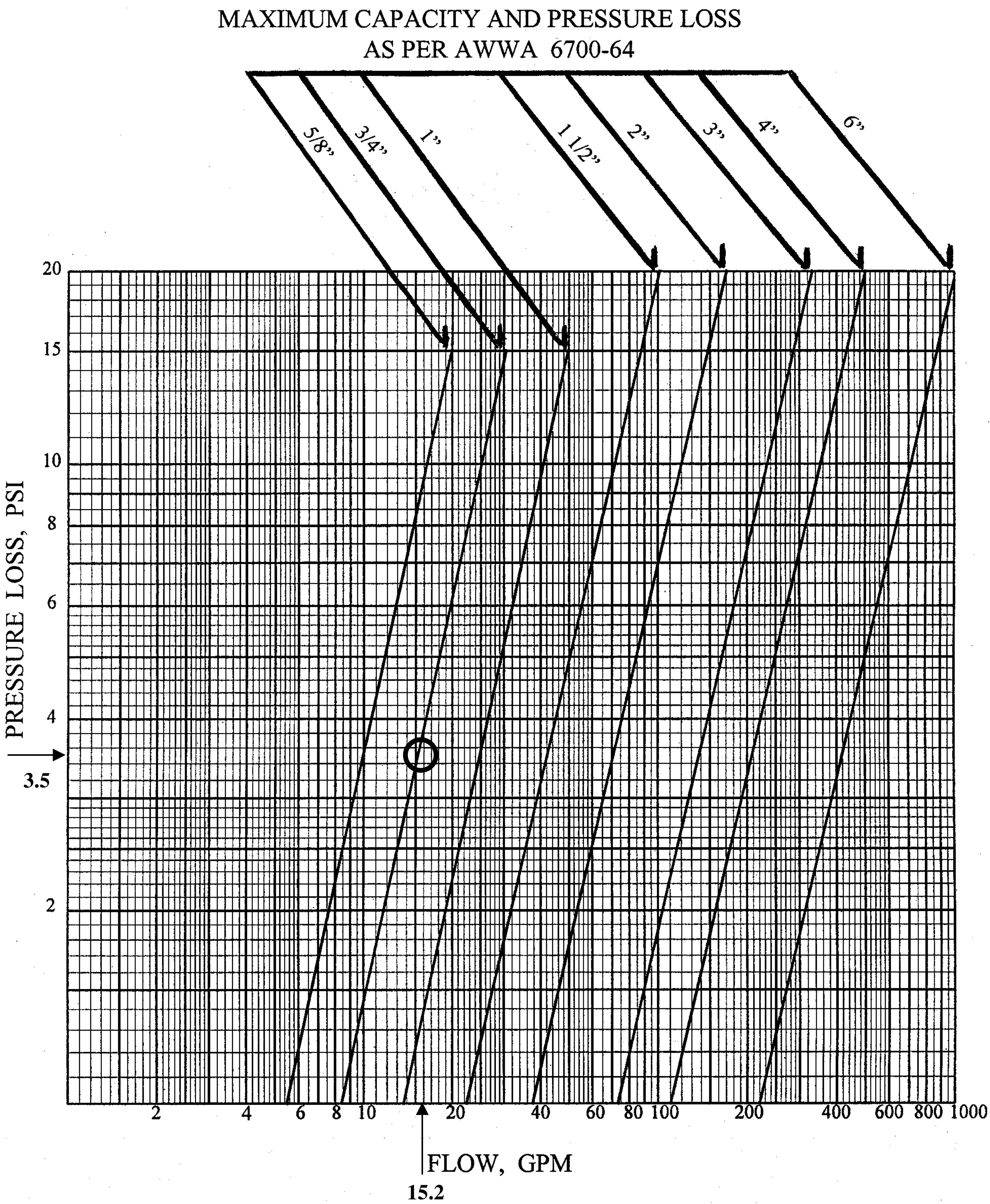


Figure 5-4

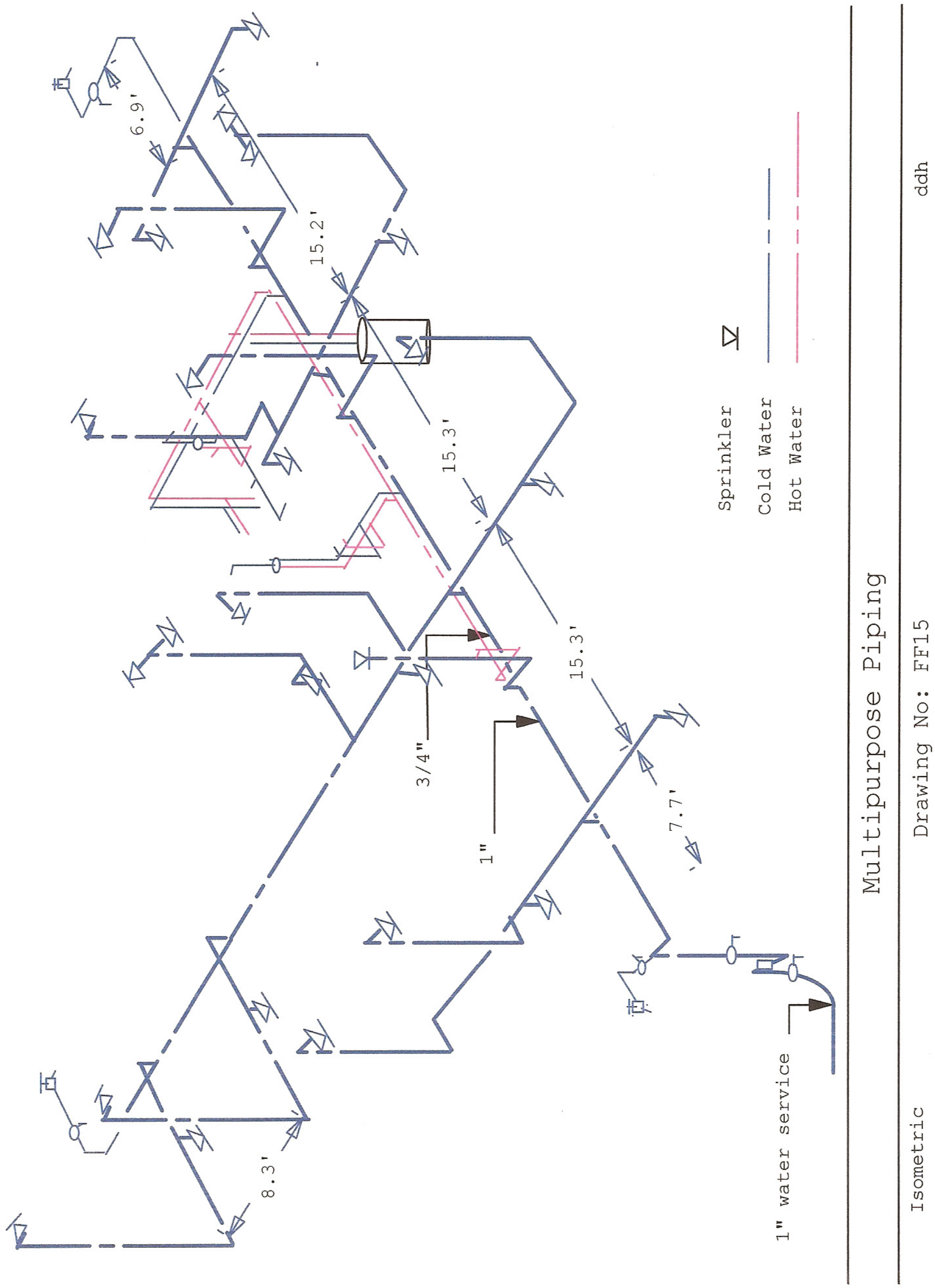
Table 382.40-6

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING-TYPE M, ASTM B88; (C=150)

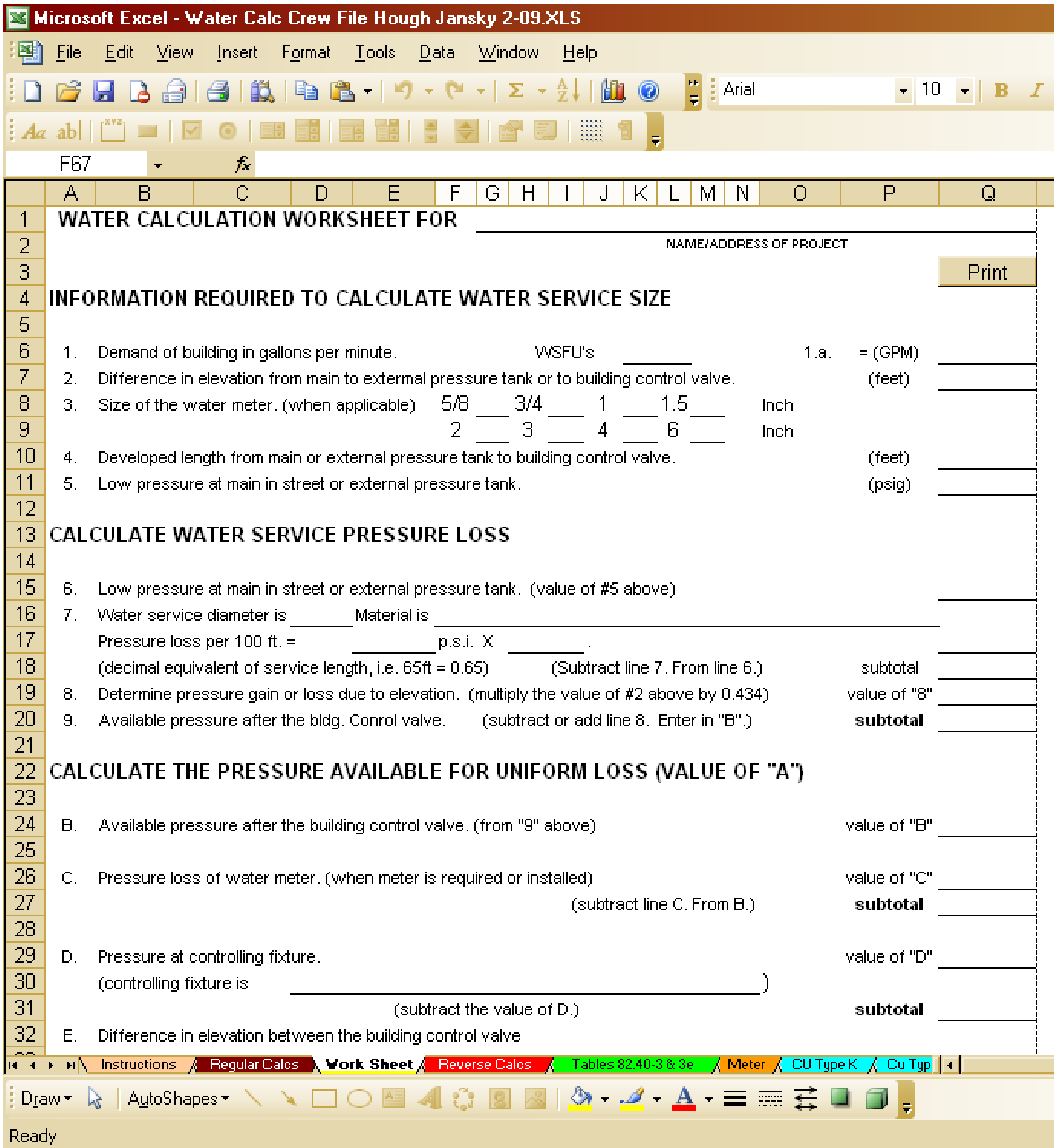
Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																								
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU		
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM
0.5	0.5	-	0.5	2.0	-	2.0	4.0	-	4.0	7.0	-	9.0	11.5	4.0	15.5	23.0	7.5	37.0	42.0	33.0	100	67.0	96.0	210	139
1	1.0	-	1.0	3.0	-	3.0	6.0	-	7.0	10.5	4.0	14.0	16.5	5.5	24.0	34.0	18.5	66.0	61.0	77.0	180	97.0	227	360	202
2	1.5	-	1.5	4.5	-	5.0	9.0	-	11.5	15.5	5.0	22.5	24.0	8.0	40.0	50.0	48.0	128	88.0	184	315	141	493	588	294
3	2.0	-	2.0	5.5	-	6.5	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0	62.0	80.0	185	110	300	425	174	731	776	303
4	2.5	-	2.5	6.5	-	8.0	13.0	4.5	18.0	22.0	7.0	35.0	35.0	20.0	70.0	73.0	120	240	121	374	484	NP			
5	2.5	-	2.5	7.5	-	9.5	15.0	5.0	21.5	25.0	8.5	42.0	40.0	30.0	86.0	79.0	144	270	NP						
6	3.0	-	3.0	8.0	-	10.0	16.5	5.5	24.0	28.0	11.0	50.0	44.0	36.0	106	NP									
7	3.5	-	3.5	9.0	-	11.5	18.0	6.0	26.5	30.0	13.5	55.0	45.0	39.0	112										
8	3.5	-	3.5	9.5	-	12.5	19.5	6.5	29.0	32.0	17.0	62.0	NP												
9	4.0	-	4.0	10.0	4.0	13.0	20.5	6.5	31.0	NP															
10	4.0	-	4.0	11.0	4.0	15.0	21.5	7.0	34.0																
11	4.5	-	5.0	11.5	4.0	15.5	NP																		
12	4.5	-	5.0	12.0	4.0	16.5																			
13	5.0	-	6.0	12.5	4.5	17.5																			
14	5.0	-	6.0	12.5	4.5	18.0																			
15	5.0	-	6.0	NP																					
16	5.5	-	6.5																						
17	5.5	-	6.5																						
18	5.5	-	6.5																						
19	6.0	-	7.0																						
20	6.0	-	7.0																						
21	6.0	-	7.5																						
	NP																								

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means - not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40(7)(f) & (g) specifies minimum sizes for water distribution piping.

Figure 5-5


6.9'
15.2'
15.3'
15.3'
3/4"
1"
7.7'
8.3'
1" water service
Sprinkler
Cold Water
Hot Water
Multipurpose Piping
Drawing No: FF15
Isometric
ddh

- The Department of Safety & Professional Services has available an Excel water calculator and a fire / water calculator designed to follow the water calc worksheet format. These calculators will greatly speed up the process of determining proper pipe sizing for the water service serving the water distribution system and the fire / water distribution system piping we call Multipurpose Piping.
- The following print screens on pages 5-9 to 5-19 show the water calc worksheet and the calculations for our example drawing.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File Edit View Insert Format Tools Data Window Help

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F67

WATER CALCULATION WORKSHEET FOR

NAME/ADDRESS OF PROJECT

Print

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Demand of building in gallons per minute. WSFU's 1.a. = (GPM)
2. Difference in elevation from main to external pressure tank or to building control valve. (feet)
3. Size of the water meter. (when applicable) 5/8 3/4 1 1.5 Inch
2 3 4 6 Inch
4. Developed length from main or external pressure tank to building control valve. (feet)
5. Low pressure at main in street or external pressure tank. (psig)

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above)
7. Water service diameter is Material is
Pressure loss per 100 ft. = p.s.i. X .
(decimal equivalent of service length, i.e. 65ft = 0.65) (Subtract line 7. From line 6.) subtotal
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8"
9. Available pressure after the bldg. Conrol valve. (subtract or add line 8. Enter in "B".) **subtotal**

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B"

C. Pressure loss of water meter. (when meter is required or installed) value of "C"
(subtract line C. From B.) **subtotal**

D. Pressure at controlling fixture. value of "D"
(controlling fixture is)
(subtract the value of D.) **subtotal**

E. Difference in elevation between the building control valve

Instructions | Regular Calcs | Work Sheet | Reverse Calcs | Tables 82.40-3 & 3e | Meter | CU Type K | Cu Typ

Draw AutoShapes

Ready

Microsoft Excel - Water Calc Crew File Hough Jansky 2-09.XLS

C. Pressure loss of water meter. (when meter is required or installed) value of "C" ________

(subtract line C. From B.) **subtotal** ________

D. Pressure at controlling fixture. value of "D" ________

(controlling fixture is ____)

(subtract the value of D.) **subtotal** ________

E. Difference in elevation between the building control valve
and the controlling fixture in feet ________ X 0.434 psi/ft. value of "E" ________

(subtract the value of E.) **subtotal** ________

F. Pressure loss due to water treatment devices, and backflow preventers which
serve the controlling fixture.
Pressure loss due to ______________________ (subtract the value of F)

F1. WSFU's downstream of Water Treatment Device: ________

F2. Convert wsfu's to GPM usin **Table 382.40-3** ________

OR

F3. Convert wsfu's to GPM using **Table 382.40-3e** ________

F4. Refer to manufacturer's graph to obtain pressure loss: value of "F4" ________

(If no water treatment device enter "0") **subtotal** ________

G. Pressure loss through tankless water heaters, combination boiler / hot water heaters, heat exchangers;

Hot water WSFU's; ______ convert to; GPM = ________ (Table 382.40-3)

Refer to manufacturer's pressure loss graph to determine loss at required GPM: ________ pressure loss.

(If no pressure loss through hot water appliance enter "0") value of "G" ________

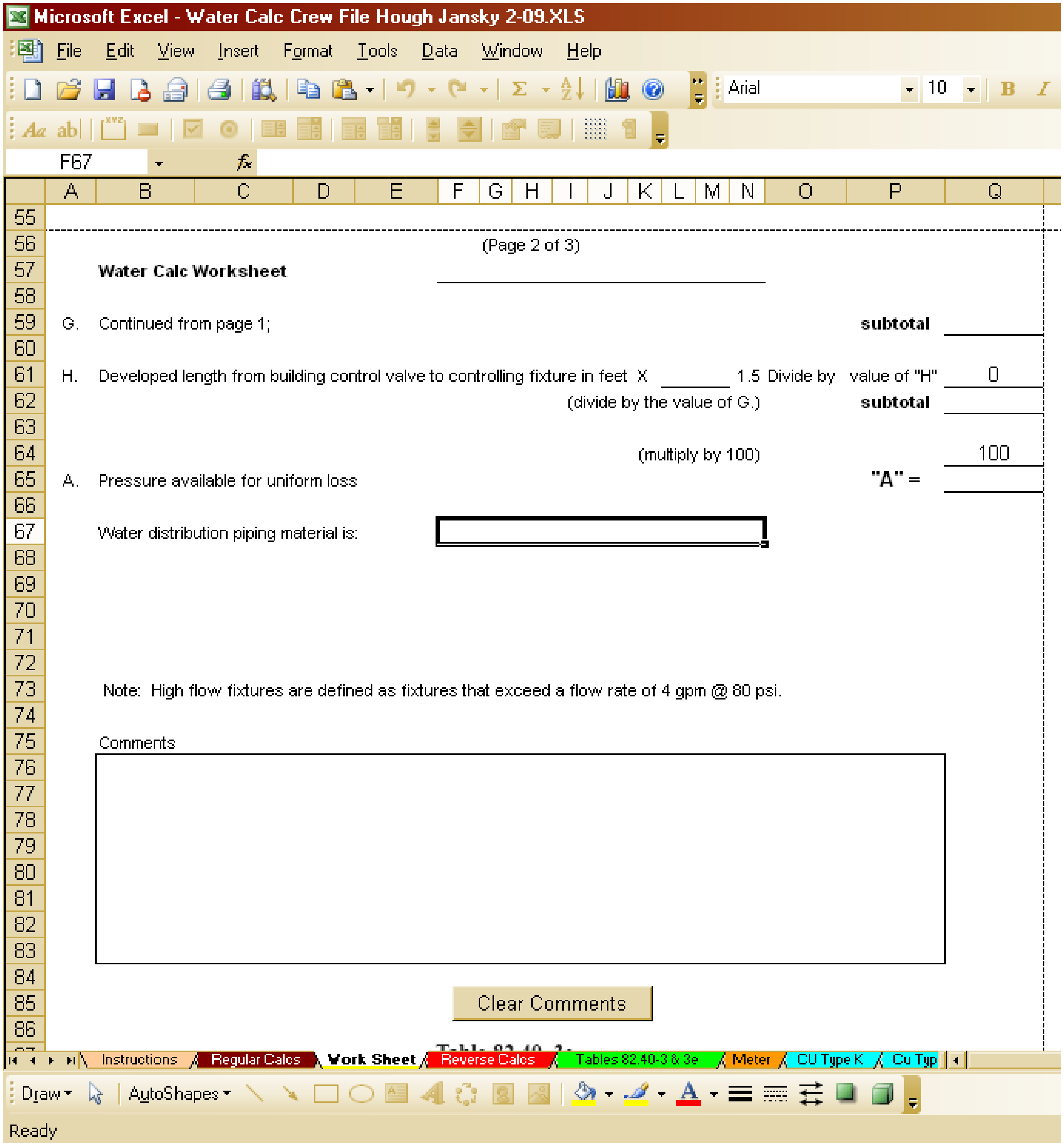
subtotal ________

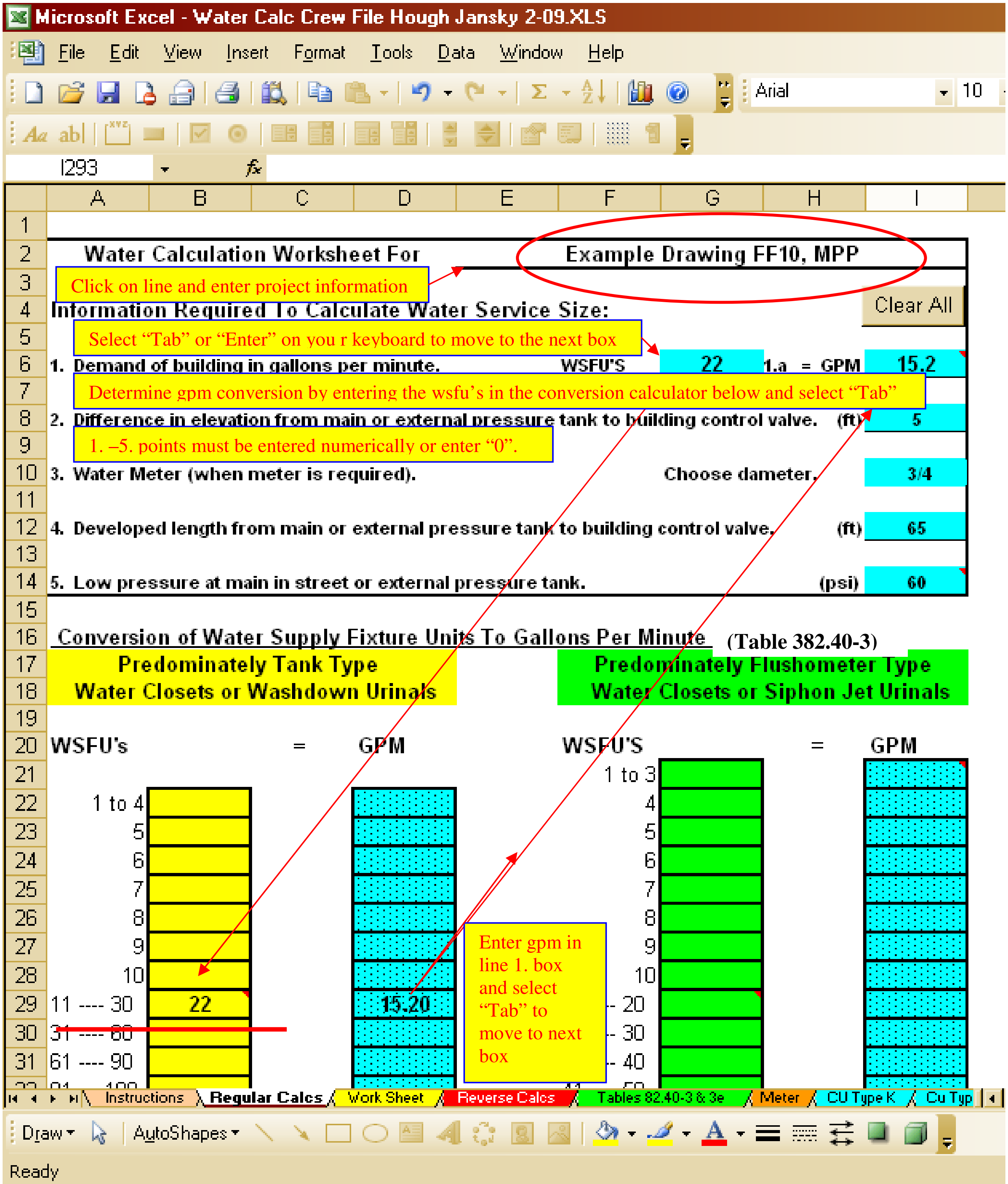
(Page 1 of 3)

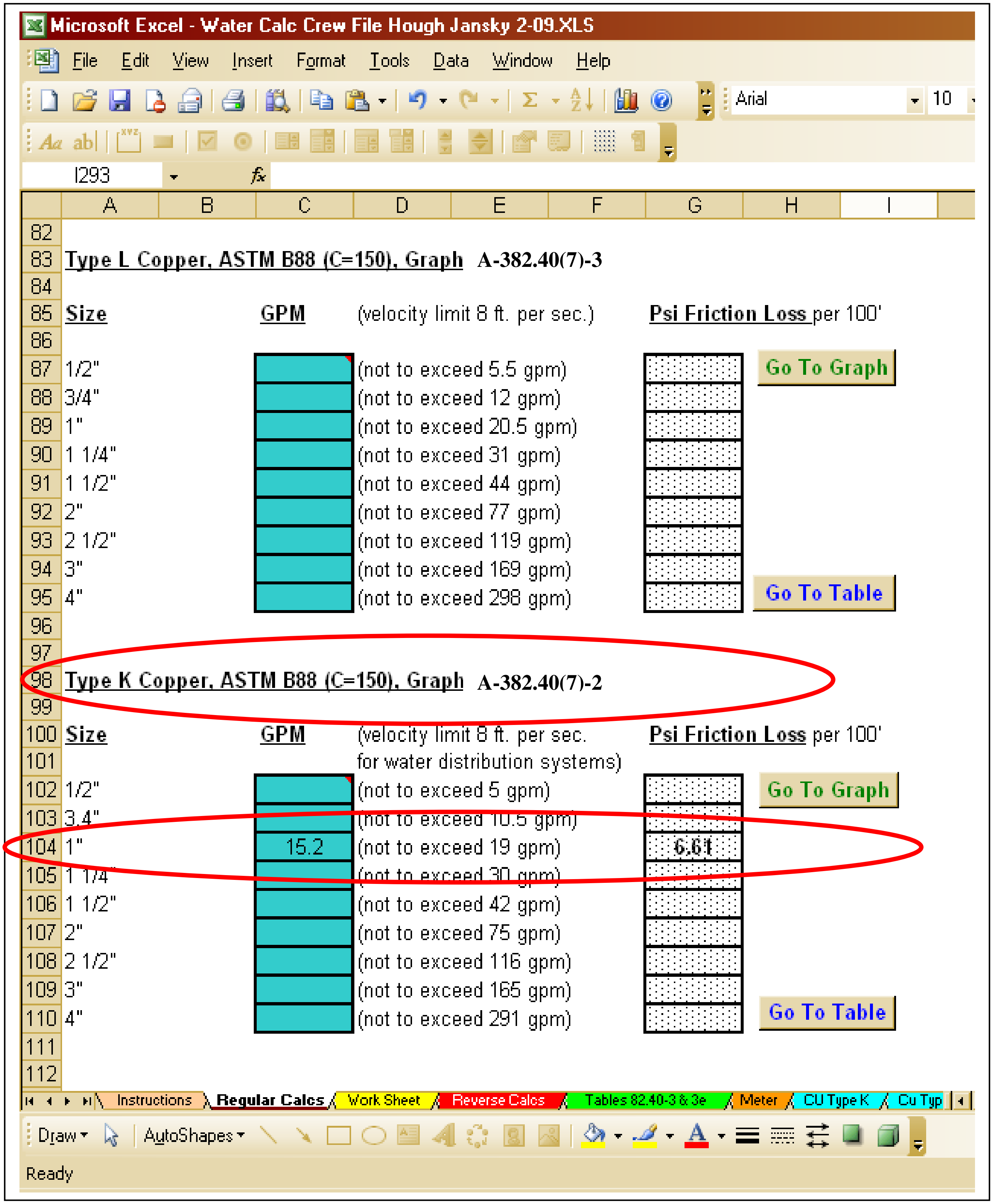
(Page 2 of 3)

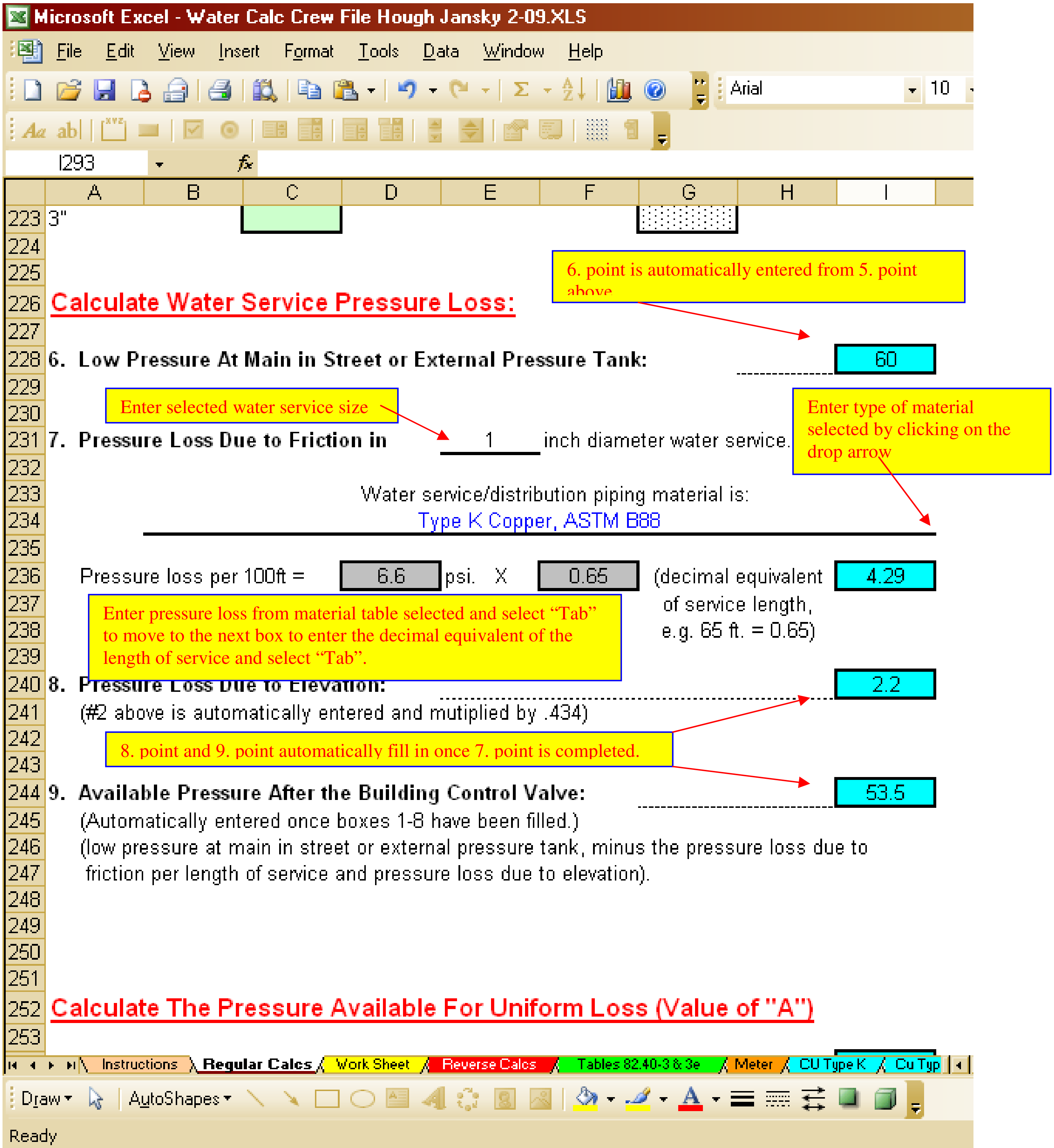
Instructions | Regular Calcs | Work Sheet | Reverse Calcs | Tables 82.40-3 & 3e | Meter | CU Type K | Cu Typ

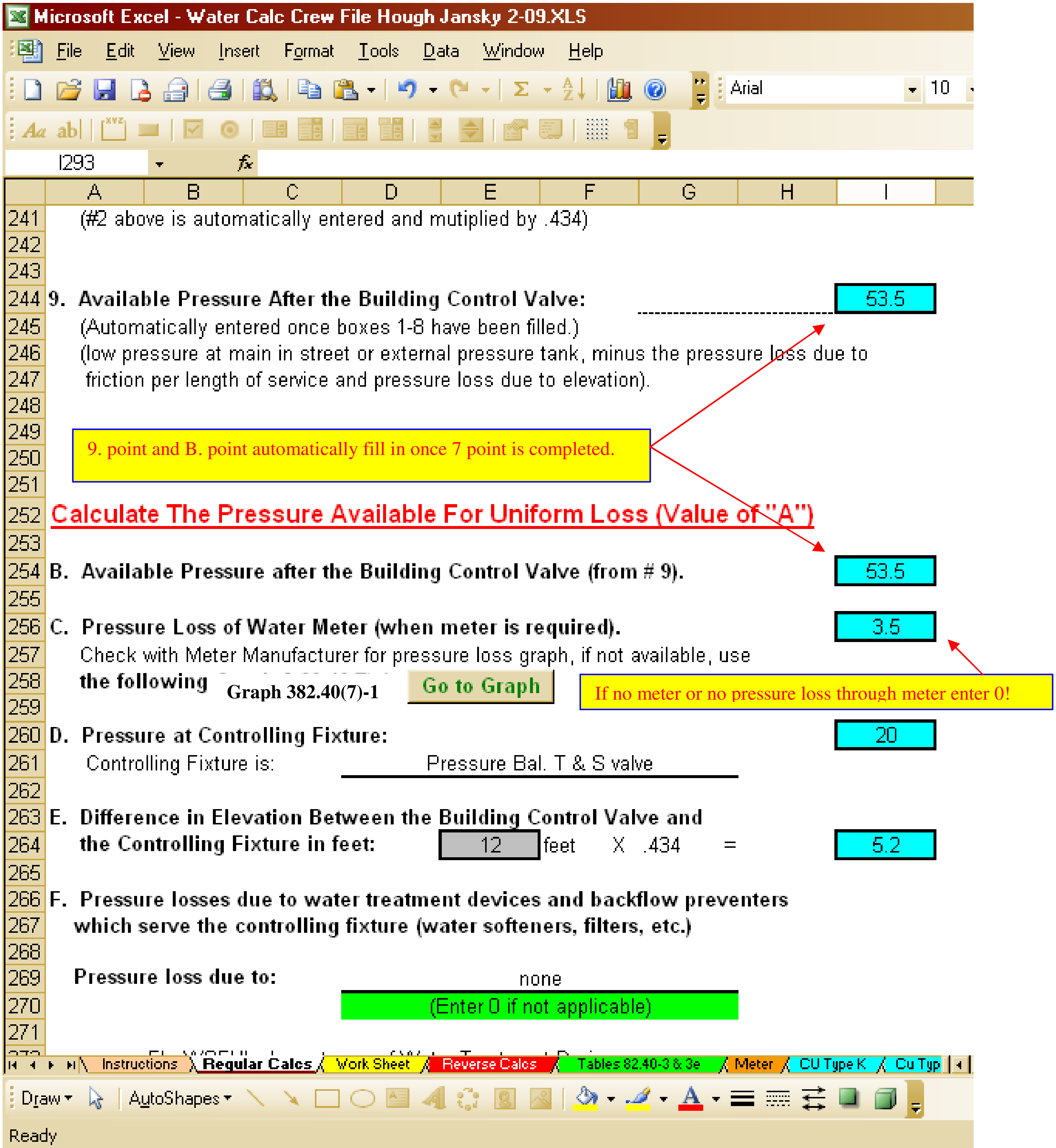
Ready

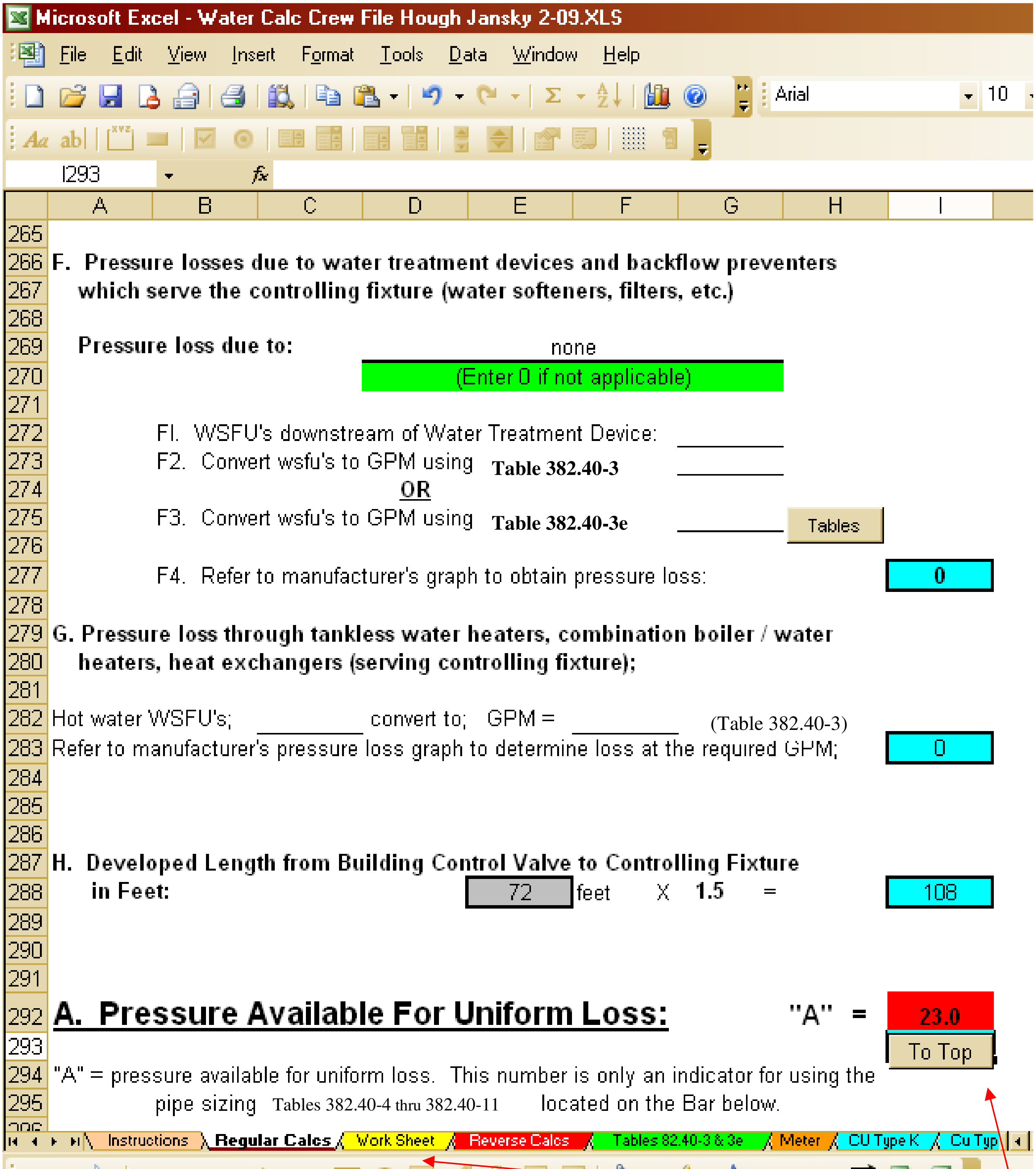

Microsoft Excel - Water Calc Crew File Hough Jansky 2-09.XLS
File Edit View Insert Format Tools Data Window Help
Arial 10
F67
(Page 2 of 3)
Water Calc Worksheet
G. Continued from page 1;
subtotal
H. Developed length from building control valve to controlling fixture in feet X
1.5 Divide by
value of "H"
0
(divide by the value of G.)
subtotal
(multiply by 100)
100
A. Pressure available for uniform loss
"A" =
Water distribution piping material is:
Note: High flow fixtures are defined as fixtures that exceed a flow rate of 4 gpm @ 80 psi.
Comments
Clear Comments
Instructions
Regular Calcs
Work Sheet
Reverse Calcs
Tables 82.40-3 & 3e
Meter
CU Type K
Cu Typ
Draw
AutoShapes
Ready


Microsoft Excel - Water Calc Crew File Hough Jansky 2-09.XLS
File Edit View Insert Format Tools Data Window Help
Arial 10
I293
Water Calculation Worksheet For
Example Drawing FF10, MPP
Click on line and enter project information
Information Required To Calculate Water Service Size:
Clear All
Select “Tab” or “Enter” on you r keyboard to move to the next box
1. Demand of building in gallons per minute.
WSFU'S 22 1.a = GPM 15.2
Determine gpm conversion by entering the wsfu’s in the conversion calculator below and select “Tab”
2. Difference in elevation from main or external pressure tank to building control valve. (ft) 5
1. –5. points must be entered numerically or enter “0”.
3. Water Meter (when meter is required). Choose dameter. 3/4
4. Developed length from main or external pressure tank to building control valve. (ft) 65
5. Low pressure at main in street or external pressure tank. (psi) 60
Conversion of Water Supply Fixture Units To Gallons Per Minute (Table 382.40-3)
Predominately Tank Type Water Closets or Washdown Urinals
Predominately Flushometer Type Water Closets or Siphon Jet Urinals
WSFU's = GPM
WSFU'S = GPM
1 to 4
5
6
7
8
9
10
11 ---- 30 22 15.20
31 ---- 60
61 ---- 90
1 to 3
4
5
6
7
8
9
10
-- 20
-- 30
-- 40
Enter gpm in line 1. box and select “Tab” to move to next box
Instructions
Regular Calcs
Work Sheet
Reverse Calcs
Tables 82.40-3 & 3e
Meter
CU Type K
Cu Typ
Draw
AutoShapes
Ready


Microsoft Excel - Water Calc Crew File Hough Jansky 2-09.XLS
File Edit View Insert Format Tools Data Window Help
Arial 10
I293
Type L Copper, ASTM B88 (C=150), Graph A-382.40(7)-3
Size GPM (velocity limit 8 ft. per sec.) Psi Friction Loss per 100'
1/2" (not to exceed 5.5 gpm)
3/4" (not to exceed 12 gpm)
1" (not to exceed 20.5 gpm)
1 1/4" (not to exceed 31 gpm)
1 1/2" (not to exceed 44 gpm)
2" (not to exceed 77 gpm)
2 1/2" (not to exceed 119 gpm)
3" (not to exceed 169 gpm)
4" (not to exceed 298 gpm)
Go To Graph
Go To Table
Type K Copper, ASTM B88 (C=150), Graph A-382.40(7)-2
Size GPM (velocity limit 8 ft. per sec.
for water distribution systems) Psi Friction Loss per 100'
1/2" (not to exceed 5 gpm)
3.4" (not to exceed 10.5 gpm)
1" 15.2 (not to exceed 19 gpm) 6.61
1 1/4" (not to exceed 30 gpm)
1 1/2" (not to exceed 42 gpm)
2" (not to exceed 75 gpm)
2 1/2" (not to exceed 116 gpm)
3" (not to exceed 165 gpm)
4" (not to exceed 291 gpm)
Go To Graph
Go To Table
Instructions Regular Calcs Work Sheet Reverse Calcs Tables 82.40-3 & 3e Meter CU Type K Cu Typ
Draw AutoShapes
Ready

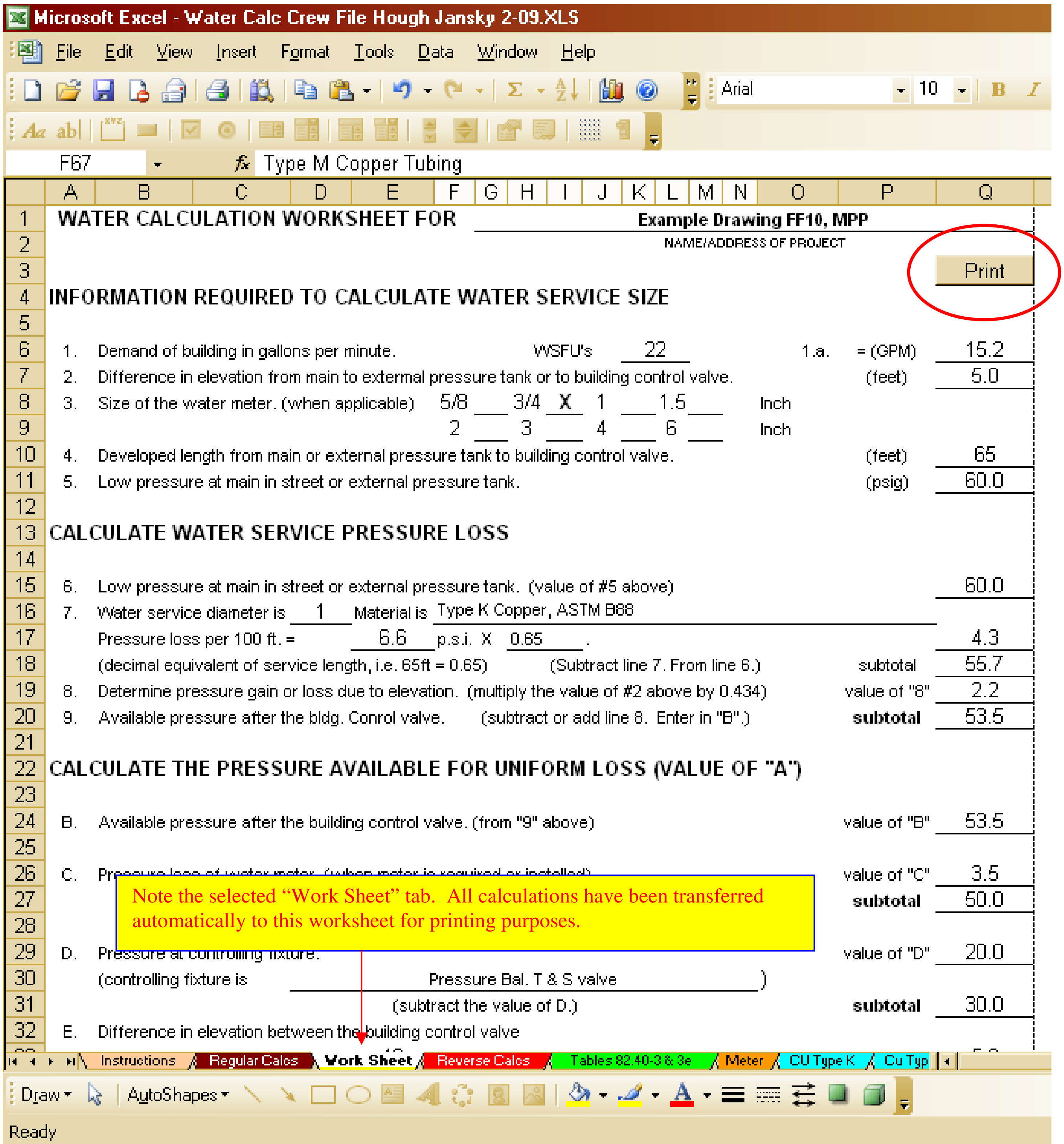

Microsoft Excel - Water Calc Crew File Hough Jansky 2-09.XLS
File Edit View Insert Format Tools Data Window Help
Arial 10
I293
223 3"
6. point is automatically entered from 5. point above
Calculate Water Service Pressure Loss:
6. Low Pressure At Main in Street or External Pressure Tank:
60
Enter selected water service size
7. Pressure Loss Due to Friction in
1
inch diameter water service.
Enter type of material selected by clicking on the drop arrow
Water service/distribution piping material is:
Type K Copper, ASTM B88
Pressure loss per 100ft =
6.6
psi. X
0.65
(decimal equivalent of service length, e.g. 65 ft. = 0.65)
4.29
Enter pressure loss from material table selected and select "Tab" to move to the next box to enter the decimal equivalent of the length of service and select "Tab".
8. Pressure Loss Due to Elevation:
2.2
(#2 above is automatically entered and mutiplied by .434)
8. point and 9. point automatically fill in once 7. point is completed.
9. Available Pressure After the Building Control Valve:
53.5
(Automatically entered once boxes 1-8 have been filled.)
(low pressure at main in street or external pressure tank, minus the pressure loss due to friction per length of service and pressure loss due to elevation).
Calculate The Pressure Available For Uniform Loss (Value of "A")
Instructions
Regular Calcs
Work Sheet
Reverse Calcs
Tables 82.40-3 & 3e
Meter
CU Type K
Cu Typ
Draw
AutoShapes
Ready


Microsoft Excel - Water Calc Crew File Hough Jansky 2-09.XLS
File Edit View Insert Format Tools Data Window Help
I293
(#2 above is automatically entered and mutiplied by .434)
9. Available Pressure After the Building Control Valve:
53.5
(Automatically entered once boxes 1-8 have been filled.)
(low pressure at main in street or external pressure tank, minus the pressure loss due to friction per length of service and pressure loss due to elevation).
9. point and B. point automatically fill in once 7 point is completed.
Calculate The Pressure Available For Uniform Loss (Value of "A")
B. Available Pressure after the Building Control Valve (from # 9).
53.5
C. Pressure Loss of Water Meter (when meter is required).
3.5
Check with Meter Manufacturer for pressure loss graph, if not available, use the following
Graph 382.40(7)-1
Go to Graph
If no meter or no pressure loss through meter enter 0!
D. Pressure at Controlling Fixture:
20
Controlling Fixture is:
Pressure Bal. T & S valve
E. Difference in Elevation Between the Building Control Valve and the Controlling Fixture in feet:
12
feet X .434 =
5.2
F. Pressure losses due to water treatment devices and backflow preventers which serve the controlling fixture (water softeners, filters, etc.)
Pressure loss due to:
none
(Enter 0 if not applicable)
Instructions
Regular Calcs
Work Sheet
Reverse Calcs
Tables 82.40-3 & 3e
Meter
CU Type K
Cu Typ
Draw
AutoShapes
Ready



To print out the completed calculation and "A" value, select the "Work Sheet" tab. The water calc worksheet has a "Print" button you may select.
Note the "To Top" button just below the "A" value box, selecting this button will take you to the top of this calculator for another calculation or changes.

- The next three pages show the print out sheet the calculator provides. Note the “Work Sheet” Tab has been selected at the bottom of the page. Note also the “Print” button on the sheet which will enable you to print out the sheet for record keeping.



Microsoft Excel - Water Calc Crew File Hough Jansky 2-09.XLS

File Edit View Insert Format Tools Data Window Help

F67 Type M Copper Tubing

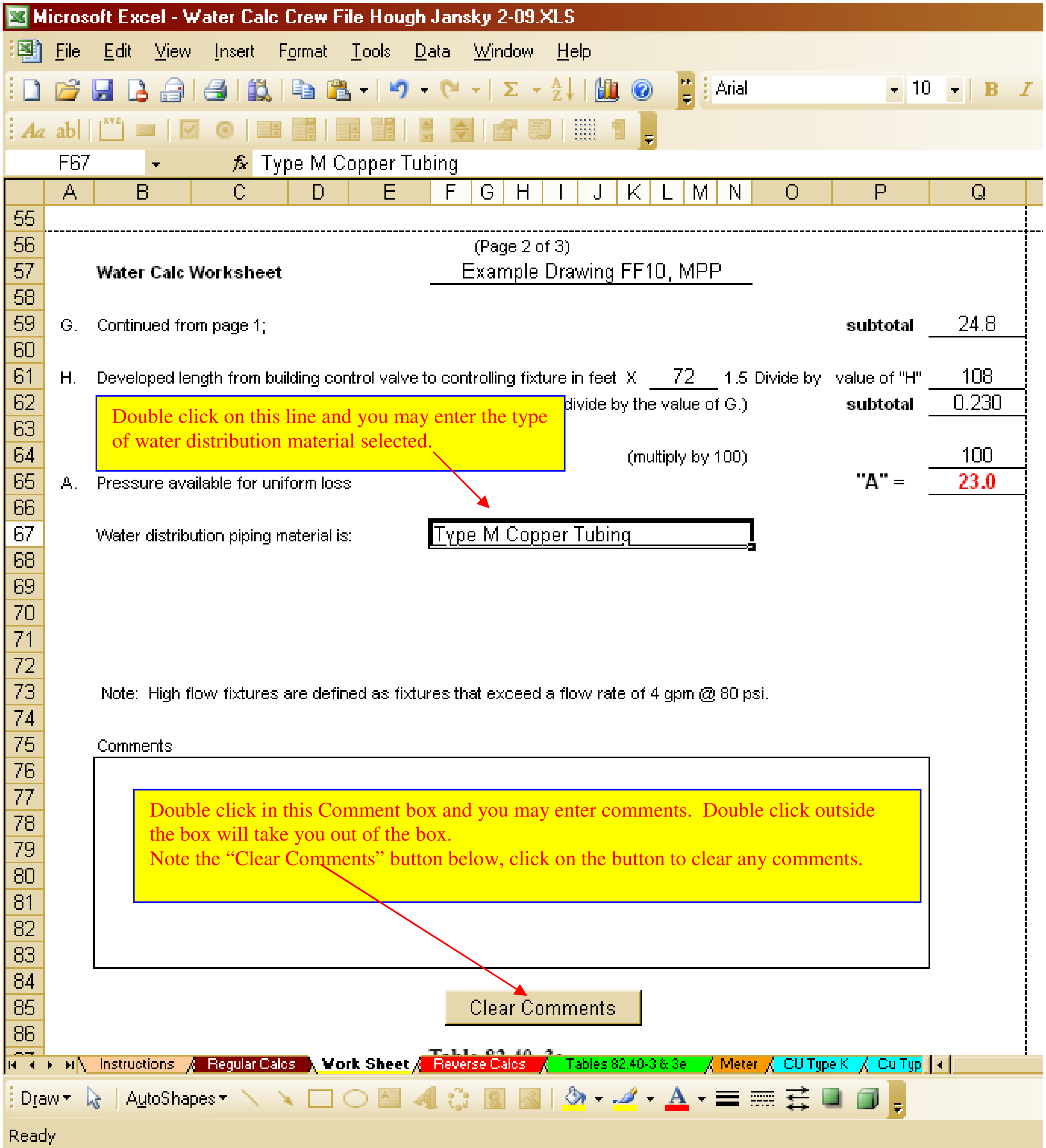
CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B.	Available pressure after the building control valve. (from "9" above)	value of "B"	53.5
C.	Pressure loss of water meter. (when meter is required or installed)	value of "C"	3.5
	(subtract line C. From B.)	**subtotal**	50.0
D.	Pressure at controlling fixture.	value of "D"	20.0
	(controlling fixture is Pressure Bal. T & S valve)		
	(subtract the value of D.)	**subtotal**	30.0
E.	Difference in elevation between the building control valve		
	and the controlling fixture in feet 12 X 0.434 psi/ft.	value of "E"	5.2
	(subtract the value of E.)	**subtotal**	24.8
F.	Pressure loss due to water treatment devices, and backflow preventers which serve the controlling fixture.		
	Pressure loss due to none (subtract the value of F)		
	F1. WSFU's downstream of Water Treatment Device:		
	F2. Convert wsfu's to GPM using **Table 382.40-3**		
	OR		
	F3. Convert wsfu's to GPM using **Table 382.40-3e**		
	F4. Refer to manufacturer's graph to obtain pressure loss:	value of "F4"	0.0
	(If no water treatment device enter "0")	**subtotal**	24.8
G.	Pressure loss through tankless water heaters, combination boiler / hot water heaters, heat exchangers;		
	Hot water WSFU's; convert to; GPM = (Table 382.40-3)		
	Refer to manufacturer's pressure loss graph to determine loss at required GPM: 0 pressure loss.		
	(If no pressure loss through hot water appliance enter "0")	value of "G"	0.0
		subtotal	24.8

Instructions / Regular Calcs / Work Sheet / Reverse Calcs / Tables 82.40-3 & 3e / Meter / CU Type K / Cu Typ

Draw AutoShapes

Ready



Once the calculations have been completed for the domestic plumbing fixture demand, the next step in our design calculations is determining the greatest sprinkler demand load. Chapter 6 introduces us to this process.

Chapter 6
Sizing the System for the Sprinklers,
Master Bedroom

- The Multipurpose Piping System has now been sized for the domestic plumbing portion, and a quick review of our system would be good.

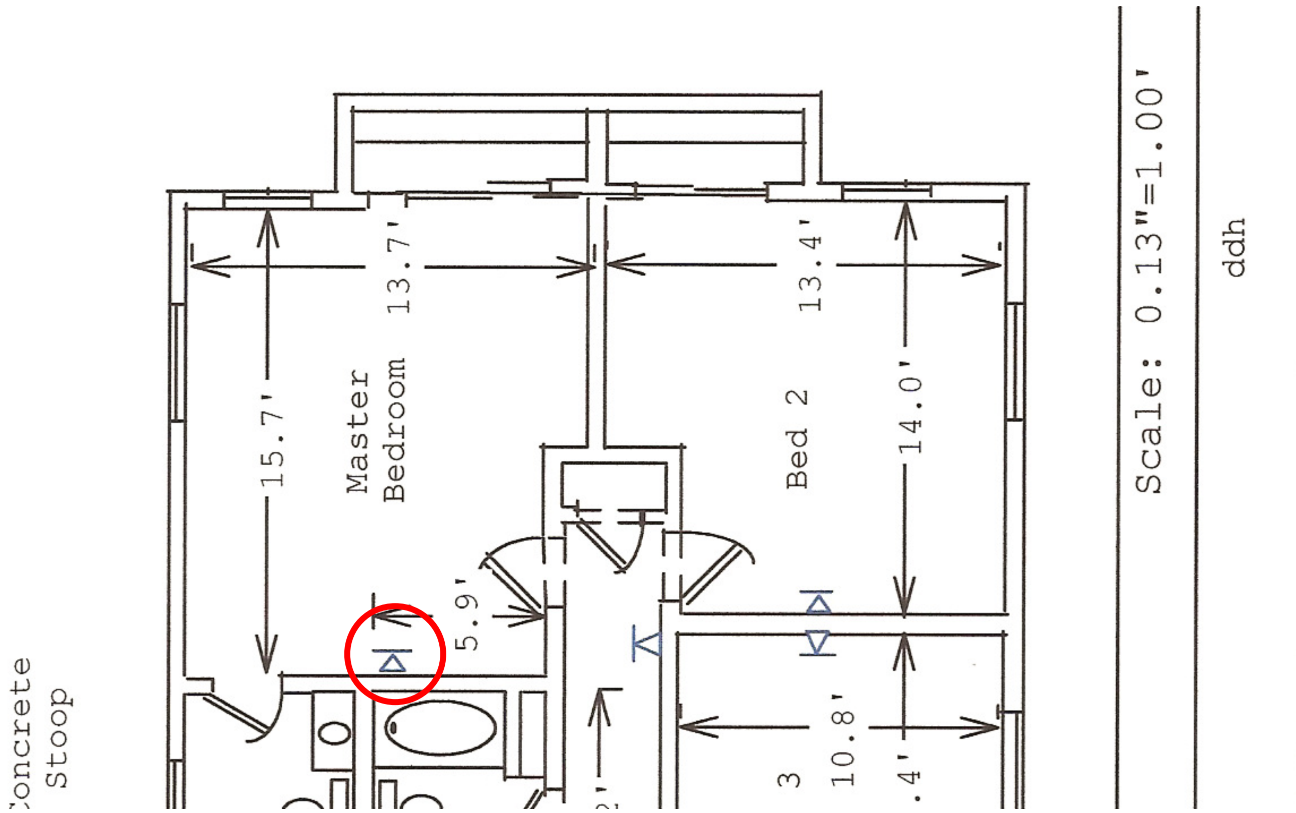
- For plumbing demand only, we have sized for a 1" K copper water service, and a M copper water distribution system with an A value of 23.

- For our sprinkler system, we have selected Reliable pendent RFC 43 sprinklers for the basement area, and F 1 RES 44 sidewall sprinklers for the main floor. At this point we have designed the water distribution system and provided an isometric detailing the piping.

- The next step in our design process for a multipurpose piping system is sizing the water service and water distribution system for the required <u>building sprinkler demand</u>. What needs to be determined is which demand has the greater gpm requirement; the plumbing with its controlling fixture, or the sprinkler demand with its controlling sprinkler(s). The water distribution system will be sized for which ever has the greater demand.

- According to the NFPA 13D Standard; 8.1.1.2.1 and 8.1.2, the system shall provide at least the gpm demand flow required for the multiple and single sprinkler operating criteria specified by the sprinkler listing. And the number of design sprinklers under a flat, smooth horizontal ceiling shall include a maximum of two sprinklers that require the greatest hydraulic demand.
- <u>**Fire / Water Calcs are required for every compartment:**</u>
  Master Bedroom, single most remote
  Living Room compartment, single and two most hydraulically demanding
  Family Room compartment, single and two most hydraulically demanding
  Basement compartment, single and two most hydraulically demanding
- A total of 7 Fire / Water Calculations will satisfy the NFPA 13D Standard requirements and enable us to identify the most hydraulically demanding sprinkler or two most demanding sprinklers in a compartment. If the sprinkler demand is greater than the plumbing controlling fixture demand, the dwelling water supply is to be sized as the sprinkler being the controlling fixture.
- Generally the highest most remote sprinkler should be the first calculation. If all the compartments require only one sprinkler and the most remote sprinkler has the highest demand, it may well be that the distribution piping will be sized per that sprinkler.
- Some compartments may have a different type of sprinkler that requires a higher pressure to cover the same area. Some compartments may require more than one sprinkler. Because a compartment with two sprinklers requires it not only to be sized per the single sprinkler criteria, but also per two sprinklers, the furthest sprinkler may not always be the most demanding.
- For ease of design, it will work out better if the sprinklers are all the same type and manufacturer. The sprinklers used in this manual are for demonstration purposes only and are not intended to be an endorsement.
- The most remote sprinkler in this dwelling is the sidewall sprinkler in the master bedroom.
- In the partial plan on page 6-2, Figure 6-1 illustrates sprinkler MB1 in the master bedroom. This is the furthest and highest sprinkler and will be the first in the calculations. A fire / water multipurpose calculation worksheet for this sprinkler is illustrated in Figure 6-8 on Page 6-8.

Figure 6-1



- The first step in starting the calculations is to determine the hydraulic design criteria for the side wall sprinkler. Figure 6-2 is the manufacturer's design and installation guide. Because the NFPA 13D 2007 Standard mandates sprinklers designed and installed in accordance with their listing, a thorough reading of the manufacturer's specifications, installation guides, and sprinkler wet patterns should be carefully reviewed.
- Column one in the table specifies the maximum size of the compartment at the design flow. If the size of the room is 11 ft x 13 ft, the 14 x 14 coverage area row is the minimum coverage area. The master bedroom is 13'- 7" by 15'- 7". This means 16' x 16' is the smallest coverage area. The amount of pressure required to supply 17 GPM for the coverage area of 16' ft X 16' ft is circled. Tables used to determine the criteria must be from the manufacturers table for the specific sprinkler installed. Generally this information is available from the supplier of the sprinklers and is readily available on the manufacturer's website (see Figure 6-2 on page 6-3).

- Looking at the specifications, a single pendant sprinkler requires 17 GPM at 15 PSI to cover a 16ft x 16ft area. A flow and pressure criterion for sizing the piping to the sprinkler is established in this manner.
- A fire – water calc worksheet has been developed along with an Excel calculator that is based upon the same Hazen and Williams's formula and velocity formula that the plumbing water calc worksheet is based upon and the sprinkler calculations required in NFPA 13. Hydraulic calculations are required for the general straight run systems that are not connected to a municipal water main of at least 4 inches in diameter (8.4.4). The fire – water calculator satisfies this requirement. (See Figure 6-3.)

Figure 6-2

Bulletin 140 Rev.I

Reliable® Model F1 Res and RFC Residential Sprinkler Design and Installation Guide

Bulletin 140 Rev.I

1.

The F1RES 44 SWC (Sidewall, Concealed):

- Flows equal to or only slightly higher than the RES 44 HSW.
- cULus Listed for up to 12" (305mm) below the ceiling.
- The slot-less coverplate provides protection to the thermal element.
- 155°F (68°C) sprinkler 135°F (57°C) coverplate.

The F1RES 44 SWC:

Sprinkler Model	Technical Bulletin Number	Sprinkler Identification Number (SIN)	Nominal K factor	Temperature °F (°C)	Thread Size in. (mm)	Max. Pressure (bar)	Max. Adjustment in. (mm)
F1RES 44 SWC	135	R3531	4.4	155 (68)	1/2 (13)	175 psi (12)	1/2 (13)

Flows Required for Single Sprinkler Demand (Pressures)						
12′ x 12′ (3,6 x 3,6)	14′ x 14′ (4,3 x 4,3)	16′ x 16′ (4,9 x 4,9)	16′ x 18′ (4,9 x 5,5)	18′ x 18′ (5,5 x 5,5)	16′ x 20′ (4,9 x 6,1)	20′ x 20′ (6,1 x 6,1)
13 gpm (8.7 psi)	14 gpm (10.2 psi)	17 gpm (15.0 psi)	19 gpm (18.7 psi)	———	23 gpm (27.4 psi)	———

2.

- The sprinkler manufacturer's specifications for the sprinkler selected provides us the information to initiate our worksheet calculations to determine the total load on the water distribution system if the master bedroom sprinkler discharged. Remember, sprinklers shall be installed in accordance with their listing and careful examination of the sprinklers installation requirements, sprinkler wet wall pattern guide, ceiling requirements, type of piping requirements and distances from obstructions should all be carefully considered in the selection process.

- Points 1 – 5 can be filled in (Figure 6-4) from the sprinkler specs and information obtained on the plumbing water calculation worksheet.

Figure 6-3

FIRE-WATER CALC WORKSHEET FOR ____
NAME/ADDRESS OF PROJECT

(Based upon the Hazen-Williams Formula)

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) ____ 2 Sprinklers (gpm) ____ Total GPM = ________
   Sprinkler Manufacturer; ________________ Model # ________ K-Factor; ________
2. Difference in elevation from main to external pressure tank or to building control valve. (feet) ________
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. ________
4. Developed length from main or external pressure tank to building control valve. (feet) ________
5. Low pressure at main in street or external pressure tank. (psig) ________

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) ________
7. Water service diameter is ______ Material is ________________ Pressure loss
   per 100 ft = ________ psi X ________ (decimal equivalent of service length, i.e. 65 ft = 0.65) ________
   (Subtract line 7. From line 6.) subtotal ________
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" ________
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** ________

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" ________

C. Pressure loss of water meter. (when meter is required or installed) value of "C" ________
   (subtract line C. From B.) **subtotal** ________

D. Pressure at controlling sprinkler(s). value of "D" ________
   (controlling sprinkler(s) is ________________________________)
   (subtract the value of D.) **subtotal** ________

E. Difference in elevation between the building control valve and
   the controlling sprinkler(s) in feet; ________ X 0.434 psi/ft. value of "E" ________
   (subtract the value of E.) **subtotal** ________

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow
   preventers which serve the controlling fixture. value of "F" ________
   Pressure loss due to ________________ (subtract the value of F) **subtotal** ________

G. Developed length from building control valve to controlling sprinkler in feet ________ X 1.5 value of "G" ________
   (divide by the value of G.) **subtotal** ________
   (Note: Excesive number of fittings refer to material fitting pressure loss tables)
   Water distribution piping material is: ________________________________

(multiply by 100) 100

A. Pressure available for uniform loss **"A" =** ________

Figure 6-4

FIRE-WATER CALC WORKSHEET FOR **Drawing #FF10, Master Bedroom Sprinkler**

(Based upon the Hazen-Williams Formula) NAME/ADDRESS OF PROJECT

Print

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1.	Sprinkler Demand: 1 Sprinkler (gpm) 17 2 Sprinklers (gpm) ____ Total	GPM =	17.0
	Sprinkler Manufacturer; Reliable Model # F1 44SW K-Factor; 4.4		
2.	Difference in elevation from main to external pressure tank or to building control valve.	(feet)	5.0
3.	Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4.		3/4
4.	Developed length from main or external pressure tank to building control valve.	(feet)	65
5.	Low pressure at main in street or external pressure tank.	(psig)	60.0

CALCULATE WATER SERVICE PRESSURE LOSS

- The next step is Calculating Water Service Pressure Loss, points 6. – 9.
- 6. point is the same as 5. point.
- 7. point records the friction loss through the water service which is dependent upon the type of material, pipe diameter, service length, and gpm flow rate.

Figure 6-5

FIRE-WATER CALC WORKSHEET FOR **Drawing #FF10, Master Bedroom Sprinkler**

(Based upon the Hazen-Williams Formula) NAME/ADDRESS OF PROJECT

Print

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1.	Sprinkler Demand: 1 Sprinkler (gpm) 17 2 Sprinklers (gpm) ____ Total	GPM =	17.0
	Sprinkler Manufacturer; Reliable Model # F1 44SW K-Factor; 4.4		
2.	Difference in elevation from main to external pressure tank or to building control valve.	(feet)	5.0
3.	Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4.		3/4
4.	Developed length from main or external pressure tank to building control valve.	(feet)	65
5.	Low pressure at main in street or external pressure tank.	(psig)	60.0

CALCULATE WATER SERVICE PRESSURE LOSS

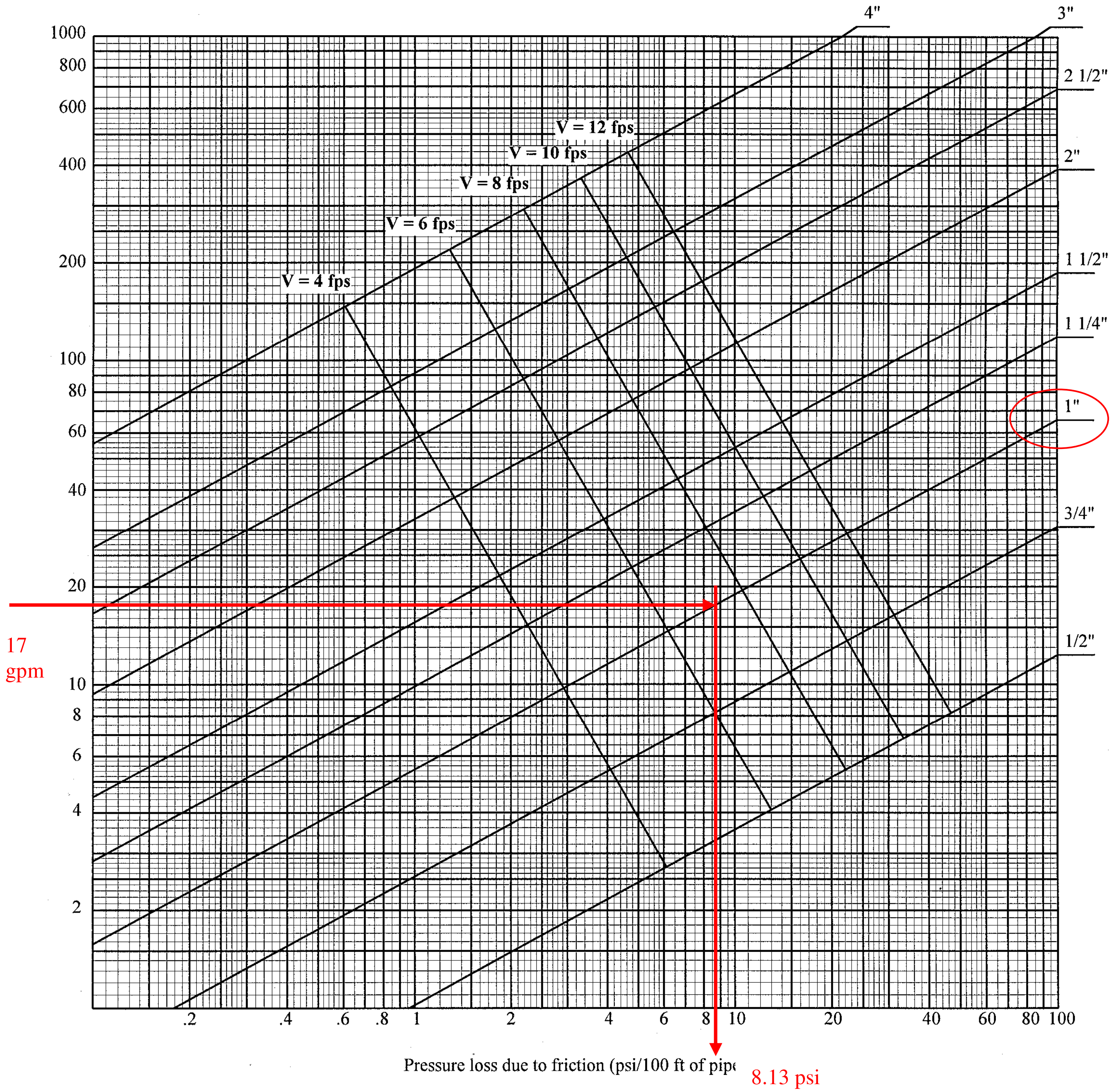
6.	Low pressure at main in street or external pressure tank. (value of #5 above)		60.0
7.	Water service diameter is 1 Material is Copper Type K, ASTM B88 Pressure loss		
	per 100 ft = 8.13 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65)		5.3
	(Subtract line 7. From line 6.)	subtotal	54.7
8.	Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434)	value of "8"	2.2
9.	Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".)	**subtotal**	52.5

- Using the Appendix Graph A-382.40(7)-2. (See Figure 6-6), the pressure loss due to friction at 17 gpm is 8.13 psi per 100 ft. of length. Multiplying the actual water service length decimal equivalent by 8.13 will provide the actual pressure loss for the water service.

- Point 8 addresses the pressure loss or gain incurred due to the elevation difference as the water service travels to the building control valve. Five feet of rise in the water service multiplied by .434 equals 2.2.
- Point 9 records the available pressure at the building control valve.

Figure 6-6

Graph A-382.40(7)-2, Copper Tube – Type K, ASTM B-88



- The last section of the Fire – Water Calc Worksheet is provided in Figure 6-7. The final steps of B – G. will provide an "A" value which represents the available pressure for uniform loss per 100 feet. From this "A" value we will be able to refer to our material tables and size the water distribution system according to the gpm demand or load and its relationship to the pressure available to serve the sprinklers or plumbing fixtures.

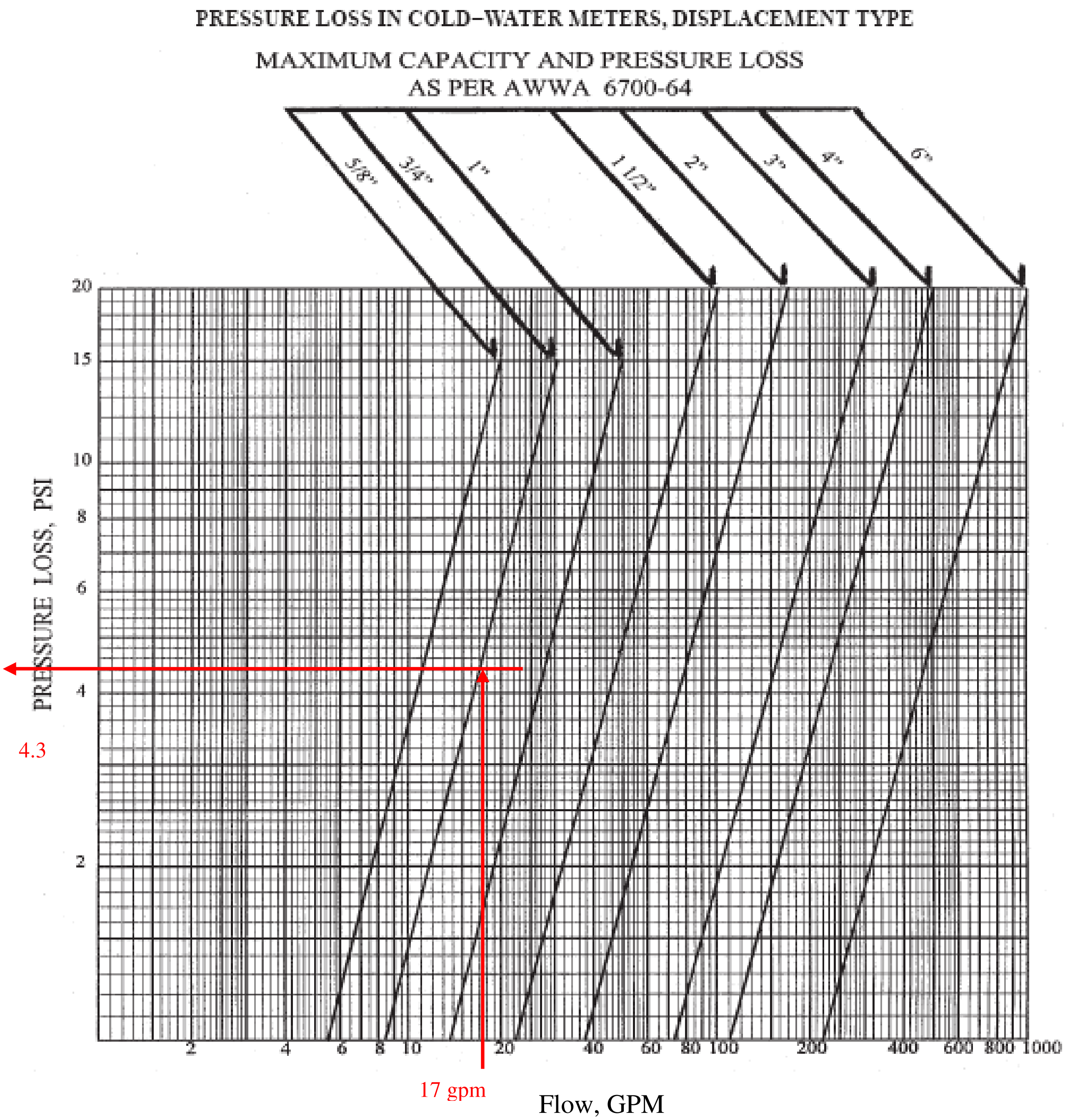
Figure 6-7

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B.	Available pressure after the building control valve. (from "9" above)	value of "B"	52.5
C.	Pressure loss of water meter. (when meter is required or installed)	value of "C"	4.3
	(subtract line C. From B.)	**subtotal**	48.2
D.	Pressure at controlling sprinkler(s)	value of "D"	15.0
	(controlling sprinkler(s) is Master Bedroom sidewall sprinkler)		
	(subtract the value of D.)	**subtotal**	33.2
E.	Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 16 X 0.434 psi/ft.	value of "E"	6.9
	(subtract the value of E.)	**subtotal**	26.3
F.	Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture.	value of "F"	0.0
	Pressure loss due to none (subtract the value of F)	**subtotal**	26.3
G.	Developed length from building control valve to controlling sprinkler in feet 65 X 1.5	value of "G"	97.5
	(divide by the value of G.)	**subtotal**	0.270
	(Note: Excesive number of fittings refer to material fitting pressure loss tables)		
	Water distribution piping material is: Copper type M tubing		
	(multiply by 100)		100
A.	Pressure available for uniform loss	**"A" =**	**27.0**

- **B.** point is the same as the 9. point showing available pressure at the building control valve.
- **C.** point is the pressure loss through the water meter. This information can be obtained from the water meter manufacturer's pressure loss graph or from the Appendix graph A-382.40(7)-1 that is provided below, Figure 6-8.
- **D.** point is the pressure required at the sprinkler(s) that is (are) being calculated for available pressure. This is obtained from the sprinkler manufacturer's specifications (Figure 6-2) In this case, for the sprinkler selected for the master bedroom, 15 psi. is the required pressure for the sprinkler to operate properly in a 16' X 16' foot room or less.
- **E.** point is the elevation difference between the building control valve and the sprinkler multiplied by .434.
- **F.** point captures the pressure losses for any water treatment device or backflow preventers which serve the sprinkler(s) being calculated. In this example, there are none.
- **G.** point is the developed length from the building control valve to the controlling sprinkler multiplied by 1.5. Dividing this number (97.5) into the F. point subtotal (26.3) will provide a subtotal of 0.270. Multiply this number by 100 and you will get an "A" value of 27. The worksheet is following the Hazen Williams formula as you go through each step.

Figure 6-8
Graph A-382.40(7)-1



- Having determined the A value for the master bedroom sprinkler (27) we can now go to our material Table 382.40-6 Maximum Allowable Load For Copper Tubing – Type M, ASTM B88 (Figure 6-9, page 6-9.)
- The table provides WSFU loads for A values up to 21, and in effect limits our pipe sizing to a velocity of 8 feet per second. Any A value obtained that exceeds the table such as our 27 does, we would use the maximum load for each pipe size column.

Figure 6-9

Table 382.40-6

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING–TYPE M, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches) 1/2"			3/4"			1"			1 1/4"		
		WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	–	0.5	2.0	–	2.0	4.0	–	4.0	7.0	–	9.0
1	1.0	–	1.0	3.0	–	3.0	6.0	–	7.0	10.5	4.0	14.0
2	1.5	–	1.5	4.5	–	5.0	9.0	–	11.5	15.5	5.0	22.5
3	2.0	–	2.0	5.5	–	6.5	11.5	4.0	15.5	19.5	6.5	29.0
4	2.5	–	2.5	6.5	–	8.0	13.0	4.5	18.0	22.0	7.0	35.0
5	2.5	–	2.5	7.5	–	9.5	15.0	5.0	21.5	25.0	8.5	42.0
6	3.0	–	3.0	8.0	–	10.0	16.5	5.5	24.0	28.0	11.0	50.0
7	3.5	–	3.5	9.0	–	11.5	18.0	6.0	26.5	30.0	13.5	55.0
8	3.5	–	3.5	9.5	–	12.5	19.5	6.5	29.0	32.0	17.0	62.0
9	4.0	–	4.0	10.0	4.0	13.0	20.5	6.5	31.0	NP		
10	4.0	–	4.0	11.0	4.0	15.0	21.5	7.0	34.0			
11	4.5	–	5.0	11.5	4.0	15.5	NP					
12	4.5	–	5.0	12.0	4.0	16.5						
13	5.0	–	6.0	12.5	4.5	17.5						
14	5.0	–	6.0	12.5	4.5	18.0						
15	5.0	–	6.0	NP								
16	5.5	–	6.5									
17	5.5	–	6.5									
18	5.5	–	6.5									
19	6.0	–	7.0									
20	6.0	–	7.0									
21	6.0	–	7.5									
	NP											

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	11.5	4.0	15.5	23.0	7.5	37.0	42.0	33.0	100	67.0	96.0	210	139	481	577
1	16.5	5.5	24.0	34.0	18.5	66.0	61.0	77.0	180	97.0	227	360	202	945	953
2	24.0	8.0	40.0	50.0	48.0	128	88.0	184	315	141	493	588	294	1750	1750
3	30.0	13.5	55.0	62.0	80.0	185	110	300	425	174	731	776	303	1835	1835
4	35.0	20.0	70.0	73.0	120	240	121	374	484	NP			NP		
5	40.0	30.0	86.0	79.0	144	270	NP								
6	44.0	36.0	106	NP											
7	45.0	39.0	112												
8	NP														

Note:WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.

27

- The Fire – Water Calculations for Sprinkler MB1 is complete. This is the first of seven fire-water calcs that have to be performed. If the master bedroom sprinkler was the most demanding sprinkler on the multipurpose system, we would be able to size our water distribution system with an A value of 27 and a 1" K copper water service. The Fire – Water calculator has been developed to speed this process of finding the most hydraulically demanding sprinkler(s). The next step is to introduce the Fire- Water calculator by calculating for the same sprinkler, MB1 in the following pages.

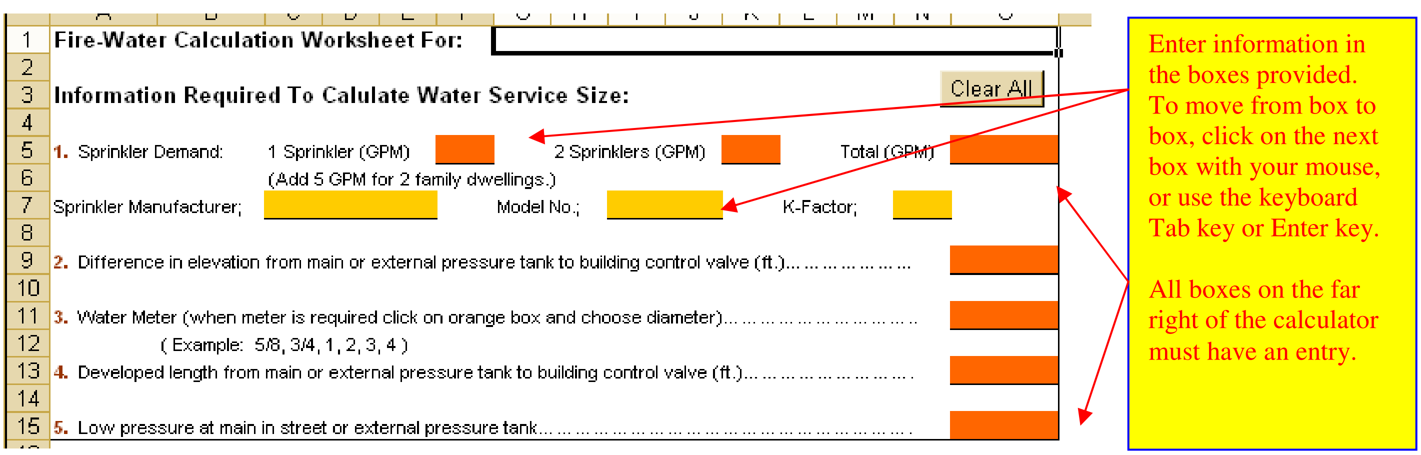
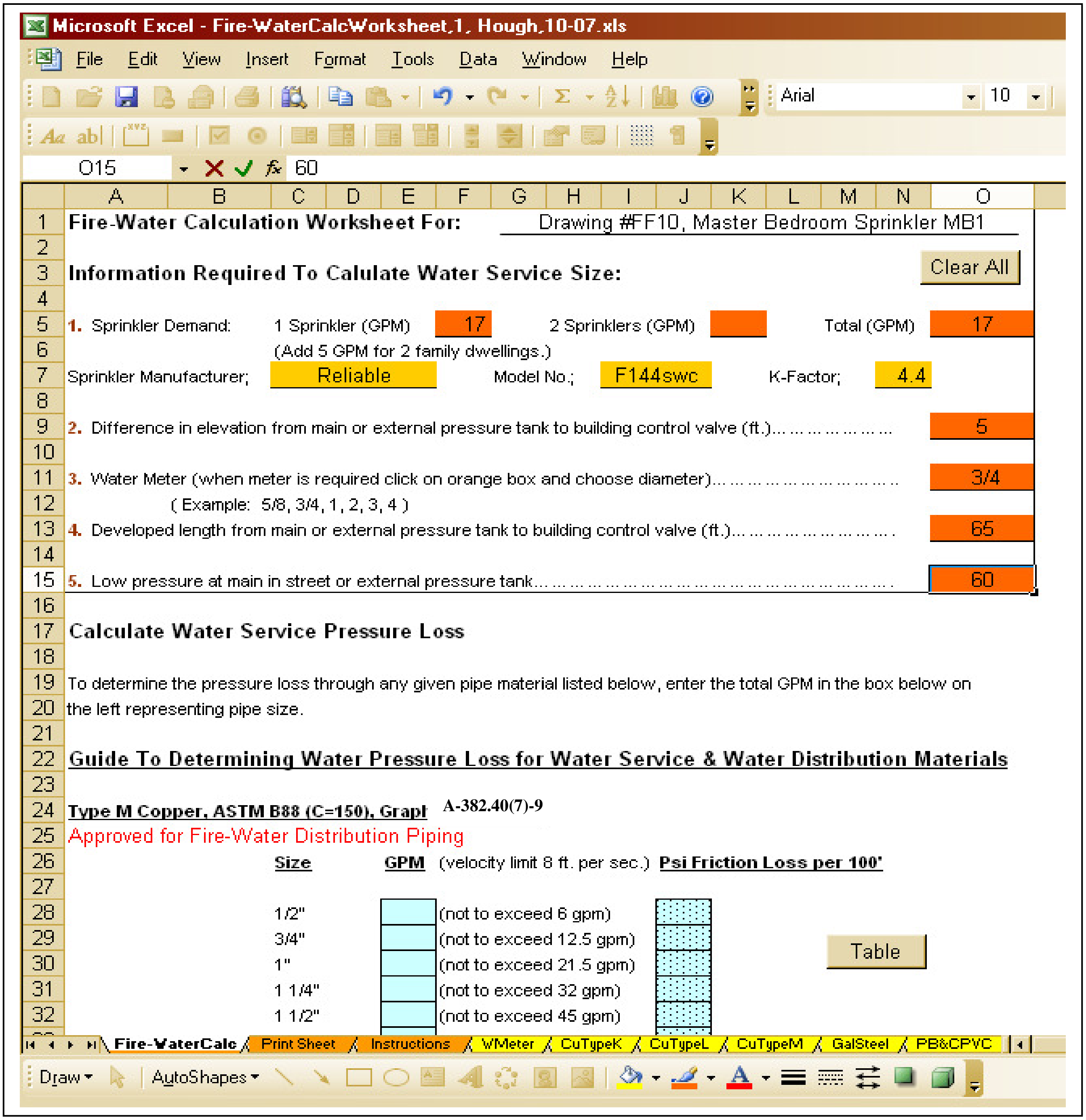


Figure 6-10



- The 1 – 5 points of the calculator should look like this.

- Next step is calculating the water service pressure loss. The Guide To Determining Water Pressure Loss for Water Service and Water Distribution Materials is provided. Scroll down to the desired water service material to find the pressure loss due to friction through the service at the GPM required in point 1.

Figure 6-11

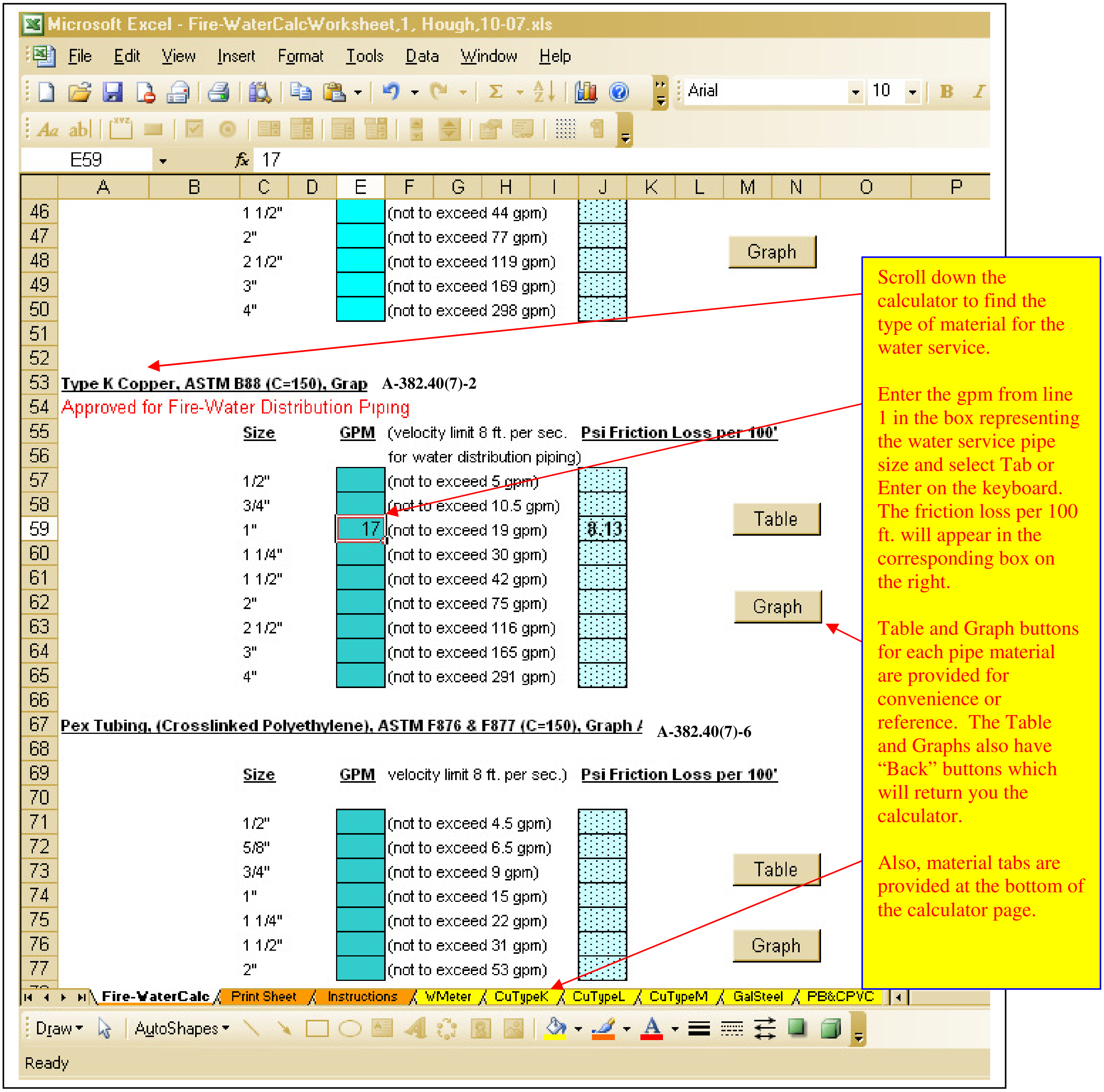
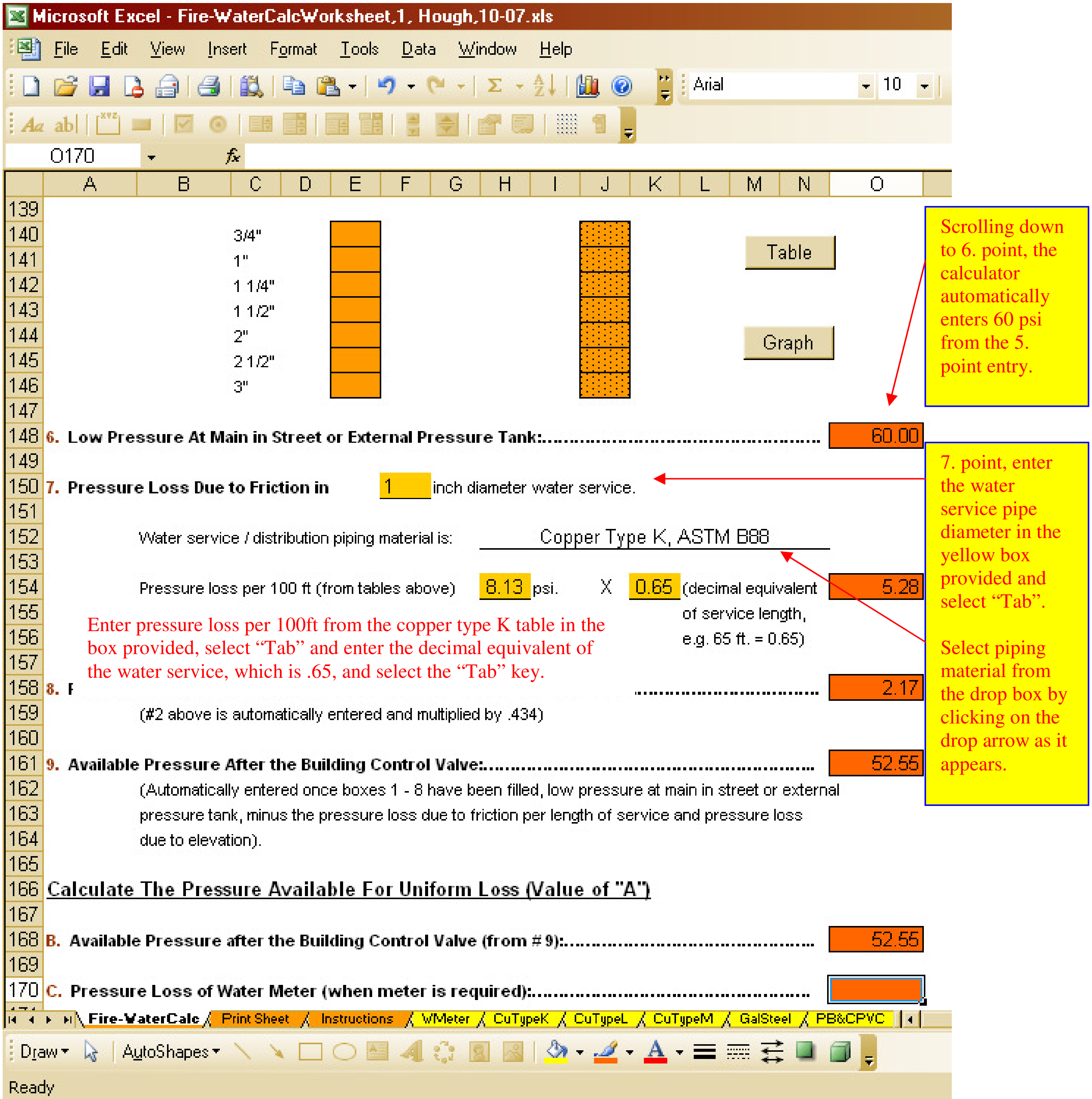
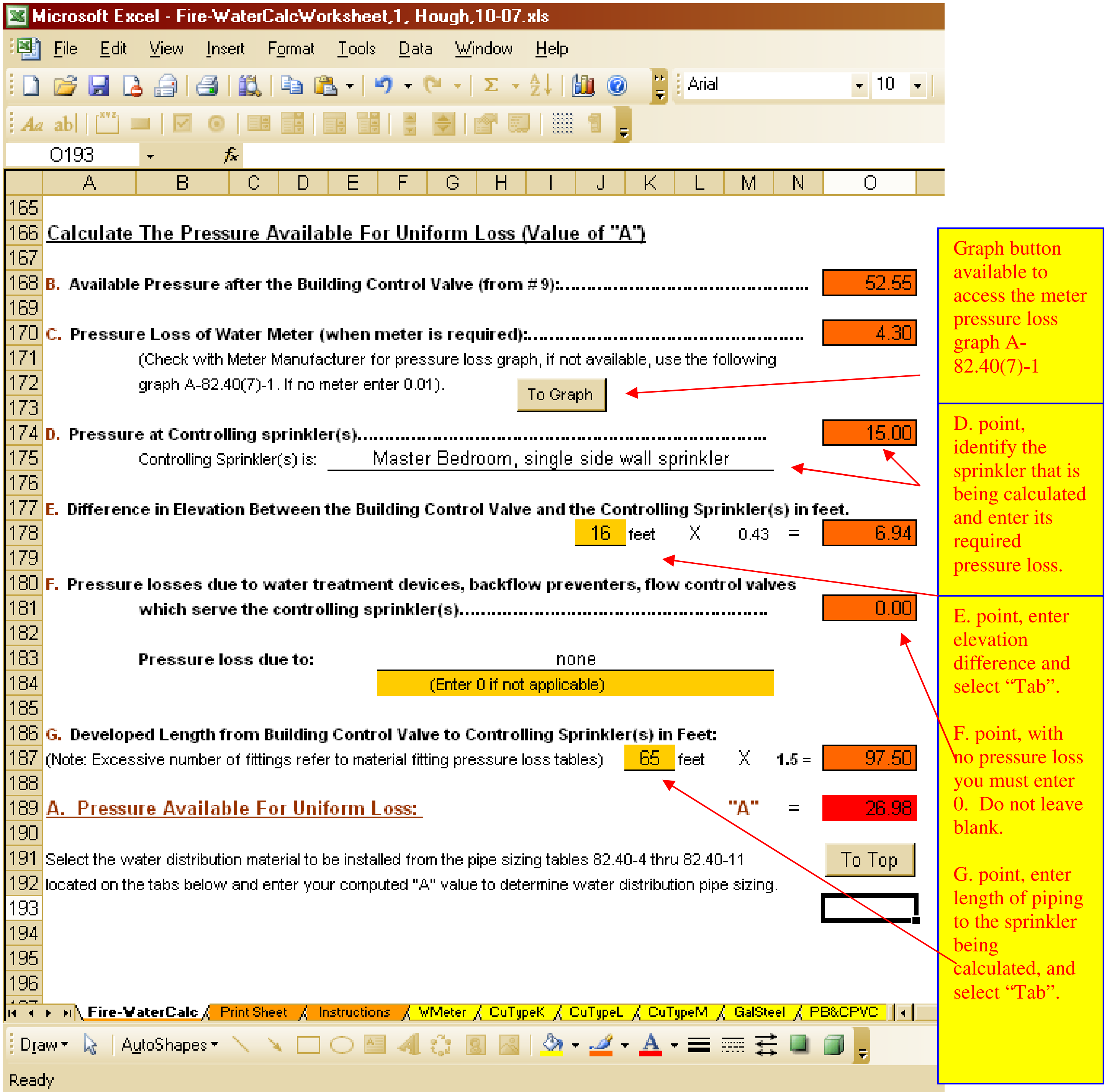

Microsoft Excel - Fire-WaterCalcWorksheet,1, Hough,10-07.xls
File Edit View Insert Format Tools Data Window Help
Arial 10
E59 17
46 1 1/2" (not to exceed 44 gpm)
47 2" (not to exceed 77 gpm)
48 2 1/2" (not to exceed 119 gpm)
49 3" (not to exceed 169 gpm)
50 4" (not to exceed 298 gpm)
Graph
53 Type K Copper, ASTM B88 (C=150), Grap A-382.40(7)-2
54 Approved for Fire-Water Distribution Piping
55 Size GPM (velocity limit 8 ft. per sec. Psi Friction Loss per 100'
56 for water distribution piping)
57 1/2" (not to exceed 5 gpm)
58 3/4" (not to exceed 10.5 gpm)
59 1" 17 (not to exceed 19 gpm) 8.13
60 1 1/4" (not to exceed 30 gpm)
61 1 1/2" (not to exceed 42 gpm)
62 2" (not to exceed 75 gpm)
63 2 1/2" (not to exceed 116 gpm)
64 3" (not to exceed 165 gpm)
65 4" (not to exceed 291 gpm)
Table
Graph
67 Pex Tubing, (Crosslinked Polyethylene), ASTM F876 & F877 (C=150), Graph A A-382.40(7)-6
69 Size GPM velocity limit 8 ft. per sec.) Psi Friction Loss per 100'
71 1/2" (not to exceed 4.5 gpm)
72 5/8" (not to exceed 6.5 gpm)
73 3/4" (not to exceed 9 gpm)
74 1" (not to exceed 15 gpm)
75 1 1/4" (not to exceed 22 gpm)
76 1 1/2" (not to exceed 31 gpm)
77 2" (not to exceed 53 gpm)
Table
Graph
Fire-WaterCalc Print Sheet Instructions WMeter CuTypeK CuTypeL CuTypeM GalSteel PB&CPVC
Draw AutoShapes
Ready
Scroll down the calculator to find the type of material for the water service.
Enter the gpm from line 1 in the box representing the water service pipe size and select Tab or Enter on the keyboard. The friction loss per 100 ft. will appear in the corresponding box on the right.
Table and Graph buttons for each pipe material are provided for convenience or reference. The Table and Graphs also have “Back” buttons which will return you the calculator.
Also, material tabs are provided at the bottom of the calculator page.

Figure 6-12



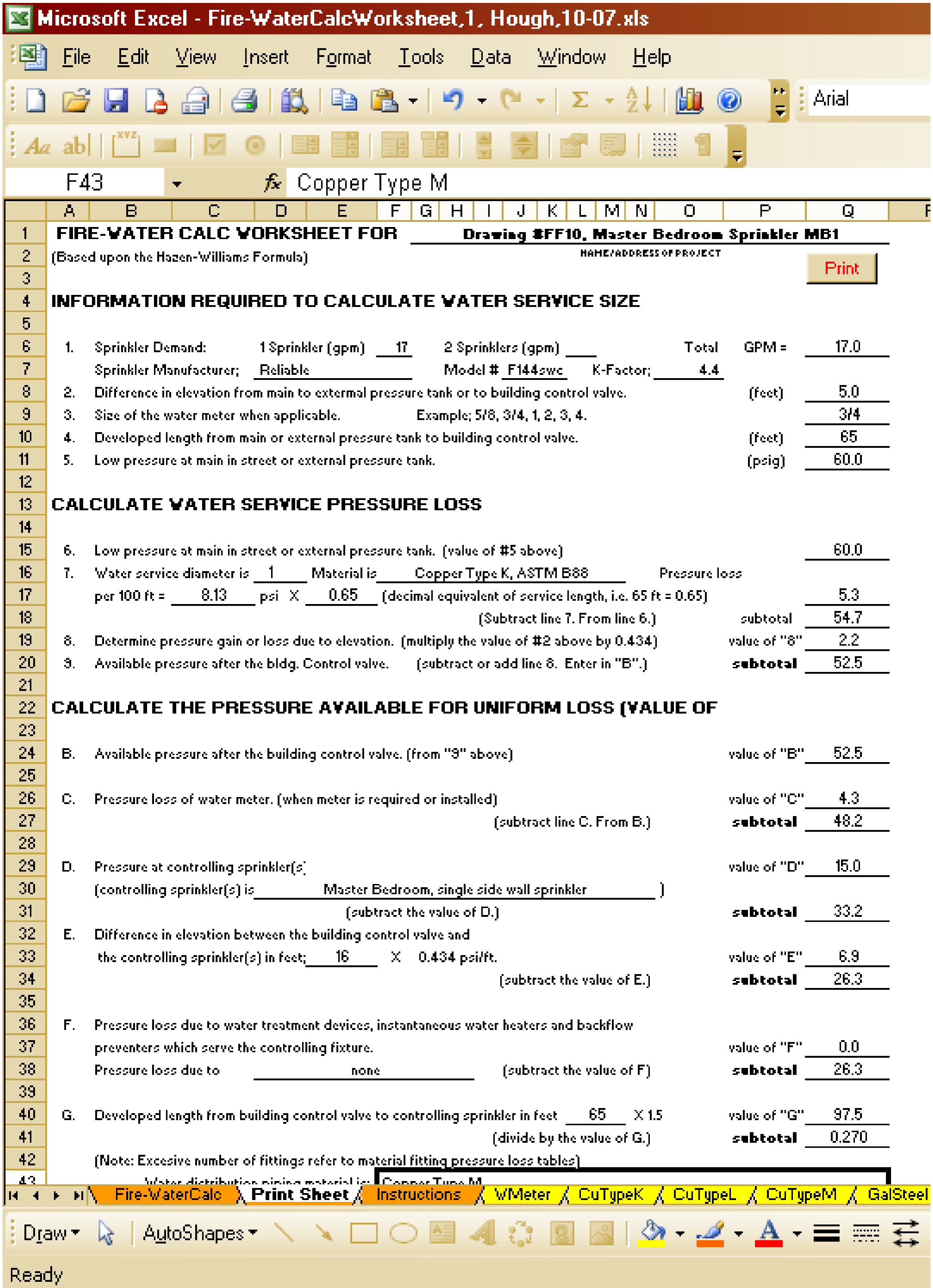
- Once 7. point is completed, the calculator automatically fills in the 8., 9., and B. point boxes. The next entry that requires a numerical value is C. point, pressure loss through the water meter.

Figure 6-13



- Once G. point is entered, the calculator provides an A value of 26.98, or rounded off, 27.
- Select the “Print Sheet” Tab at the bottom of the page. This will provide you with a printable worksheet that captures the design calculations for the sprinkler selected which will be required as part of the owner’s information packet (See Figure 6-14).

Figure 6-14


Microsoft Excel - Fire-WaterCalcWorksheet,1, Hough,10-07.xls

F43 Copper Type M

FIRE-WATER CALC WORKSHEET FOR Drawing #FF10, Master Bedroom Sprinkler MB1

NAME/ADDRESS OF PROJECT

(Based upon the Hazen-Williams Formula)

Print

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) 17 2 Sprinklers (gpm) ____ Total GPM = 17.0
   Sprinkler Manufacturer; Reliable Model # F144swc K-Factor; 4.4
2. Difference in elevation from main to external pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 3/4
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 8.13 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 5.3
   (Subtract line 7. From line 6.) subtotal 54.7
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 52.5

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF

B. Available pressure after the building control valve. (from "9" above) value of "B" 52.5

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 4.3
   (subtract line C. From B.) **subtotal** 48.2

D. Pressure at controlling sprinkler(s) value of "D" 15.0
   (controlling sprinkler(s) is Master Bedroom, single side wall sprinkler)
   (subtract the value of D.) **subtotal** 33.2

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 16 X 0.434 psi/ft. value of "E" 6.9
   (subtract the value of E.) **subtotal** 26.3

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
   Pressure loss due to none (subtract the value of F) **subtotal** 26.3

G. Developed length from building control valve to controlling sprinkler in feet 65 X 1.5 value of "G" 97.5
   (divide by the value of G.) **subtotal** 0.270

(Note: Excessive number of fittings refer to material fitting pressure loss tables)

Water distribution piping material is: Copper Type M

Fire-WaterCalc / Print Sheet / Instructions / WMeter / CuTypeK / CuTypeL / CuTypeM / GalSteel

Ready

- To Sum Up Chapter 5 and Chapter 6:

- Plumbing demand only; 1” K copper water service, 1” M copper water distribution, A value of 23.

- Sprinkler demand;
  - Master Bedroom single most remote sprinkler
    - 17 gpm, 15 psi requirement for 16’ X 16’ coverage
    - 1” K copper water service, 1”,M copper water distribution, A value of 27

- Chapter 7

- Sprinkler demand;
  - Living Room Compartment
    - Single most hydraulically demanding
    - Two most hydraulically demanding

- Chapter 8

- Sprinkler demand;
  - Family Room Compartment
    - Single most hydraulically demanding
    - Two most hydraulically demanding

- Chapter 9

- Sprinkler demand;
  - Basement Compartment
    - Single most hydraulically demanding
    - Two most hydraulically demanding

- Chapter 10

- Documentation

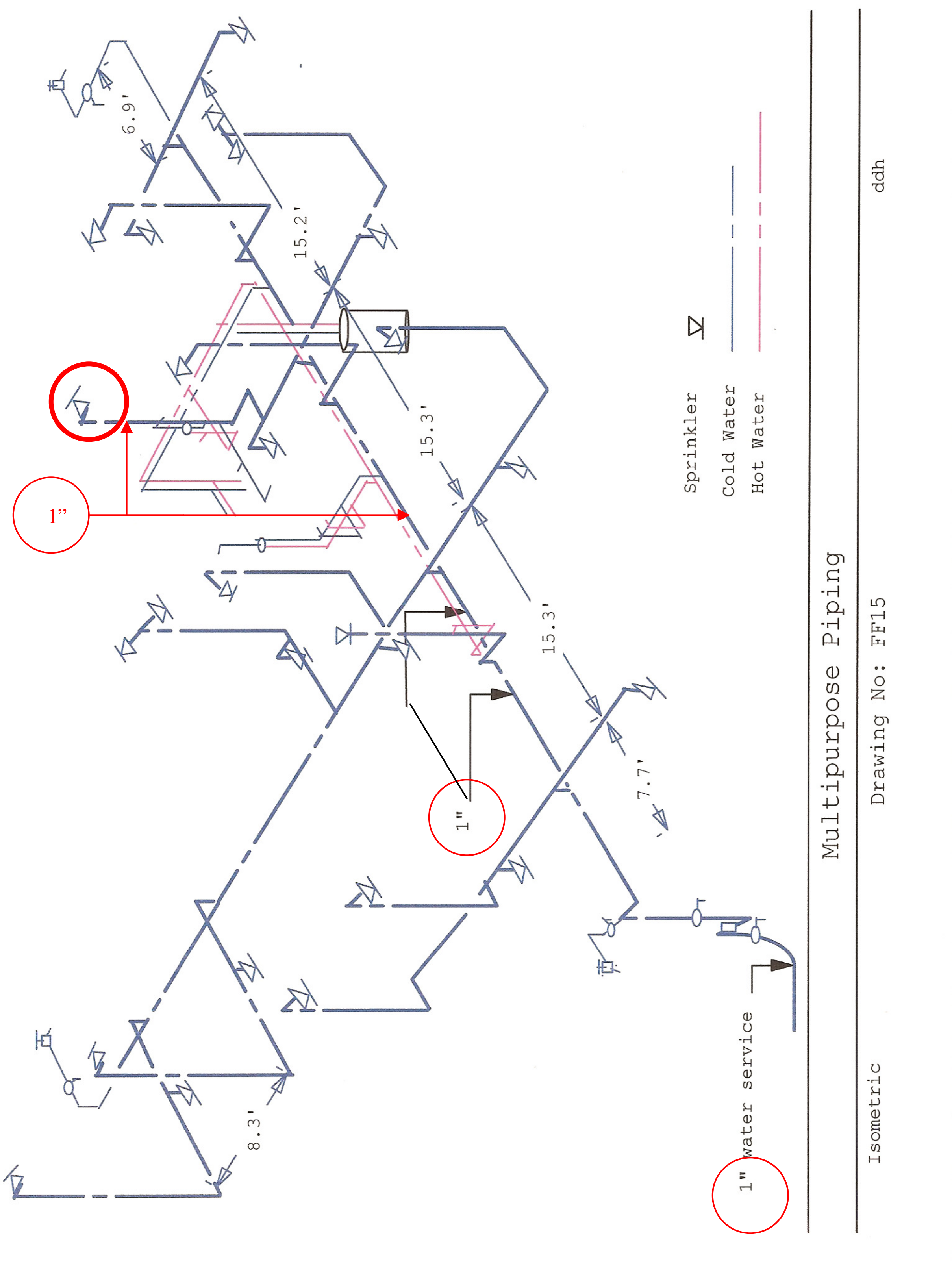
- Chapter 11

- Public Buildings, Water Service, Private Water Main Sizing

- The following isometric shows the Master Bedroom sprinkler location and the pipe sizing to meet the sprinkler demand required if the sprinkler was the most hydraulically demanding sprinkler within the dwelling. This will only be determined by calculating the demand for the remaining most hydraulically demanding sprinklers in each compartment within the dwelling.

- The next step is determining the sprinkler demand in the Living Room Compartment, Chapter 7.

Figure 6-15


6.9'
15.2'
15.3'
15.3'
7.7'
8.3'
1"
1"
1" water service
Sprinkler
Cold Water
Hot Water
Multipurpose Piping
Drawing No: FF15
Isometric
ddh

Chapter 7
Living Room Sprinkler Compartment

- In Chapter 6, the master bedroom was a single sprinkler compartment. Many rooms or combinations of rooms are multiple sprinkler compartments. If the room is too large or obstructions require more than one sprinkler, several may have to be installed. Even though there may be 4 or more sprinklers in the compartment, the number to include in the calculations remains at 2. Sprinklers included in the calculations shall include the most demanding in the compartment and a sprinkler adjacent to it. Both sprinklers shall be located in the same compartment, with their coverage area's overlapping.
- For instance a compartment could be 16 foot wide by 32 foot long. Sprinklers do not cover that large of an area alone. At least two sprinklers would be required.
- The single most remote sprinkler coverage area for Chapter 6 was 16 ft. x 16 ft. Sprinkler flow for that single sprinkler is 17 GPM at 15 psig. In order to completely cover a 32-foot long room, two sprinklers would have to be placed at 16 feet apart and 8 feet from the sides and ends.
- Piping that supplies water to both sprinklers has a flow rate of 34 GPM all the way back to the main in the street or the pressure tank. Remember, only the flow rate is doubled, not the pressure required by the sprinklers. This chapter will concentrate on the Living Room Compartment.

- Figure 7-1 below is the Reliable F1 Res 44 SWC, side wall sprinkler specifications selected for the main floor of the dwelling.

Figure 7-1

1.

The F1RES 44 SWC (Sidewall, Concealed):
- Flows equal to or only slightly higher than the RES 44 HSW.
- cULus Listed for up to 12" (305mm) below the ceiling.
- The slot-less coverplate provides protection to the thermal element.
- 155°F (68°C) sprinkler 135°F (57°C) coverplate.

The F1RES 44 SWC:

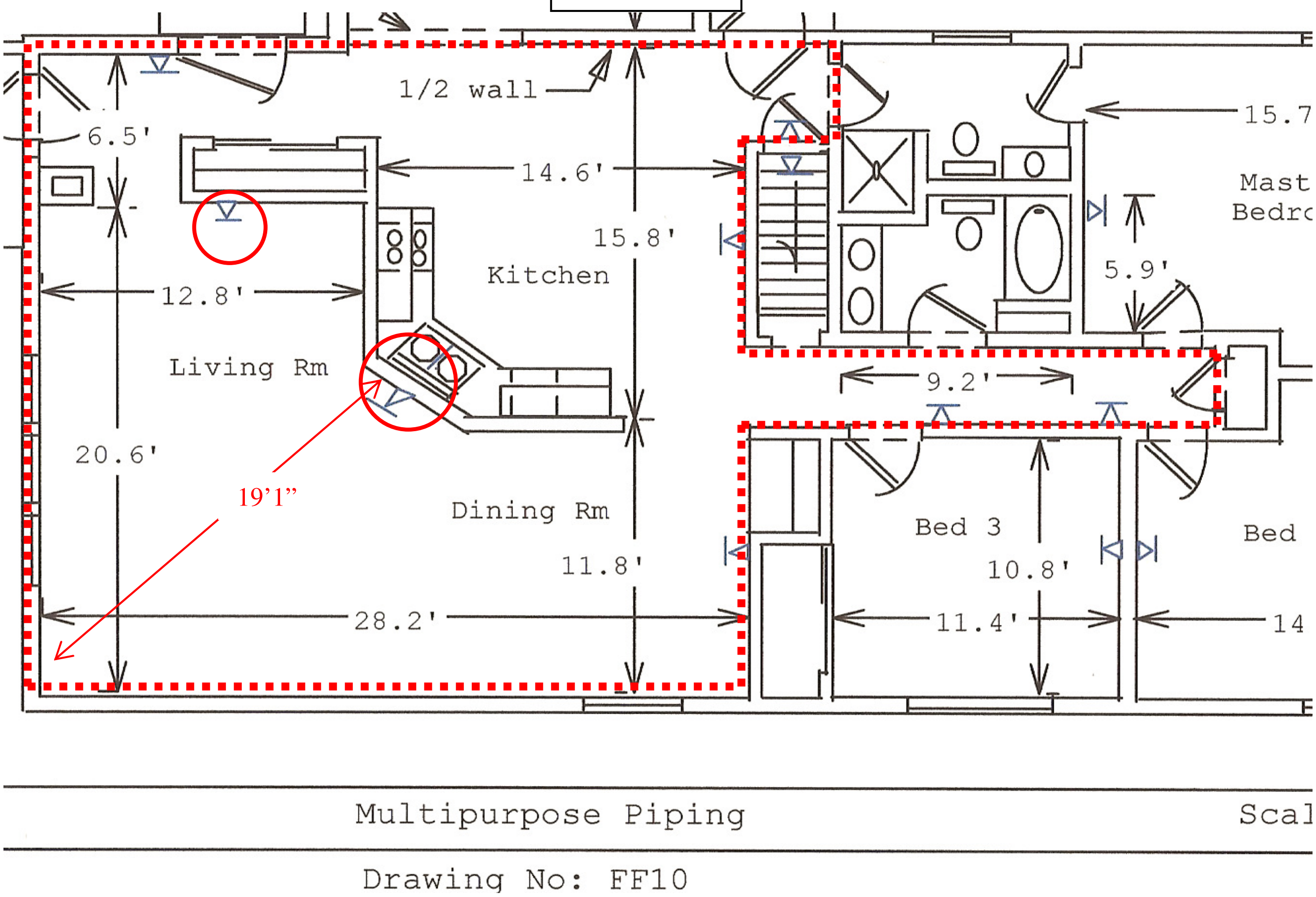
Sprinkler Model	Technical Bulletin Number	Sprinkler Identification Number (SIN)	Nominal K factor	Temperature °F (°C)	Thread Size in. (mm)	Max. Pressure (bar)	Max. Adjustment in. (mm)
F1RES 44 SWC	135	R3531	4.4	155 (68)	1/2 (13)	175 psi (12)	1/2 (13)

Flows Required for Single Sprinkler Demand (Pressures)						
12′ x 12′ (3,6 x 3,6)	14′ x 14′ (4,3 x 4,3)	16′ x 16′ (4,9 x 4,9)	16′ x 18′ (4,9 x 5,5)	18′ x 18′ (5,5 x 5,5)	16′ x 20′ (4,9 x 6,1)	20′ x 20′ (6,1 x 6,1)
13 gpm (8.7 psi)	14 gpm (10.2 psi)	17 gpm (15.0 psi)	19 gpm (18.7 psi)	———	23 gpm (27.4 psi)	———

2.

- Figure 4-1 in Chapter 4, page 4-2 illustrates a plan view of the first floor with the sprinklers illustrated including the measurements from walls and other reference points. Figure 7-2 below shows the Living Room Compartment detail of the plan highlighted by the dotted lines.
- There are eight sprinklers in the living room compartment. The most demanding sprinkler in the living room is the sprinkler located opposite the kitchen sink. It has the largest coverage area, 16 ft. x 20 ft, and the other living room sprinkler has a coverage area of 16 ft. X 16 ft. which is located on the closet entry wall. The dining room has 12 ft. X 12 ft. coverage, while the kitchen would require 16 ft. X 16 ft. coverage. The other 4 sprinklers in the compartment are the front and rear entry sprinklers and the hallway sprinklers, each of these sprinklers would require a minimum coverage of 12 ft X 12 ft.
- The two most demanding sprinklers are the living room sprinklers, with a 16' X 16' coverage, and a 16' X 20' coverage, pressure requirement of 27.4 psi, and a gpm demand of 40 (23 gpm for one, and 17 gpm for the other).
-

Figure 7-2



- Remember, by satisfying the hydraulic sprinkler demand for the single most demanding and the two most demanding adjacent sprinklers in a compartment, we know the other sprinklers within the compartment will be satisfied.
- Starting the calculations for the most hydraulically demanding single sprinkler will be our next step. On page 7-3 the basic specifications for the dwelling is entered into the appropriate boxes on the Fire-Water Calculation Worksheet. Open the provided CD S&B Fire-Water Excel Crew File and enter the following:

Figure 7-3

Fire-Water Calculation Worksheet For: Drawing #FF10, Living Room Single Sprinkler

Information Required To Calulate Water Service Size: Clear All

1. Sprinkler Demand: 1 Sprinkler (GPM) 23 2 Sprinklers (GPM) Total (GPM) 23

(Add 5 GPM for 2 family dwellings.)

Sprinkler Manufacturer; Reliable Model No.; F1 44SWC K-Factor; 4.4

2. Difference in elevation from main or external pressure tank to building control valve (ft.)... 5

3. Water Meter (when meter is required click on orange box and choose diameter)... ... ... 3/4

(Example: 5/8, 3/4, 1, 2, 3, 4)

4. Developed length from main or external pressure tank to building control valve (ft.)... 65

5. Low pressure at main in street or external pressure tank... 60

Enter sprinkler data under point one

Points 2., 3.,4., and 5., will be the same as the previous fire-water calculation on the master bedroom sprinkler.

Next step is to scroll down through the Guide to Determining Water Pressure Loss for Water Service & Water Distribution Materials to the Type K Copper material section.

Calculate Water Service Pressure Loss

To determine the pressure loss through any given pipe material listed below, enter the total GPM in the box below on the left representing pipe size.

Guide To Determining Water Pressure Loss for Water Service & Water Distribution Materials

Type L Copper, ASTM B88 (C=150), Graph / A-382.40(7)-3

Approved for Fire-Water Distribution Piping

Size	GPM	(velocity limit 8 ft. per sec.)	Psi Friction Loss per 100'
1/2"		(not to exceed 5.5 gpm)	
3/4"		(not to exceed 12 gpm)	
1"		(not to exceed 20.5 gpm)	
1 1/4"		(not to exceed 31 gpm)	
1 1/2"		(not to exceed 44 gpm)	
2"		(not to exceed 77 gpm)	
2 1/2"		(not to exceed 119 gpm)	
3"		(not to exceed 169 gpm)	
4"		(not to exceed 298 gpm)	

Table

Graph

Type K Copper, ASTM B88 (C=150), Graph / A-382.40(7)-2

Approved for Fire-Water Distribution Piping

Size	GPM	(velocity limit 8 ft. per sec. for water distribution piping)	Psi Friction Loss per 100'
1/2"		(not to exceed 5 gpm)	
3/4"		(not to exceed 10.5 gpm)	
1"	23	(not to exceed 19 gpm)	14.2
1 1/4"		(not to exceed 30 gpm)	
1 1/2"		(not to exceed 42 gpm)	
2"		(not to exceed 75 gpm)	
2 1/2"		(not to exceed 116 gpm)	
3"		(not to exceed 165 gpm)	
4"		(not to exceed 291 gpm)	

Table

Graph

Enter the gpm requirement for the sprinkler demand in the appropriate water service size box, in this case, 1".

Select "Tab" on the keyboard and the psi friction loss per 100' is calculated.

Scroll down through the rest of the Guide and stop at the 6. and 7. points for the next entry.

Figure 7-4

6. Low Pressure At Main in Street or External Pressure Tank:.. 60.00

7. Pressure Loss Due to Friction in 1 inch diameter water service.

Water service / distribution piping material is: Copper Type K, ASTM B88

Pressure loss per 100 ft (from tables above) 14.2 psi. X 0.65 (decimal equivalent of service length, e.g. 65 ft. = 0.65) 9.23

8. Pressure Loss Due To Elevation:... 2.17

(#2 above is automatically entered and multiplied by .434)

9. Available Pressure After the Building Control Valve:.. 48.60

(Automatically entered once boxes 1 - 8 have been filled, low pressure at main in street or external pressure tank, minus the pressure loss due to friction per length of service and pressure loss due to elevation).

Calculate The Pressure Available For Uniform Loss (Value of "A")

B. Available Pressure after the Building Control Valve (from # 9):.. 48.60

C. Pressure Loss of Water Meter (when meter is required):..

(Check with Meter Manufacturer for pressure loss graph, if not available, use the following graph A-82.40(7)-1. If no meter enter 0.01).

To Graph

D. Pressure at Controlling sprinkler(s)...

Controlling Sprinkler(s) is:

E. Difference in Elevation Between the Building Control Valve and the Controlling Sprinkler(s) in feet.

feet X 0.43 =

F. Pressure losses due to water treatment devices, backflow preventers, flow control valves which serve the controlling sprinkler(s)... 0.00

Pressure loss due to:

(Enter 0 if not applicable)

G. Developed Length from Building Control Valve to Controlling Sprinkler(s) in Feet:

(Note: Excessive number of fittings refer to material fitting pressure loss tables) feet X **1.5 =** 0.00

A. Pressure Available For Uniform Loss: "A" =

Select the water distribution material to be installed from the pipe sizing tables 82.40-4 thru 82.40-11 located on the tabs below and enter your computed "A" value to determine water distribution pipe sizing.

To Top

6. point is entered automatically.

7. point enter the water service size, and piping material in the box and line provided and select "Tab".

Enter the pressure loss per 100 ft. in the yellow box from the Guide and select "Tab".

Enter the decimal equivalent of the service length and select "Tab".

8. point, 9.point, and B. point is then automatically calculated. Next entry is C. point

C. point; click on "To Graph" button provided if manufactures graph is not available. To find the pressure loss through the water meter at the gpm required for the sprinkler being calculated, see next page, Figure 7-5.

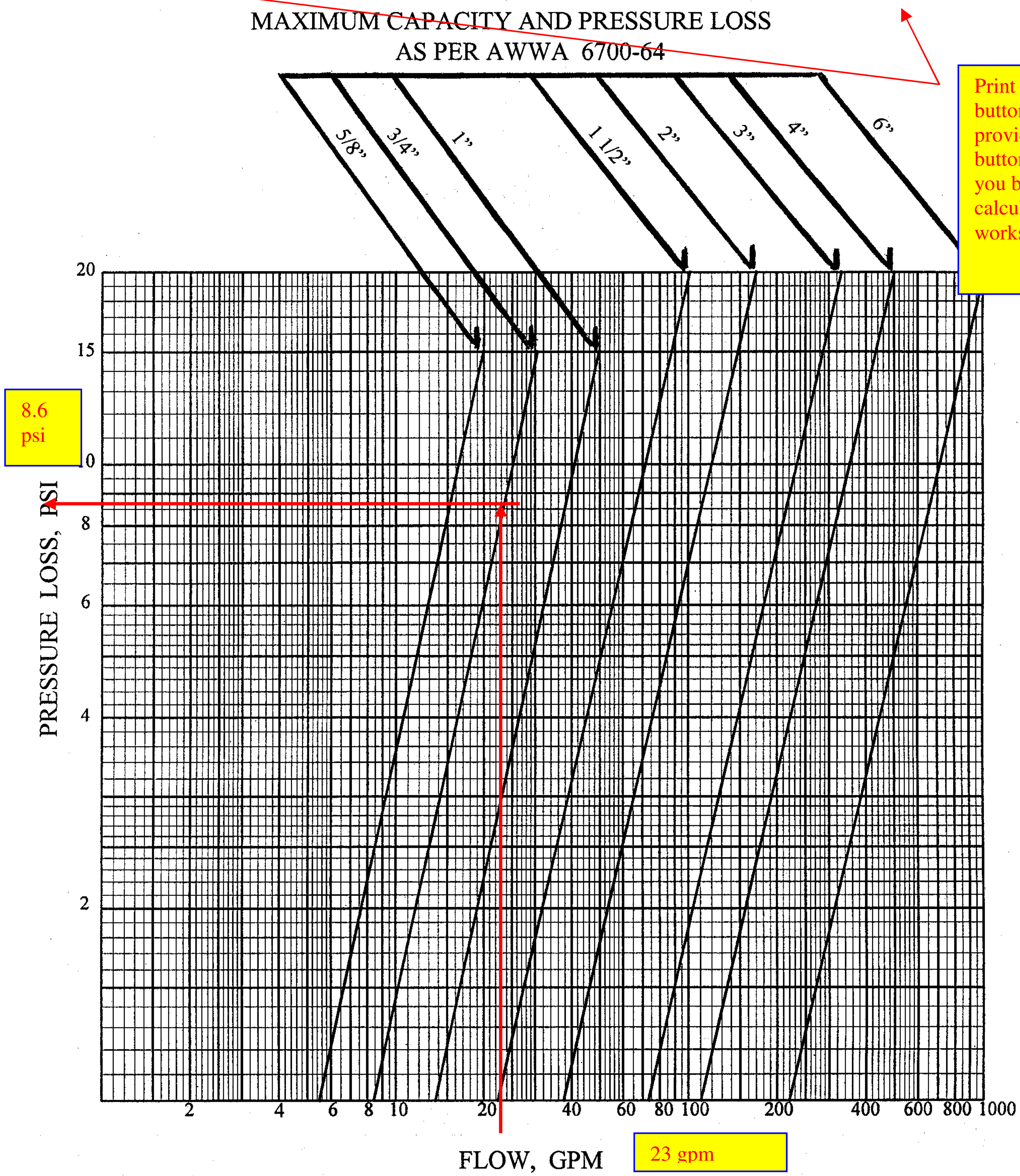
Figure 7-5

Graph A-382.40(7)-1

Print

Pressure Loss in cold-water meters, displacement type

Back



Print and Back buttons provided. Back button takes you back to the calculator worksheet.

Figure 7-6

Calculate The Pressure Available For Uniform Loss (Value of "A")

B. Available Pressure after the Building Control Valve (from # 9):.. 48.60

C. Pressure Loss of Water Meter (when meter is required):.. 8.60

(Check with Meter Manufacturer for pressure loss graph, if not available, use the following Graph A-382.40(7)-1 If no meter enter 0.01).

To Graph

D. Pressure at Controlling sprinkler(s).. 27.40

Controlling Sprinkler(s) is: Living Room, single most demanding sprinkler

E. Difference in Elevation Between the Building Control Valve and the Controlling Sprinkler(s) in feet.

16 feet X 0.43 = 6.94

F. Pressure losses due to water treatment devices, backflow preventers, flow control valves which serve the controlling sprinkler(s).. 0.00

Pressure loss due to: None

(Enter 0 if not applicable)

G. Developed Length from Building Control Valve to Controlling Sprinkler(s) in Feet:

(Note: Excessive number of fittings refer to material fitting pressure loss tables) 34 feet X **1.5 =** 51.00

A. Pressure Available For Uniform Loss: **"A"** = 11.09

Select the water distribution material to be installed from the pipe sizing tables 82.40-4 thru 82.40-11 located on the tabs below and enter your computed "A" value to determine water distribution pipe sizing.

To Top

D. point, identify the sprinkler being calculated and enter the pressure required from manufacturers specifications.

E. point, enter the elevation difference in the yellow box and select "Tab".

F. point, enter 0.0 if there are no pressure losses, do not leave blank.

G. point, enter the developed length in the yellow box and select "Tab". "A" value is now provided.

- Fire – Water Calculations have been completed for the single most demanding sprinkler in the Living Room compartment area. With a type K 1" copper water service, and a 23 gpm demand at the sprinkler, we have a "A" value of 11.09, or rounding up, an "A" value of 12. At the bottom of the page, select "Print Sheet" tab, this will provide you with a printable worksheet that captures the design calculations for the sprinkler selected and will be required as part of the owners information packet.

- Referring to our Water Distribution Table 382.40-6 for type M copper, we are able to size the water distribution system with an A value of 12 if the single most demanding sprinkler in the Living Room compartment was the most demanding sprinkler or sprinklers in the MPP system. In order to determine this we need to proceed and finish the rest of the fire- water calculations for the two most demanding sprinklers in the living room compartment and the rest of the compartments, the family room and basement.

- Note: G. point value can be altered to reflect a water distribution system with an excessive number of fittings and a greater pressure loss experienced than the equivalent of ½ the developed pipe length from the building control valve and the sprinkler being calculated.

Figure 7-7

FIRE-WATER CALC WORKSHEET FOR Drawing #FF10, Living Room Single Sprinkler
NAME/ADDRESS OF PROJECT

(Based upon the Hazen-Williams Formula)

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) 23 2 Sprinklers (gpm) ____ Total GPM = 23.0
   Sprinkler Manufacturer; Reliable Model # F1 44SW(K-Factor; 4.4
2. Difference in elevation from main to external pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 3/4
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 14.2 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 9.2
   (Subtract line 7. From line 6.) subtotal 50.8
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 48.6

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 48.6

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 8.6
(subtract line C. From B.) **subtotal** 40.0

D. Pressure at controlling sprinkler(s). value of "D" 27.4
(controlling sprinkler(s) is Living Room, single most demanding sprinkler)
(subtract the value of D.) **subtotal** 12.6

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 16 X 0.434 psi/ft. value of "E" 6.9
(subtract the value of E.) **subtotal** 5.7

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
Pressure loss due to None (subtract the value of F) **subtotal** 5.7

G. Developed length from building control valve to controlling sprinkler in feet 34 X 1.5 value of "G" 51.0
(divide by the value of G.) **subtotal** 0.111
(Note: Excessive number of fittings refer to material fitting pressure loss tables)
Water distribution piping material is: ____________

Double click on this line to enter piping material

(multiply by 100) 100

A. **Pressure available for uniform loss** **"A" =** **11.1**

Comments

Double click in this box to add any comments, double click out of the box to exit.

SBD- 10860 10/07

Figure 7-8

Table 382.40-6

Table 82.40-6

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING-TYPE M, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																										
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	-	0.5	2.0	-	2.0	4.0	-	4.0	7.0	-	9.0	11.5	4.0	15.5	23.0	7.5	37.0	42.0	33.0	100	67.0	96.0	210	139	481	577
1	1.0	-	1.0	3.0	-	3.0	6.0	-	7.0	10.5	4.0	14.0	16.5	5.5	24.0	34.0	18.5	66.0	61.0	77.0	180	97.0	227	360	202	945	953
2	1.5	-	1.5	4.5	-	5.0	9.0	-	11.5	15.5	5.0	22.5	24.0	8.0	40.0	50.0	48.0	128	88.0	184	315	141	493	588	294	1750	1750
3	2.0	-	2.0	5.5	-	6.5	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0	62.0	80.0	185	110	300	425	174	731	776	303	1835	1835
4	2.5	-	2.5	6.5	-	8.0	13.0	4.5	18.0	22.0	7.0	35.0	35.0	20.0	70.0	73.0	120	240	121	374	484		NP			NP	
5	2.5	-	2.5	7.5	-	9.5	15.0	5.0	21.5	25.0	8.5	42.0	40.0	30.0	86.0	79.0	144	270		NP							
6	3.0	-	3.0	8.0	-	10.0	16.5	5.5	24.0	28.0	11.0	50.0	44.0	36.0	106		NP										
7	3.5	-	3.5	9.0	-	11.5	18.0	6.0	26.5	30.0	13.5	55.0	45.0	39.0	112												
8	3.5	-	3.5	9.5	-	12.5	19.5	6.5	29.0	32.0	17.0	62.0		NP													
9	4.0	-	4.0	10.0	4.0	13.0	20.5	6.5	31.0		NP																
10	4.0	-	4.0	11.0	4.0	15.0	21.5	7.0	34.0																		
11	4.5	-	5.0	11.5	4.0	15.5		NP																			
12	4.5	-	5.0	12.0	4.0	16.5																					
13	5.0	-	6.0	12.5	4.5	17.5																					
14	5.0	-	6.0	12.5	4.5	18.0																					
15	5.0	-	6.0		NP																						
16	5.5	-	6.5																								
17	5.5	-	6.5																								
18	5.5	-	6.5																								
19	6.0	-	7.0																								
20	6.0	-	7.0																								
21	6.0	-	7.5																								
		NP																									

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means - not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
Comm 82.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

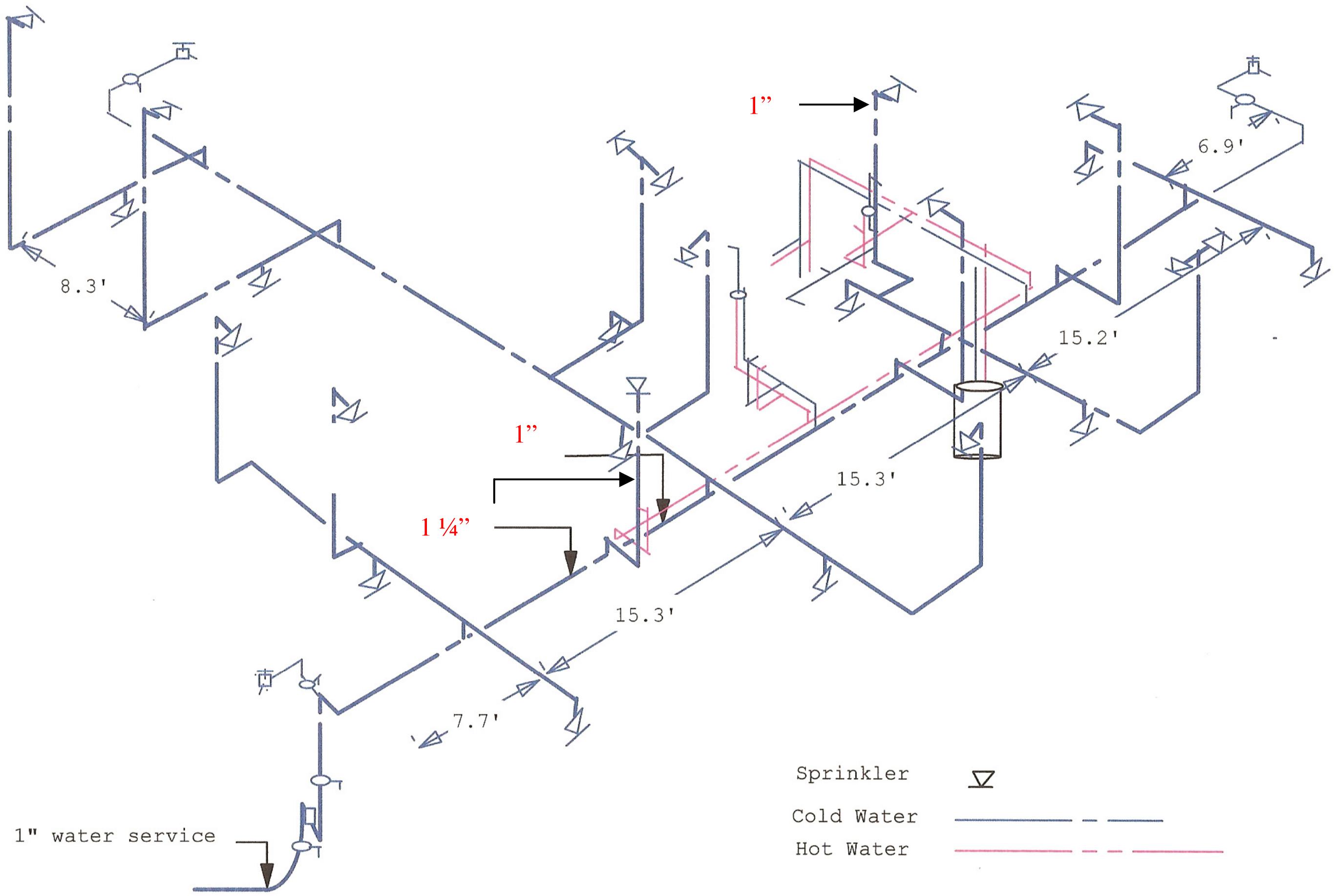
- The Table in Figure 7-8 shows a 11/4" pipe size requirement to provide 23 gpm to the living room single most demanding sprinkler with an "A" value of 12. This is a higher demand requirement and a change in pipe size from our sizing of the master bedroom sprinkler, which indicates the fact that it has a higher demand. Note the isometric in Figure 7-9.

- The next step is to determine the sprinkler demand and the "A" value of the <u>two most demanding sprinklers in the living room compartment.</u>

- Much of the information entered in the Fire-Water Calculator for sizing the Living Room single most demanding sprinkler can be used and adjusted to size the Living Room two most demanding sprinklers.

- Going back to the calculator, the following adjustments can be made to determine the "A" value or pressure loss per 100 feet. These changes start on page 7-10.

Figure 7-9



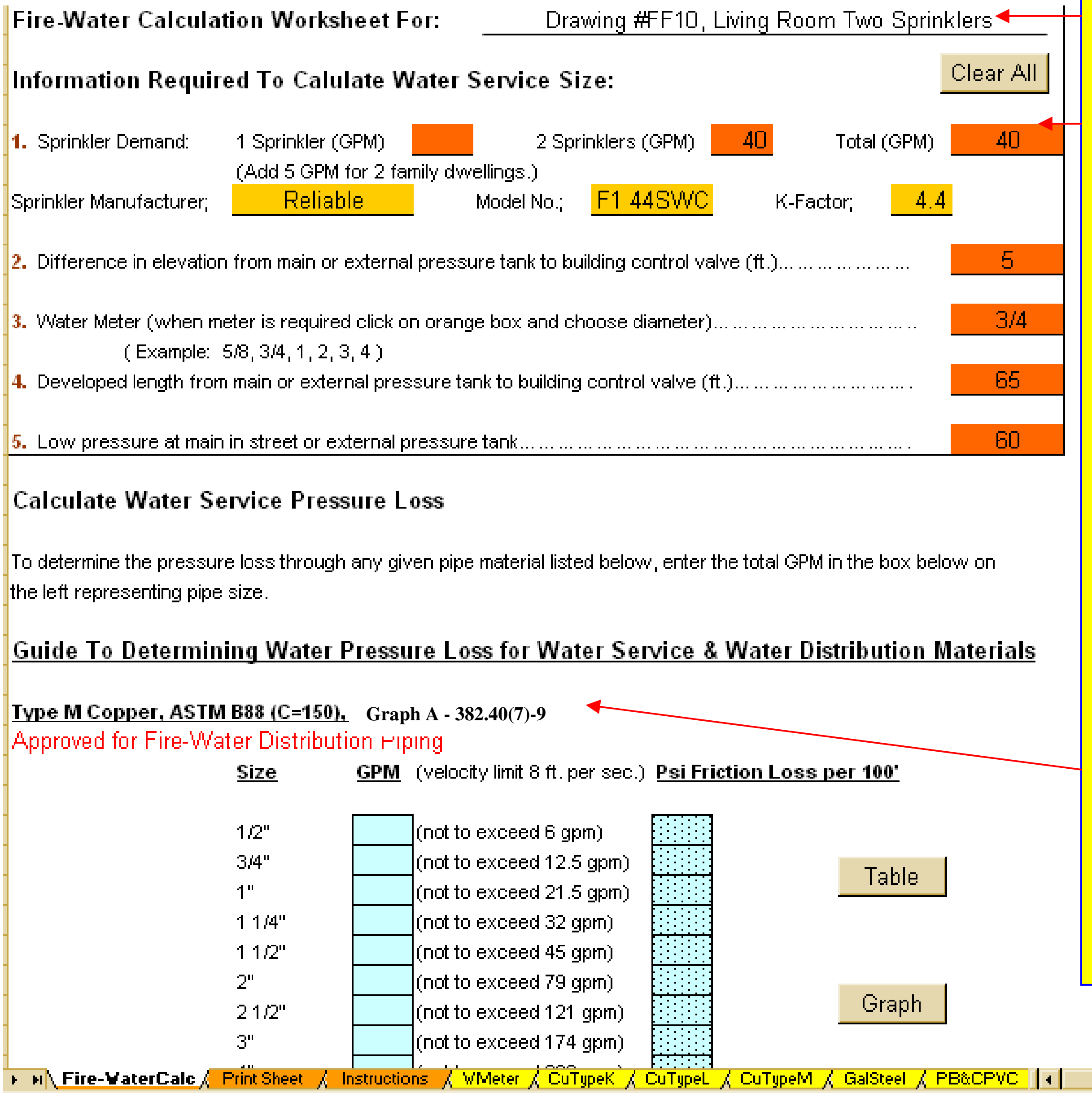
Multipurpose Piping

Isometric

Drawing No: FF15

ddh

Figure 7-10



Adjust the heading to indicate two sprinkler demand.

1. point, delete the single sprinkler gpm and enter the sprinkler gpm for two sprinklers in the appropriate boxes.

Points 2. – 5. remain the same at this time.

Scroll down the Guide to the Type K Copper section.

- Adjusting the calculator to go from a single sprinkler calculation for the Living Room compartment to the two most demanding sprinklers in the compartment is easy. Just click on the appropriate box or line and enter the new data or delete where needed. The calculator will do the rest.

- A first line adjustment "Two Sprinklers" was entered. Data entered in the 1 sprinkler box was deleted. 40 gpm was entered in the 2 sprinkler box and the total box. The rest of the entries remain the same at this time.

Figure 7-11

Type L Copper, ASTM B88 (C=150), Graph A-382.40(7)-3

Approved for Fire-Water Distribution Piping

Size	GPM	(velocity limit 8 ft. per sec.)	Psi Friction Loss per 100'
1/2"		(not to exceed 5.5 gpm)	
3/4"		(not to exceed 12 gpm)	
1"		(not to exceed 20.5 gpm)	
1 1/4"		(not to exceed 31 gpm)	
1 1/2"		(not to exceed 44 gpm)	
2"		(not to exceed 77 gpm)	
2 1/2"		(not to exceed 119 gpm)	
3"		(not to exceed 169 gpm)	
4"		(not to exceed 298 gpm)	

Table

Graph

Type K Copper, ASTM B88 (C=150), Graph A-382.40(7)-2

Approved for Fire-Water Distribution Piping

Size	GPM	(velocity limit 8 ft. per sec. for water distribution piping)	Psi Friction Loss per 100'
1/2"		(not to exceed 5 gpm)	
3/4"		(not to exceed 10.5 gpm)	
1"	40	(not to exceed 19 gpm)	39.6
1 1/4"		(not to exceed 30 gpm)	
1 1/2"		(not to exceed 42 gpm)	
2"		(not to exceed 75 gpm)	
2 1/2"		(not to exceed 116 gpm)	
3"		(not to exceed 165 gpm)	
4"		(not to exceed 291 gpm)	

Table

Graph

In the Type K Copper table, enter 40 gpm in the corresponding box for a 1" service and select Tab or enter on your keyboard. A friction loss of 39.6 is computed.

Note: High psi friction loss may indicate the water service is undersized for the required gpm.

Scroll down to the 6. and 7. points.

Pex Tubing, (Crosslinked Polyethylene), ASTM F876 & F877 (C=150), Graph A-382.40(7)-6

Size	GPM	velocity limit 8 ft. per sec.)	Psi Friction Loss per 100'
1/2"		(not to exceed 4.5 gpm)	

Fire-WaterCalc | Print Sheet | Instructions | WMeter | CuTypeK | CuTypeL | CuTypeM | GalSteel | PB&CPVC

Figure 7-12

2 1/2"

3"

6. Low Pressure At Main in Street or External Pressure Tank:... 60.00

7. Pressure Loss Due to Friction in 1 inch diameter water service.

Water service / distribution piping material is: Copper Type K, ASTM B88

Pressure loss per 100 ft (from tables above) 39.6 psi. X 0.65 (decimal equivalent of service length, e.g. 65 ft. = 0.65) 25.74

8. Pressure Loss Due To Elevation:.. 2.17

(#2 above is automatically entered and multiplied by .434)

9. Available Pressure After the Building Control Valve:... 32.09

(Automatically entered once boxes 1 - 8 have been filled, low pressure at main in street or external pressure tank, minus the pressure loss due to friction per length of service and pressure loss due to elevation).

Calculate The Pressure Available For Uniform Loss (Value of "A")

B. Available Pressure after the Building Control Valve (from # 9):....................................... 32.09

C. Pressure Loss of Water Meter (when meter is required):... 20.00

(Check with Meter Manufacturer for pressure loss graph, if not available, use the following Graph A-382.40(7)-1 If no meter enter 0.01).

To Graph

D. Pressure at Controlling sprinkler(s).. 27.40

Controlling Sprinkler(s) is: Living Room Two Most Demanding Sprinklers

E. Difference in Elevation Between the Building Control Valve and the Controlling Sprinkler(s) in feet.

16 feet X 0.43 = 6.94

Fire-WaterCalc | Print Sheet | Instructions | WMeter | CuTypeK | CuTypeL | CuTypeM | GalSteel | PB&CPVC

Point 6 box is automatically filled in.

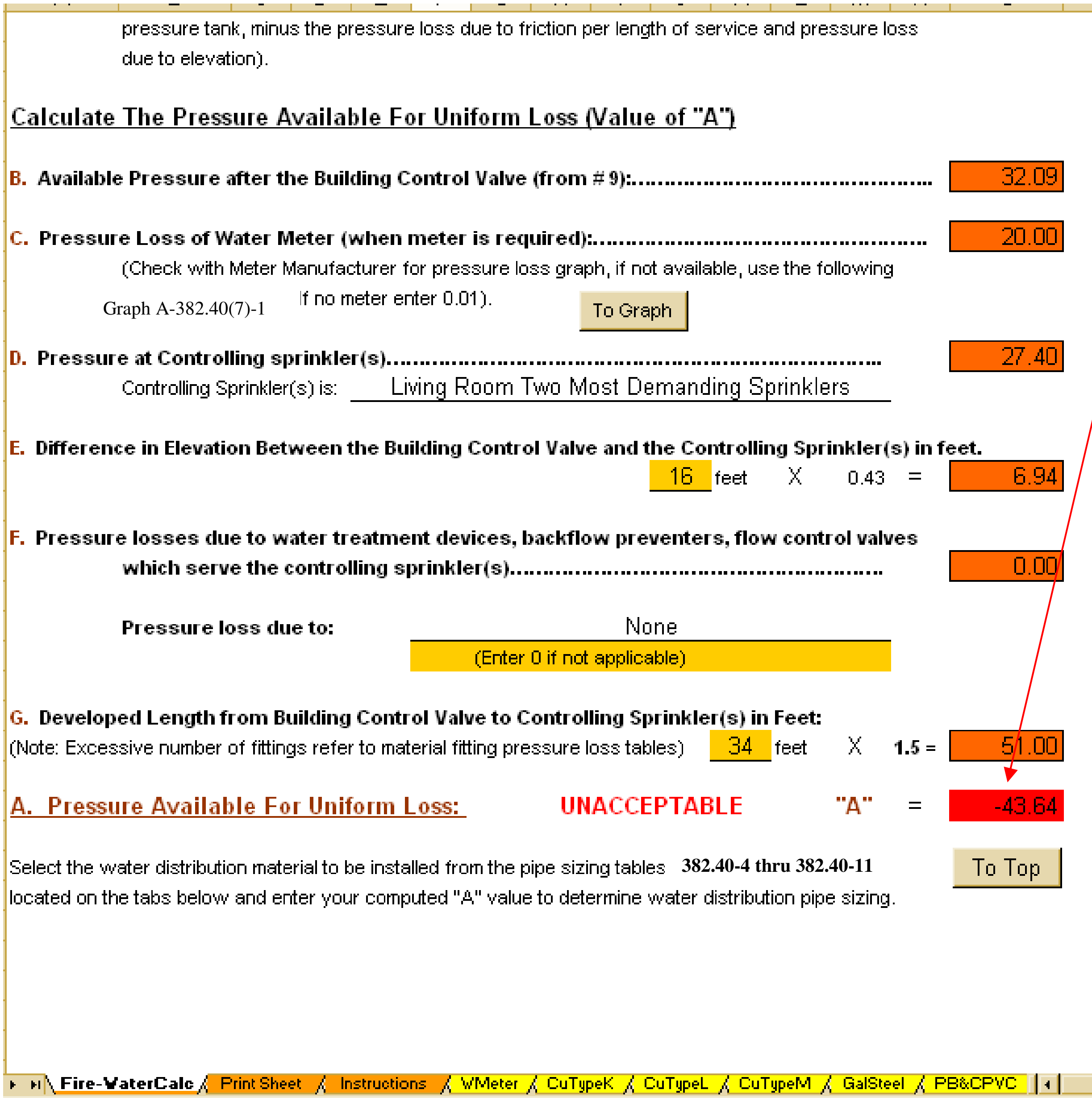
Point 7 enter the new pressure loss per 100 ft and select Tab or enter on your keyboard. The rest of the boxes automatically fill in . The next adjustment is the pressure loss of the water meter, "C" point.

According to the graph, the pressure loss through a ¾" meter is at least 20 psi.

D. point; change the identification of the sprinklers from single to two most demanding.

E point; no change.

Figure 7-13



E.F. and G. point, no change.

"A" value of negative 43.64 means we do not have enough pressure to meet the two most demanding sprinklers in the Living Room compartment.

Adjustments have to be made. One adjustment would be the water service size, another would be the water meter size. Let's make the adjustments and see if we have a workable "A" value.

- Remember, any time the calculator computes a negative "A" value there is no longer sufficient pressure available to provide water at 8 feet per second. Design changes have to be made such as increasing the size of the water service and water distribution piping, and / or the water meter if one is required, or designing a storage tank with pressure assist, or a combination storage tank and booster pump.

- Design change to a higher velocity than 8 feet per second is not an option for plumbing water distribution systems as per SPS 382.40(7) (e).

- The next step in our calculating and design work is to adjust the water service size and water meter which will provide a greater gpm flow while not exceeding our velocity limitations. The new "A" value obtained will be noted that design changes were made to obtain it. One way of doing so, is to provide a Fire-Water Calc worksheet showing the negative "A" value along with the new worksheet, see Figure 7-18.

Figure 7-14

3"		(not to exceed 169 gpm)	
4"		(not to exceed 298 gpm)	

Type K Copper, ASTM B88 (C=150), Graph A-382.40(7)-2

Approved for Fire-Water Distribution Piping

Size	GPM	(velocity limit 8 ft. per sec. for water distribution piping)	Psi Friction Loss per 100'
1/2"		(not to exceed 5 gpm)	
3/4"		(not to exceed 10.5 gpm)	
1"	40	(not to exceed 19 gpm)	39.6
1 1/4"	40	(not to exceed 30 gpm)	13.3
1 1/2"	40	(not to exceed 42 gpm)	5.72
2"		(not to exceed 75 gpm)	
2 1/2"		(not to exceed 116 gpm)	
3"		(not to exceed 165 gpm)	
4"		(not to exceed 291 gpm)	

Table

Graph

Going back to the material pressure loss guide, enter 40 gpm in the boxes representing 1 ¼" and 1 ½" K copper piping.

Select the pressure loss and pipe size that seems 'reasonable' and enter the pressure loss data in the 7. point box as you scroll back down.

Pex Tubing, (Crosslinked Polyethylene), ASTM F876 & F877 (C=150), Graph A-382.40(7)-6

Size	GPM	velocity limit 8 ft. per sec.)	Psi Friction Loss per 100'
1/2"		(not to exceed 4.5 gpm)	
5/8"		(not to exceed 6.5 gpm)	
3/4"		(not to exceed 9 gpm)	
1"		(not to exceed 15 gpm)	
1 1/4"		(not to exceed 22 gpm)	
1 1/2"		(not to exceed 31 gpm)	
2"		(not to exceed 53 gpm)	

Table

Graph

PE (Polyethylene Tubing), Copper Tube Size, ASTM D2737, (C=150), Graph A-382.40(7)-7

Size	GPM	(no velocity restrictions for water service sizing)	Psi Friction Loss per 100'
1/2"			

Fire-WaterCalc | Print Sheet | Instructions | WMeter | CuTypeK | CuTypeL | CuTypeM | GalSteel | PB&CPVC

Figure 7-15

2 1/2"
3"

6. **Low Pressure At Main in Street or External Pressure Tank:**.. 60.00

7. **Pressure Loss Due to Friction in** 1 1/2 inch diameter water service.

Water service / distribution piping material is: Copper Type K, ASTM B88

Pressure loss per 100 ft (from tables above) 5.72 psi. X 0.65 (decimal equivalent of service length, e.g. 65 ft. = 0.65) 3.72

8. **Pressure Loss Due To Elevation:**.. 2.17
(#2 above is automatically entered and multiplied by .434)

9. **Available Pressure After the Building Control Valve:**.. 54.11
(Automatically entered once boxes 1 - 8 have been filled, low pressure at main in street or external pressure tank, minus the pressure loss due to friction per length of service and pressure loss due to elevation).

Calculate The Pressure Available For Uniform Loss (Value of "A")

B. **Available Pressure after the Building Control Valve (from # 9):**.. 54.11

C. **Pressure Loss of Water Meter (when meter is required):**.. 9.00
(Check with Meter Manufacturer for pressure loss graph, if not available, use the following Graph A-382.40(7)-1 . If no meter enter 0.01).

To Graph

D. **Pressure at Controlling sprinkler(s)**.. 27.40
Controlling Sprinkler(s) is: Living Room Two Most Demanding Sprinklers

E. **Difference in Elevation Between the Building Control Valve and the Controlling Sprinkler(s) in feet.**
16 feet X 0.43 = 6.94

Fire-WaterCalc / Print Sheet / Instructions / WMeter / CuTypeK / CuTypeL / CuTypeM / GalSteel / PB&CPVC

7. point; enter 1½".

Enter the new psi pressure loss and select Tab.

Points 8.,9., and B. automatically adjust.

Next entry is the C point, water meter pressure loss. Here we change the size of the meter to 1" and enter the new pressure loss.

Figure 7-16

pressure tank, minus the pressure loss due to friction per length of service and pressure loss due to elevation).

Calculate The Pressure Available For Uniform Loss (Value of "A")

B. Available Pressure after the Building Control Valve (from # 9):.. 54.11

C. Pressure Loss of Water Meter (when meter is required):.. 9.00

(Check with Meter Manufacturer for pressure loss graph, if not available, use the following

Graph A-382.40(7)-1 If no meter enter 0.01). To Graph

D. Pressure at Controlling sprinkler(s).. 27.40

Controlling Sprinkler(s) is: Living Room Two Most Demanding Sprinklers

E. Difference in Elevation Between the Building Control Valve and the Controlling Sprinkler(s) in feet.

16 feet X 0.43 = 6.94

F. Pressure losses due to water treatment devices, backflow preventers, flow control valves which serve the controlling sprinkler(s).. 0.00

Pressure loss due to: None

(Enter 0 if not applicable)

G. Developed Length from Building Control Valve to Controlling Sprinkler(s) in Feet:

(Note: Excessive number of fittings refer to material fitting pressure loss tables) 34 feet X 1.5 = 51.00

A. Pressure Available For Uniform Loss: "A" = 21.11

Select the water distribution material to be installed from the pipe sizing tables 82.40-4 thru 82.40-11 located on the tabs below and enter your computed "A" value to determine water distribution pipe sizing. To Top

Fire-WaterCalc / Print Sheet / Instructions / WMeter / CuTypeK / CuTypeL / CuTypeM / GalSteel / PB&CPVC

After the C point has been adjusted, there is no change in the rest of the entries and the "A" value of 21.11 or rounded up, 22 is obtained.

Note: Keep in mind this "A" value required adjustments to the water service and water meter, increasing the water service to 1 ½" and the meter to 1".

By making these two changes, our "A" value changed from a negative 43.64, to a positive 21.11

Figure 7-17

FIRE-WATER CALC WORKSHEET FOR Drawing #FF10, Living Room Two Sprinklers

(Based upon the Hazen-Williams Formula) NAME/ADDRESS OF PROJECT

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) ____ 2 Sprinklers (gpm) 40 Total GPM = 40.0
   Sprinkler Manufacturer; Reliable Model # F1 44SW(K-Factor; 4.4
2. Difference in elevation from main to external pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 1
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 1/2 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 5.72 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 3.7
   (Subtract line 7. From line 6.) subtotal 56.3
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 54.1

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 54.1

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 9.0
(subtract line C. From B.) **subtotal** 45.1

D. Pressure at controlling sprinkler(s). value of "D" 27.4
(controlling sprinkler(s) is Living Room Two Most Demanding Sprinklers)
(subtract the value of D.) **subtotal** 17.7

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 16 X 0.434 psi/ft. value of "E" 6.9
(subtract the value of E.) **subtotal** 10.8

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
Pressure loss due to None (subtract the value of F) **subtotal** 10.8

G. Developed length from building control valve to controlling sprinkler in feet 34 X 1.5 value of "G" 51.0
(divide by the value of G.) **subtotal** 0.211
(Note: Excesive number of fittings refer to material fitting pressure loss tables)
Water distribution piping material is: Type M Copper Tubing

(multiply by 100) 100

A. Pressure available for uniform loss **"A" =** **21.1**

Comments

- Figure 7-17 shows the fire-water calculations with the adjusted water service size of 1 ½" and water distribution. "A" value of 21.1 rounded up to 22.

Figure 7-18

FIRE-WATER CALC WORKSHEET FOR Drawing #FF10, Living Room Two Sprinklers
(Based upon the Hazen-Williams Formula) NAME/ADDRESS OF PROJECT

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) ____ 2 Sprinklers (gpm) 40 Total GPM = 40.0
   Sprinkler Manufacturer: Reliable Model # F1 44SW(K-Factor: 4.4
2. Difference in elevation from main to external pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example: 5/8, 3/4, 1, 2, 3, 4. 3/4
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 ... Material is Copper Type K, ASTM B88 Pressure loss
   per 100 ft = 39.6 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 25.7
   (Subtract line 7. From line 6.) subtotal 34.3
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 32.1

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 32.1

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 20.0
   (subtract line C. From B.) **subtotal** 12.1

D. Pressure at controlling sprinkler(s). value of "D" 27.4
   (controlling sprinkler(s) is Living Room Two Most Demanding Sprinklers)
   (subtract the value of D.) **subtotal** -15.3

E. Difference in elevation between the building control valve and
   the controlling sprinkler(s) in feet; 16 X 0.434 psi/ft. value of "E" 6.9
   (subtract the value of E.) **subtotal** -22.3

F. **Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture.** value of "F" 0.0
   Pressure loss due to None (subtract the value of F) **subtotal** -22.3

G. Developed length from building control valve to controlling sprinkler in feet 34 X 1.5 value of "G" 51.0
   (divide by the value of G.) **subtotal** -0.436
   (Note: Excesive number of fittings refer to material fitting pressure loss tables)
   Water distribution piping material is: ____

   (multiply by 100) 100

A. Pressure available for uniform loss **"A" =** -43.6

WARNING: A is <= 0 -- uniform loss is unacceptable!
Comments

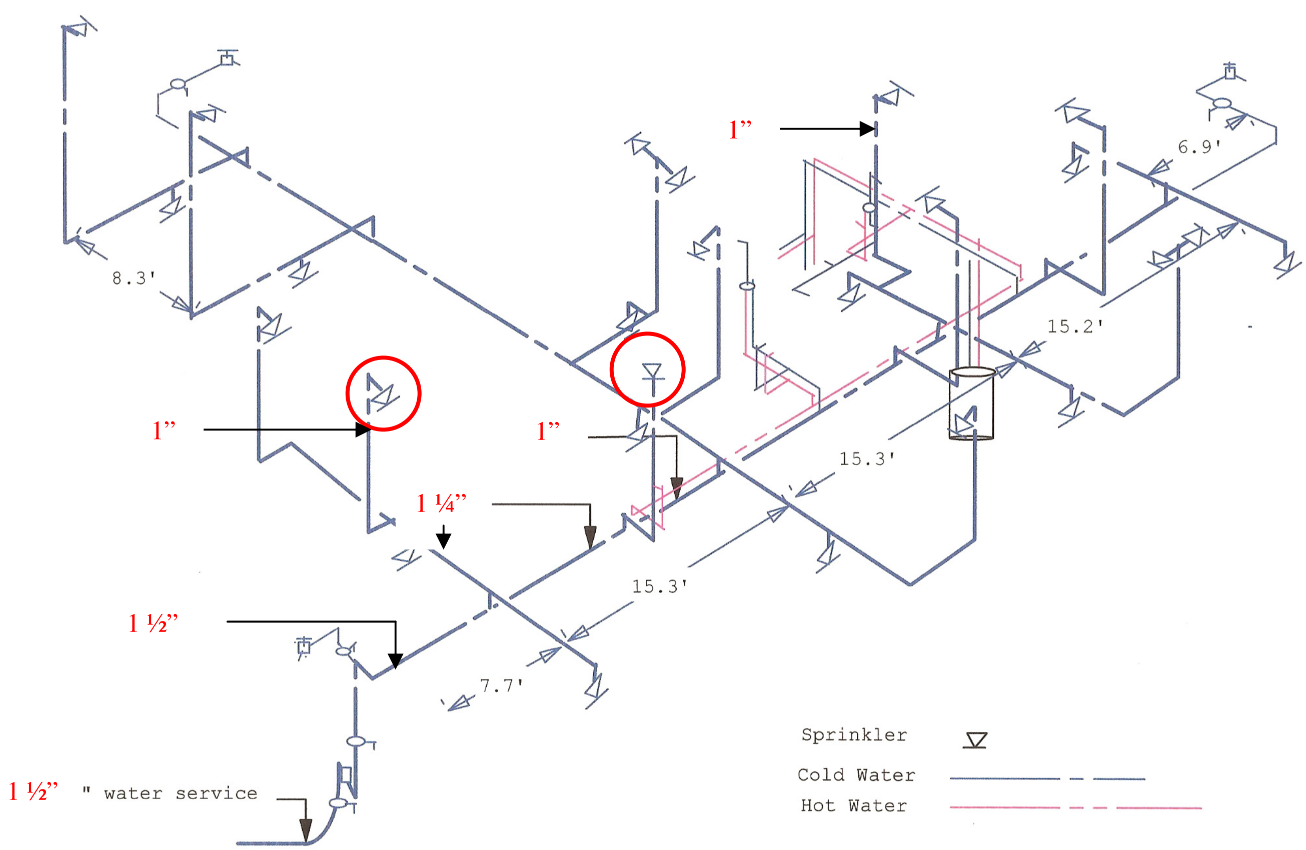
Table 382.40-6

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING-TYPE M, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches) 1/2"			3/4"			1"			1 1/4"			1 1/2"		
	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT
0.5	0.5	-	0.5	2.0	-	2.0	4.0	-	4.0	7.0	-	9.0	11.5	4.0	15.5
1	1.0	-	1.0	3.0	-	3.0	6.0	-	7.0	10.5	4.0	14.0	16.5	5.5	24.0
2	1.5	-	1.5	4.5	-	5.0	9.0	-	11.5	15.5	5.0	22.5	24.0	8.0	40.0
3	2.0	-	2.0	5.5	-	6.5	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0
4	2.5	-	2.5	6.5	-	8.0	13.0	4.5	18.0	22.0	7.0	35.0	35.0	20.0	70.0
5	2.5	-	2.5	7.5	-	9.5	15.0	5.0	21.5	25.0	8.5	[illegible]	40.0	30.0	86.0
6	3.0	-	3.0	8.0	-	10.0	16.5	5.5	24.0	28.0	11.0	50.0	44.0	36.0	106
7	3.5	-	3.5	9.0	-	11.5	18.0	6.0	26.5	30.0	13.5	55.0	45.0	39.0	112
8	3.5	-	3.5	9.5	-	12.5	19.5	6.5	29.0	32.0	17.0	62.0	NP		
9	4.0	-	4.0	10.0	4.0	13.0	20.5	6.5	31.0	NP					
10	4.0	-	4.0	11.0	4.0	15.0	21.5	7.0	34.0						
11	4.5	-	5.0	11.5	4.0	15.5	NP								
12	4.5	-	5.0	12.0	4.0	16.5									
13	5.0	-	6.0	12.5	4.5	17.5									
14	5.0	-	6.0	12.5	4.5	18.0									
15	5.0	-	6.0	NP											
16	5.5	-	6.5												
17	5.5	-	6.5												
18	5.5	-	6.5												
19	6.0	-	7.0												
20	6.0	-	7.0												
21	6.0	-	7.5												
	NP														

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	2"			2 1/2"			3"			4"		
	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT
0.5	23.0	7.5	37.0	42.0	33.0	100	67.0	96.0	210	139	481	577
1	34.0	18.5	66.0	61.0	77.0	180	97.0	227	360	202	945	953
2	50.0	48.0	128	88.0	184	315	141	493	588	294	1750	1750
3	62.0	80.0	185	110	300	425	174	731	776	303	1835	1835
4	73.0	120	240	121	374	484	NP			NP		
5	79.0	144	270	NP								
6	NP											

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means - not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
Comm 82.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.



Multipurpose Piping

Isometric | Drawing No: FF15 | ddh

- As the isometric on page 7-19 shows, the water service has been changed from 1” to 1 ½” in size to provide a minimum 40 gpm flow at a ‘reasonable’ velocity to serve the fire-water distribution system Living Room Compartment, two most demanding sprinklers. Could a 1 ¼” water service be sufficient to provide the required gpm demand? Perhaps… but finding out for sure only takes a few adjustments on the calculations to find out for sure and this is the advantage of the calculator, it saves time as you adjust your system to pipe size, materials, type of sprinklers, and cost.

- The water distribution system pipe sizing was also adjusted to 1 ½” to the second branch connection. With an “A” value of 22, the entire Table 382.40-6 is available for proper branch sizing depending upon the branch wsfu/gpm load.

- To Sum Up:

- <u>Chapter 5</u>
- Plumbing Demand:
    - 1” K copper water service, 1”M copper water distribution (to second branch connection),
    - 22 wsfu’s, 15.2 gpm demand requirement
    - “A” value of 23

- <u>Chapter 6</u>
- Master Bedroom single most remote sprinkler.
    - 17 gpm, 15 psi requirement for 16’ X 16’ coverage
    - 1” K copper water service, 1” M copper water distribution
    - “A” value of 27

- <u>Chapter 7</u>
- Living Room Compartment
    - Single most hydraulically demanding sprinkler
        - 23 gpm, 27.4 psi requirement for 16’ X 20’ coverage
        - “A” value of 12
        - 1” K copper water service, 1 ¼” M copper water distribution

    - Two most hydraulically demanding sprinklers
        - 40 gpm, 27.4 psi requirement
        - “A” value of – 44
        - 1” K copper water service,
    - “A” value of 22
        - 1 ½” K copper water service, 1 ½” M copper water distribution (to second branch connection).

- <u>Chapter 8</u>
- Family Room Compartment
    - Single most hydraulically demanding sprinkler
    - Two most hydraulically demanding sprinklers

- <u>Chapter 9</u>
- Basement Compartment, Example Completion
    - Single most hydraulically demanding sprinkler
    - Two most hydraulically demanding sprinklers

- <u>Chapter 10</u>
- Documentation

- <u>Chapter 11</u>
- Public Buildings, Water Service, Private Water Main Sizing

Chapter 8
Family Room

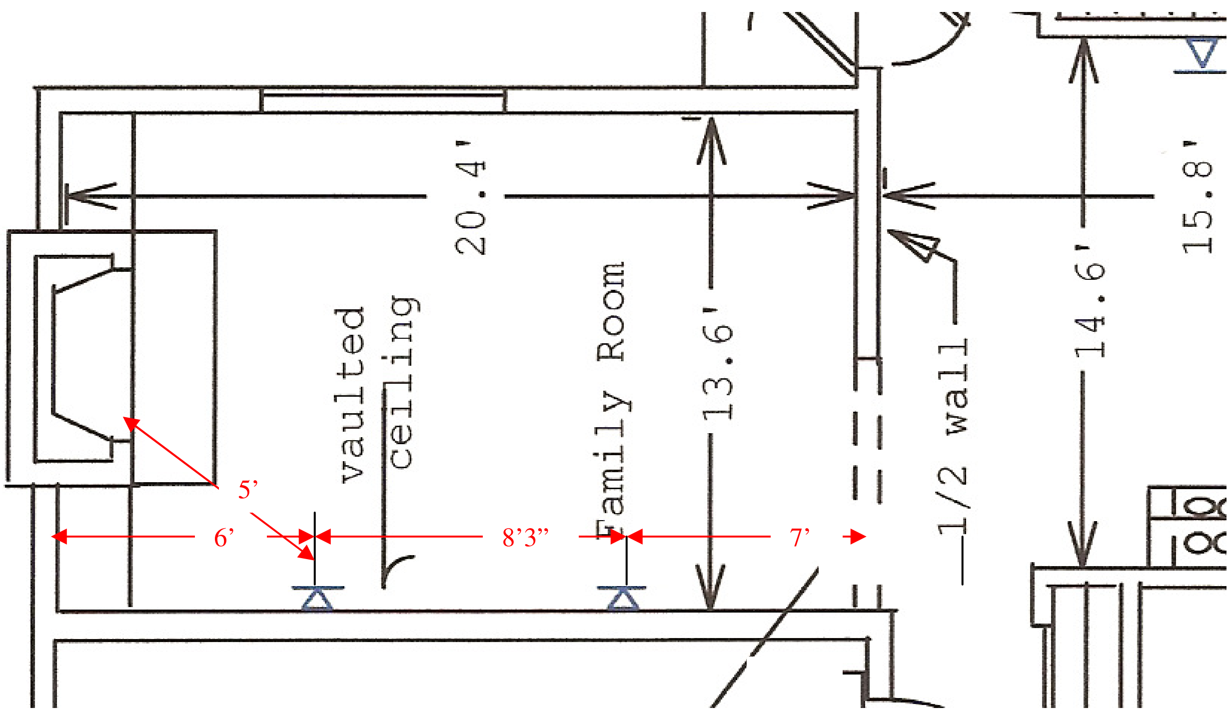
- There is still one more compartment on the main floor to include in the multipurpose piping calculations. Family room sprinklers or the piping to them have not been included in any of the calculations as of yet. The sprinklers below the family room in the basement are part of a multiple compartment.

- The ceiling in the family room is a vaulted ceiling. That means there is a slope from the garage wall down to the back outside wall. This will add a little more elevation to the sprinklers.

- Notice the measurements in Figure 8-1 below. A fireplace is a heat source as specified in NFPA 13D table 7.5.5.3. A sprinkler must be a minimum of 60 inches from the front of the fireplace and 36 inches from the side of it. The sprinkler is less than 7 feet from the outside end wall. This means that the coverage area will be 14 ft. x 14 ft. Ordinary temperature-rated sidewall sprinklers can be installed in this compartment.

- The minimum distance between sprinklers is greater than 8 foot. Across the way you can see the kitchen sprinkler. If the ceiling would not be sloped and create an obstruction in the flow to the kitchen area, certain criteria would have to be maintained. According to printed literature from the manufacturer of the sprinkler being installed, the horizontal distance left to right between the two sprinklers would have to be at least 8 feet or the distance across must be at least 14 feet.

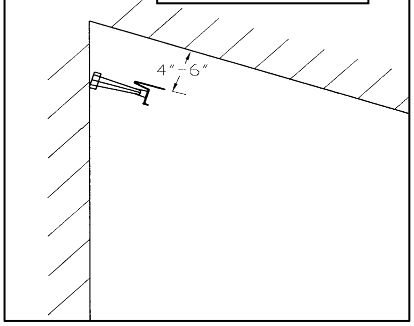
Figure 8-1



- These two sprinklers are installed on what could be considered a cold wall. They are on the opposite side of the garage wall. If the overhead garage door is left open and it faces to the North or West, that wall could be exposed to very cold temperatures. There is no other option in this room other than to install them in a cold wall or ceiling. Adequate measures will have to be taken to prevent freezing.

- The ceiling is sloped and the deflectors on the sprinklers will have to be installed parallel to the slope. Figure 8-2 below illustrates this.

Figure 8-2



- The isometric drawing for the family room sprinklers is Figure 8-4 on page 8-4. The sprinkler furtherest downstream is the most demanding sprinkler. This is not hard to see as the configuration is identical for both. The only difference is the 8' 3" of pipe length to the furtherest downstream sprinkler.

Figure 8-3

1.

The F1RES 44 SWC (Sidewall, Concealed):
- Flows equal to or only slightly higher than the RES 44 HSW.
- cULus Listed for up to 12" (305mm) below the ceiling.
- The slot-less coverplate provides protection to the thermal element.
- 155°F (68°C) sprinkler 135°F (57°C) coverplate.

Flows Required for Single Sprinkler Demand (Pressures)

12' x 12' (3,6 x 3,6)	14' x 14' (4,3 x 4,3)	16' x 16' (4,9 x 4,9)	16' x 18' (4,9 x 5,5)	18' x 18' (5,5 x 5,5)	16' x 20' (4,9 x 6,1)	20' x 20' (6,1 x 6,1)
13 gpm (8.7 psi)	14 gpm (10.2 psi)	17 gpm (15.0 psi)	19 gpm (18.7 psi)	———	23 gpm (27.4 psi)	———

2.

The F1RES 44 SWC:

Sprinkler Model	Technical Bulletin Number	Sprinkler Identification Number (SIN)	Nominal K factor	Temperature °F (°C)	Thread Size in. (mm)	Max. Pressure (bar)	Max. Adjustment in. (mm)
F1RES 44 SWC	135	R3531	4.4	155 (68)	1/2 (13)	175 psi (12)	1/2 (13)

- Different than the living room compartment, the flow rate from these two sprinklers is 28 gpm. The length of piping from the building control valve to the sprinklers is much greater and the sprinklers are at a higher elevation.

- The water service diameter was calculated at 1” diameter and 1 ¼” diameter water distribution piping is proposed all the way to the common tee supplying the two sprinklers. There is 122.55 equivalent feet of tubing and rounded up to 123. The water service can be installed with 1” piping because there are no restrictions on velocity in water services (unless specified by the pipe manufacturer) as there is for water distribution. If the water service pipe size selected does not create an excessive pressure loss, then it can certainly be considered in the calculations.

- That gap between the pressure available and the pressure required is called the safety factor. Unknown circumstances may occur raising the pressure loss and closing that gap. A close gap does not allow for changes in design or for mineral buildup in the piping which will cause a greater loss per foot. If a greater safety margin is desired, some of the piping can be increased from the building control valve down stream until a satisfactory margin is attained. That would also increase the safety margin to the rest of the compartments.

Figure 8-4

Fire-Water Calculation Worksheet For: Drawing #FF10, Family Room, Single Sprinkler

Information Required To Calulate Water Service Size: Clear All

1. Sprinkler Demand: 1 Sprinkler (GPM) 14 2 Sprinklers (GPM) Total (GPM) 14
(Add 5 GPM for 2 family dwellings.)
Sprinkler Manufacturer; Reliable Model No.; F1 44SWC K-Factor; 4.4

2. Difference in elevation from main or external pressure tank to building control valve (ft.)... 5

3. Water Meter (when meter is required click on orange box and choose diameter)... 1
(Example: 5/8, 3/4, 1, 2, 3, 4)

4. Developed length from main or external pressure tank to building control valve (ft.)... 65

5. Low pressure at main in street or external pressure tank... 60

Calculate Water Service Pressure Loss

Type K Copper, ASTM B88 (C=150), Graph A-382.40(7)-2
Approved for Fire-Water Distribution Piping

Size	GPM	(velocity limit 8 ft. per sec. for water distribution piping)	Psi Friction Loss per 100'
1/2"		(not to exceed 5 gpm)	
3/4"		(not to exceed 10.5 gpm)	
1"	14	(not to exceed 19 gpm)	5.68
1 1/4"		(not to exceed 30 gpm)	
1 1/2"		(not to exceed 42 gpm)	
2"		(not to exceed 75 gpm)	
2 1/2"		(not to exceed 116 gpm)	
3"		(not to exceed 165 gpm)	
4"		(not to exceed 291 gpm)	

Table

Graph

6. Low Pressure At Main in Street or External Pressure Tank:.. 60.00

7. Pressure Loss Due to Friction in 1 inch diameter water service.

Water service / distribution piping material is: Copper Type K, ASTM B88

Pressure loss per 100 ft (from tables above) 5.68 psi. X 0.65 (decimal equivalent of service length, e.g. 65 ft. = 0.65) 3.69

8. Pressure Loss Due To Elevation:.. 2.17

(#2 above is automatically entered and multiplied by .434)

9. Available Pressure After the Building Control Valve:... 54.14

(Automatically entered once boxes 1 - 8 have been filled, low pressure at main in street or external pressure tank, minus the pressure loss due to friction per length of service and pressure loss due to elevation).

Calculate The Pressure Available For Uniform Loss (Value of "A")

B. Available Pressure after the Building Control Valve (from # 9):.. 54.14

C. Pressure Loss of Water Meter (when meter is required):... 0.00

(Check with Meter Manufacturer for pressure loss graph, if not available, use the following Graph A-382.40(7)-1 If no meter enter 0.01).

To Graph

D. Pressure at Controlling sprinkler(s)... 10.20

Controlling Sprinkler(s) is: Family Room, Single Most Demanding Sprinkler

E. Difference in Elevation Between the Building Control Valve and the Controlling Sprinkler(s) in feet.

20 feet X 0.43 = 8.68

F. Pressure losses due to water treatment devices, backflow preventers, flow control valves which serve the controlling sprinkler(s).. 0.00

Pressure loss due to: None

(Enter 0 if not applicable)

G. Developed Length from Building Control Valve to Controlling Sprinkler(s) in Feet:

(Note: Excessive number of fittings refer to material fitting pressure loss tables) 81.7 feet X **1.5 =** 122.55

A. Pressure Available For Uniform Loss: "A" = 28.77

Select the water distribution material to be installed from the pipe sizing tables 82.40-4 thru 82.40-11 located on the tabs below and enter your computed "A" value to determine water distribution pipe sizing.

To Top

Figure 8-5

FIRE-WATER CALC WORKSHEET FOR Drawing #FF10, Family Room, Single Sprinkler
(Based upon the Hazen-Williams Formula) NAME/ADDRESS OF PROJECT

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1.	Sprinkler Demand: 1 Sprinkler (gpm) 14 2 Sprinklers (gpm) ___ Total	GPM =	14.0
	Sprinkler Manufacturer; Reliable Model # F1 44SW(K-Factor; 4.4		
2.	Difference in elevation from main to extermal pressure tank or to building control valve.	(feet)	5.0
3.	Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4.		1
4.	Developed length from main or external pressure tank to building control valve.	(feet)	65
5.	Low pressure at main in street or external pressure tank.	(psig)	60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6.	Low pressure at main in street or external pressure tank. (value of #5 above)		60.0
7.	Water service diameter is 1 Material is Copper Type K, ASTM B88 Pressure loss		
	per 100 ft = 5.68 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65)		3.7
	(Subtract line 7. From line 6.)	subtotal	56.3
8.	Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434)	value of "8"	2.2
9.	Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".)	**subtotal**	54.1

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B.	Available pressure after the building control valve. (from "9" above)	value of "B"	54.1
C.	Pressure loss of water meter. (when meter is required or installed)	value of "C"	0.0
	(subtract line C. From B.)	**subtotal**	54.1
D.	Pressure at controlling sprinkler(s).	value of "D"	10.2
	(controlling sprinkler(s) is Family Room, Single Most Demanding Sprinkler)		
	(subtract the value of D.)	**subtotal**	43.9
E.	Difference in elevation between the building control valve and		
	the controlling sprinkler(s) in feet; 20 X 0.434 psi/ft.	value of "E"	8.7
	(subtract the value of E.)	**subtotal**	35.3
F.	Pressure loss due to water treatment devices, instantaneous water heaters and backflow		
	preventers which serve the controlling fixture.	value of "F"	0.0
	Pressure loss due to None (subtract the value of F)	**subtotal**	35.3
G.	Developed length from building control valve to controlling sprinkler in feet 81.7 X 1.5	value of "G"	122.6
	(divide by the value of G.)	**subtotal**	0.288
	(Note: Excesive number of fittings refer to material fitting pressure loss tables)		
	Water distribution piping material is: Type M Copper Tubing		
	(multiply by 100)		100
A.	Pressure available for uniform loss	**"A" =**	**28.8**

- All fire-water calculations shall be retained and submitted as a packet and will be part of the instructions the master plumber or plumbing designer shall provide to the homeowner. An inspector must be able to determine by the information provided the controlling fixture whether it be a sprinkler(s) or plumbing fixture and how the fire-water distribution system was sized.

Figure 8-6

FIRE-WATER CALC WORKSHEET FOR Drawing #FF10, Family Room, Two Sprinklers

(Based upon the Hazen-Williams Formula) NAME/ADDRESS OF PROJECT

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) ____ 2 Sprinklers (gpm) 28 Total GPM = 28.0
   Sprinkler Manufacturer; Reliable Model # F1 44SW(K-Factor; 4.4
2. Difference in elevation from main to external pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 1
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 20.5 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 13.3
   (Subtract line 7. From line 6.) subtotal 46.7
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 44.5

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 44.5

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 5.0
(subtract line C. From B.) **subtotal** 39.5

D. Pressure at controlling sprinkler(s). value of "D" 10.2
(controlling sprinkler(s) is Family Room, Two Most Demanding Sprinklers)
(subtract the value of D.) **subtotal** 29.3

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 20 X 0.434 psi/ft. value of "E" 8.7
(subtract the value of E.) **subtotal** 20.6

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
Pressure loss due to None (subtract the value of F) **subtotal** 20.6

G. Developed length from building control valve to controlling sprinkler in feet 73.4 X 1.5 value of "G" 110.1
(divide by the value of G.) **subtotal** 0.187
(Note: Excesive number of fittings refer to material fitting pressure loss tables)
Water distribution piping material is: Type M Copper Tubing

(multiply by 100) 100

A. Pressure available for uniform loss **"A" =** **18.7**

- Figure 8-5 and 8-6 are the Fire-Water Calc Worksheets for the Family Room compartment, single most demanding and two most demanding sprinklers. The "A" value of 18.7, or rounded up, 19, is the most demanding sprinkler(s) with a 28 gpm flow requirement to serve both sprinklers. As we size our water distribution system, we now know that any pipe serving both sprinklers in the Family Room compartment will be a minimum of 1 ¼" according to the Table 382.40-6, Figure 8-7.

- Generally speaking, the lower the "A" value, the higher the gpm demand requirement unless there is a change in the basic information that is submitted. If a larger water service is required or water meter, or if the water distribution system is connected to a well and the pressure setting is changed, then, the "A" value will correspond to the altered system. The very fact that the basic information provided for water calculation was required to be altered would tell the designer or master plumber that the demand load for the compartment being calculated is greater than previous calculations

Figure 8-7
Table 382.40-6

A value

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING-TYPE M, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																										
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	-	0.5	2.0	-	2.0	4.0	-	4.0	7.0	-	9.0	11.5	4.0	15.5	23.0	7.5	37.0	42.0	33.0	100	67.0	96.0	210	139	481	577
1	1.0	-	1.0	3.0	-	3.0	6.0	-	7.0	10.5	4.0	14.0	16.5	5.5	24.0	34.0	18.5	66.0	61.0	77.0	180	97.0	227	360	202	945	953
2	1.5	-	1.5	4.5	-	5.0	9.0	-	11.5	15.5	5.0	22.5	24.0	8.0	40.0	50.0	48.0	128	88.0	184	315	141	493	588	294	1750	1750
3	2.0	-	2.0	5.5	-	6.5	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0	62.0	80.0	185	110	300	425	174	731	776	303	1835	1835
4	2.5	-	2.5	6.5	-	8.0	13.0	4.5	18.0	22.0	7.0	35.0	35.0	20.0	70.0	73.0	120	240	121	374	484	NP			NP		
5	2.5	-	2.5	7.5	-	9.5	15.0	5.0	21.5	25.0	8.5	42.0	40.0	30.0	86.0	79.0	144	270	NP								
6	3.0	-	3.0	8.0	-	10.0	16.5	5.5	24.0	28.0	11.0	50.0	44.0	36.0	106	NP											
7	3.5	-	3.5	9.0	-	11.5	18.0	6.0	26.5	30.0	13.5	55.0	45.0	39.0	112												
8	3.5	-	3.5	9.5	-	12.5	19.5	6.5	29.0	32.0	17.0	62.0	NP														
9	4.0	-	4.0	10.0	4.0	13.0	20.5	6.5	31.0	NP																	
10	4.0	-	4.0	11.0	4.0	15.0	21.5	7.0	34.0																		
11	4.5	-	5.0	11.5	4.0	15.5	NP																				
12	4.5	-	5.0	12.0	4.0	16.5																					
13	5.0	-	6.0	12.5	4.5	17.5																					
14	5.0	-	6.0	12.5	4.5	18.0																					
15	5.0	-	6.0	NP																							
16	5.5	-	6.5																								
17	5.5	-	6.5																								
18	5.5	-	6.5																								
19	6.0	-	7.0																								
20	6.0	-	7.0																								
21	6.0	-	7.5																								
	NP																										

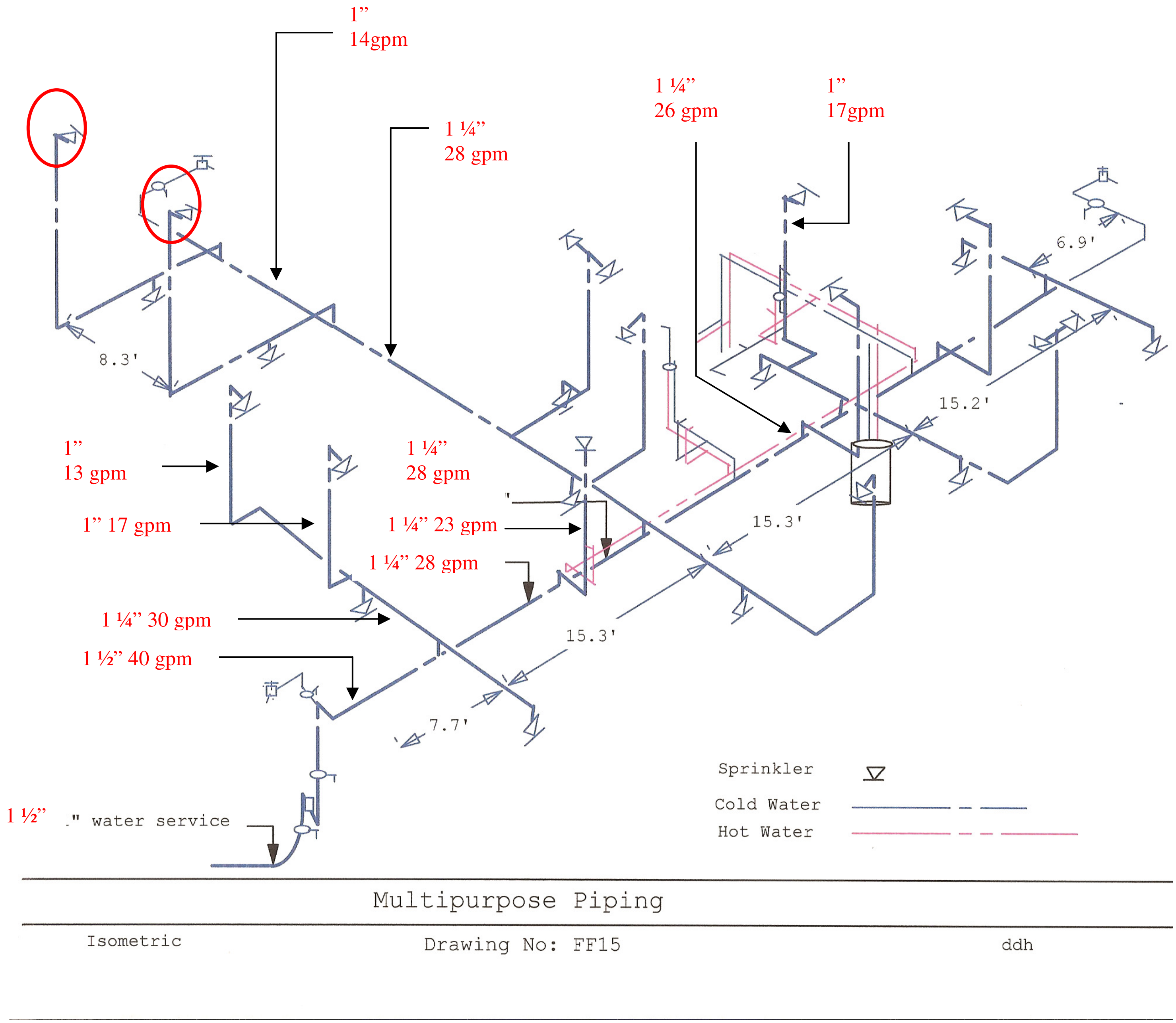
Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means - not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
Comm 82.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

- Figure 8-8 is the isometric for the water distribution piping

- Fire-Water calculations have been completed for the main floor. The most demanding fixture on the water distribution system up to this point is the Living Room compartment, two most demanding sprinklers with a 40 gpm flow requirement.

- Basement compartment calculations will be provided in Chapter 9 to verify proper pipe sizing and the lesser demand requirement to serve that compartment.

Figure 8-8



1”
14gpm
1 ¼”
28 gpm
1 ¼”
26 gpm
1”
17gpm
6.9'
8.3'
15.2'
1”
13 gpm
1 ¼”
28 gpm
1” 17 gpm
1 ¼” 23 gpm
1 ¼” 28 gpm
15.3'
1 ¼” 30 gpm
15.3'
1 ½” 40 gpm
7.7'
1 ½”
." water service
Sprinkler
Cold Water
Hot Water
Multipurpose Piping
Isometric
Drawing No: FF15
ddh

Chapter 9
Basement Compartment
Example Completion

- For our MPP system, we have selected the Reliable pendent RFC 43 sprinkler for the basement area.

Bulletin 006 Rev.D

Reliable®

Model RFC43 (SIN RA0612)
Model RFC49 (SIN RA0616)
Flat Concealed
Residential Sprinklers

Bulletin 006 Rev.D

A Concealed Residential Sprinkler engineered for a minimum design density of 0.05 gpm/ft² with low GPM requirements.

Features

1. Very low water flow requirements.
2. ½" (13mm) Total adjustment.
3. Thread-On/Thread-Off or Push-On/Thread Off

Temperature Rating

Sprinkler	Cover Plate	Max. Ambient Temp.
165°F/74°C	135°F/57°C	100°F/38°C

Installation Data: RFC43 (SIN RA0612)

Thread Size inch (mm)	K Factor	Sprinkler Spacing ft. (m)	Maximum Distance to Wall ft. (m)	Minimum Distance between sprinklers, ft. (m)	Minimum Required Sprinkler Discharge	
					Flow gpm (Lpm)	Press. psi (bar)
½" (15mm)	4.3	12 x 12 (3.6x3.6)	6 (1.83)	8 (2.43)	12 (45)	7.8 (0.54)
½" (15mm)	4.3	14 x 14 (4.3x4.3)	7 (2.13)	8 (2.43)	13 (49)	9.1 (0.63)
½" (15mm)	4.3	16 x 16 (4.9x4.9)	8 (2.43)	8 (2.43)	13 (49)	9.1 (0.63)
½" (15mm)	4.3	18 x 18 (5.5x5.5)	9 (2.74)	8 (2.43)	18 (68)	17.5 (1.21)
½" (15mm)	4.3	20 x 20 (6.0x6.0)	10 (3.05)	8 (2.43)	21 (79)	23.8 (1.64)

Note: 1 bar = 100 Kpa

- The drawing in Figure 9-1 on page 9-2 illustrates the location of sprinklers in the basement. It is assumed that the entire basement is going to have a finished ceiling. The width of the basement is less than 28 feet.

- Note the sprinklers are all pendants. In the front to rear direction of the basement, the sprinklers are placed so that a 16 ft x 16 ft coverage area can be used for all the sprinklers. Even though there are more than 2 sprinklers in the basement, the whole basement can be considered 1 compartment. This is assuming that the ceiling will be dropped far enough that the beam will not create an 8 inch or greater change in elevation.

- Note that a sprinkler was placed behind the stairs. The area under the stairs would then be included in the coverage. Another option would be to enclose the area under the stairs and the additional sprinkler would not be necessary (8.6.5).

- The area of basement behind the garage and under the family room is included because it is a full height area of the basement (8.6.5).
- Basement Pendent Sprinklers………………..11 – 16’ X 16’

- Remember, according to NFPA 13D Standard; 8.1.1.2.1 and 8.1.2, the system shall provide at least the gpm demand flow required for the multiple (26 gpm) and single (13 gpm) sprinkler operating criteria specified by the sprinkler listing. The number of design sprinklers under a flat, smooth horizontal ceiling shall include a maximum of two sprinklers that require the greatest hydraulic demand. The two sprinklers behind the unexcavated garage area are the two sprinklers with the greatest demand due to friction loss / length of piping.

Figure 9-1

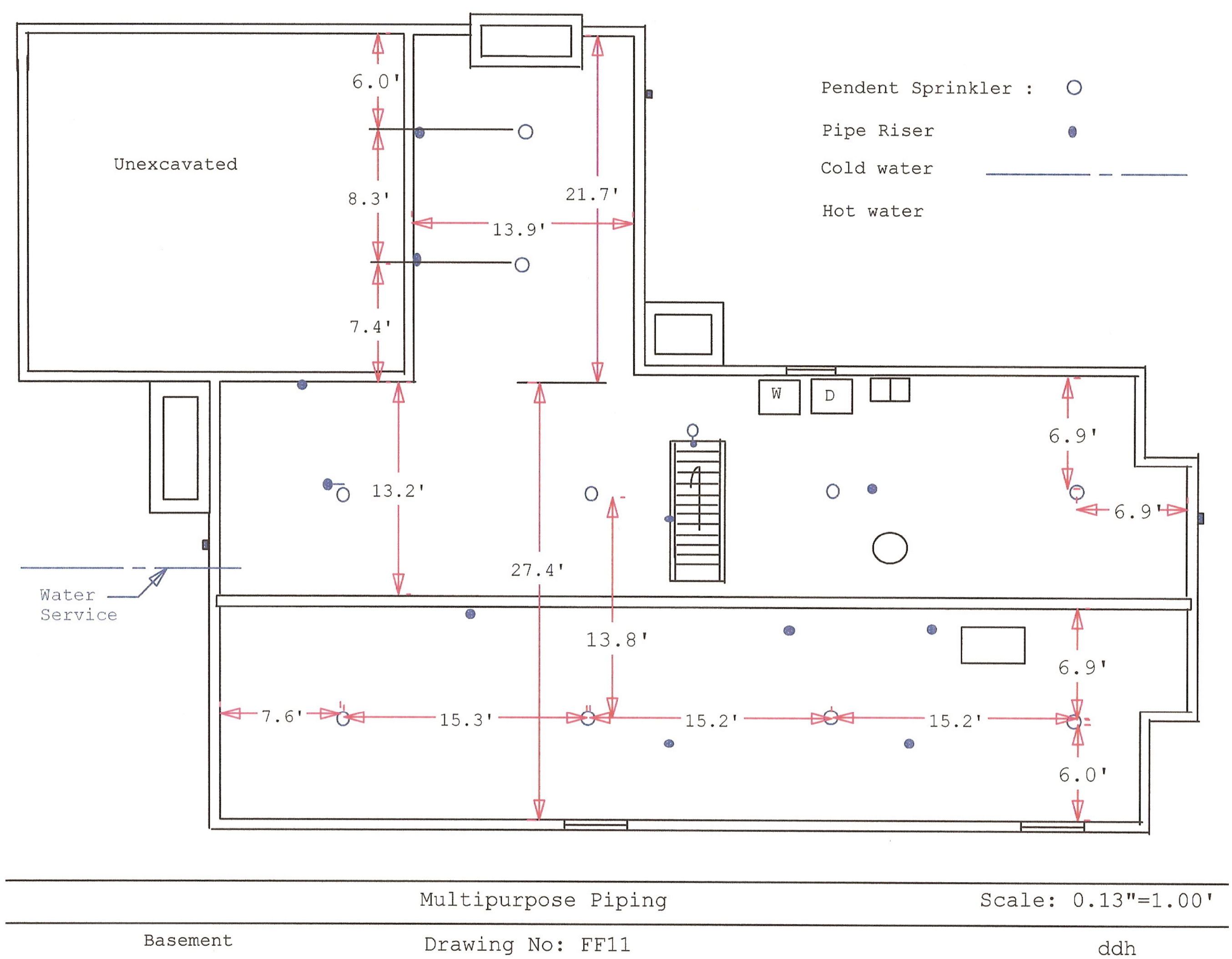
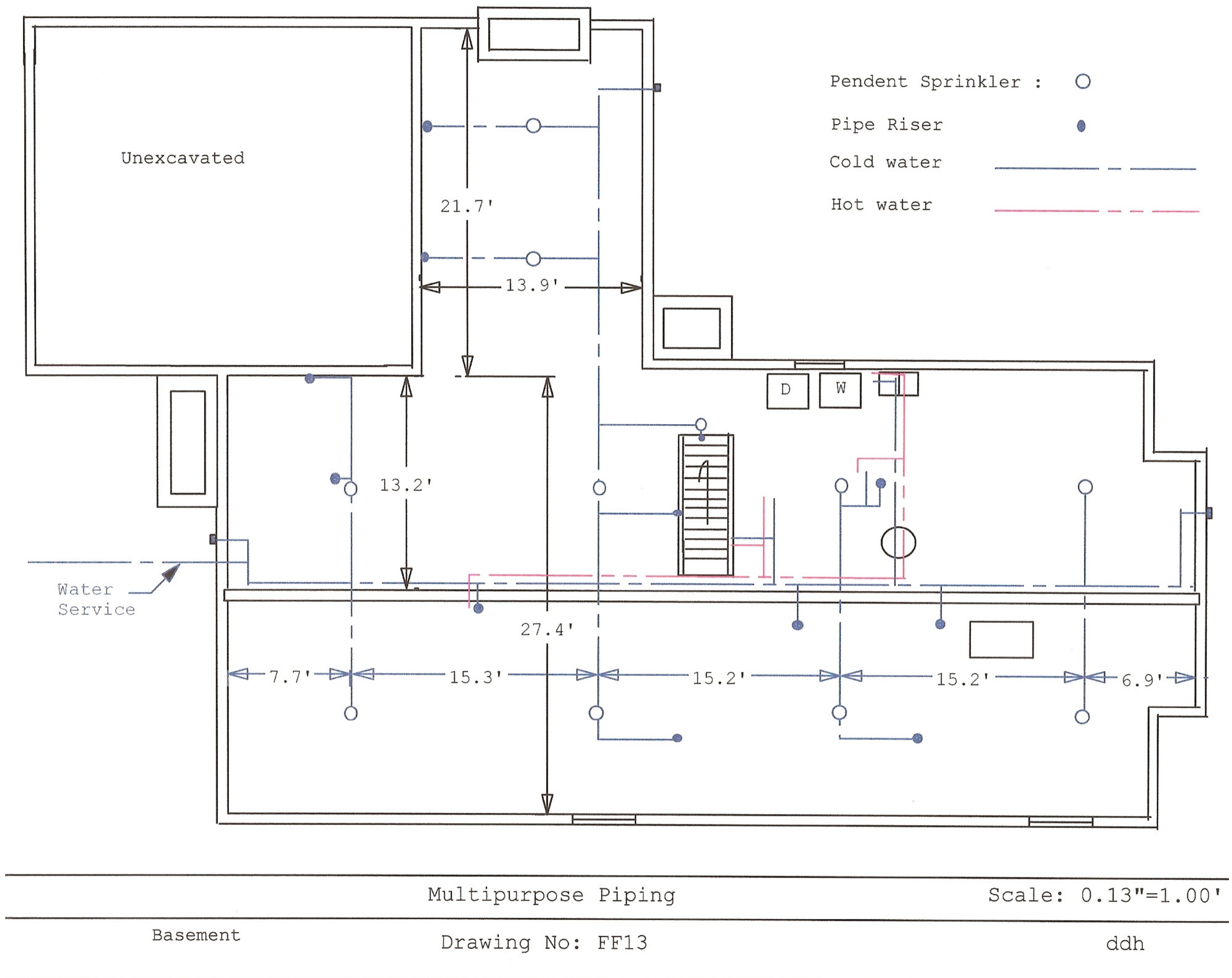


Figure 9-2



- From our previous Fire-Water Calcs of the Living Room and Family Room Compartments, a 1 ½" water service and a 1" water meter has been selected to meet the demand for the Controlling Fixture which is the Living Room two most demanding sprinklers. <u>Using this required change in our Basement Compartment calculations</u>, the following Fire-Water Calcs are computed on the next two pages

Figure 9-3

FIRE-WATER CALC WORKSHEET FOR Drawing #FF13, Basement Single Sprinkler

(Based upon the Hazen-Williams Formula) NAME/ADDRESS OF PROJECT

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) 13 2 Sprinklers (gpm) ____ Total GPM = 13.0
   Sprinkler Manufacturer; Reliable Model # RFC43 K-Factor; 4.3
2. Difference in elevation from main to extermal pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 1
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 1/2 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 0.71 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 0.5
   (Subtract line 7. From line 6.) subtotal 59.5
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 57.4

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 57.4

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 0.0
(subtract line C. From B.) **subtotal** 57.4

D. Pressure at controlling sprinkler(s). value of "D" 9.1
(controlling sprinkler(s) is Basement Single most remote sprinkler)
(subtract the value of D.) **subtotal** 48.3

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 8 X 0.434 psi/ft. value of "E" 3.5
(subtract the value of E.) **subtotal** 44.8

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
Pressure loss due to None (subtract the value of F) **subtotal** 44.8

G. Developed length from building control valve to controlling sprinkler in feet 67 X 1.5 value of "G" 100.5
(divide by the value of G.) **subtotal** 0.446
(Note: Excesive number of fittings refer to material fitting pressure loss tables)
Water distribution piping material is: Copper Type M

(multiply by 100) 100

A. Pressure available for uniform loss **"A" = 44.6**

Figure 9-4

FIRE-WATER CALC WORKSHEET FOR Drawing #FF13, Basement Two Sprinklers
(Based upon the Hazen-Williams Formula) NAME/ADDRESS OF PROJECT

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) ____ 2 Sprinklers (gpm) 26 Total GPM = 26.0
   Sprinkler Manufacturer; Reliable Model # RFC43 K-Factor; 4.3
2. Difference in elevation from main to external pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 1
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 1/2 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 2.58 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 1.7
   (Subtract line 7. From line 6.) subtotal 58.3
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 56.2

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 56.2

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 3.8
   (subtract line C. From B.) **subtotal** 52.4

D. Pressure at controlling sprinkler(s). value of "D" 9.1
   (controlling sprinkler(s) is Basement Two most demanding sprinklers)
   (subtract the value of D.) **subtotal** 43.3

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 8 X 0.434 psi/ft. value of "E" 3.5
   (subtract the value of E.) **subtotal** 39.8

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
   Pressure loss due to None (subtract the value of F) **subtotal** 39.8

G. Developed length from building control valve to controlling sprinkler in feet 67 X 1.5 value of "G" 100.5
   (divide by the value of G.) **subtotal** 0.396
   (Note: Excesive number of fittings refer to material fitting pressure loss tables)
   Water distribution piping material is: Copper Type M

   (multiply by 100) 100

A. Pressure available for uniform loss **"A" =** **39.6**

- To Sum Up:

- <u>Chapter 5</u>
- Plumbing Demand:
    - 1” K copper water service, 1”M copper water distribution (to second branch connection),
        - 22 wsfu’s, 15.2 gpm demand requirement
    - “A” value of 23

- <u>Chapter 6</u>
- Master Bedroom single most remote sprinkler.
    - 17 gpm, 15 psi requirement for 16’ X 16’ coverage
    - 1” K copper water service, 1” M copper water distribution
    - “A” value of 27

- <u>Chapter 7</u>
- Living Room Compartment
    - Single most hydraulically demanding sprinkler
        - 23 gpm, 27.4 psi requirement for 16’ X 20’ coverage
        - “A” value of 12
        - 1” K copper water service, 1 ¼” M copper water distribution

    - Two most hydraulically demanding sprinklers
        - 40 gpm, 27.4 psi requirement
        - “A” value of – 44
        - 1” K copper water service,
    - “A” value of 22
        - 1 ½” K copper water service, 1 ½” M copper water distribution (to second branch connection).

- <u>Chapter 8</u>
- Family Room Compartment
    - Single most hydraulically demanding sprinkler (1” water service)
        - 14 gpm, 10.2 psi requirement for 14’ X 14’ coverage.
        - “A” value of 29

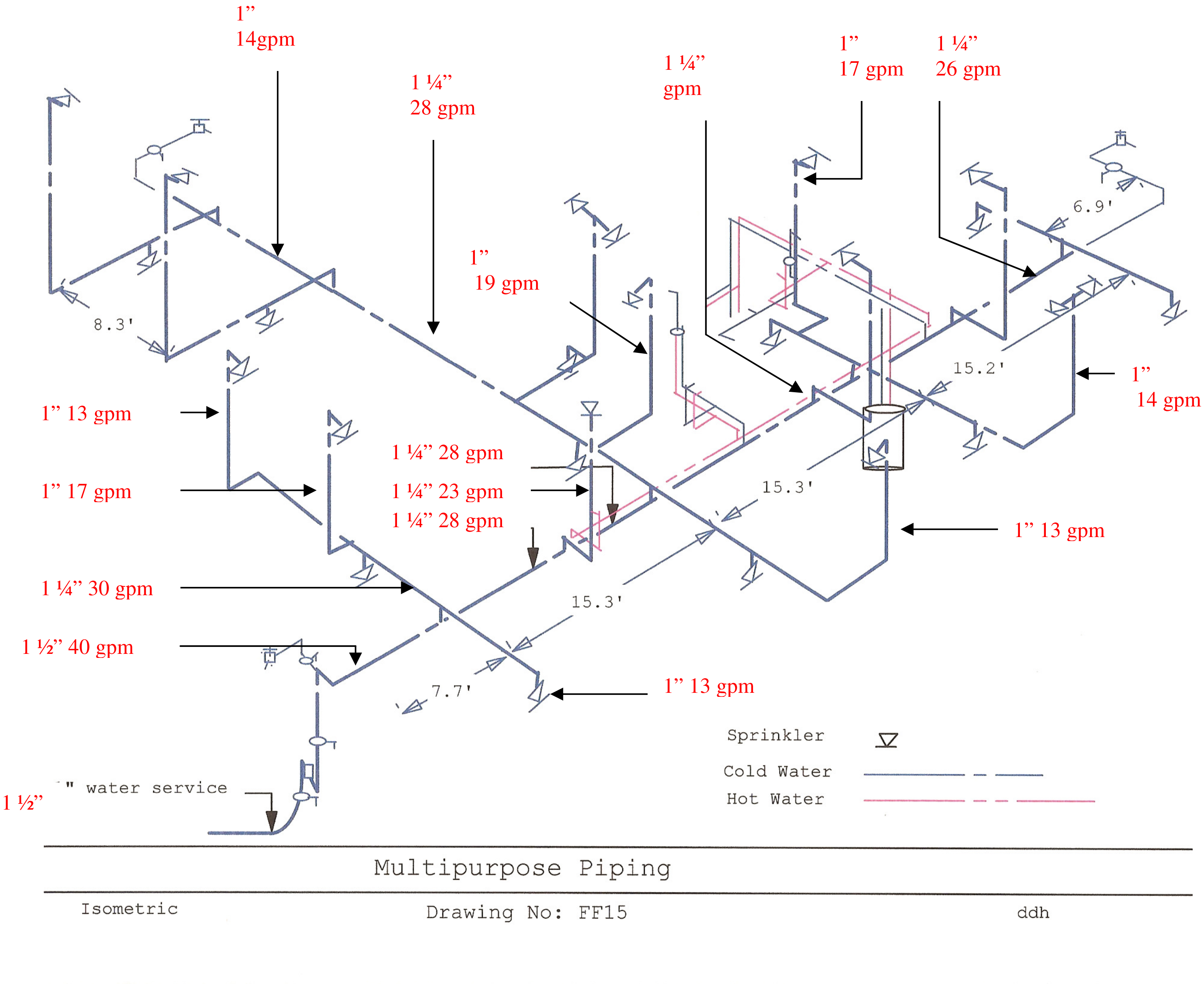
    - Two most hydraulically demanding sprinklers (1” water service)
        - 28 gpm, 10.2 psi requirement
        - “A” value of 19

- <u>Chapter 9</u>
- Basement Compartment
    - Single most hydraulically demanding sprinkler (1 ½” water service)
        - 13 gpm, 9.1 psi requirements for 16’X16’ coverage
        - “A” value of 45
    - Two most hydraulically demanding sprinklers (1 ½” water service)
        - 16 gpm, 9.1 psi
        - “A value of 40

The Living Room Compartment, two most hydraulically demanding sprinklers would be the controlling fixture for the Fire-Water Distribution System, or MPP.

All sizing of the fire-water distribution system and all its branches would be sized with an “A” value of 22 and in accordance with our Table 382.40-2-6 Copper Type M Tubing.

Figure 9-5



- Once the controlling fixture(s) for the fire-water distribution has been established, the pipe sizing can be completed. Since no sprinkler gpm demand is less than 13 gpm, we can determine from our Table 382.40-6, Figure 9-6 that the minimum pipe size serving a sprinkler will be 1" or greater. Our most demanding sprinklers in the living room compartment determine our maximum gpm of 40, which will be a design selected 1 ½" pipe size.

Figure 9-6

Table 382.40-6

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING-TYPE M, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																										
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	-	0.5	2.0	-	2.0	4.0	-	4.0	7.0	-	9.0	11.5	4.0	15.5	23.0	7.5	37.0	42.0	33.0	100	67.0	96.0	210	139	481	577
1	1.0	-	1.0	3.0	-	3.0	6.0	-	7.0	10.5	4.0	14.0	16.5	5.5	24.0	34.0	18.5	66.0	61.0	77.0	180	97.0	227	360	202	945	953
2	1.5	-	1.5	4.5	-	5.0	9.0	-	11.5	15.5	5.0	22.5	24.0	8.0	40.0	50.0	48.0	128	88.0	184	315	141	493	588	294	1750	1750
3	2.0	-	2.0	5.5	-	6.5	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0	62.0	80.0	185	110	300	425	174	731	776	303	1835	1835
4	2.5	-	2.5	6.5	-	8.0	13.0	4.5	18.0	22.0	7.0	35.0	35.0	20.0	70.0	73.0	120	240	121	374	484	NP			NP		
5	2.5	-	2.5	7.5	-	9.5	15.0	5.0	21.5	25.0	8.5	42.0	40.0	30.0	86.0	79.0	144	270	NP								
6	3.0	-	3.0	8.0	-	10.0	16.5	5.5	24.0	28.0	11.0	50.0	44.0	36.0	106	NP											
7	3.5	-	3.5	9.0	-	11.5	18.0	6.0	26.5	30.0	13.5	55.0	45.0	39.0	112												
8	3.5	-	3.5	9.5	-	12.5	19.5	6.5	29.0	32.0	17.0	62.0	NP														
9	4.0	-	4.0	10.0	4.0	13.0	20.5	6.5	31.0	NP																	
10	4.0	-	4.0	11.0	4.0	15.0	21.5	7.0	34.0																		
11	4.5	-	5.0	11.5	4.0	15.5	NP																				
12	4.5	-	5.0	12.0	4.0	16.5																					
13	5.0	-	6.0	12.5	4.5	17.5																					
14	5.0	-	6.0	12.5	4.5	18.0																					
15	5.0	-	6.0	NP																							
16	5.5	-	6.5																								
17	5.5	-	6.5																								
18	5.5	-	6.5																								
19	6.0	-	7.0																								
20	6.0	-	7.0																								
21	6.0	-	7.5																								
	NP																										

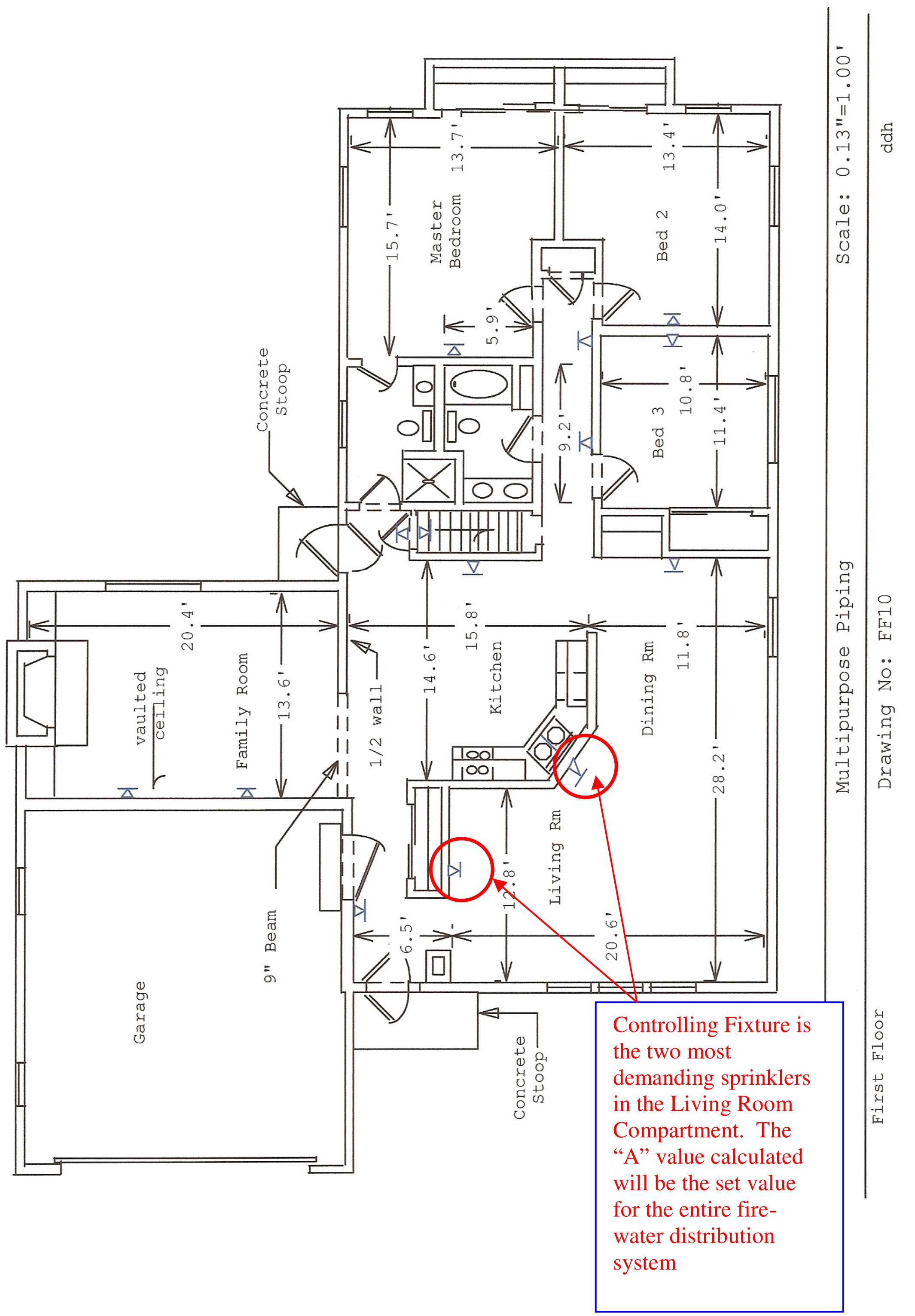
A = 22

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means - not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
Comm 82.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

- Once the multipurpose piping system is completed, a record of the calculations and design work needs to be retained for the homeowner and for anyone who may inspect the MPP system or alter it in the future. A packet example is discussed in Chapter 10.

- Section 8.2, and 8.2.5 of the NFPA 13D 2007 Standard provides the guidelines for positioning of the sprinklers and distances required from obstructions. A careful review of the dwelling ceiling fans, lighting, cabinetry, and distances from heat sources is critically important in sprinkler placement.

Figure 9-7


Master Bedroom
Bed 2
Bed 3
Kitchen
Dining Rm
Living Rm
Family Room
vaulted ceiling
Garage
1/2 wall
9" Beam
Concrete Stoop
Concrete Stoop
13.7'
13.4'
15.7'
14.0'
5.9'
9.2'
10.8'
11.4'
20.4'
13.6'
14.6'
15.8'
11.8'
28.2'
12.8'
6.5'
20.6'
Multipurpose Piping
Scale: 0.13"=1.00'
Drawing No: FF10
ddh
First Floor
Controlling Fixture is the two most demanding sprinklers in the Living Room Compartment. The "A" value calculated will be the set value for the entire fire-water distribution system

Chapter 10
Documentation

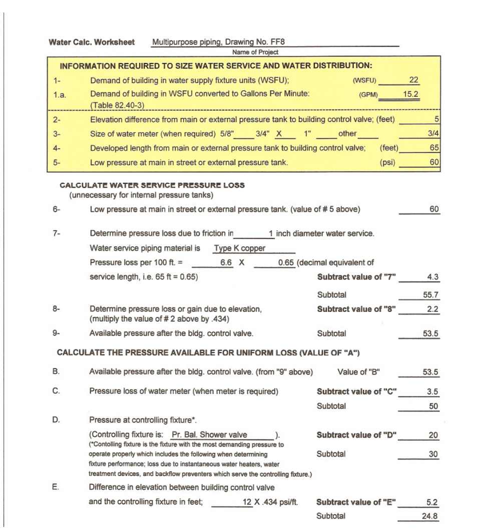
- Documentation shall be available upon request (4.8).
- Ensure adequate water supply
- Listed devices
- Adequate sprinkler coverage

- New to the 13D Standard in 2007, the requirement to document the MPP system design provides a record of design conditions. The following list of information should be included in the documentation.

  - A scaled print or drawing, along with an isometric drawing of the fire-water distribution system
  - Location, address
  - Size of water service
  - Water meter size
  - Residual (low) water pressure at the main or low well pressure setting
  - Interior walls
  - Sprinkler specification sheets
  - Type of pipe material
  - Hanger spacing
  - Riser detail, gpm flow requirement on branch piping
  - Installing contractor information
  - Hydraulic calculations, plumbing and sprinkler water calcs.
  - Warning sign

- In Wisconsin, when a master plumber uses the Fire-Water Crew File available from the Department, much of the information required is captured on the Fire-Water Calc Worksheets.
- For our example the following information would be placed in a packet and retained by the homeowner.

Domestic Plumbing Water Calculations



Water Calc. Worksheet Multipurpose piping, Drawing No. FF8
Name of Project

INFORMATION REQUIRED TO SIZE WATER SERVICE AND WATER DISTRIBUTION:

1-	Demand of building in water supply fixture units (WSFU);	(WSFU)	22
1.a.	Demand of building in WSFU converted to Gallons Per Minute: (Table 82.40-3)	(GPM)	15.2
2-	Elevation difference from main or external pressure tank to building control valve; (feet)		5
3-	Size of water meter (when required) 5/8"____ 3/4" X 1" ____ other____		3/4
4-	Developed length from main or external pressure tank to building control valve;	(feet)	65
5-	Low pressure at main in street or external pressure tank.	(psi)	60

CALCULATE WATER SERVICE PRESSURE LOSS
(unnecessary for internal pressure tanks)

6- Low pressure at main in street or external pressure tank. (value of # 5 above) 60

7- Determine pressure loss due to friction in 1 inch diameter water service.
Water service piping material is Type K copper
Pressure loss per 100 ft. = 6.6 X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) **Subtract value of "7"** 4.3
Subtotal 55.7

8- Determine pressure loss or gain due to elevation, (multiply the value of # 2 above by .434) **Subtract value of "8"** 2.2

9- Available pressure after the bldg. control valve. Subtotal 53.5

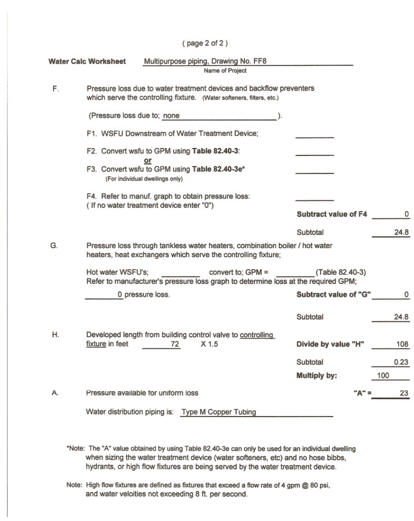
CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the bldg. control valve. (from "9" above) Value of "B" 53.5

C. Pressure loss of water meter (when meter is required) **Subtract value of "C"** 3.5
Subtotal 50

D. Pressure at controlling fixture*.
(Controlling fixture is: Pr. Bal. Shower valve). **Subtract value of "D"** 20
(*Contolling fixture is the fixture with the most demanding pressure to operate properly which includes the following when determining fixture performance; loss due to instantaneous water heaters, water treatment devices, and backflow preventers which serve the controlling fixture.) Subtotal 30

E. Difference in elevation between building control valve and the controlling fixture in feet; 12 X .434 psi/ft. **Subtract value of "E"** 5.2
Subtotal 24.8



(page 2 of 2)

Water Calc Worksheet Multipurpose piping, Drawing No. FF8
Name of Project

F. Pressure loss due to water treatment devices and backflow preventers which serve the controlling fixture. (Water softeners, filters, etc.)

(Pressure loss due to; none).

F1. WSFU Downstream of Water Treatment Device; ____

F2. Convert wsfu to GPM using **Table 82.40-3**: ____
or
F3. Convert wsfu to GPM using **Table 82.40-3e*** ____
(For individual dwellings only)

F4. Refer to manuf. graph to obtain pressure loss: ____
(If no water treatment device enter "0")
Subtract value of F4 0
Subtotal 24.8

G. Pressure loss through tankless water heaters, combination boiler / hot water heaters, heat exchangers which serve the controlling fixture;

Hot water WSFU's; ____ convert to; GPM = ____ (Table 82.40-3)
Refer to manufacturer's pressure loss graph to determine loss at the required GPM;
0 pressure loss. **Subtract value of "G"** 0
Subtotal 24.8

H. Developed length from building control valve to controlling fixture in feet 72 X 1.5 **Divide by value "H"** 108
Subtotal 0.23
Multiply by: 100

A. Pressure available for uniform loss **"A" =** 23

Water distribution piping is: Type M Copper Tubing

*Note: The "A" value obtained by using Table 82.40-3e can only be used for an individual dwelling when sizing the water treatment device (water softeners, etc) and no hose bibbs, hydrants, or high flow fixtures are being served by the water treatment device.

Note: High flow fixtures are defined as fixtures that exceed a flow rate of 4 gpm @ 80 psi, and water veloities not exceeding 8 ft. per second.

Master Bedroom Single Sprinkler Calcs

FIRE-WATER CALC WORKSHEET FOR Drawing #FF10, Family Room, Two Sprinklers
NAME/ADDRESS OF PROJECT
(Based upon the Hazen-Williams Formula)

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) ___ 2 Sprinklers (gpm) 28 Total GPM = 28.0
   Sprinkler Manufacturer; Reliable Model # F1 44SWC K-Factor; 4.4
2. Difference in elevation from main to extermal pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 1
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 20.5 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 13.3
   (Subtract line 7. From line 6.) subtotal 46.7
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 44.5

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 44.5

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 5.0
   (subtract line C. From B.) **subtotal** 39.5

D. Pressure at controlling sprinkler(s). value of "D" 10.2
   (controlling sprinkler(s) is Family Room, Two Most Demanding Sprinklers)
   (subtract the value of D.) **subtotal** 29.3

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 20 X 0.434 psi/ft. value of "E" 8.7
   (subtract the value of E.) **subtotal** 20.6

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
   Pressure loss due to None (subtract the value of F) **subtotal** 20.6

G. Developed length from building control valve to controlling sprinkler in feet 73.4 X 1.5 value of "G" 110.1
   (divide by the value of G.) **subtotal** 0.187
   (Note: Excesive number of fittings refer to material fitting pressure loss tables)
   Water distribution piping material is: Type M Copper Tubing

(multiply by 100) 100

A. Pressure available for uniform loss **"A" =** **18.7**

Family Room Compartment, Single and Two Most Demanding Sprinklers Calcs

FIRE-WATER CALC WORKSHEET FOR Drawing #FF10, Master Bedroom Sprinkler
NAME/ADDRESS OF PROJECT
(Based upon the Hazen-Williams Formula)

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) 17 2 Sprinklers (gpm) ___ Total GPM = 17.0
   Sprinkler Manufacturer; Reliable Model # F1 44SWC K-Factor; 4.4
2. Difference in elevation from main to extermal pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 3/4
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 8.13 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 5.3
   (Subtract line 7. From line 6.) subtotal 54.7
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 52.5

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 52.5

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 4.3
   (subtract line C. From B.) **subtotal** 48.2

D. Pressure at controlling sprinkler(s). value of "D" 15.0
   (controlling sprinkler(s) is Master Bedroom, single side wall sprinkler)
   (subtract the value of D.) **subtotal** 33.2

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 16 X 0.434 psi/ft. value of "E" 6.9
   (subtract the value of E.) **subtotal** 26.3

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
   Pressure loss due to none (subtract the value of F) **subtotal** 26.3

G. Developed length from building control valve to controlling sprinkler in feet 65 X 1.5 value of "G" 97.5
   (divide by the value of G.) **subtotal** 0.270
   (Note: Excesive number of fittings refer to material fitting pressure loss tables)
   Water distribution piping material is: Copper Type M

(multiply by 100) 100

A. Pressure available for uniform loss **"A" =** **27.0**

FIRE-WATER CALC WORKSHEET FOR Drawing #FF10, Family Room, Single Sprinkler
NAME/ADDRESS OF PROJECT
(Based upon the Hazen-Williams Formula)

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) 14 2 Sprinklers (gpm) ___ Total GPM = 14.0
   Sprinkler Manufacturer; Reliable Model # F1 44SWC K-Factor; 4.4
2. Difference in elevation from main to extermal pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 1
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 5.68 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 3.7
   (Subtract line 7. From line 6.) subtotal 56.3
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 54.1

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 54.1

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 0.0
   (subtract line C. From B.) **subtotal** 54.1

D. Pressure at controlling sprinkler(s). value of "D" 10.2
   (controlling sprinkler(s) is Family Room, Single Most Demanding Sprinkler)
   (subtract the value of D.) **subtotal** 43.9

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 20 X 0.434 psi/ft. value of "E" 8.7
   (subtract the value of E.) **subtotal** 35.3

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
   Pressure loss due to None (subtract the value of F) **subtotal** 35.3

G. Developed length from building control valve to controlling sprinkler in feet 81.7 X 1.5 value of "G" 122.6
   (divide by the value of G.) **subtotal** 0.288
   (Note: Excesive number of fittings refer to material fitting pressure loss tables)
   Water distribution piping material is: Type M Copper Tubing

(multiply by 100) 100

A. Pressure available for uniform loss **"A" =** **28.8**

Living Room Compartment, Single and Two Most Demanding Sprinklers Calcs

FIRE-WATER CALC WORKSHEET FOR Drawing #FF10, Living Room Single Sprinkler
NAME/ADDRESS OF PROJECT
(Based upon the Hazen-Williams Formula)

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) 23 2 Sprinklers (gpm) ___ Total GPM = 23.0
   Sprinkler Manufacturer; Reliable Model # F1 44SWC K-Factor; 4.4
2. Difference in elevation from main to extermal pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 3/4
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 14.2 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 9.2
   (Subtract line 7. From line 6.) subtotal 50.8
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 48.6

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 48.6

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 8.6
   (subtract line C. From B.) **subtotal** 40.0

D. Pressure at controlling sprinkler(s). value of "D" 27.4
   (controlling sprinkler(s) is Living Room, single most demanding sprinkler)
   (subtract the value of D.) **subtotal** 12.6

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 16 X 0.434 psi/ft. value of "E" 6.9
   (subtract the value of E.) **subtotal** 5.7

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
   Pressure loss due to None (subtract the value of F) **subtotal** 5.7

G. Developed length from building control valve to controlling sprinkler in feet 34 X 1.5 value of "G" 51.0
   (divide by the value of G.) **subtotal** 0.111
   (Note: Excesive number of fittings refer to material fitting pressure loss tables)
   Water distribution piping material is:

(multiply by 100) 100

A. Pressure available for uniform loss **"A" =** **11.1**

FIRE-WATER CALC WORKSHEET FOR Drawing #FF10, Living Room Two Sprinklers
NAME/ADDRESS OF PROJECT
(Based upon the Hazen-Williams Formula)

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) ___ 2 Sprinklers (gpm) 40 Total GPM = 40.0
   Sprinkler Manufacturer; Reliable Model # F1 44SWC K-Factor; 4.4
2. Difference in elevation from main to extermal pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 1
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 1/2 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 5.72 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 3.7
   (Subtract line 7. From line 6.) subtotal 56.3
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 54.1

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 54.1

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 9.0
   (subtract line C. From B.) **subtotal** 45.1

D. Pressure at controlling sprinkler(s). value of "D" 27.4
   (controlling sprinkler(s) is Living Room Two Most Demanding Sprinklers)
   (subtract the value of D.) **subtotal** 17.7

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 16 X 0.434 psi/ft. value of "E" 6.9
   (subtract the value of E.) **subtotal** 10.8

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
   Pressure loss due to None (subtract the value of F) **subtotal** 10.8

G. Developed length from building control valve to controlling sprinkler in feet 34 X 1.5 value of "G" 51.0
   (divide by the value of G.) **subtotal** 0.211
   (Note: Excesive number of fittings refer to material fitting pressure loss tables)
   Water distribution piping material is: Type M Copper Tubing

(multiply by 100) 100

A. Pressure available for uniform loss **"A" =** **21.1**

Basement Compartment, Single and Two Most Demanding Sprinklers Calcs

FIRE-WATER CALC WORKSHEET FOR Drawing #FF13, Basement Single Sprinkler
NAME/ADDRESS OF PROJECT
(Based upon the Hazen-Williams Formula)

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) 13 2 Sprinklers (gpm) ___ Total GPM = 13.0
   Sprinkler Manufacturer; Reliable Model # RFC43 K-Factor; 4.3
2. Difference in elevation from main to extermal pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 1
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 1/2 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 0.71 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 0.5
   (Subtract line 7. From line 6.) subtotal 59.5
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 57.4

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 57.4

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 0.0
   (subtract line C. From B.) **subtotal** 57.4

D. Pressure at controlling sprinkler(s). value of "D" 9.1
   (controlling sprinkler(s) is Basement Single most remote sprinkler)
   (subtract the value of D.) **subtotal** 48.3

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 8 X 0.434 psi/ft. value of "E" 3.5
   (subtract the value of E.) **subtotal** 44.8

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
   Pressure loss due to None (subtract the value of F) **subtotal** 44.8

G. Developed length from building control valve to controlling sprinkler in feet 67 X 1.5 value of "G" 100.5
   (divide by the value of G.) **subtotal** 0.446
   (Note: Excesive number of fittings refer to material fitting pressure loss tables)
   Water distribution piping material is: Copper Type M

(multiply by 100) 100

A. Pressure available for uniform loss **"A" =** **44.6**

FIRE-WATER CALC WORKSHEET FOR Drawing #FF13, Basement Two Sprinklers
NAME/ADDRESS OF PROJECT
(Based upon the Hazen-Williams Formula)

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) ___ 2 Sprinklers (gpm) 26 Total GPM = 26.0
   Sprinkler Manufacturer; Reliable Model # RFC43 K-Factor; 4.3
2. Difference in elevation from main to extermal pressure tank or to building control valve. (feet) 5.0
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. 1
4. Developed length from main or external pressure tank to building control valve. (feet) 65
5. Low pressure at main in street or external pressure tank. (psig) 60.0

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) 60.0
7. Water service diameter is 1 1/2 Material is Copper Type K, ASTM B88 Pressure loss per 100 ft = 2.58 psi X 0.65 (decimal equivalent of service length, i.e. 65 ft = 0.65) 1.7
   (Subtract line 7. From line 6.) subtotal 58.3
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" 2.2
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** 56.2

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the building control valve. (from "9" above) value of "B" 56.2

C. Pressure loss of water meter. (when meter is required or installed) value of "C" 3.8
   (subtract line C. From B.) **subtotal** 52.4

D. Pressure at controlling sprinkler(s). value of "D" 9.1
   (controlling sprinkler(s) is Basement Two most demanding sprinklers)
   (subtract the value of D.) **subtotal** 43.3

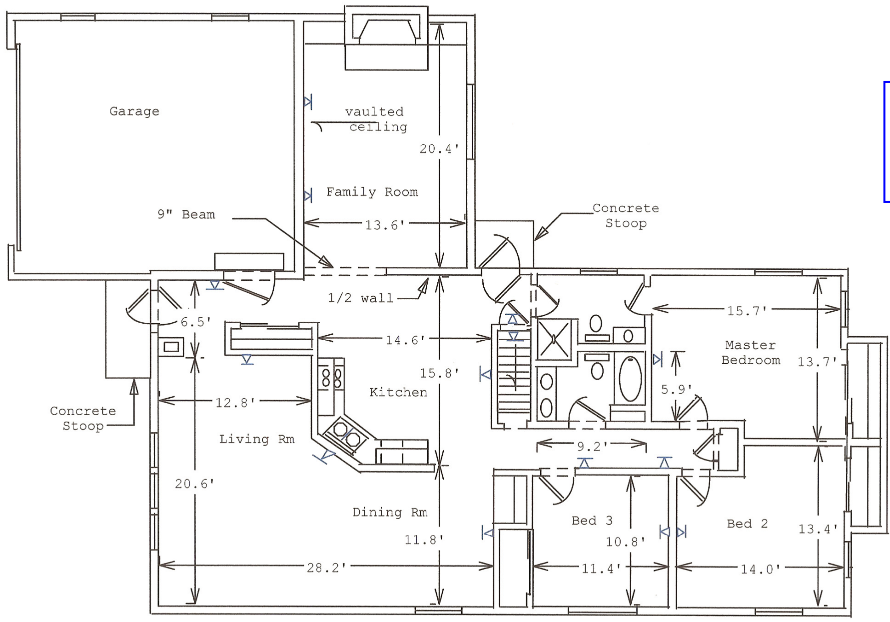
E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; 8 X 0.434 psi/ft. value of "E" 3.5
   (subtract the value of E.) **subtotal** 39.8

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" 0.0
   Pressure loss due to None (subtract the value of F) **subtotal** 39.8

G. Developed length from building control valve to controlling sprinkler in feet 67 X 1.5 value of "G" 100.5
   (divide by the value of G.) **subtotal** 0.396
   (Note: Excesive number of fittings refer to material fitting pressure loss tables)
   Water distribution piping material is: Copper Type M

(multiply by 100) 100

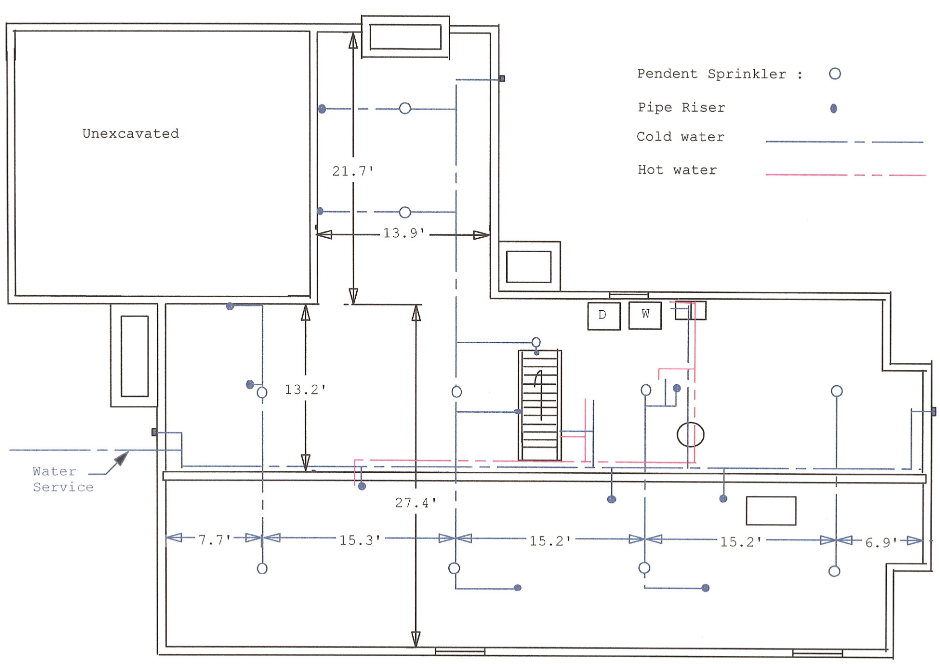
A. Pressure available for uniform loss **"A" =** **39.6**



First Floor	Multipurpose Piping	Scale: 0.13"=1.00'
	Drawing No: FF10	ddh

A scaled drawing or print, main floor.

A scaled drawing or print, basement.



Basement	Multipurpose Piping	Scale: 0.13"=1.00'
	Drawing No: FF13	ddh

Table 382.40-6

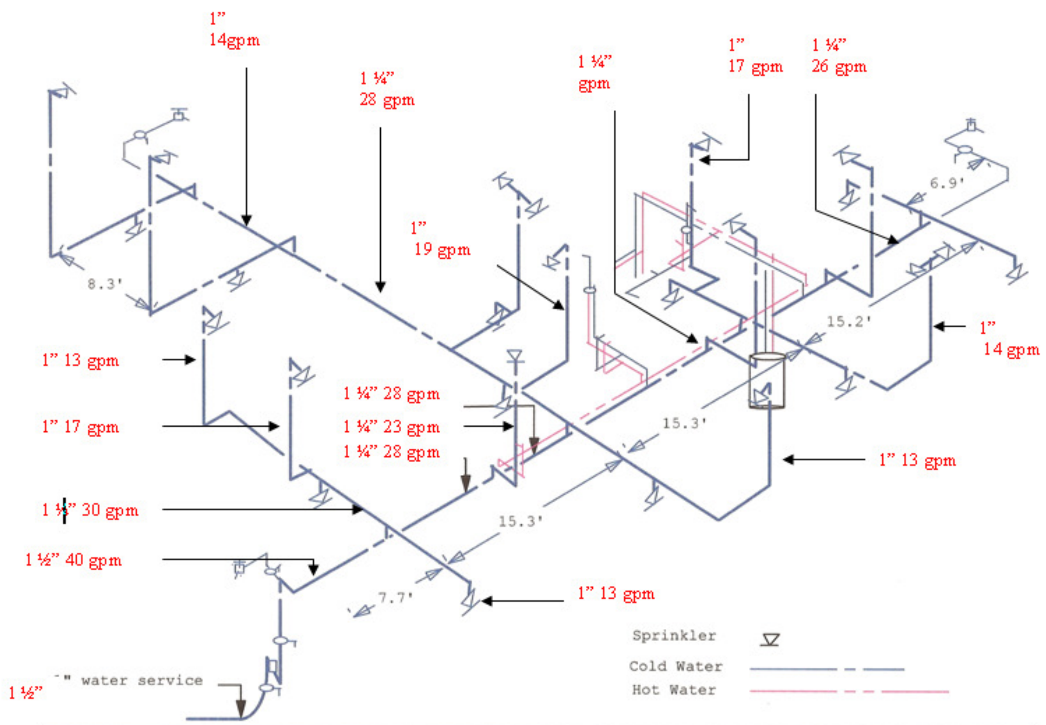
Table 82.40-6

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING-TYPE M, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																										
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	-	0.5	2.0	-	2.0	4.0	-	4.0	7.0	-	9.0	11.5	4.0	15.5	23.0	7.5	37.0	42.0	33.0	100	67.0	96.0	210	139	481	577
1	1.0	-	1.0	3.0	-	3.0	6.0	-	7.0	10.5	4.0	14.0	16.5	5.5	24.0	34.0	18.5	66.0	61.0	77.0	180	97.0	227	360	202	945	953
2	1.5	-	1.5	4.5	-	5.0	9.0	-	11.5	15.5	5.0	22.5	24.0	8.0	40.0	50.0	48.0	128	88.0	184	315	141	493	588	294	1750	1750
3	2.0	-	2.0	5.5	-	6.5	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0	62.0	80.0	185	110	300	425	174	731	776	303	1835	1835
4	2.5	-	2.5	6.5	-	8.0	13.0	4.5	18.0	22.0	7.0	35.0	35.0	20.0	70.0	73.0	120	240	121	374	484	NP			NP		
5	2.5	-	2.5	7.5	-	9.5	15.0	5.0	21.5	25.0	8.5	42.0	40.0	30.0	86.0	79.0	144	270	NP								
6	3.0	-	3.0	8.0	-	10.0	16.5	5.5	24.0	28.0	11.0	50.0	44.0	36.0	106	NP											
7	3.5	-	3.5	9.0	-	11.5	18.0	6.0	26.5	30.0	13.5	55.0	45.0	39.0	112												
8	3.5	-	3.5	9.5	-	12.5	19.5	6.5	29.0	32.0	17.0	62.0	NP														
9	4.0	-	4.0	10.0	4.0	13.0	20.5	6.5	31.0	NP																	
10	4.0	-	4.0	11.0	4.0	15.0	21.5	7.0	34.0																		
11	4.5	-	5.0	11.5	4.0	15.5	NP																				
12	4.5	-	5.0	12.0	4.0	16.5																					
13	5.0	-	6.0	12.5	4.5	17.5																					
14	5.0	-	6.0	12.5	4.5	18.0																					
15	5.0	-	6.0	NP																							
16	5.5	-	6.5																								
17	5.5	-	6.5																								
18	5.5	-	6.5																								
19	6.0	-	7.0																								
20	6.0	-	7.0																								
21	6.0	-	7.5																								
	NP																										

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means - not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
Comm 82.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Type of Pipe material, and load limitations per pipe size.



Isometric of the fire-water distribution system, with sizing gpm load requirements.

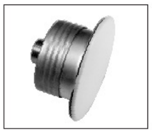
Bulletin 006 Rev.D

Reliable®

Model RFC43 (SIN RA0612) Model RFC49 (SIN RA0616) Flat Concealed Residential Sprinklers

Bulletin 006 Rev.D

A Concealed Residential Sprinkler engineered for a minimum design density of 0.05 gpm/ft² with low GPM requirements.



Features

1. Very low water flow requirements.
2. ½″ (13mm) Total adjustment.
3. Thread-On/Thread-Off or Push-On/Thread Off cover attachment option.
4. Smooth aesthetic ceiling profile.
5. Available in brass, chrome and black plated or painted finishes.

Listings & Approval
1. Listed by Underwriters Laboratories, and certified by UL for Canada (cULus)
2. NYC MEA 258-93-E

UL Listing Categories
Residential Automatic Sprinklers

UL Guide Number
VKKW

Product Description

Temperature Rating

Sprinkler	Cover Plate	Max. Ambient Temp.
165°F/74°C	135°F/57°C	100°F/38°C

Installation Data: RFC43 (SIN RA0612)

Thread Size inch (mm)	K Factor	Sprinkler Spacing ft. (m)	Maximum Distance to Wall ft. (m)	Minimum Distance between sprinklers, ft. (m)	Minimum Required Sprinkler Discharge	
					Flow gpm (Lpm)	Press. psi (bar)
½″ (15mm)	4.3	12 x 12 (3.6x3.6)	6 (1.83)	8 (2.43)	12 (45)	7.8 (0.54)
½″ (15mm)	4.3	14 x 14 (4.3x4.3)	7 (2.13)	8 (2.43)	13 (49)	9.1 (0.63)
½″ (15mm)	4.3	16 x 16 (4.9x4.9)	8 (2.43)	8 (2.43)	13 (49)	9.1 (0.63)
½″ (15mm)	4.3	18 x 18 (5.5x5.5)	9 (2.74)	8 (2.43)	18 (68)	17.5 (1.21)
½″ (15mm)	4.3	20 x 20 (6.0x6.0)	10 (3.05)	8 (2.43)	21 (79)	23.8 (1.64)

Note: 1 bar = 100 Kpa

Installation Data: RFC49 (RA0616)

Thread Size inch (mm)	K Factor	Sprinkler Spacing ft. (m)	Maximum Distance to Wall ft. (m)	Minimum Distance between sprinklers, ft. (m)	Minimum Required Sprinkler Discharge	
					Flow gpm (Lpm)	Press. psi (bar)
½″ (15mm)	4.9	12 x 12 (3.6x3.6)	6 (1.83)	8 (2.43)	13 (49)	7.0 (0.48)
½″ (15mm)	4.9	14 x 14 (4.3x4.3)	7 (2.13)	8 (2.43)	13 (49)	7.0 (0.48)
½″ (15mm)	4.9	16 x 16 (4.9x4.9)	8 (2.43)	8 (2.43)	13 (49)	7.0 (0.48)
½″ (15mm)	4.9	18 x 18 (5.5x5.5)	9 (2.74)	8 (2.43)	17 (64.3)	12.0 (0.83)
½″ (15mm)	4.9	20 x 20 (6.0x6.0)	10 (3.05)	8 (2.43)	20 (75.7)	16.7 (1.14)

Note: 1 bar = 100 Kpa

FOR SLOPED CEILING APPLICATIONS SEE RASCO BULLETIN 035.

Sprinkler manufacturer specifications

• Model F1 Res 44 SWC

Technical Data: F1 Res 44 SWC

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating		Cover Temp. Rating		Max. Pressure psi (bar)	Max. Ambient Temp.		K Factor	Sprinkler Length Inch (mm)
		°F	°C	°F	°C		°F	°C		
½″ NPT (R½)	⅜″ (10)	155	68	135	57	175 (12)	100	38	4.4	2.45 (62)

Max. Sprinkler Spacing ft (m)	"A" Ceiling-to-Deflector Inch (mm)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3.6x3.6)	4 - 6 (101-152)	13 (49.2)	8.7 (0.60)	R3531
14 x 14 (4.3x4.3)		14 (53.0)	10.2 (0.71)	
16 x 16 (4.9x4.9)		17 (64.3)	15.0 (1.1)	
16 x 18 (4.9x5.5)		19 (71.8)	18.7 (1.13)	
16 x 20 (4.9x6.1)		23 (87.1)	27.4 (1.89)	
12 x 12 (3.6x3.6)	6 - 12 (152-305)	14 (52.9)	10.2 (0.71)	
14 x 14 (4.3x4.3)		15 (56.7)	11.7 (0.81)	
16 x 16 (4.9x4.9)		18 (68.1)	16.8 (1.16)	
16 x 18 (4.9x5.5)		20 (75.6)	20.7 (1.43)	

Bulletin 140 Rev.I

Reliable®

Model F1 Res and RFC Residential Sprinkler Design and Installation Guide

Bulletin 140 Rev.I


F1 Res 49, 58 & 76 Pendent


F1 Res 49, 58 & 76 Recessed Pendent/F1


F1 Res 49, 58 & 76 Recessed Pendent/FP


F1 Res 44 & 58 HSW


F1 Res 44 & 58 Recessed HSW/F2


F1 Res 40 HSW


F1 Res 40 Recessed HSW/F2


F1 Res 49, 58 & 76 CCP Pendent


F1 Res 44 SWC


RFC 43


RFC 56

Sprinkler Model and Type	Sprinkler Identification Number	Reliable Bulletin Number
F1 Res 49 Pendent F1 Res 49 Recessed Pendent/F1 F1 Res 49 Recessed Pendent/FP F1 Res 49 Concealed Pendent/CCP	R3516	Horizontal Ceilings - 135 Sloped Ceilings - 035
F1 Res 58 Pendent F1 Res 58 Recessed Pendent/F1 F1 Res 58 Recessed Pendent/FP F1 Res 58 Concealed Pendent/CCP	R3513	Horizontal Ceilings - 135
RFC43 Concealed Pendent	RA0612	Horizontal Ceilings - 006 Sloped Ceilings - 035
RFC56 Concealed Pendent	RA0814	Horizontal Ceilings - 009
F1 Res 44 Horizontal Sidewall F1 Res 44 Recessed Horizontal Sidewall	R3531	Horizontal Ceilings - 135 Sloped Ceilings - 035
F1 Res 44 SWC Concealed Horizontal Sidewall	R3531	Horizontal Ceilings - 135
F1 Res 58 Horizontal Sidewall F1 Res 58 Recessed Horizontal Sidewall/F2	R3533	Horizontal Ceilings - 135
F1 Res 40 Horizontal Sidewall F1 Res 40 Recessed Horizontal Sidewall/F2	R3538	Horizontal Ceilings - 135 Sloped Ceilings - 035
F1 Res 76 Pendent F1 Res 76 Recessed Pendent/F1 F1 Res 76 Recessed Pendent/FP F1 Res 76 Concealed Pendent/CCP	R7618	Horizontal Ceilings - 135, 176

Table A
Model F1 Res and Model RFC Residential Sprinklers

The Reliable Automatic Sprinkler Co., Inc., 103 Fairview Park Drive, Elmsford, New York 10523

Bulletin 035 Rev.G

Reliable®

Residential Sprinklers For Sloped Ceilings

Bulletin 035 Rev.G

Guidelines for Listed Residential Sprinkler installations below Sloped Ceilings

The installation guidelines cover Residential Sprinkler Models:

F1 Res 49 Pendent
F1 Res 49 Recessed Pendent/F2
F1 Res 58 Pendent
F1 Res 58 Recessed Pendent
F1 Res 44 HSW
F1 Res 44 Recessed HSW/F2
F1 Res 40 HSW
F1 Res 40 Recessed HSW/F2
F1 Res 49 CCP
RFC 43 Flat Concealed

Listings & Approvals
1. Listed by Underwriters Laboratories Inc. and UL Certified for Canada (cULus)
2. NYC MEA 258-93-E

UL Listing Category
Residential Automatic Sprinkler

UL Guide Number
VKKW

Patents: US Patent number 6,516,893
Model F1 Res 49

Product Description for F1 Res Sprinklers

Model F1 Res Pendent sprinklers are fast response sprinklers combining excellent durability, high sensitivity glass-bulb and low profile decorative design. The F1 Res Horizontal Sidewall sprinklers are equally attractive when above ceiling piping cannot be used.

The 3mm glass-bulb pendent sprinklers, with a K Factor of 4.9 & 5.8 for pendent and 4.4 for horizontal sidewall, permit the efficient use of residential water supplies for sprinkler coverage in residential fire protection design.

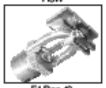
The low flow F1 Res sprinklers are specially engineered for fast thermal response to meet the sensitive fire protection application needs of the latest residential market standards (UL 1626 Standard *). Upon fire conditions, rising heat causes a sprinkler's heat-sensitive glass-bulb to shatter, releasing the waterway for water flow onto the deflector, evenly distributing the discharged water to control a fire.


F1 Res 49 & 58 Pendent

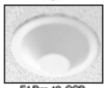

F1 Res 49 & 58 Recessed Pendent / F2


F1 Res 44 HSW


F1 Res 44 Recessed HSW/F2


F1 Res 40 HSW


F1 Res 40 Recessed HSW/F2


F1 Res 49 CCP Pendent


RFC 43

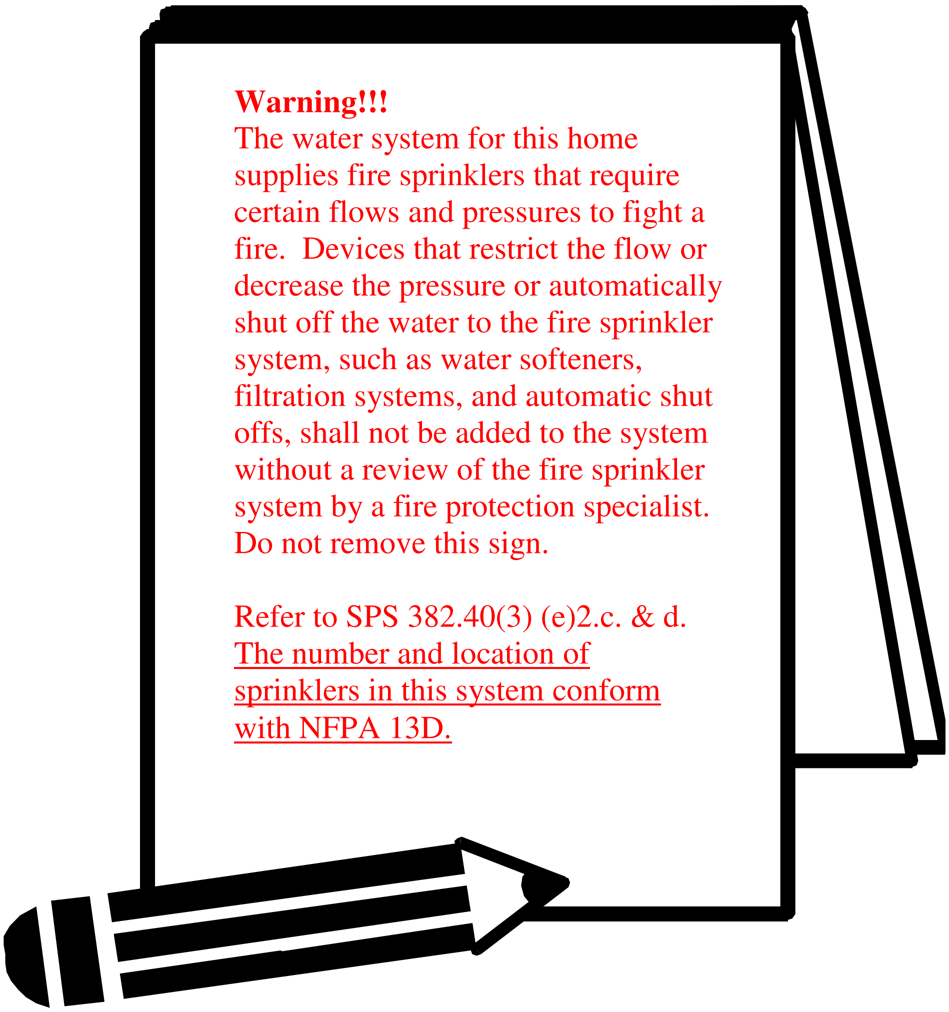

RFC 43

* Effective date July 12, 2002

The Reliable Automatic Sprinkler Co., Inc., 103 Fairview Park Drive, Elmsford, New York 10523

Sprinkler manufacturer's design and installation guides

- A sign shall be positioned adjacent to the main shutoff control valve that states in ¼” or larger letters (6.3(5));



- If the multipurpose piping system is a partial system, then the wording on the warning sign would reflect that the number and location of sprinklers in the system does not conform to NFPA 13D.

Job Done!

Chapter 11
Public Buildings
Water Service, Private Water Main Sizing

- **Multipurpose Piping Systems**
- Where can a MPP system be installed? An MPP system installed in any:

- **<u>One or Two family dwellings, Non-public</u>**

- A dwelling being served by community, municipal, non-community water system or private well, there are no restrictions in any code as to the type of water source. The plumbing code as of 3-1-09 permits non-potable sources (such as storm) to serve MPP.

- In Wisconsin, partial MPP systems can be installed with a reference attached to the warning sign at the building control valve stating that the number and location of sprinklers in the system does not conform to NFPA 13D (SPS 382.40(3)(e)2.d.).

- **<u>Public Buildings</u>**

- Changes (March 1, 2008) to the building code in SPS 362.0903(6) allow MPP systems to be installed in multi-family dwellings with three and four units, and townhouses up to 20 dwellings and a maximum of 3 stories in height (with conditions).

- As of January 1, 2011, sprinklers shall be required in all multi-family dwellings with three or four units, except as noted below for townhouses.

    - **<u>Multi-Family, Apartment Buildings, Condo's, etc. Other Than Townhouses:</u>**

- SPS 362.0903(6)(c) is an <u>exemption</u> that allows MPP systems where the building has three or four units, is two stories or less, <u>and is not served by a municipal or community water system</u>. The water supply definition restricts the use of MPP systems to no more than 24 people living in the four unit and the water system itself doesn't serve 7 or more homes or 10 or more condos, or apartments. (Note that a firewall meeting IBC 705 may separate multiple buildings with three or four units that are sprinklered with MPP systems per this exception.).

    - **<u>Townhouses</u>**

- SPS 362.0903(6)(d)1. & 2. An automatic fire sprinkler system need not be installed in a townhouse provided the townhouse complies with all of the following;
    - (d)1.a. Not more than 3 stories above grade plane in height.
    - (d)1.b. Does not contain more than 20 dwelling units.
    - (d)1.c. Total gross floor area of all the individual dwelling units within the townhouse does not exceed 16,000 square feet.

    - (d)2. Each dwelling is separated from other dwelling units by at least 2 hour fire resistant rated separation walls constructed in accordance with the requirements of IBC Section 705, except structural stability and horizontal continuity requirements of IBC Section 705 do not apply; and the separation walls do not contain any openings and plumbing equipment and mechanical equipment.

- SPS 362.0903(6)(d)3. In lieu of an automatic sprinkler system, a SPS 382.40 compliant MPP system may be installed conforming to sub. (14) provided the townhouse does not exceed more than 3 stories, and each dwelling is separated from other dwelling units by at least 2 hour fire resistant rated separation walls built per SPS 362.0903(6)(d)2. Note: No restrictions on water supply.

- SPS 362.0903(6)(d)4. No automatic sprinkler system is required for any size townhouse provided the townhouse meets the construction requirements of (d)3., is constructed of at least 2 hour fire resistance as defined under s. 101.14(4m)(a)5m., Stats. Note: "Two hour fire separations for all walls that separate dwelling units, exit corridors and exit stair enclosures and for all floors and ceilings are capable of resisting fire for a period not shorter than 2 hours.'

- **DNR Definitions:**

- NR 811.02(9) "Community water system" means a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents. Any water system serving 7 or more homes, 10 or more mobile homes, 10 or more apartment units or 10 or more condominium units shall be considered a community water system unless information is provided by the owners indicating that 25 year-round residents will not be served.

- (20) "Municipal water system" means a community water system owned by a city, village, county, town, town sanitary district, utility district, public inland lake and rehabilitation district, municipal water district or a federal, state, county or municipal owned institution for congregate care or correction, or a privately owned water utility serving the foregoing.

- (21) "Non-community water system" means a public water system that is not a community water system.

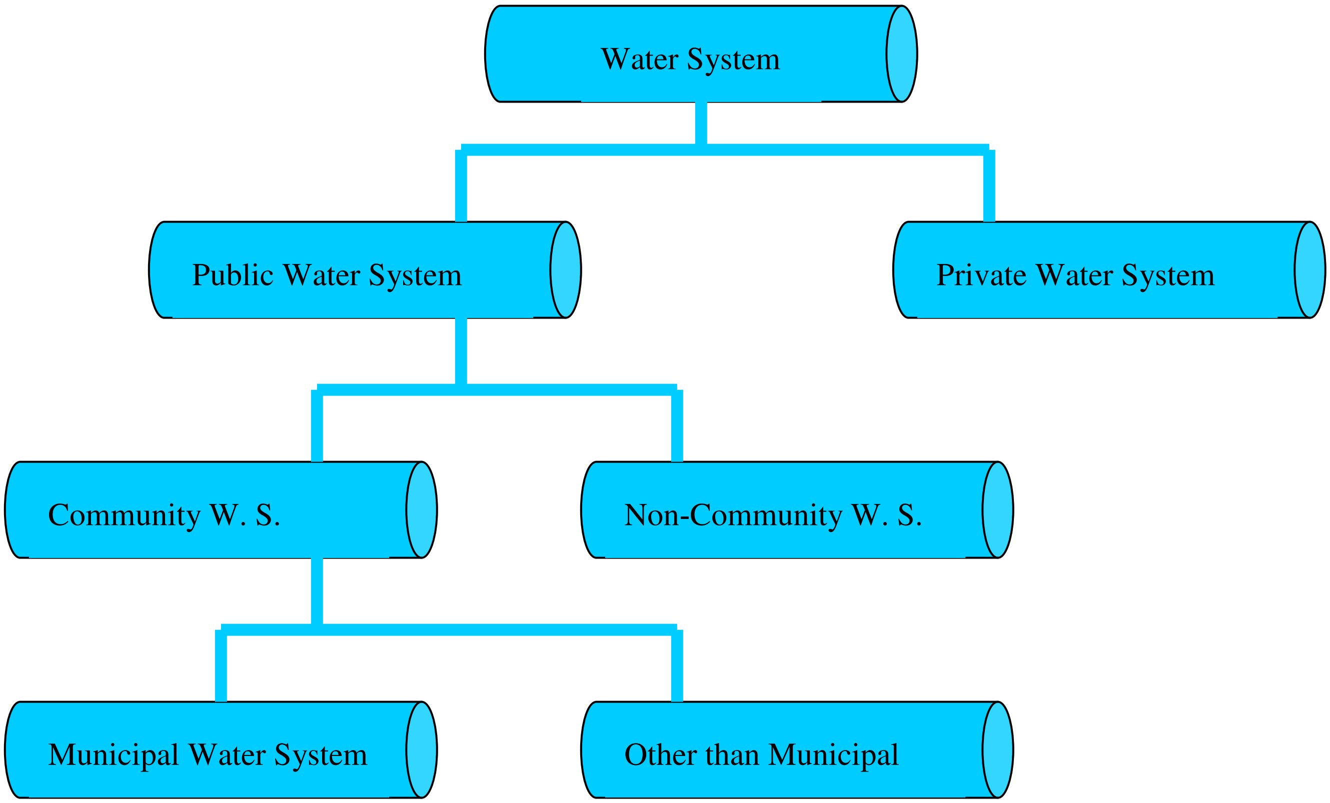
- (23)"Other-than-municipal water system" means a community water system that is not a municipal water system

- (25) "Public water system" means a system for the provision to the public of piped water for human consumption, if a system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. A public water system is either a "community water system" or a "non-community water system". A system includes:
- Any collection, treatment, storage and distribution facilities under control of the operator of a system and used primarily in connection with a system, **and**
- Any collection or pretreatment storage facilities not under such control of the operator of a public water system which are used primarily in connection with a system. Note: The definition of public water system as regulated by this chapter is broader and includes more water systems than those governed by the public service commission under its definition of a public utility in ch. 196, Stats.

- (31) "Waterworks" or "water system" means all structures, conduits, and appurtenances by means of which water is delivered to consumers except piping and fixtures inside buildings served, and service pipes from buildings to street mains.

- NR 812.07(78) "Private water system" means any water system supplying water that is not a public water system.

Figure 11-1



Sizing The Water Supply

- **Encapsulating, with the changes in SPS 362.0903(6), Multipurpose Piping Systems may be installed in 3 and 4 unit dwelling buildings and townhouses up to 20 units that are served by a private water system, potable or non-potable water source. Townhouses may be served by the public water system.** The NFPA 13D standard limits the MPP system to one and two family installations and the water service is sized by either the gpm sprinkler demand or the gpm plumbing demand, whichever may be the greater demand. <u>So how do we size for installations outside of the sizing criteria of a two family dwelling?</u>

- The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of this document (NFPA 13D – 2007 Standard). Nothing in the NFPA standard is intended to restrict new technologies or alternative arrangements, provided that the level of safety prescribed by the standard is not reduced (1.4).

- The Authority Having Jurisdiction (Dept. of Safety & Professional Services, Safety & Buildings Division) is responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure (3.2.2)

- The solution to sizing the water distribution system for buildings beyond the 2 family limitation is to design a water distribution system in the same way as a one or two family system. Each water distribution system serving up to two dwellings shall be independent of each other downstream from the water service connection.

- How do you size for gpm demand on the water service? The 13D Standard requires the larger of the two demands, fire sprinkler(s) or domestic to size the water distributions system and water service. This demand is identified as the controlling fixture. Once we start designing a water supply system for 3 and 4 unit dwelling buildings and townhouses the dynamics of melding key functions of the system such as frequency of use of fixtures, peak demand, type of fixtures and velocity limitations, will require a design that includes both adding the plumbing demand and the most demanding sprinkler(s) being served by the water service.

The sizing of the water supply in a nutshell:

- **1 & 2 Family Dwellings:**

    - Water Service and Water Distribution System is sized by the greatest gpm requirement (controlling fixture), whether it be a plumbing fixture, or the most demanding or two most demanding sprinklers in a compartment. Add 5 gpm to the building demand for two family dwelling water services.

- **3 & 4 Unit Dwelling Buildings, and Townhouses up to 20 Unit Dwellings:**

- Water Distribution System
    - Size for most demanding plumbing fixture or sprinkler(s)
    - Water distribution piping may serve up to two dwellings
    - Piping serving both dwellings, 5 gpm added to the demand.
- Water Service
    - Water service serving two dwellings
        - Add 5 gpm to the demand.
        - Size for most demanding plumbing fixture or sprinkler(s)
    - Water service serving 3 or more dwellings
        - Add plumbing fixture demand and 2 most demanding adjacent sprinklers being served (for flat, smooth, horizontal ceilings).
- In all cases, peak demand requirements must be maintained for a minimum of 10 minutes, 7 minutes for dwellings and manufactured homes, 2000 square feet or less.

Examples: The following examples of Figure 11-2 and 11-3 shows the water supply sizing for a 6 unit townhome.
- The plumbing fixture demand for each dwelling is 20 wsfu's, which converts to 14 gpm, SPS 382.40-3 Table. The sprinkler demand is the two most demanding sprinklers within a compartment, each sprinkler requiring 15 gpm, the two most demanding; 30 gpm. The controlling fixture for each dwelling for our example will be the two most demanding sprinklers in a compartment.

- The water service would be sized so that;
    - Water service piping serving a dwelling would have a gpm load of 30.
        - Two most demanding sprinklers
    - Water service piping serving two dwellings would have a gpm load of 35.

        - Two most demanding sprinklers plus 5 gpm.
    - Water service piping serving three of more dwellings would have a gpm load of:
        - 68 gpm load on piping serving 4 dwelling units.
            - 30 gpm for the two most demanding sprinklers plus
            - 38 gpm plumbing demand, 80 wsfu's
        - 78 gpm load on piping serving 6 dwelling units
            - 30 gpm for the two most demanding sprinklers plus
            - 48 gpm plumbing demand, 120 wsfu's

- Actual pipe size would be determined by the designer or master plumber and completing the water calc and fire / water calc calculations to obtain an "A" value.

Figure 11-2

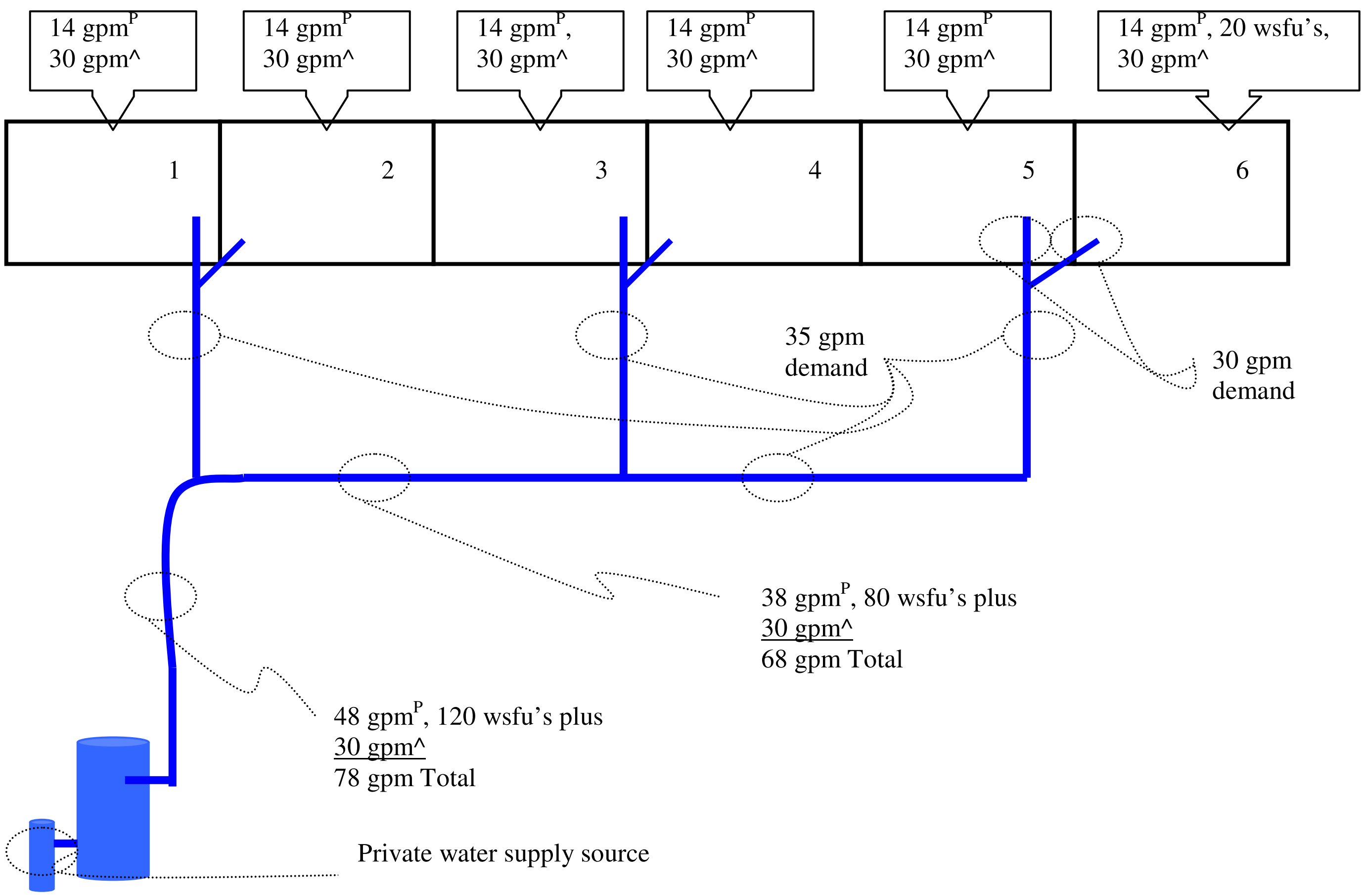
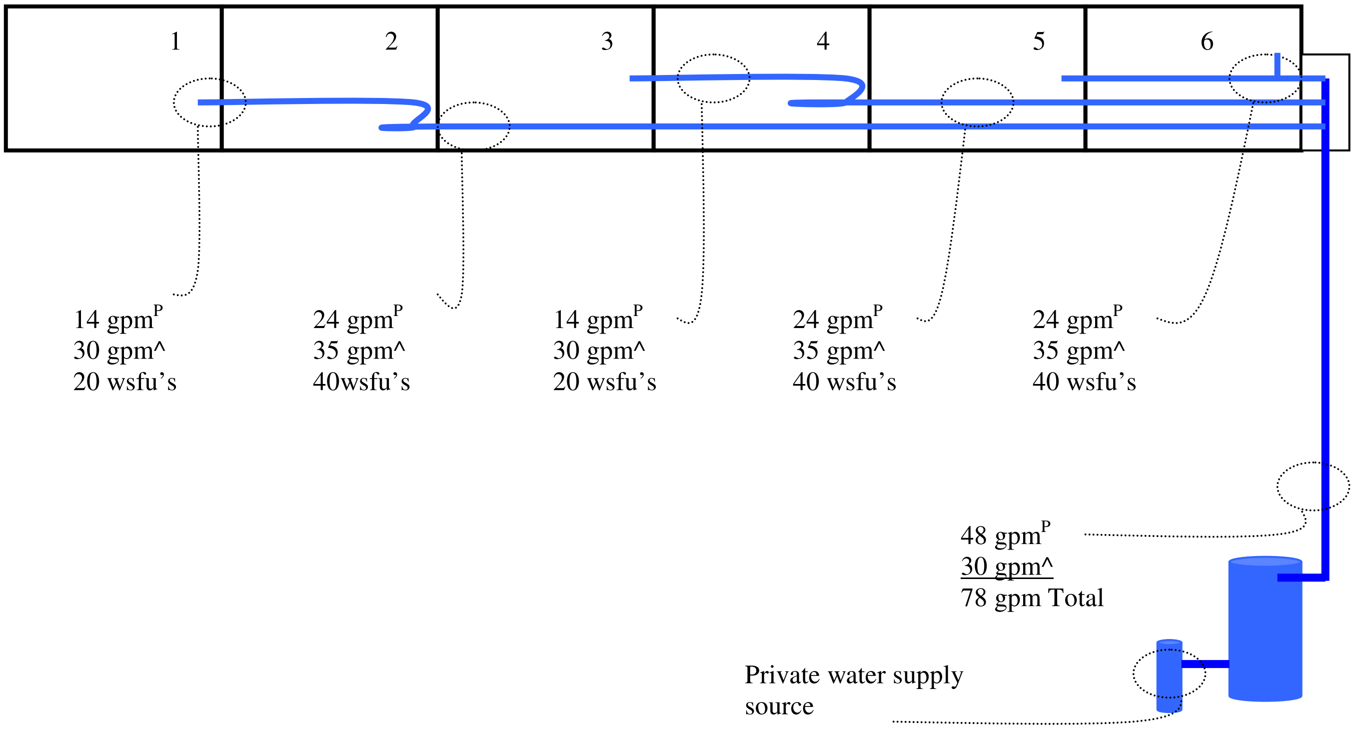


Figure 11-3



- Figure 11-3 is a water supply system with a single water service and water distribution piping to each unit serving the 6 units as identified in Figure 11-2. On a MPP 13D system, the water distribution piping may only serve up to two dwellings downstream of the indicating control valves. Figure 11-4 is a detail of the manifold pipe sizing.

Figure 11-4

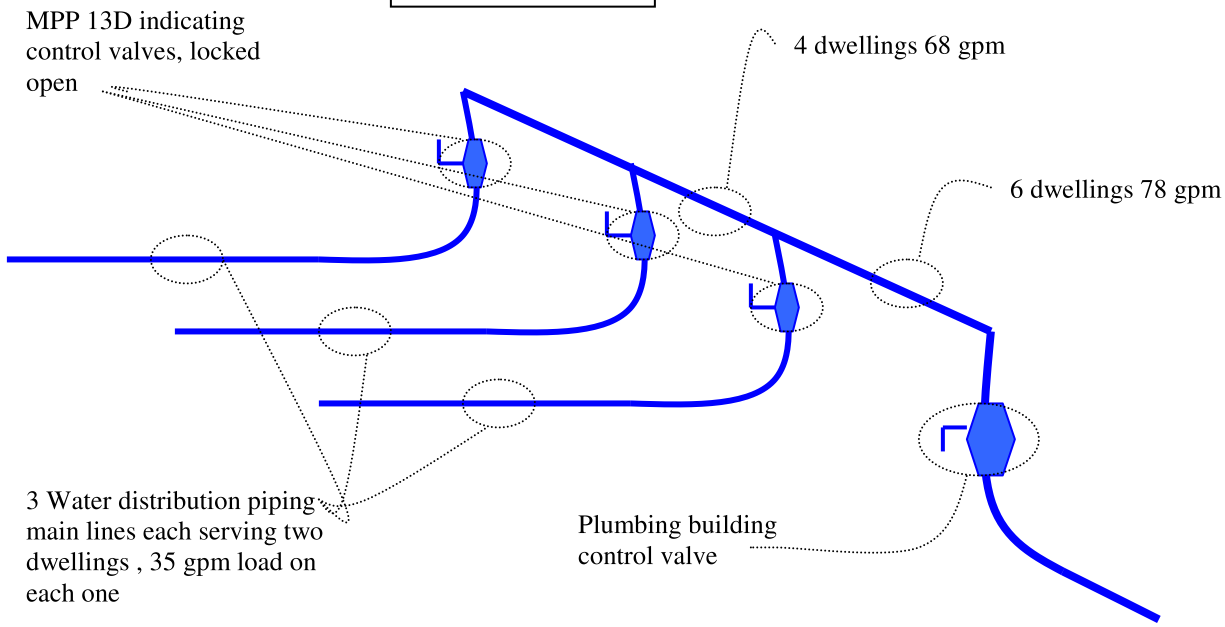
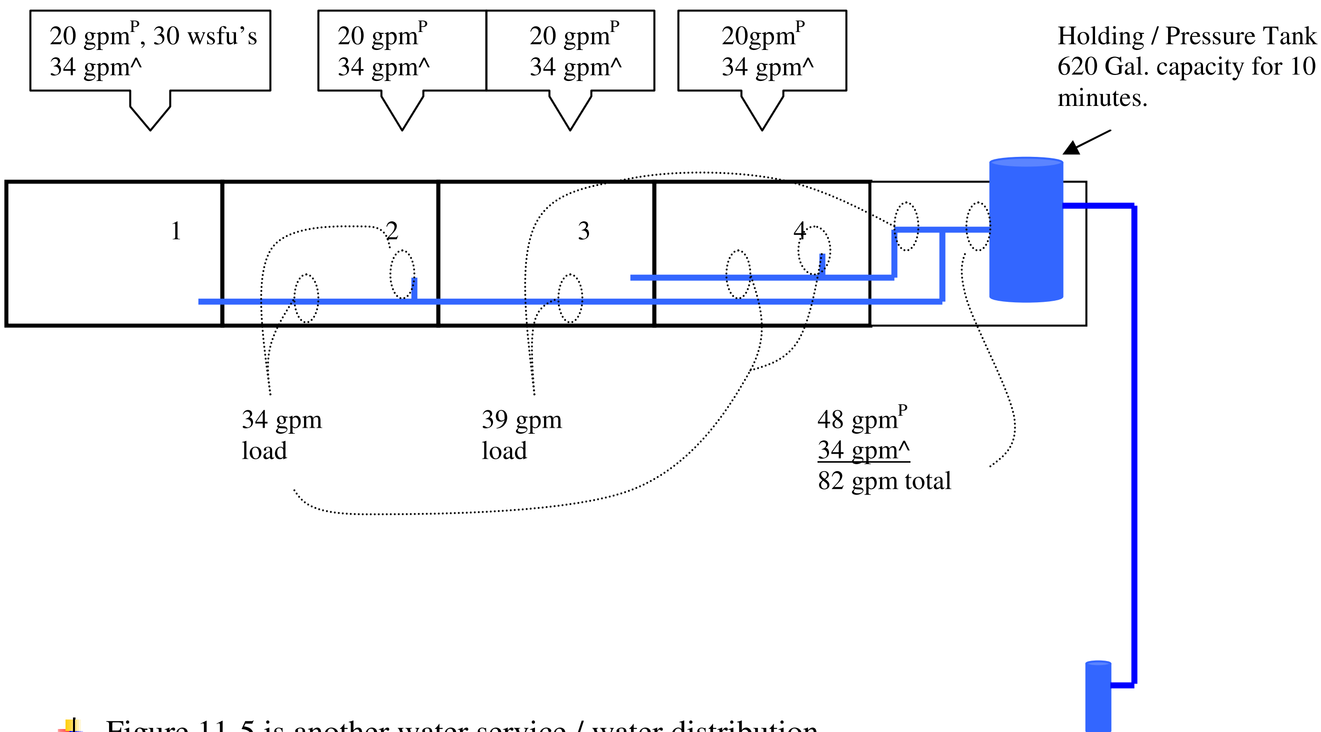


Figure 11-5



- Figure 11-5 is another water service / water distribution main pipe sizing example. The example is set up with a 1 ¼" water service providing 20 gpm to the building from a private water supply.

- The building has four dwellings, each dwelling has plumbing fixtures totaling 30 wsfu's, which converts to 20 gpm (Table 382.40-3).
- The MPP sprinkler system for each dwelling has a compartment with two sprinklers each requiring a 17 gpm demand and 34 gpm is the controlling sprinklers load for sizing each dwelling because it has a higher demand load than the plumbing fixtures.

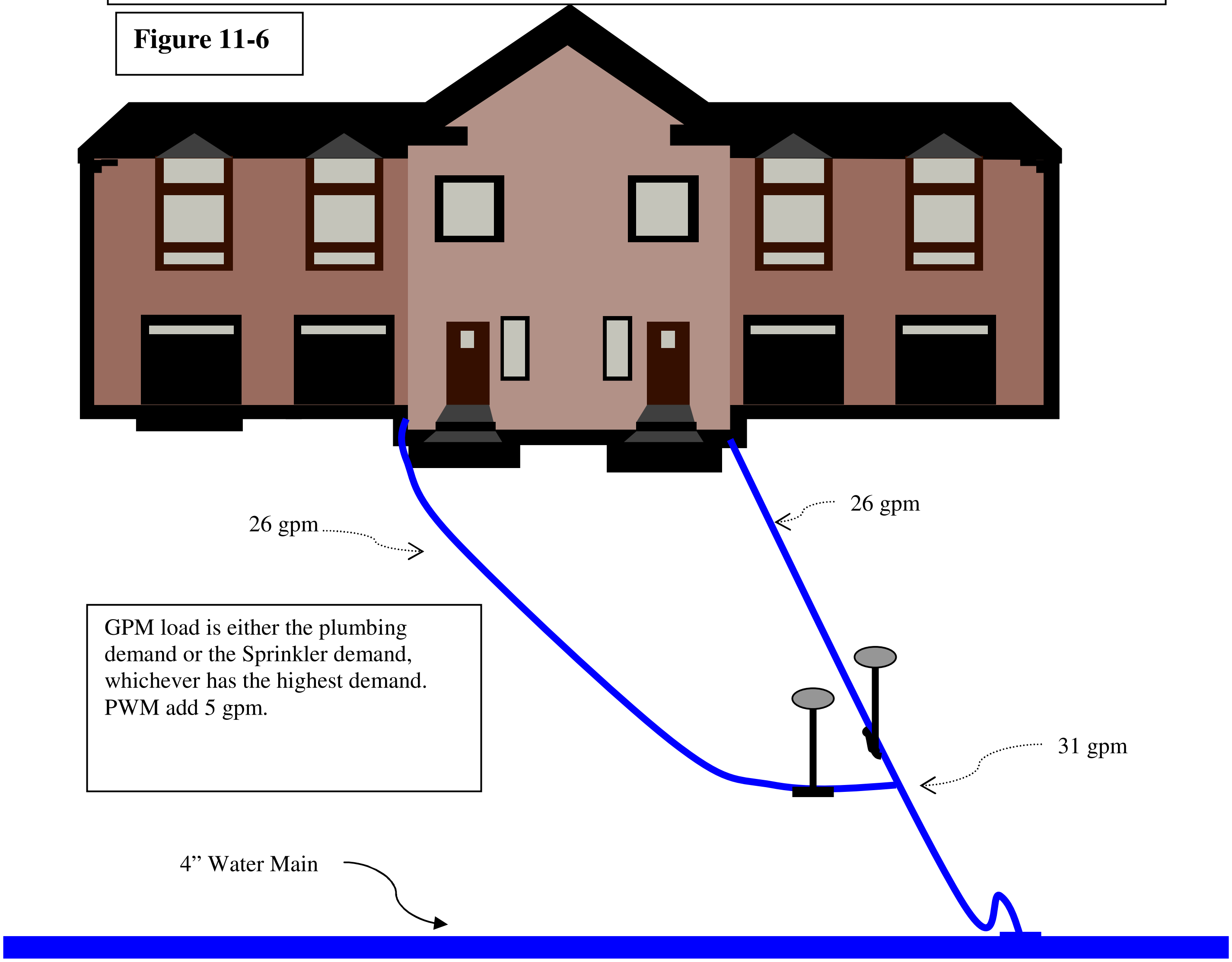
- Piping serving two dwellings shall add 5 gpm to the controlling sprinkler demand, which is 39 gpm.
- Piping serving three or more dwellings shall size the piping with the 2 most demanding sprinklers, 34 gpm, plus the domestic plumbing demand of 120 wsfu's, or 48 gpm. The total load on the main piping or manifold would be 82 gpm.

- Sizing the holding tank requires the total fire – water building demand of 82 gpm for a duration of 10 minutes, 7 minutes for dwellings that are 2000 square feet or less. In this case the total capacity of the well and holding/ pressure tank would require a minimum of 820 gallons. This capacity represents the worse case scenario of the two most demanding sprinklers discharging for 10 minutes to extinguish a fire or at least contain it so the occupants can escape.

- If the well and water service can provide 20 gallons per minute and 82 gallons per minute is our demand rate, then we are short 62 gallons per minute. The holding tank/ pressure tank or a combination holding tank and booster pump would need to have a capacity of providing 62 gpm for 10 minutes, or 620 gallons.

Duplex, Water Service Multipurpose Piping System Adequate
Municipal Water Supply – Main, Private Water Main, Water Services

Figure 11-6

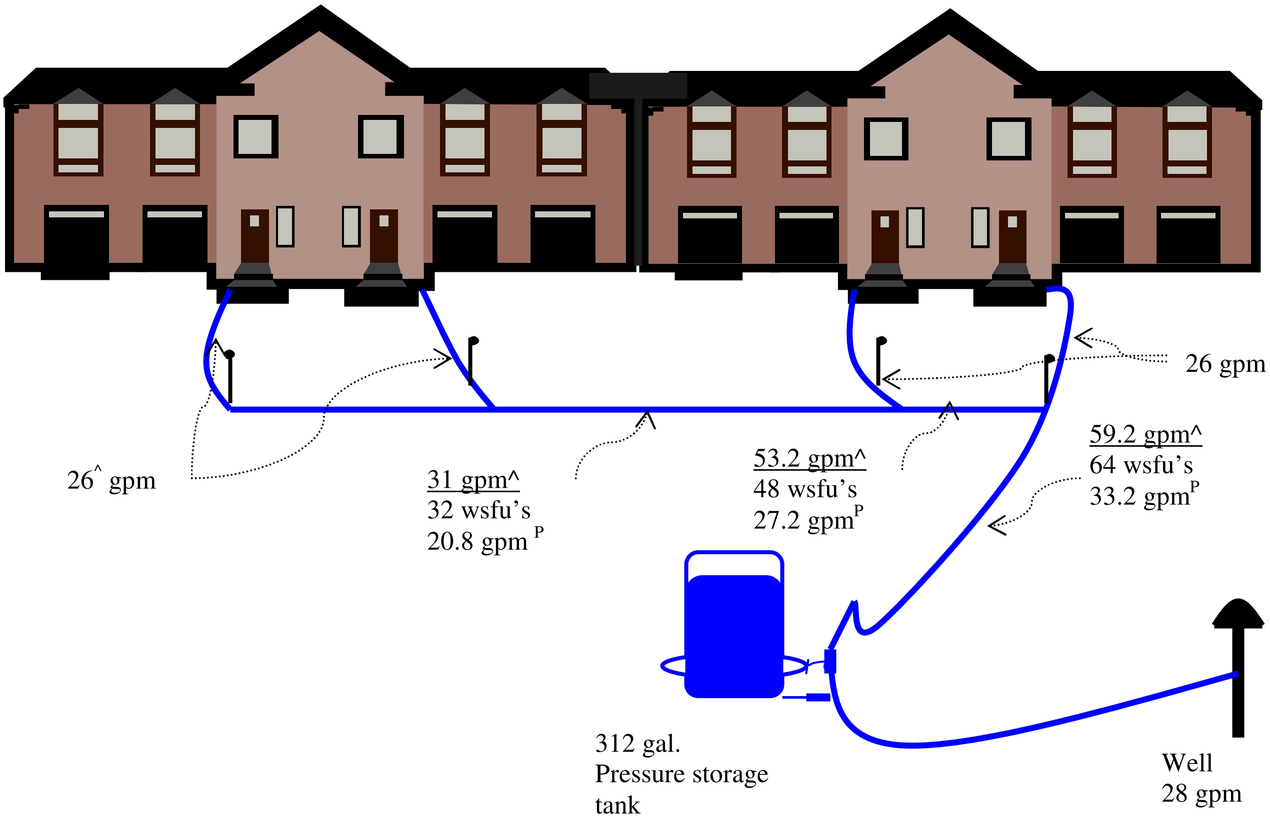


UDC – One & Two Family Construction, Dwelling

Unit 1, Unit 2 identical.		WSFU's		
2 BathroomGroups, one shower, one tub		7.5		
Kitchen Sink		1.5		
Laundry Tub & Washer Hook-up		3.0		
1 Dishwasher		1.0		
1 Frostproof wall hydrant		3.0		
	Bldg Demand:	16.0	=	11.6 gpm
	Two Units	32.0		20.8 gpm

MPP
2 Most demanding adjacent sprinklers
13 gpm, 8.7 psi Total Sprinkler Demand: 26 gpm

4 Unit Dwelling – Multipurpose Piping System
Private Water Main, Well
Figure 11-7

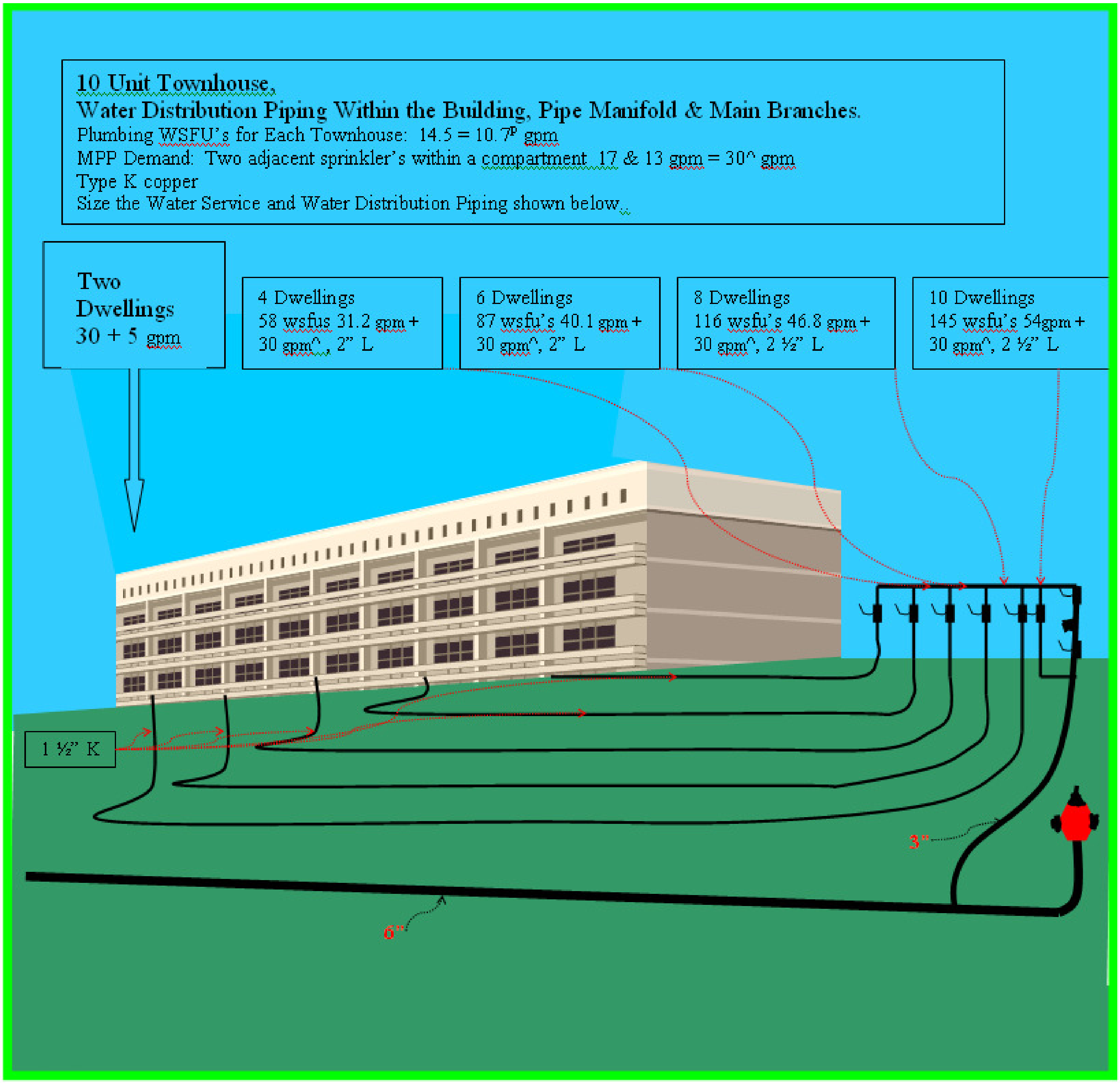


Public Building Construction

Each Unit has a plumbing fixture demand load of 16 WSFU's = 11.6 gpm (Table 382.40-3)
Each Unit has 2 Most demanding adjacent sprinklers (13 gpm, 8.7 psi), 26 gpm (NFPA 13D 8.1.2)
Note:
Any section of water service piping or section of water distribution piping serving one or two dwellings shall be sized for either the plumbing demand or the sprinkler demand, whichever has the greater demand load that needs to be satisfied. For two dwellings, add 5 gpm to the building demand load on the section of private water main or water distribution piping serving both units.

Any section of water service or section of water distribution piping serving three or more dwellings shall be sized for both the plumbing fixture demand and the sprinkler demand (either the most demanding sprinkler or if two or more sprinklers are within a compartment, the two most demanding adjacent sprinklers).

Figure 11-8

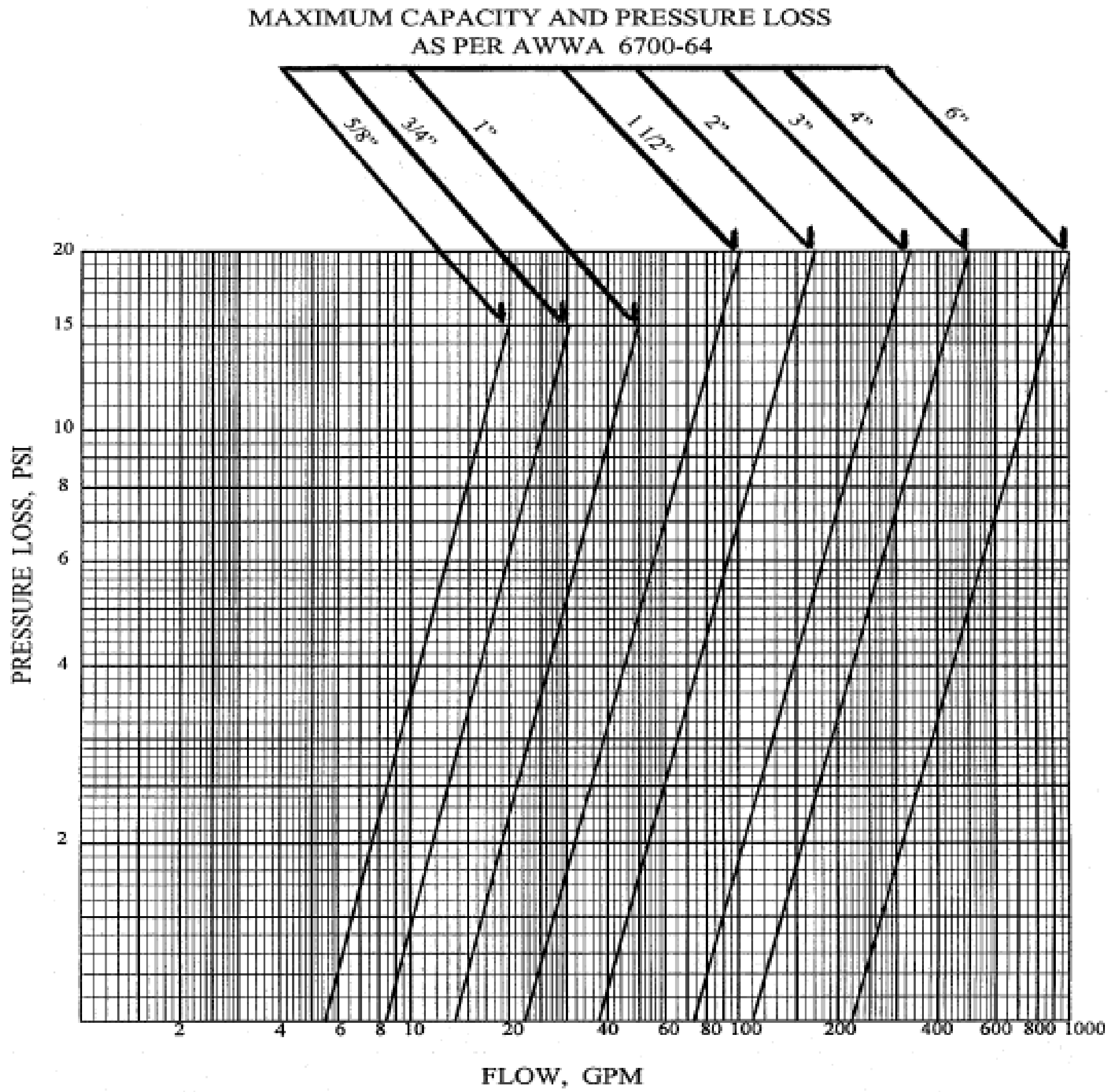

10 Unit Townhouse,
Water Distribution Piping Within the Building, Pipe Manifold & Main Branches.
Plumbing WSFU's for Each Townhouse: 14.5 = 10.7P gpm
MPP Demand: Two adjacent sprinkler's within a compartment 17 & 13 gpm = 30^ gpm
Type K copper
Size the Water Service and Water Distribution Piping shown below.
Two Dwellings 30 + 5 gpm
4 Dwellings 58 wsfus 31.2 gpm + 30 gpm^, 2" L
6 Dwellings 87 wsfu's 40.1 gpm + 30 gpm^, 2" L
8 Dwellings 116 wsfu's 46.8 gpm + 30 gpm^, 2 ½" L
10 Dwellings 145 wsfu's 54gpm + 30 gpm^, 2 ½" L
1 ½" K
3"
6"

Appendix A

Graphs

The pressure losses due to flow friction through displacement type cold−water meters may be calculated from Graph A−382.40 (7)−1.

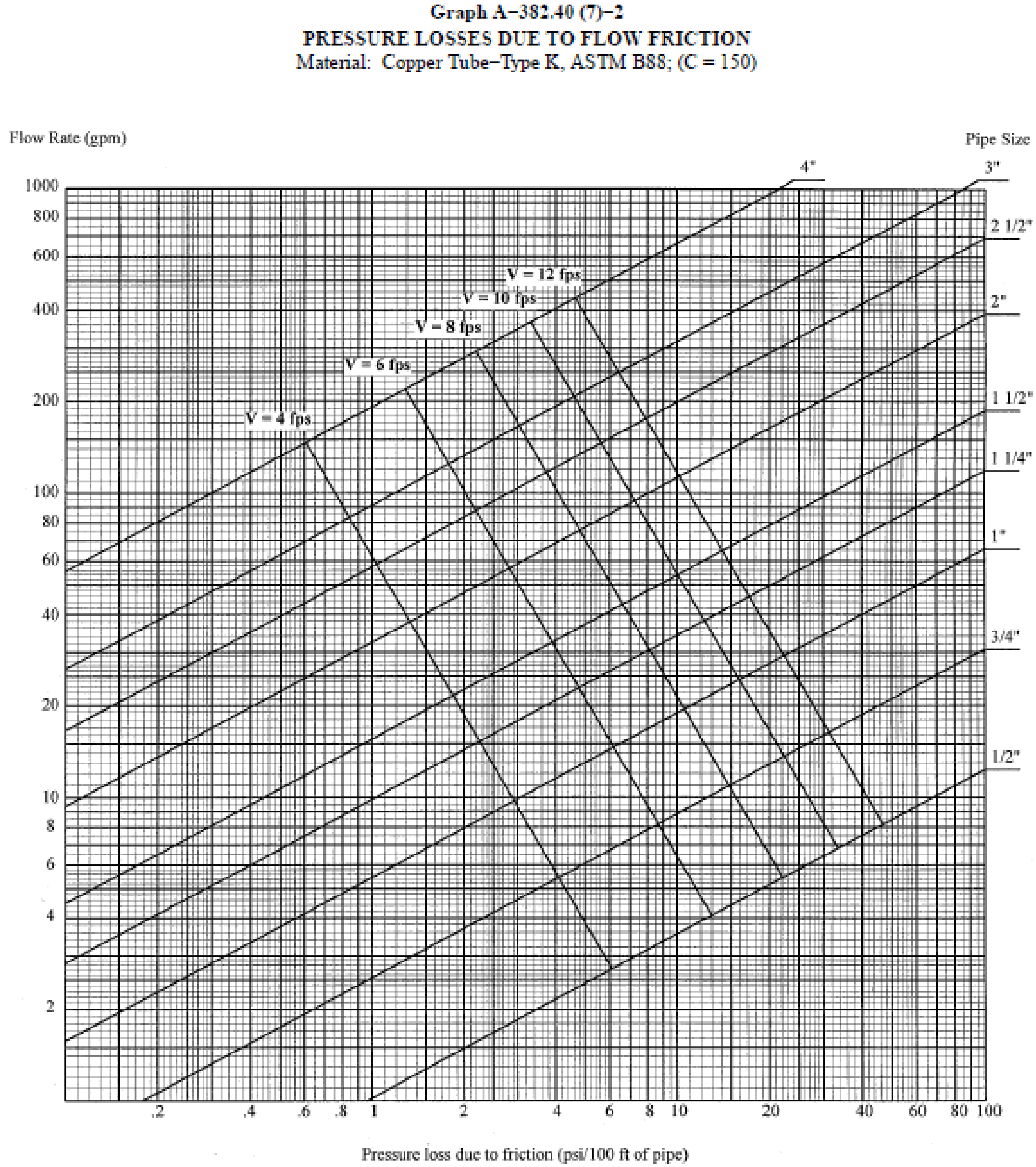
Graph A−382.40 (7)−1
PRESSURE LOSS IN COLD−WATER METERS, DISPLACEMENT TYPE



Graph A-82.40 (7)-2

Pressure losses due to flow friction

Material: Copper Tube-Type K, ASTM B88; (C = 150)



Graph A-82.40 (7)-3

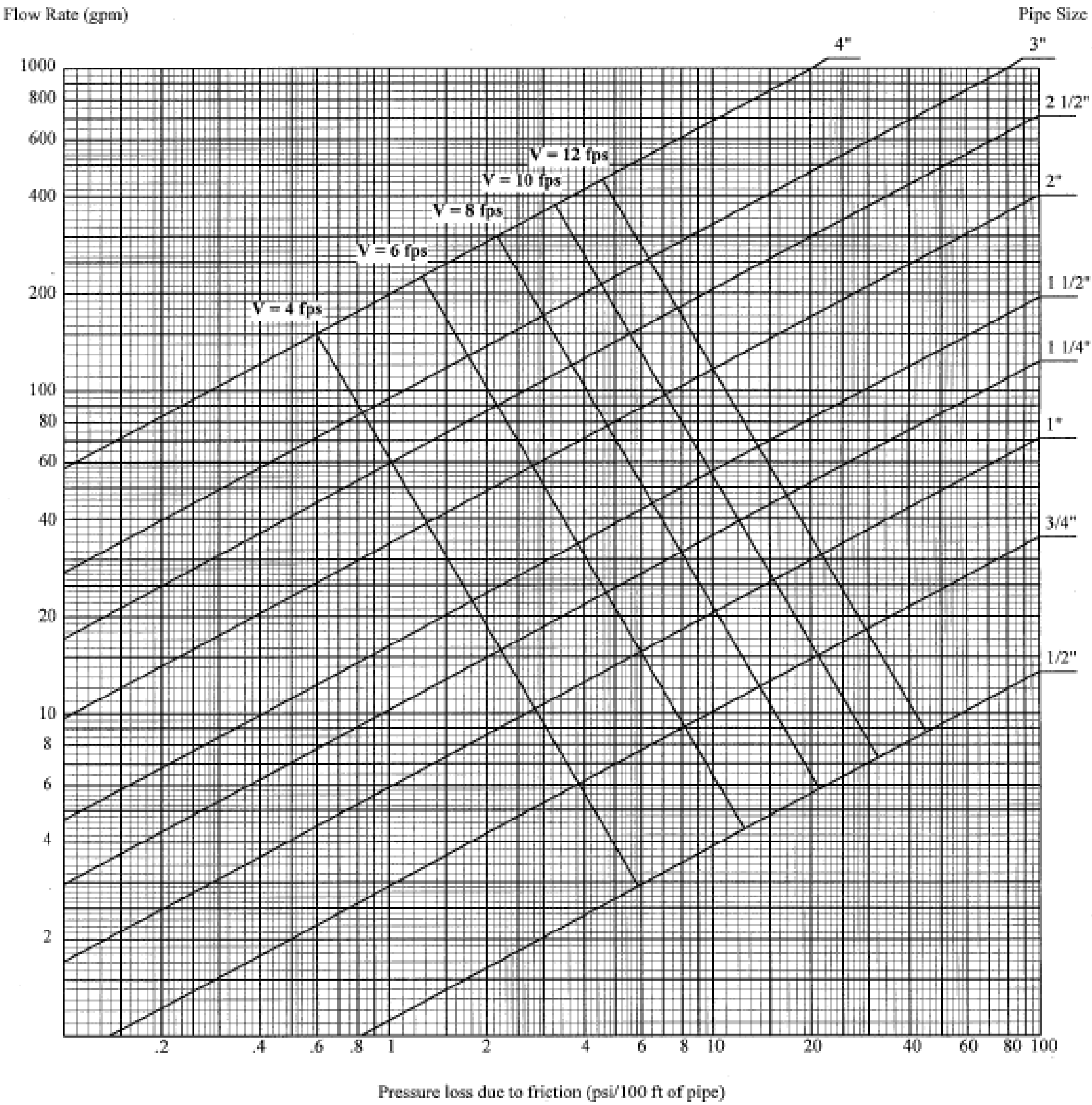
Pressure losses due to flow friction

Material: Copper Tube-Type L, ASTM B88; (C = 150)

Graph A−382.40 (7)−3

PRESSURE LOSSES DUE TO FLOW FRICTION

Material: Copper Tube−Type L, ASTM B88; (C = 150)



Graph A-82.40 (7)-4

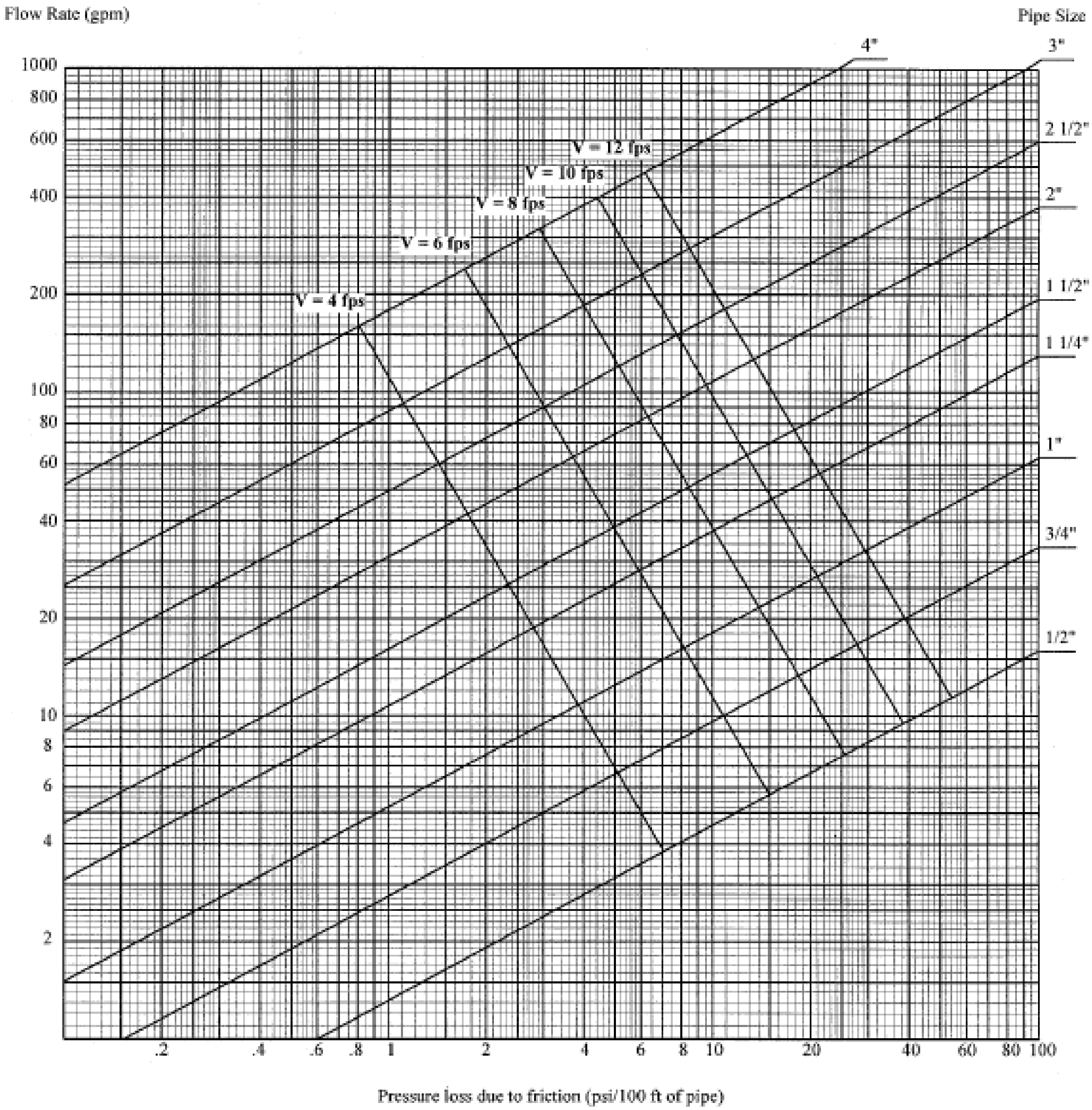
Pressure losses due to flow friction

Material: Galvanized Steel Pipe-Schedule 40, ASTM A53, ASTM A120; (C = 125)

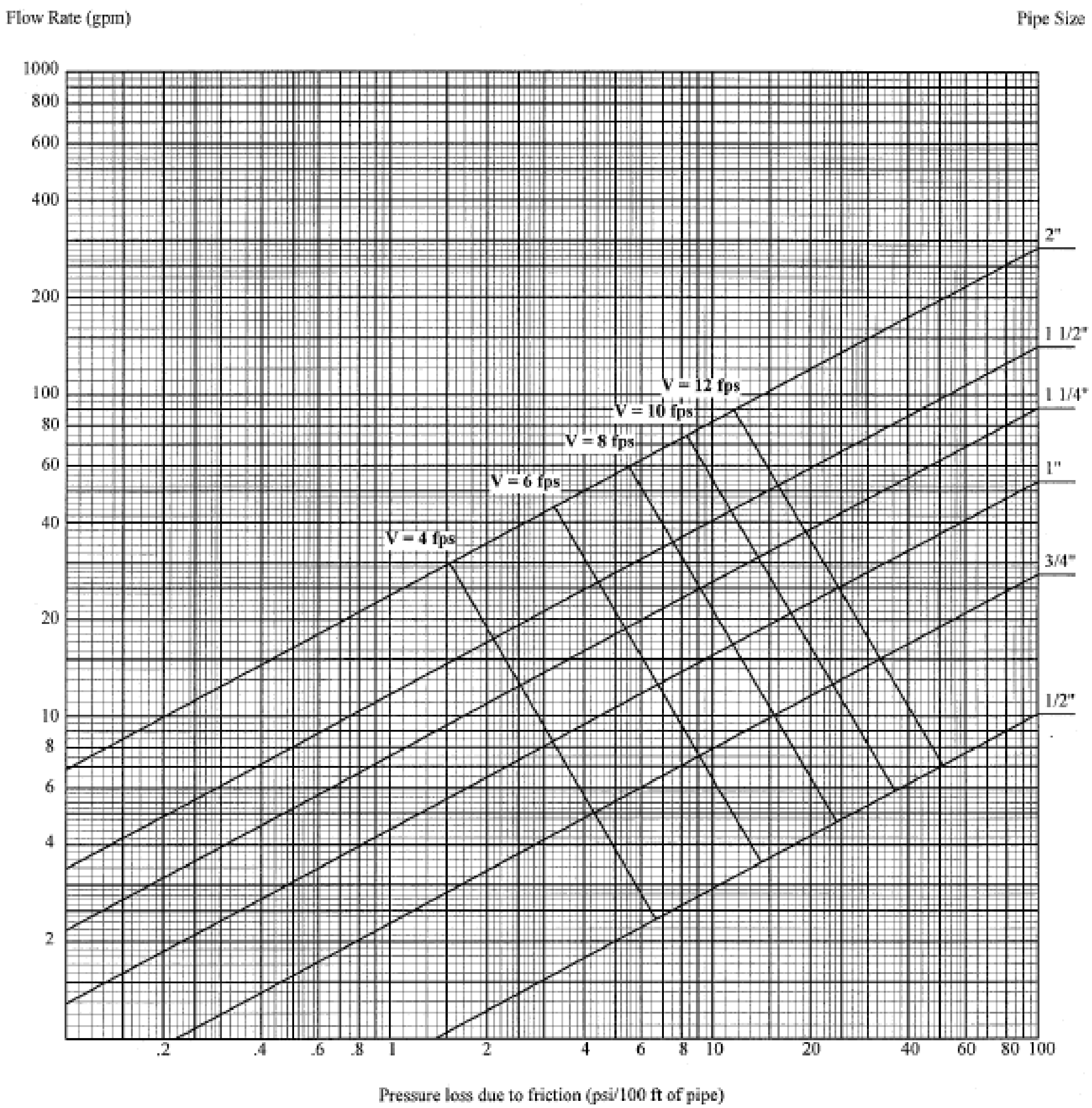
Graph A−382.40 (7)−4

PRESSURE LOSSES DUE TO FLOW FRICTION

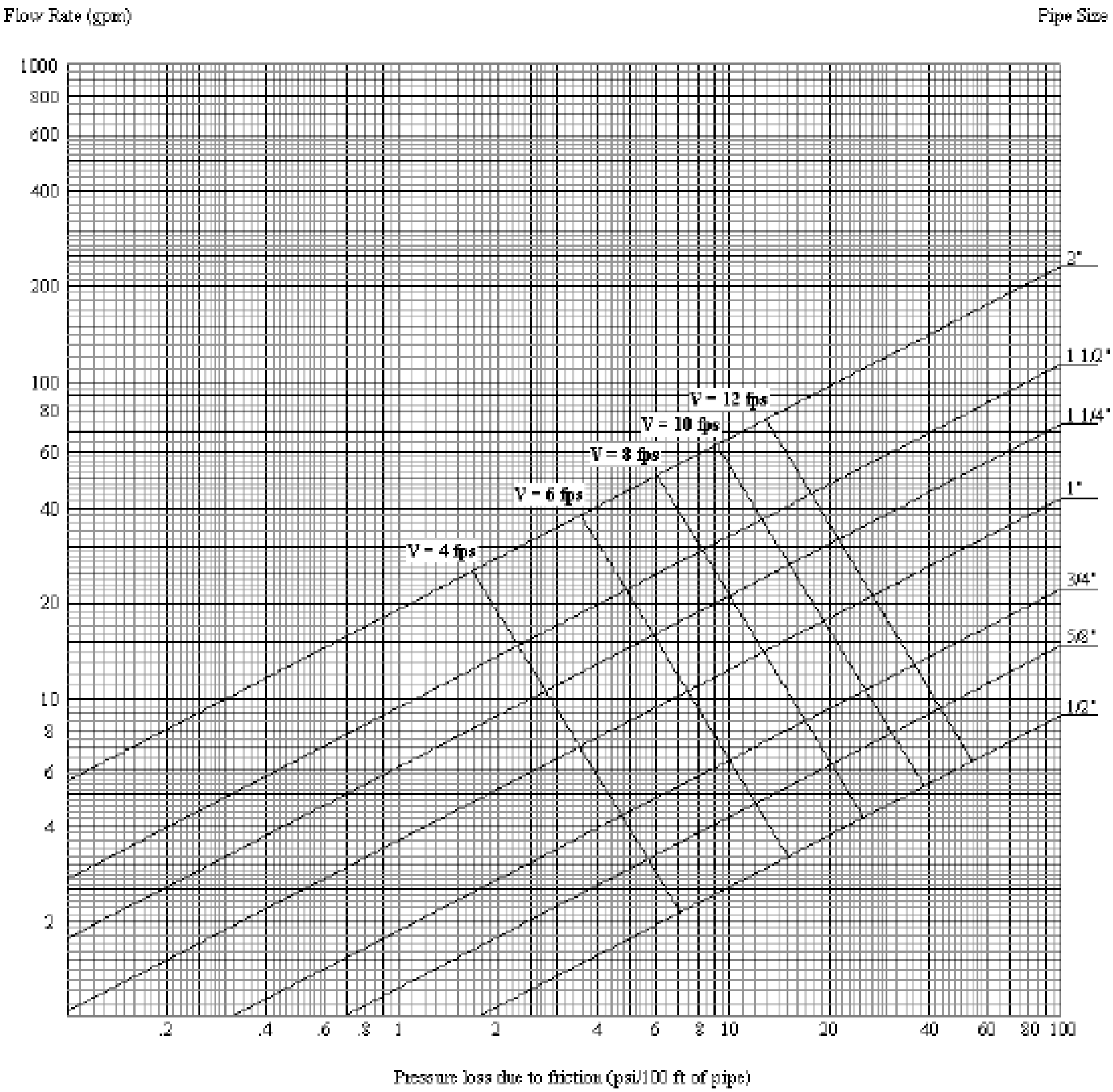
Material: Galvanized Steel Pipe−Schedule 40, ASTM A53, ASTM A120; (C = 125)



Graph A−382.40 (7)−5
PRESSURE LOSSES DUE TO FLOW FRICTION
Material: Polybutylene Tubing, ASTM D3309; or CPVC Tubing, ASTM D2846; (C = 150)



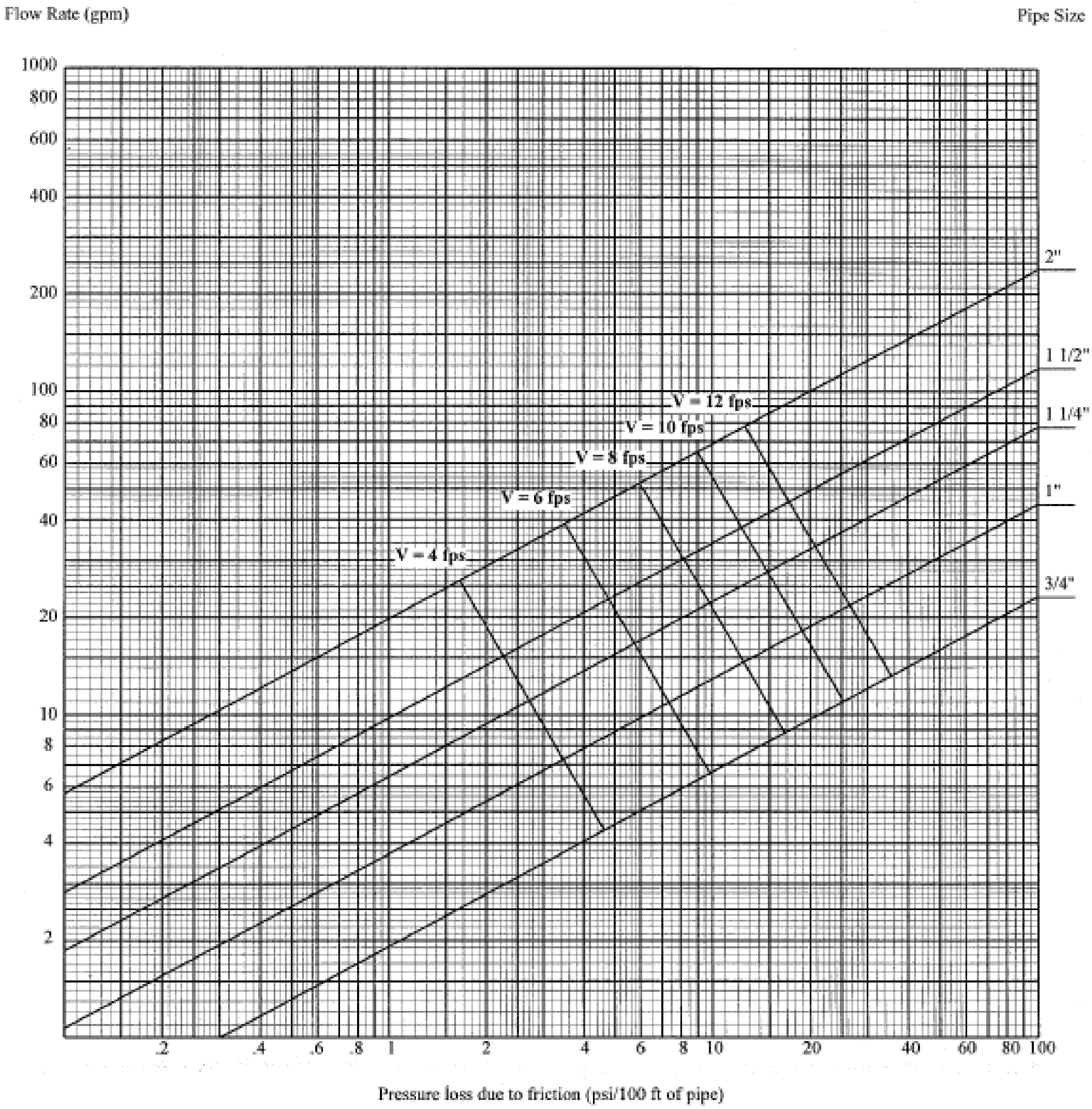
Graph A-382.40 (7)-6
PRESSURE LOSSES DUE TO FLOW FRICTION
Material: Crosslinked Polyethylene (PEX) Tubing, ASTM F876; (C = 150)



Graph A−382.40 (7)−7

PRESSURE LOSSES DUE TO FLOW FRICTION

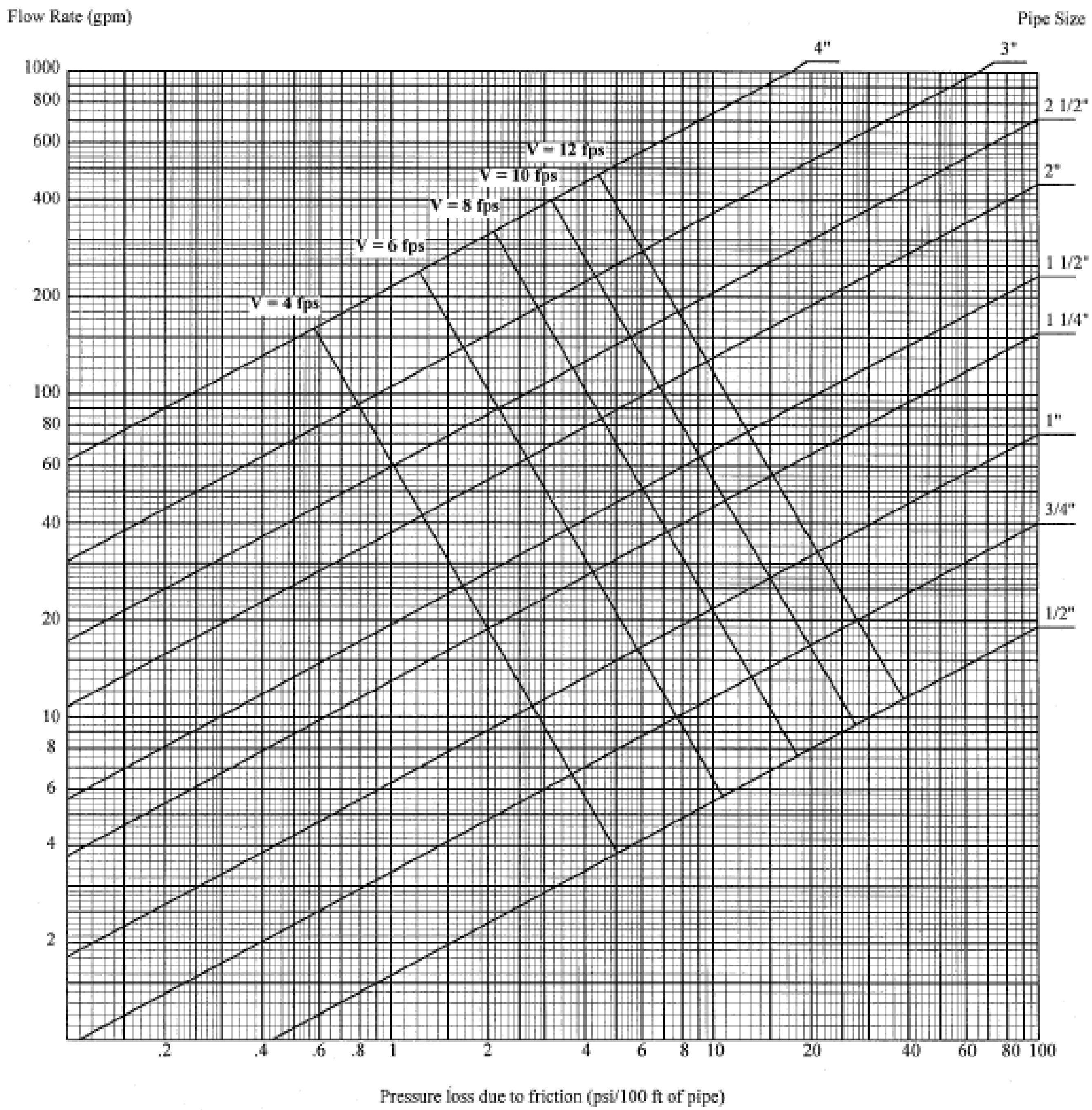
Material: Polyethylene Tubing, Copper Tube Size, ASTM D2737; (C = 150)



Graph A−382.40 (7)−8

PRESSURE LOSSES DUE TO FLOW FRICTION

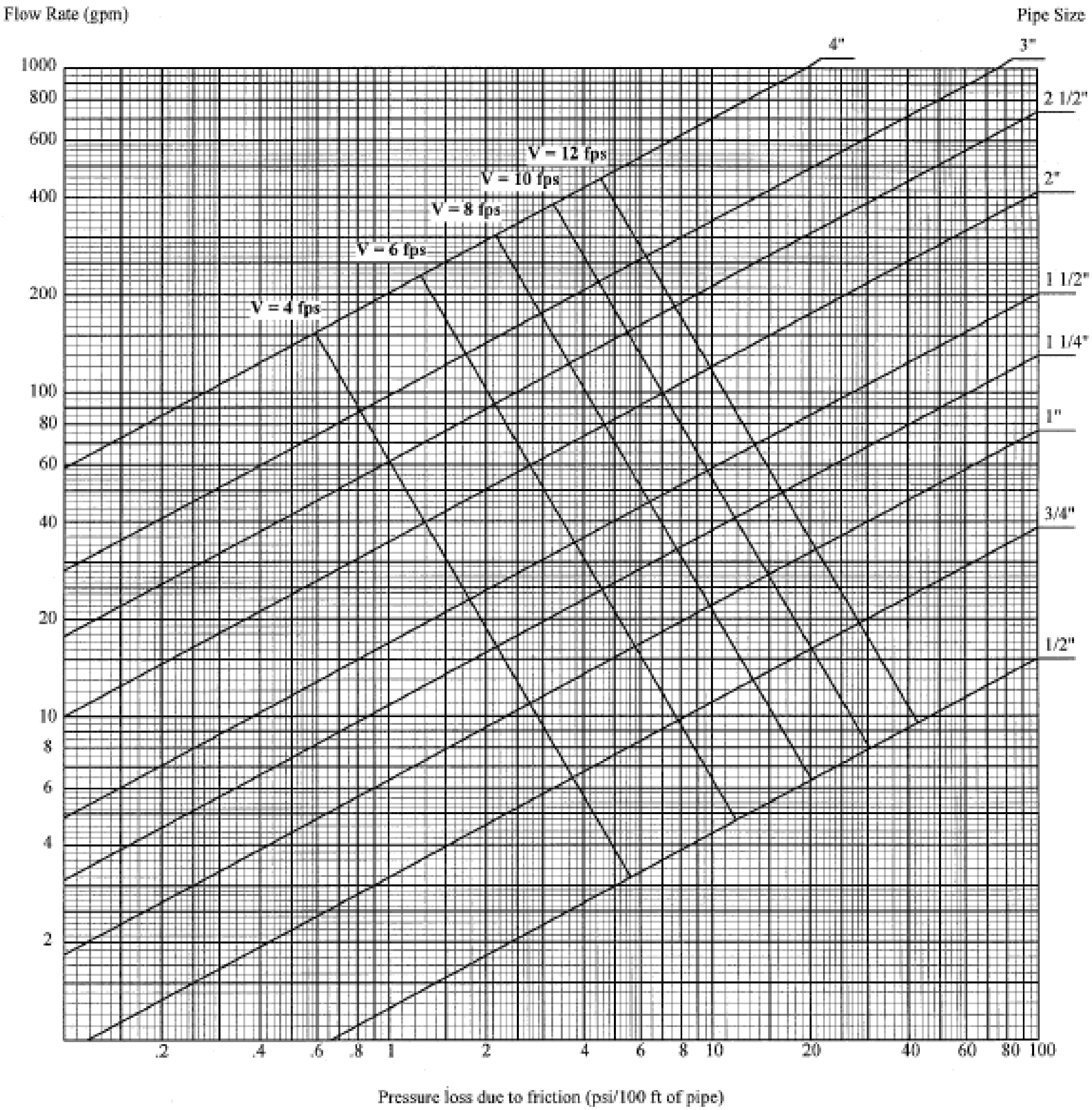
Material: ABS Pipe−Schedule 40; ASTM D1527; or
CPVC Pipe−Schedule 40; ASTM F441; or
PE Pipe−Schedule 40; ASTM D2104; ASTM D2447; or
PVC Pipe−Schedule 40; ASTM D1785; ASTM D2672; (C =150)



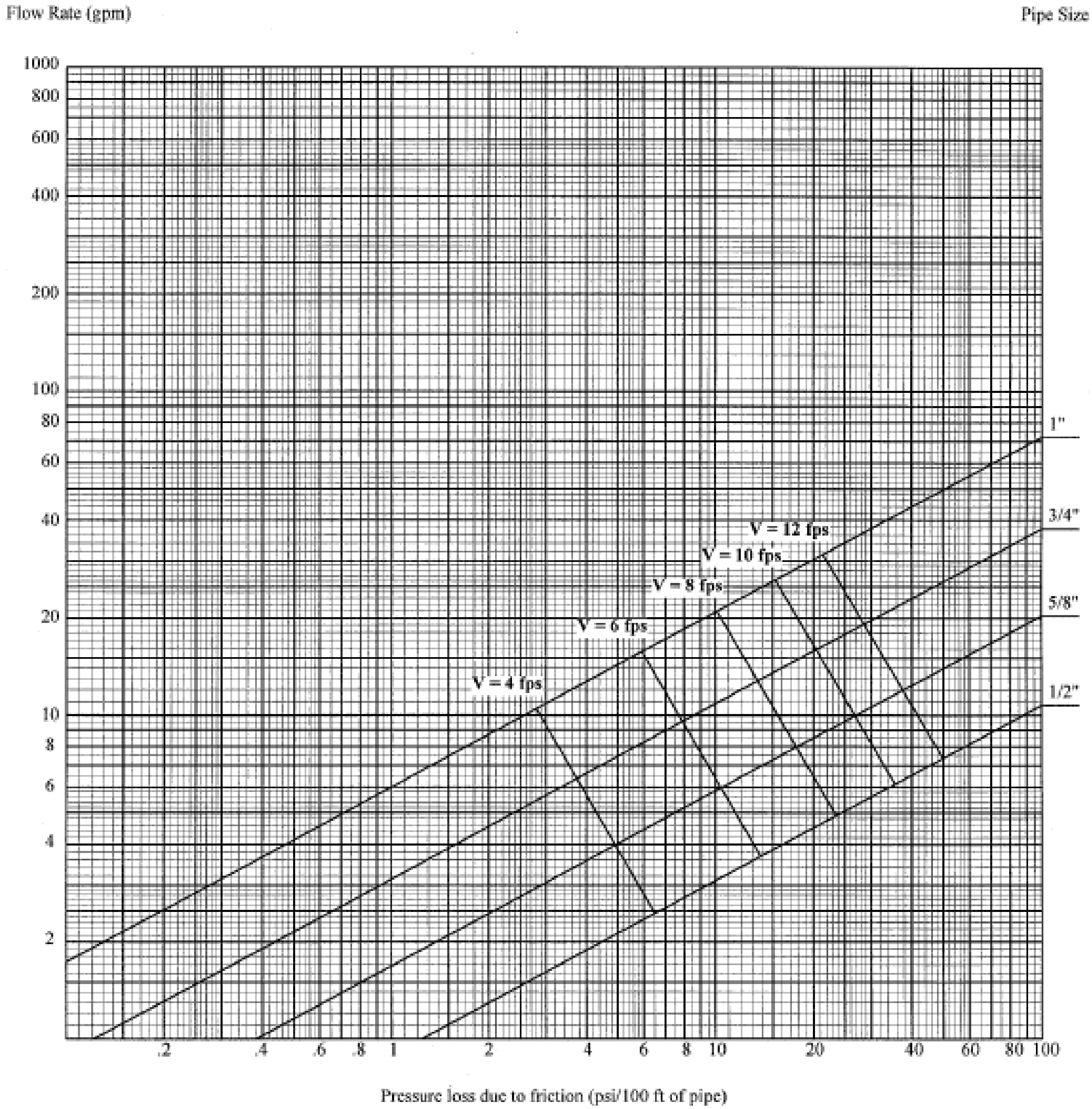
Graph A−382.40 (7)−9

PRESSURE LOSSES DUE TO FLOW FRICTION

Material: Copper Tube−Type M, ASTM B88; (C = 150)



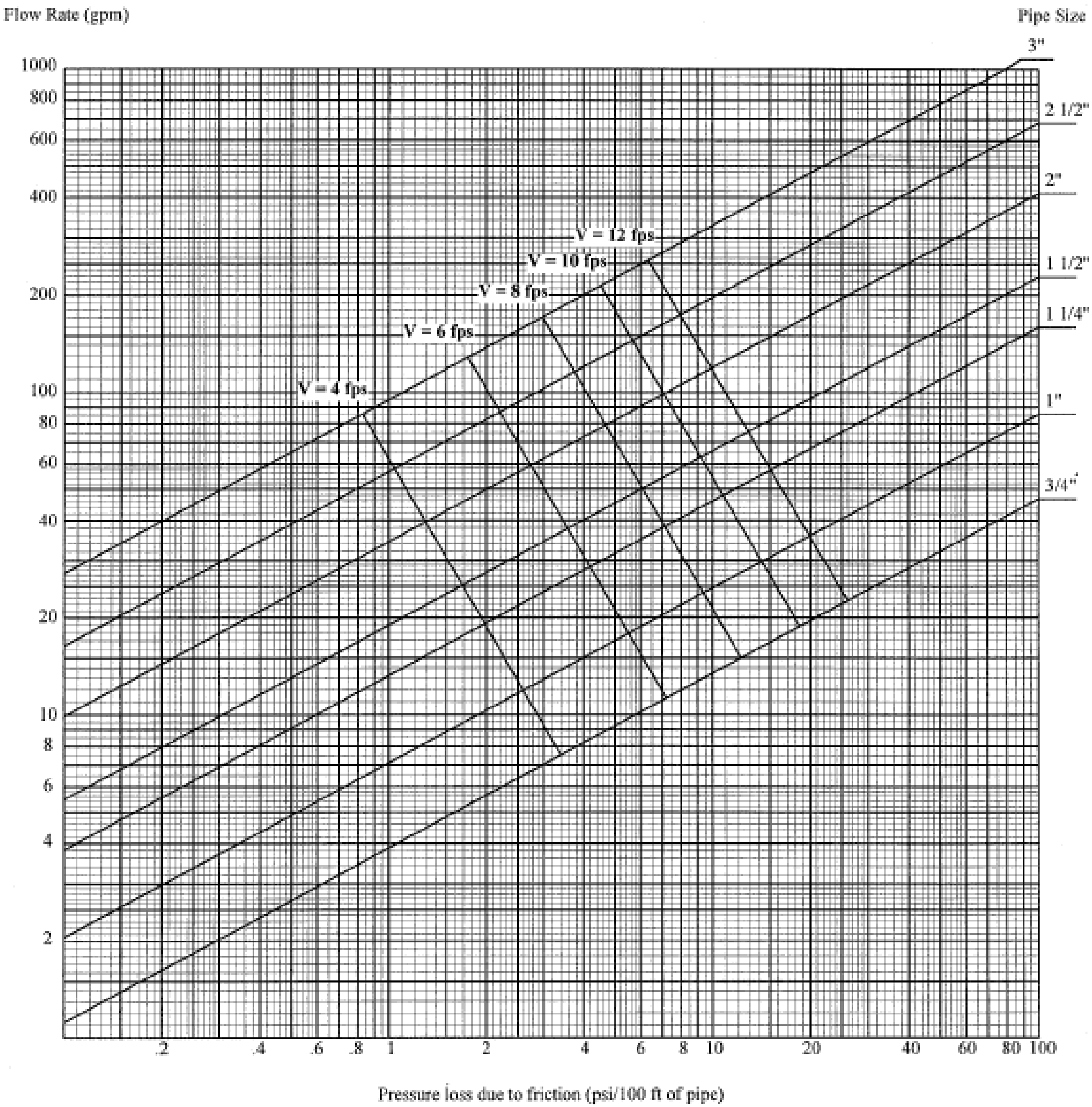
Graph A−382.40 (7)−10
PRESSURE LOSSES DUE TO FLOW FRICTION
Material: Polyethylene Aluminum Polyethylene Tubing (PexAlPex), ASTM F1281; (C = 150)



Graph A–382.40 (7)–11

PRESSURE LOSSES DUE TO FLOW FRICTION

Material: CPVC Tubing, SDR 13.5; ASTM F442; (C = 150)



Appendix
B
Tables

Table 382.40–4

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING–TYPE K, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																										
	1/2”			3/4”			1”			1 1/4”			1 1/2”			2”			2 1/2”			3”			4”		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	–	0.5	1.5	–	1.5	3.5	–	3.5	6.5	–	8.0	10.5	4.0	14.0	22.0	7.0	35.0	39.0	28.0	83.0	62.0	80.0	185	132	437	538
1	1.0	–	1.0	2.5	–	2.5	5.0	–	6.0	9.5	–	12.5	15.5	5.0	22.5	32.0	16.0	60.0	57.0	67.0	160	91.0	196	330	192	864	882
2	1.0	–	1.0	3.5	–	3.5	7.5	–	9.5	14.0	4.5	20.0	22.0	7.0	35.0	47.0	42.0	116	83.0	160	290	132	437	538	279	1611	1611
3	1.5	–	1.5	4.5	–	5.0	9.5	–	12.5	17.5	5.5	25.5	28.0	11.0	50.0	58.0	70.0	165	103	261	390	165	661	723	291	1725	1725
4	2.0	–	2.0	5.0	–	6.0	11.5	4.0	15.5	20.5	6.5	31.0	32.0	16.0	60.0	68.0	100	215	116	338	455	165	665	726		NP	
5	2.0	–	2.0	6.0	–	7.0	13.0	4.5	18.0	23.0	7.5	37.0	36.0	22.0	73.0	75.0	128	250		NP			NP				
6	2.5	–	2.5	6.5	–	8.0	14.0	4.5	20.0	25.0	8.5	42.0	40.0	30.0	86.0		NP										
7	2.5	–	2.5	7.0	–	9.0	15.5	5.0	22.5	28.0	11.0	50.0	42.0	34.0	103												
8	3.0	–	3.0	7.5	–	9.5	16.5	5.5	24.0	30.0	13.5	55.0		NP													
9	3.0	–	3.0	8.0	–	10.0	17.5	5.5	25.5		NP																
10	3.5	–	3.5	8.5	–	10.5	18.5	6.0	27.5																		
11	3.5	–	3.5	9.0	–	11.5	19.0	6.0	28.5																		
12	3.5	–	3.5	9.5	–	12.5		NP																			
13	4.0	–	4.0	10.0	4.0	13.0																					
14	4.0	–	4.0	10.5	4.0	14.0																					
15	4.0	–	4.0	10.5	4.0	14.5																					
16	4.5	–	5.0		NP																						
17	4.5	–	5.0																								
18	4.5	–	5.0																								
19	5.0	–	6.0																								
		NP																									

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–5

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING–TYPE L, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																										
	1/2”			3/4”			1”			1 1/4”			1 1/2”			2”			2 1/2”			3”			4”		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	–	0.5	2.0	–	2.0	4.0	–	4.0	7.0	–	9.0	11.0	4.0	15.0	23.0	7.5	37.0	40.0	30.0	86.0	65.0	90.0	200	136	462	561
1	1.0	–	1.0	2.5	–	2.5	5.5	–	6.5	10.0	4.0	13.0	16.0	5.0	23.0	33.0	17.5	63.0	59.0	72.0	170	94.0	211	345	198	909	923
2	1.5	–	1.5	4.0	–	4.0	8.5	–	10.5	14.5	4.5	20.5	23.0	7.5	37.0	48.0	44.0	120	86.0	175	305	137	468	566	288	1694	1694
3	2.0	–	2.0	5.0	–	6.0	10.5	4.0	14.0	18.5	6.0	27.5	29.0	12.5	52.0	60.0	75.0	175	107	283	410	169	698	752	298	1792	1792
4	2.0	–	2.0	6.0	–	7.0	12.0	4.0	16.5	21.5	7.0	33.0	34.0	18.5	66.0	70.0	108	225	119	356	469		NP			NP	
5	2.5	–	2.5	6.5	–	8.0	14.0	4.5	20.0	24.0	8.0	40.0	38.0	26.0	80.0	77.0	136	260		NP							
6	2.5	–	2.5	7.5	–	9.5	15.5	5.0	22.5	26.0	9.0	45.0	42.0	33.0	100		NP										
7	3.0	–	3.0	8.0	–	10.0	16.5	5.5	24.0	29.0	12.5	52.0	44.0	37.0	107												
8	3.0	–	3.0	8.5	–	10.5	18.0	6.0	26.5	31.0	15.0	58.0		NP													
9	3.5	–	3.5	9.5	–	12.5	19.0	6.0	28.0		NP																
10	3.5	–	3.5	10.0	4.0	13.0	20.0	6.5	30.0																		
11	4.0	–	4.0	10.5	4.0	14.0	20.5	6.5	31.0																		
12	4.0	–	4.0	11.0	4.0	15.0		NP																			
13	4.0	–	4.0	11.5	4.0	15.5																					
14	4.5	–	5.0	12.0	4.0	16.5																					
15	4.5	–	5.0		NP																						
16	5.0	–	6.0																								
17	5.0	–	6.0																								
18	5.0	–	6.0																								
19	5.0	–	6.0																								
20	5.5	–	6.5																								
		NP																									

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–6
MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING–TYPE M, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																										
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT
0.5	0.5	–	0.5	2.0	–	2.0	4.0	–	4.0	7.0	–	9.0	11.5	4.0	15.5	23.0	7.5	37.0	42.0	33.0	100	67.0	96.0	210	139	481	577
1	1.0	–	1.0	3.0	–	3.0	6.0	–	7.0	10.5	4.0	14.0	16.5	5.5	24.0	34.0	18.5	66.0	61.0	77.0	180	97.0	227	360	202	945	953
2	1.5	–	1.5	4.5	–	5.0	9.0	–	11.5	15.5	5.0	22.5	24.0	8.0	40.0	50.0	48.0	128	88.0	184	315	141	493	588	294	1750	1750
3	2.0	–	2.0	5.5	–	6.5	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0	62.0	80.0	185	110	300	425	174	731	776	303	1835	1835
4	2.5	–	2.5	6.5	–	8.0	13.0	4.5	18.0	22.0	7.0	35.0	35.0	20.0	70.0	73.0	120	240	121	374	484		NP			NP	
5	2.5	–	2.5	7.5	–	9.5	15.0	5.0	21.5	25.0	8.5	42.0	40.0	30.0	86.0	79.0	144	270		NP							
6	3.0	–	3.0	8.0	–	10.0	16.5	5.5	24.0	28.0	11.0	50.0	44.0	36.0	106		NP										
7	3.5	–	3.5	9.0	–	11.5	18.0	6.0	26.5	30.0	13.5	55.0	45.0	39.0	112												
8	3.5	–	3.5	9.5	–	12.5	19.5	6.5	29.0	32.0	17.0	62.0		NP													
9	4.0	–	4.0	10.0	4.0	13.0	20.5	6.5	31.0		NP																
10	4.0	–	4.0	11.0	4.0	15.0	21.5	7.0	34.0																		
11	4.5	–	5.0	11.5	4.0	15.5		NP																			
12	4.5	–	5.0	12.0	4.0	16.5																					
13	5.0	–	6.0	12.5	4.5	17.5																					
14	5.0	–	6.0	12.5	4.5	18.0																					
15	5.0	–	6.0		NP																						
16	5.5	–	6.5																								
17	5.5	–	6.5																								
18	5.5	–	6.5																								
19	6.0	–	7.0																								
20	6.0	–	7.0																								
21	6.0	–	7.5																								
		NP																									

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–7
MAXIMUM ALLOWABLE LOAD FOR GALVANIZED STEEL PIPE, SCHEDULE 40, ASTM A53; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																										
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT
0.5	0.5	–	0.5	1.5	–	1.5	3.5	–	3.5	7.0	–	9.0	11.0	4.0	15.0	21.0	7.0	32.0	34.0	18.5	66.0	60.0	75.0	175	123	381	490
1	1.0	–	1.0	2.5	–	2.5	5.0	–	6.0	10.5	4.0	14.0	16.0	5.0	23.0	31.0	15.0	57.0	49.0	46.0	124	87.0	180	310	179	769	805
2	1.5	–	1.5	4.0	–	4.0	7.5	–	9.5	15.5	5.0	22.5	23.0	7.5	37.0	45.0	38.0	110	72.0	116	235	127	406	511	260	1435	1435
3	2.0	–	2.0	5.0	–	6.0	9.0	–	11.5	19.0	6.0	28.0	29.0	12.5	52.0	56.0	65.0	155	89.0	188	320	158	607	683	317	1966	1966
4	2.5	–	2.5	5.5	–	6.5	11.0	4.0	15.0	22.0	7.0	35.0	34.0	18.5	66.0	65.0	90	200	104	266	395	184	809	837		NP	
5	3.0	–	3.0	6.5	–	8.0	12.0	4.0	16.5	25.0	8.5	42.0	38.0	26.0	80.0	74.0	124	245	118	350	465		NP				
6	3.0	–	3.0	7.0	–	9.0	13.5	4.5	19.0	28.0	11.0	50.0	42.0	33.0	100	81.0	152	280	119	358	471						
7	3.5	–	3.5	7.5	–	9.5	14.5	4.5	20.5	30.0	13.5	55.0	46.0	40.0	113	83.0	163	293		NP							
8	4.0	–	4.0	8.0	–	10.0	16.0	5.0	23.0	33.0	17.5	63.0	49.0	46.0	124		NP										
9	4.0	–	4.0	9.0	–	11.5	17.0	5.5	25.0	35.0	20.0	70.0	50.0	49.0	131												
10	4.5	–	5.0	9.5	–	12.5	18.0	6.0	26.5	37.0	24.0	76.0		NP													
11	4.5	–	5.0	10.0	4.0	13.0	19.0	6.0	28.0	37.0	24.0	77.0															
12	5.0	–	6.0	10.5	4.0	14.0	19.5	6.5	29.0		NP																
13	5.0	–	6.0	11.0	4.0	15.0	20.5	6.5	31.0																		
14	5.0	–	6.0	11.0	4.0	15.0	21.5	7.0	33.0																		
15	5.5	–	6.5	11.5	4.0	15.5		NP																			
16	5.5	–	6.5	12.0	4.0	16.5																					
17	6.0	–	7.0	12.5	4.5	17.5																					
18	6.0	–	7.0	13.0	4.5	18.0																					
19	6.0	–	7.0	13.0	4.5	18.5																					
20	6.5	–	8.0		NP																						
21	6.5	–	8.0																								
22	7.0	–	9.0																								
23	7.0	–	9.0																								
24	7.0	–	9.0																								
25	7.5	–	9.5																								
		NP																									

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–8
CHLORINATED POLYVINYL CHLORIDE TUBING, ASTM D2846 and F442, SDR 11; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches) 1/2"			3/4"			1"			1 1/4"			1 1/2"			2"		
	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT
0.5	0.5	–	0.5	1.5	–	1.5	3.0	–	3.0	5.0	–	6.0	8.0	–	10.0	16.0	5.0	23.0
1	0.5	–	0.5	2.0	–	2.0	4.0	–	4.0	7.5	–	9.5	11.5	4.0	15.5	23.0	7.5	37.0
2	1.0	–	1.0	3.0	–	3.0	6.0	–	7.0	10.5	4.0	14.0	16.5	5.5	24.0	34.0	18.5	66.0
3	1.5	–	1.5	4.0	–	4.0	8.0	–	10.0	13.5	4.5	19.0	21.0	7.0	32.0	42.0	33.0	100
4	1.5	–	1.5	4.5	–	5.0	9.0	–	11.5	15.5	5.0	22.5	24.0	8.0	40.0	50.0	48.0	128
5	2.0	–	2.0	5.0	–	6.0	10.5	4.0	14.0	17.5	5.5	25.5	27.0	10.0	47.0	56.0	65.0	155
6	2.0	–	2.0	6.0	–	7.0	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0	59.0	73.0	171
7	2.0	–	2.0	6.5	–	8.0	12.5	4.5	17.5	21.5	7.0	33.0	33.0	17.5	63.0	NP		
8	2.5	–	2.5	7.0	–	9.0	13.5	4.5	19.0	23.0	7.5	37.0	34.0	19.0	68.0			
9	2.5	–	2.5	7.0	–	9.0	14.5	4.5	20.5	24.0	8.0	40.0	NP					
10	2.5	–	2.5	7.5	–	9.5	15.0	5.0	21.5	24.0	8.0	41.0						
11	3.0	–	3.0	8.0	–	10.0	16.0	5.0	23.0	NP								
12	3.0	–	3.0	8.5	–	10.5	16.5	5.5	24.0									
13	3.0	–	3.0	9.0	–	11.5	NP											
14	3.0	–	3.0	9.5	–	12.5												
15	3.5	–	3.5	9.5	–	12.5												
16	3.5	–	3.5	10.0	4.0	13.0												
17	3.5	–	3.5	NP														
18	4.0	–	4.0															
19	4.0	–	4.0															
20	4.0	–	4.0															
21	4.0	–	4.0															
22	4.0	–	4.0															
23	4.5	–	5.0															
	NP																	

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–9
MAXIMUM ALLOWABLE LOAD FOR CROSSLINKED POLYETHYLENE (PEX) TUBING, ASTM F876 and F877; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches) 1/2"			5/8"			3/4"			1"			1 1/4"			1 1/2"			2"		
	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT	GPM	WSFU FM	WSFU FT
0.5	0.5	–	0.5	0.5	–	0.5	1.0	–	1.0	2.5	–	2.5	4.0	–	4.0	6.5	–	8.0	13.5	4.5	19.0
1	0.5	–	0.5	1.0	–	1.0	1.5	–	1.5	3.5	–	3.5	6.0	–	7.0	9.5	–	12.5	19.5	6.5	29.0
2	1.0	–	1.0	1.5	–	1.5	2.5	–	2.5	5.0	–	6.0	9.0	–	11.5	14.0	4.5	20.0	28.0	11.0	50.0
3	1.0	–	1.0	2.0	–	2.0	3.0	–	3.0	6.5	–	8.0	11.0	4.0	15.0	17.5	5.5	25.5	36.0	22.0	73.0
4	1.5	–	1.5	2.5	–	2.5	4.0	–	4.0	7.5	–	9.5	13.0	4.5	18.0	20.5	6.5	31.0	42.0	33.0	100
5	1.5	–	1.5	3.0	–	3.0	4.5	–	5.0	8.5	–	10.5	15.0	5.0	21.5	23.0	7.5	37.0	47.0	42.0	116
6	2.0	–	2.0	3.0	–	3.0	5.0	–	6.0	9.5	–	12.5	16.5	5.5	24.0	25.0	8.5	42.0	51.0	53.0	135
7	2.0	–	2.0	3.5	–	3.5	5.5	–	6.5	10.5	4.0	14.0	18.0	6.0	26.5	28.0	11.0	50.0	NP		
8	2.0	–	2.0	3.5	–	3.5	5.5	–	6.5	11.0	4.0	15.0	19.0	6.0	28.0	30.0	13.5	55.0			
9	2.5	–	2.5	4.0	–	4.0	6.0	–	7.0	12.0	4.0	16.5	20.5	6.5	31.0	NP					
10	2.5	–	2.5	4.0	–	4.0	6.5	–	8.0	12.5	4.5	17.5	21.5	7.0	34.0						
11	2.5	–	2.5	4.5	–	5.0	7.0	–	9.0	13.5	4.5	19.0	NP								
12	2.5	–	2.5	4.5	–	5.0	7.0	–	9.0	14.0	4.5	20.0									
13	3.0	–	3.0	5.0	–	6.0	7.5	–	9.5	14.5	4.5	20.5									
14	3.0	–	3.0	5.0	–	6.0	8.0	–	10.0	NP											
15	3.0	–	3.0	5.5	–	6.5	8.0	–	10.0												
16	3.0	–	3.0	5.5	–	6.5	8.5	–	10.5												
17	3.5	–	3.5	5.5	–	6.5	8.5	–	11.0												
18	3.5	–	3.5	6.0	–	7.0	NP														
19	3.5	–	3.5	6.0	–	7.0															
20	3.5	–	3.5	6.0	–	7.5															
21	4.0	–	4.0	NP																	
	NP																				

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means – not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–10

MAXIMUM ALLOWABLE LOAD FOR CHLORINATED POLYVINYL CHLORIDE TUBING, ASTM F442, SDR 13.5; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																				
	3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	2.5	–	2.5	4.5	–	5.0	9.0	–	11.5	13.0	4.5	18.0	23.0	7.5	37.0	38.0	26.0	80.0	65.0	90.0	200
1	3.5	–	3.5	7.0	–	9.0	13.0	4.5	18.0	18.5	6.0	27.5	34.0	18.5	66.0	56.0	65.0	155	94.0	211	345
2	5.5	–	6.5	10.0	4.0	13.0	19.0	6.0	28.0	27.0	10.0	47.0	49.0	46.0	124	82.0	156	285	138	475	572
3	7.0	–	9.0	12.5	4.5	17.5	23.0	7.5	37.0	34.0	18.5	66.0	62.0	80.0	185	102	255	385	170	703	755
4	8.0	–	10.0	15.0	5.0	21.5	27.0	10.0	47.0	40.0	30.0	86.0	72.0	116	235	114	331	449		NP	
5	9.0	–	11.5	16.5	5.5	24.0	31.0	15.0	57.0	45.0	38.0	110	78.0	142	267		NP				
6	10.0	4.0	13.0	18.5	6.0	27.5	34.0	18.5	66.0	49.0	46.0	124		NP							
7	11.0	4.0	15.0	20.0	6.5	30.0	37.0	24.0	76.0	50.0	48.0	128									
8	11.5	4.0	15.5	21.5	7.0	33.0	38.0	26.0	80.0		NP										
9	12.5	4.5	17.5	23.0	7.5	37.0		NP													
10	13.0	4.5	18.0	23.0	7.5	39.0															
11	14.0	4.5	20.0		NP																
12	14.5	4.5	20.5																		
13	14.5	5.0	21.5																		
		NP																			

Note:
WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.
Approved for cold water use only.
Intended use is for MPP systems.

Table 382.40–11

MAXIMUM ALLOWABLE LOAD FOR POLYETHYLENE ALUMINUM POLYETHYLENE TUBING (PexAlPex), ASTM F1281; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)											
	1/2"			5/8"			3/4"			1"		
		WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	–	0.5	1.0	–	1.0	2.0	–	2.0	4.0	–	4.0
1	0.5	–	0.5	1.5	–	1.5	3.0	–	3.0	6.0	–	7.0
2	1.0	–	1.0	2.0	–	2.0	4.5	–	5.0	8.5	–	10.5
3	1.5	–	1.5	3.0	–	3.0	5.5	–	6.5	10.5	4.0	14.0
4	1.5	–	1.5	3.5	–	3.5	6.5	–	8.0	12.5	4.5	17.5
5	2.0	–	2.0	4.0	–	4.0	7.0	–	9.0	14.0	4.5	20.0
6	2.0	–	2.0	4.0	–	4.0	8.0	–	10.0	15.5	5.0	22.5
7	2.5	–	2.5	4.5	–	5.0	8.5	–	10.5	17.0	5.5	25.0
8	2.5	–	2.5	5.0	–	6.0	9.5	–	12.5	18.0	6.0	26.5
9	2.5	–	2.5	5.5	–	6.5	10.0	4.0	13.0	19.5	6.5	29.0
10	3.0	–	3.0	5.5	–	6.5	10.5	4.0	14.0	20.5	6.5	31.0
11	3.0	–	3.0	6.0	–	7.0	11.0	4.0	15.0	20.5	6.5	32.0
12	3.0	–	3.0	6.0	–	7.0	11.5	4.0	15.5		NP	
13	3.5	–	3.5	6.5	–	8.0	12.5	4.5	17.5			
14	3.5	–	3.5	7.0	–	9.0		NP				
15	3.5	–	3.5	7.0	–	9.0						
16	3.5	–	3.5	7.5	–	9.5						
17	4.0	–	4.0		NP							
18	4.0	–	4.0									
19	4.0	–	4.0									
20	4.0	–	4.0									
21	4.5	–	5.0									
		NP										

Note: WSFU means water supply fixture units.
GPM means gallons per minute.
FM means predominately flushometer type water closets or syphon jet urinals.
FT means predominately flush tank type water closets or wash down urinals.
NP means not permitted, velocities exceed 8 feet per second.
For using this table, round the calculated pressure loss due to friction to the next higher number shown.
SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Maximum Allowable Load for Schedule 80 CPVC ASTM F 441 Pipe (⅜ to 2 inches)

Press. Loss due to Friction A-Value	⅜ inch				½ inch				¾ inch				1 inch				1¼ inch				1½ inches				2 inches			
	GPM	Vel. ft/sec	WSFU FM	WSFU FT	GPM	Vel. ft/sec	WSFU FM	WSFU FT	GPM	Vel. ft/sec	WSFU FM	WSFU FT	GPM	Vel. ft/sec	WSFU FM	WSFU FT	GPM	Vel. ft/sec	WSFU FM	WSFU FT	GPM	Vel. ft/sec	WSFU FM	WSFU FT	GPM	Vel. ft/sec	WSFU FM	WSFU FT
0.5	0.36	0.8	---	0.25	0.5	0.7	---	0.5	0.6	1.1	---	0.5	3.2	1.5	---	3	6.9	1.8	---	8	10.5	2	4	14	20.7	2.3	6	31
1	0.5	1.2	---	0.5	1	1.5	---	1	2.4	1.8	---	2	4.7	2.1	---	4.5	10	2.6	4	13	15.2	2.9	5	22	30.1	3.4	13	55
2	0.75	1.8	---	0.5	1.5	2.2	---	1.5	3.5	2.7	---	2.5	6.7	3.1	---	8	14.5	3.8	4	20	22.2	4.2	7	35	43.8	4.9	36	106
3	0.97	2.3	---	1	1.7	2.4	---	1.5	4.3	3.3	---	4	8.3	3.8	---	10	18.1	4.7	6	26	27.6	5.2	10	49	54.5	6.1	60	147
4	1.1	2.7	---	1	1.8	2.6	---	1.5	5	3.9	---	6	9.7	4.5	---	12	21.1	5.5	7	32	32.2	6	16	60	63.7	7.1	85	193
5	1.24	3	---	1	2.5	3.6	---	2.5	5.7	4.4	---	6.5	11	5.1	4	15	23.8	6.2	7	39	36.4	6.8	22	74	71.8	8	115	234
6	1.37	3.3	---	1	2.7	3.9	---	2.5	6.2	4.8	---	7	12.1	5.6	4	16	26.3	6.8	9	45	40.1	7.5	30	87				
7	1.5	3.7	---	1.5	2.95	4.3	---	3	6.7	5.2	---	8	13.1	6.1	4	18	28.5	7.4	11	51	42.7	8	34	102				
8	1.6	3.9	---	1.5	3.2	4.6	---	3	7.25	5.6	---	9	14.1	6.5	4.5	20	30.8	8	14	56								
9	1.7	4.1	---	1.5	3.4	4.9	---	3	7.75	6	---	9	15	7	5	21												
10	1.8	4.4	---	1.5	3.6	5.2	---	3.5	8.3	6.4	---	10	15.9	7.4	5	23												
11	1.9	4.6	---	1.5	3.7	5.4	---	3.5	8.7	6.7	---	11	16.8	7.8	5	24												
12	2	4.9	---	2	3.9	5.7	---	3.5	9	7	---	12	17.2	8	5	25												
13	2.08	5.1	---	2	4.1	6	---	4	9.4	7.3	---	12																
14	2.16	5.3	---	2	4.3	6.3	---	4	9.8	7.6	4	13																
15	2.24	5.5	---	2	4.4	6.4	---	4	10.2	8	4	13																
16	2.32	5.7	---	2	4.6	6.7	---	5																				
17	2.4	5.9	---	2	4.8	7	---	5																				
18	2.47	6	---	2	5	7.3	---	6																				
19	2.55	6.2	---	2.5	5.1	7.4	---	6																				
20	2.63	6.4	---	2.5	5.2	7.6	---	6																				
21	2.71	6.6	---	2.5	5.3	7.7	---	6																				
22	2.78	6.8	---	2.5	5.5	8	---	6.5																				
25	3	7.3	---	3																								
30	3.25	8	---	3																								
Per 100 feet of Length																												

Maximum Allowable Load for Schedule 80 CPVC ASTM F 441 Pipe (2½ to 10 inches)

Press. Loss due to Friction	2½ inches				3 inches				4 inches				6 inches				8 inches				10 inches			
			WSFU				WSFU				WSFU				WSFU				WSFU				WSFU	
A-Value	GPM	Vel. ft/sec	FM	FT	GPM	Vel. ft/sec	FM	FT	GPM	Vel. ft/sec	FM	FT	GPM	Vel. ft/sec	FM	FT	GPM	Vel. ft/sec	FM	FT	GPM	Vel. ft/sec	FM	FT
0.5	33.2	2.6	17	64	59.8	3	74	174	125	3.5	393	500	366	4.6	2,416	2,416	768	5.5	7,134	7,134	1,393	6.3	14,756	14,756
1	48.3	3.8	44	121	87	4.3	180	310	181	5.2	784	817	533	6.7	4,117	4,117	1,116	8	11,378	11,378				
2	70.2	5.5	108	226	126	6.3	400	505	281	8	1,629	1,629												
3	87.4	6.8	181	312	157	7.8	600	677																
4	102	8	255	385																				
Per 100 feet of Length																								

Note: CPVC 3inches and larger only approved for cold water.

Maximum Allowable Load For PVC Sched. 80, ASTM 1785, (½ to 2 inches)

Press. Loss due to friction A-value	½ inch				¾ inch				1 inch				1¼ inches				1½ inches				2 inches			
	GPM	Vel. ft/sec	WSFU		GPM	Vel. ft/sec	WSFU		GPM	Vel. ft/sec	WSFU		GPM	Vel. ft/sec	WSFU		GPM	Vel ft/sec	WSFU		GPM	Vel. ft/sec	WSFU	
			FM	FT			FM	FT			FM	FT			FM	FT			FM	FT			FM	FT
0.5	0.77	1	---	0.5	1.7	1.2	---	1.5	3.5	1.5	---	3.5	7	1.7	---	9	11	2	4	16	21.6	2.3	7	33
1	1.1	1.5	---	1	2.5	1.8	---	2.5	5	2.2	---	6	10.5	2.6	4	14	16	2.9	5	23	32	3.4	17	60
2	1.6	2.2	---	1.5	3.7	2.7	---	3.5	7.1	3.1	---	9	15.5	3.8	5	21	23.5	4.2	7	39	46	5	40	87
3	2	2.7	---	2	4.6	3.4	---	4.5	9	4	---	12	19	4.7	6	29	29.4	5.3	12	55	57	6.2	69	160
4	2.4	3.2	---	2	5.3	3.9	---	6	10.5	4.6	4	14	22.3	5.5	7	31	34.2	6.2	19	60	67	7.3	97	210
5	2.7	3.6	---	2.5	6	4.4	---	7	11.8	5.2	4	16	25.3	6.3	8	40	38.4	6.9	25	80	75.4	8	134	251
6	2.9	3.9	---	2.5	6.6	4.9	---	8	13	5.7	4	18	27.7	6.9	10	49	42.1	7.6	32	100				
7	3.2	4.3	---	3	7.2	5.3	---	9	14.1	6.2	4	20	30.1	7.5	12	55	45.8	8	39	112				
8	3.4	4.6	---	3	7.7	5.7	---	9	15	6.6	5	21	32.3	8	16	60								
9	3.7	5	---	3.5	8.2	6	---	10	16	7.1	5	22												
10	3.9	5.3	---	3.5	8.7	6.4	---	10	17	7.6	5	23												
11	4.1	5.6	---	4	9.2	6.8	---	12	17.9	8	5	26												
12	4.3	5.8	---	4	9.6	7.1	---	13																
13	4.5	6.1	---	4.5	10.1	7.5	4	14																
14	4.7	6.4	---	4.5	10.5	7.8	4	14																
15	4.8	6.5	---	4.5	10.8	8	4	15																
16	5	6.8	---	6																				
17	5.2	7.1	---	6																				
18	5.3	7.2	---	6																				
19	5.5	7.5	---	6.5																				
20	5.7	7.8	---	6.5																				
21	5.8	7.9	---	6.5																				
22	5.9	8	---	6.5																				
Per 100 feet of length																								

Maximum Allowable Load For PVC Sched. 80, ASTM 1785, (2½ to 6 inches)

Press. Loss due to friction A-value	2½ inches				3 inches				3 ½ inches				4 inches				5 inches				6 inches			
			WSFU				WSFU				WSFU				WSFU				WSFU				WSFU	
	GPM	Vel. ft/sec	FM	FT	GPM	Vel. ft/sec	FM	FT	GPM	Vel. ft/sec	FM	FT	GPM	Vel. ft/sec	FM	FT	GPM	Vel. ft/sec	FM	FT	GPM	Vel. ft/sec	FM	FT
0.5	35	2.6	20	70	64	3.1	87	105	92	3.3	200	335	130	3.6	425	527	237	4	1,226	1,226	380	4.6	2,546	2,546
1	51	3.8	50	130	91	4.4	196	330	134	4.8	450	550	188	5.2	835	855	344	6	2,213	2,213	569	7	4,647	4,647
2	74	5.6	125	245	132	6.4	436	536	195	7	885	900	274	7.6	1,564	1,564								
3	92	6.9	200	330	164	8	654	717																
4	108	8	288	415																				
Per 100 feet of length																								

Appendix C

Multipurpose Piping Calculation Worksheets

WATER CALCULATION WORKSHEET FOR ______________________________
NAME/ADDRESS OF PROJECT

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Demand of building in gallons per minute. WSFU's ________ = (GPM)________
2. Difference in elevation from main or external pressure tank to building control valve. (feet)________
3. Size of the water meter. (When applicable) 5/8" __, 3/4" __, 1" __, 1-1/2" __, 2" __, 3" __, 4" __, 6" __
4. Developed length from main or external pressure tank to building control valve. (feet) ________
5. Low pressure at main in street or external pressure tank. (psig)________

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of # 5 above) ________
7. Water service diameter is _______. Material is ____________________. Pressure loss per 100 ft = ______ psi. X ________(decimal equivalent of service length, i.e.; 65ft = .65) ________

   (Subtract line 7. from line 6.) **subtotal** ________
8. Determine pressure **gain or loss** due to elevation, (multiply the value of # 2 above by .434) value of "8" ________
9. Available pressure after the bldg. control valve. (Subtract or add line 8. Enter in "B".) **subtotal** ________

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "A")

B. Available pressure after the bldg. control valve. (from "9" above) Value of "B" ________

C. Pressure loss of water meter (when meter is required or installed) Value of "C" ________

(Subtract line C. from line B.) **subtotal** ________

D. Pressure at controlling fixture. Value of "D" ________
(Controlling fixture is ______________________________)
(Subtract the value of D.) **subtotal** ________

E. Difference in elevation between the building control valve and the controlling fixture in feet ________ X .434 psi/ft. Value of "E" ________

(Subtract the value of E.) **subtotal** ________

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. Value of "F" ________
(Pressure loss due to ______________________________)
(Subtract the value of F.) **subtotal** ________

G. Developed length from building control valve to controlling fixture in feet ________ X 1.5 Value of "G" ________

(Divide by the value of G.) **subtotal** ________
(Water distribution piping material is ____________________)
Multiply by ___100___

A. Pressure available for uniform loss **"A"** = ________

SBD – 10717 – E (n. 3/01)

FIRE-WATER CALC WORKSHEET FOR ______________________

(Based upon the Hazen-Williams Formula)

NAME/ADDRESS OF PROJECT

Print

INFORMATION REQUIRED TO CALCULATE WATER SERVICE SIZE

1. Sprinkler Demand: 1 Sprinkler (gpm) ____ 2 Sprinklers (gpm) ____ Total GPM = ________
   Sprinkler Manufacturer; ____________ Model # ________ K-Factor; ________
2. Difference in elevation from main to external pressure tank or to building control valve. (feet) ________
3. Size of the water meter when applicable. Example; 5/8, 3/4, 1, 2, 3, 4. ________
4. Developed length from main or external pressure tank to building control valve. (feet) ________
5. Low pressure at main in street or external pressure tank. (psig) ________

CALCULATE WATER SERVICE PRESSURE LOSS

6. Low pressure at main in street or external pressure tank. (value of #5 above) ________
7. Water service diameter is ______ Material is ______________________ Pressure loss per 100 ft = ________ psi X ________ (decimal equivalent of service length, i.e. 65 ft = 0.65) ________
   (Subtract line 7. From line 6.) subtotal ________
8. Determine pressure gain or loss due to elevation. (multiply the value of #2 above by 0.434) value of "8" ________
9. Available pressure after the bldg. Control valve. (subtract or add line 8. Enter in "B".) **subtotal** ________

CALCULATE THE PRESSURE AVAILABLE FOR UNIFORM LOSS (VALUE OF "

B. Available pressure after the building control valve. (from "9" above) value of "B" ________

C. Pressure loss of water meter. (when meter is required or installed) value of "C" ________
   (subtract line C. From B.) **subtotal** ________

D. Pressure at controlling sprinkler(s). value of "D" ________
   (controlling sprinkler(s) is ______________________________)
   (subtract the value of D.) **subtotal** ________

E. Difference in elevation between the building control valve and the controlling sprinkler(s) in feet; ________ X 0.434 psi/ft. value of "E" ________
   (subtract the value of E.) **subtotal** ________

F. Pressure loss due to water treatment devices, instantaneous water heaters and backflow preventers which serve the controlling fixture. value of "F" ________
   Pressure loss due to ________________ (subtract the value of F) **subtotal** ________

G. Developed length from building control valve to controlling sprinkler in feet ________ X 1.5 value of "G" ________
   (divide by the value of G.) **subtotal** ________
   (Note: Excessive number of fittings refer to material fitting pressure loss tables)
   Water distribution piping material is: ______________________

(multiply by 100) 100

A. Pressure available for uniform loss **"A"** = ________

Segmented Method: May Be Used Only For MPP Systems Connected to 4" Municipal Main or Larger

MULTIPURPOSE PIPING CALCULATION WORKSHEET FOR______________________

AREA WHICH IS BEING SERVED

INFORMATION REQUIRED TO CALCULATE WATER SERVICE DIAMETER

1. Sprinkler demand 1sprinkler __, 2 sprinklers __, add 5 gpm for 2 family dwelling __ (GPM) _________
2. Difference in elevation from main or external pressure tank to building control valve. (feet) _________
3. Size of the water meter. (When applicable) 5/8" __, 3/4" __, 1" __, 1-1/2" __, 2" __, 3" __, 4" __, 6" __
4. Developed length from main or external pressure tank to building control valve. (feet) ________

CALCULATE WATER SERVICE PRESSURE LOSS

5. Low pressure at main in street or external pressure tank. _________
6. Water service diameter is ________. Material is ______________________. Pressure loss per 100 ft = _______ psi. X ________(decimal equivalent of service length, i.e.; 65ft = .65) _________

(Subtract line 6 from line 5.) **subtotal** _________

7. Determine pressure **gain or loss** due to elevation, (multiply the value of # 2 above by .434) value of "7" _________
8. Available pressure. . (Add or subtract the value of "7".) **subtotal** _________
9. Pressure loss of water meter (when meter is required or installed) value of "9" _________
10. Available pressure after the building control valve. (Subtract line 9 from line 8.) **subtotal** _________
11. Pressure loss through water softeners, filters and devices which serve this system… … … … . _________
12. Available pressure before segment loss. (Subtract line 11 from line 10.) **subtotal** _________

	Sprinkler 1		Sprinkler 2		Segment 1		Segment 2		Segment 3		Segment 4	
Pipe size												
Material												
GPM												
Elevation												
	Qty.	Equiv.	Qty.	Equiv.	Qty.	Equiv.	Qty.	Equiv.	Qty.	Equiv.	Qty.	Equiv.
45 Ell												
90 Ell												
90 L. T. Ell												
Tee, branch												
Tee, run												
Coupling												
Adapter												
Gate vlv.												
Ball vlv.												
Pipe length	XXX		XXX		XXX		XXX		XXX		XXX	

(a) Total Equiv. Length ________ ________ ________ ________ ________ ________

(b) Loss Per Foot ________ ________ ________ ________ ________ ________

(c) Loss (a) x (b) ________ ________ ________ ________ ________ ________

(d) Elev. Loss ________ ________

(e) Sprinkler psig ________ ________

(f) Total (c + d + e) ________ ________

(g) Total loss from Segments 1 through 4 … … ________

(h) Pressure loss from the most demanding sprinkler segment. (Line (f), Sprinkler 1 or Sprinkler 2)………… ________

(i) Pressure required at the building control valve or after the device listed in line 11. (Line (g) + line (h))….. ________

(j) Pressure available from line 12. (Must be equal to or greater than line (i) above)……………………………… ________

CPVC Tube ASTM F-442 SDR 13.5 (C= 150)

Flow rate (gpm)	3/4 inch Pressure loss/ft	1 inch Pressure loss/ft	1 1/4 inch Pressure loss/ft	1 1/2 inch Pressure loss/ft	2 inch Pressure loss/ft
10	**.058**	**.019**	**.006**	**.003**	**.001**
11	**.070**	**.023**	**.007**	**.004**	**.001**
12	**.082**	**.027**	**.008**	**.004**	**.001**
13	**.095**	**.031**	**.010**	**.005**	**.002**
14	**.109**	**.035**	**.011**	**.006**	**.002**
15	**.124**	**.040**	**.013**	**.006**	**.002**
16	**.139**	**.045**	**.014**	**.007**	**.002**
17	**.156**	**.051**	**.016**	**.008**	**.003**
18	**.173**	**.056**	**.018**	**.009**	**.003**
19	**.192**	**.062**	**.020**	**.010**	**.003**
20	**.211**	**.069**	**.022**	**.011**	**.004**
21	**.231**	**.075**	**.024**	**.012**	**.004**
22	**.251**	**.082**	**.026**	**.013**	**.004**
23	**.273**	**.089**	**.028**	**.014**	**.005**
24	**.295**	**.096**	**.030**	**.016**	**.005**
25	**.318**	**.104**	**.033**	**.017**	**.006**
26	**.342**	**.111**	**.035**	**.018**	**.006**
27	**.367**	**.119**	**.038**	**.019**	**.006**
28	**.393**	**.128**	**.041**	**.021**	**.007**
29	**.419**	**.136**	**.043**	**.022**	**.007**
30	**.446**	**.145**	**.046**	**.024**	**.008**
31	**.474**	**.154**	**.049**	**.025**	**.008**
32	**.503**	**.164**	**.052**	**.027**	**.009**
33	**.533**	**.173**	**.055**	**.028**	**.009**
34	**.563**	**.183**	**.058**	**.030**	**.010**
35	**.594**	**.193**	**.061**	**.032**	**.010**
36	**.626**	**.203**	**.065**	**.033**	**.011**
37	**.658**	**.214**	**.068**	**.035**	**.012**
38	**.692**	**.225**	**.071**	**.037**	**.012**
39	**.726**	**.236**	**.075**	**.039**	**.013**
40	**.761**	**.247**	**.078**	**.040**	**.013**

Copper Tube Type M ASTM B88 (C = 150)

Flow rate (gpm)	3/4 inch Pressure loss/ft	1 inch Pressure loss/ft	1 1/4 inch Pressure loss/ft	1 1/2 inch Pressure loss/ft	2 inch Pressure loss/ft
10	**.084**	**.023**	**.009**	**.004**	**.001**
11	**.100**	**.028**	**.010**	**.005**	**.001**
12	**.118**	**.033**	**.012**	**.005**	**.001**
13	**.137**	**.038**	**.014**	**.006**	**.002**
14	**.157**	**.044**	**.016**	**.007**	**.002**
15	**.178**	**.049**	**.019**	**.008**	**.002**
16	**.201**	**.056**	**.021**	**.009**	**.002**
17	**.224**	**.062**	**.023**	**.010**	**.003**
18	**.249**	**.069**	**.026**	**.011**	**.003**
19	**.276**	**.077**	**.029**	**.013**	**.003**
20	**.303**	**.084**	**.032**	**.014**	**.004**
21	**.332**	**.092**	**.035**	**.015**	**.004**
22	**.362**	**.101**	**.038**	**.017**	**.004**
23	**.393**	**.109**	**.041**	**.018**	**.005**
24	**.425**	**.118**	**.044**	**.020**	**.005**
25	**.458**	**.127**	**.048**	**.021**	**.006**
26	**.493**	**.137**	**.051**	**.023**	**.006**
27	**.529**	**.147**	**.055**	**.024**	**.006**
28	**.565**	**.157**	**.059**	**.026**	**.007**
29	**.603**	**.168**	**.063**	**.028**	**.007**
30	**.642**	**.179**	**.067**	**.030**	**.008**
31	**.683**	**.190**	**.071**	**.031**	**.008**
32	**.724**	**.201**	**.075**	**.033**	**.009**
33	**.766**	**.213**	**.080**	**.035**	**.009**
34	**.810**	**.225**	**.084**	**.037**	**.010**
35	**.855**	**.238**	**.089**	**.039**	**.010**
36	**.900**	**.250**	**.094**	**.041**	**.011**
37	**.947**	**.263**	**.099**	**.044**	**.011**
38	**.995**	**.277**	**.104**	**.046**	**.011**
39	**1.044**	**.290**	**.109**	**.048**	**.013**
40	**1.094**	**.304**	**.114**	**.050**	**.013**

CPVC ASTM F-442
Equivalent length of Pipe in Fittings

	3/4	1	1 1/4	1 1/2	2
45 ell	**1**	**1**	**2**	**2**	**2**
90 ell	**7**	**7**	**8**	**9**	**11**
Coupling	**1**	**1**	**1**	**1**	**1**
Tee on branch	**3**	**5**	**6**	**8**	**10**
Tee on run	**1**	**1**	**1**	**1**	**1**

Copper Type M ASTM B88
Equivalent length of Pipe in Fittings

	3/4	1	1 1/4	1 1/2	2
45 ell	**0**	**2**	**1**	**2**	**3**
90 ell	**2**	**3**	**3**	**5**	**7**
90 L. T. ell	**0**	**3**	**2**	**2**	**4**
Tee on branch	**4**	**8**	**7**	**9**	**13**
Tee on run	**1**	**3**	**2**	**3**	**5**

Equivalent length of Pipe in Valves

	3/4	1	1 1/4	1 1/2	2
Gate Valve	**0**	**0**	**0**	**0**	**1**
Full flow ball valve	**0**	**0**	**0**	**0**	**1**
Check Valve	**0**	**8**	**8**	**11**	**14**

WATER CALCULATION WORKSHEET INSTRUCTIONS

The front cover of this pamphlet is a standard water calculation worksheet. The multipurpose piping system must be sized for the water distribution and multipurpose piping system. Use the front cover to do the water sizing as you would for any system without sprinklers. Next do the calculations for the multipurpose system with the pages that follow. The multipurpose piping must be sized to meet the requirements of both systems.

SPRINKLER CALCULATION WORKSHEET INSTRUCTIONS

FILL IN THE SEGMENT LOSS TABLE

There are 6 columns provided for calculating the loss from friction through the length of piping. Generally a Segment is defined as the equivalent length of pipe of a given size. The first two segments are intended to be used for the sprinklers in a multiple sprinkler compartment. Only one column is required when sizing for a single sprinkler compartment.

Fill in the top 4 rows of the sprinkler columns first. The pipe size, material, gpm (flow rate) through the segment and elevation from the control valve to the sprinkler.

The column headed "Qty." is provided for the number of each of the fittings in the rows. The column headed "Equiv." is the equivalent feet of the fittings multiplied by the quantity of the fittings, i.e. 6 - 1 ¼ copper 90 degree ell's @ 3 equivalent feet for each equals 18 equivalent feet in the 90 Ell row.

The last row (Pipe length) is for entering the actual length of pipe (in feet) in the segment.

If the worksheet is being filled in for a multiple sprinkler compartment and you are not sure which sprinkler in the compartment is the most demanding, complete both sprinkler columns including all fittings and pipe for each sprinkler back to the point where they are both served by one common tee. Include that tee in the column. If the pipe diameter increases before the common tee, use one or more of the Segment columns to include the piping. The most demanding sprinkler in the compartment must be used in the calculation.

Line (a) Add the "Equiv." column from "45 Ell" down through "Pipe length".
Line (b) Go to the appropriate table on the opposite page; find the pipe size and gpm in that segment. The number in the intersecting row and column is the loss per foot. I.e. 26 gpm through a 1 ¼ " Copper tube type M equals a .051 pressure loss per foot.
Line (c) Multiply (a) the Total Equivalent Length by (b) pressure loss per foot. Enter the total in each of the columns.
Line (d) Enter the elevation loss from the building control valve to the sprinkler (height x .434). (Sprinkler columns only).
Line (e) Each sprinkler has a pressure required to supply the gpm for the coverage area. This is part of the listing. i.e. For a coverage area of 12ft x 12ft a single sprinkler may require a minimum flow of 12 gpm and residual pressure of 11.8. Enter the pressure of 11.8.
Line (f) Add rows (c), (d) and (e). This is the loss from the sprinkler or sprinklers. Compare the two sprinkler columns and any additional Segments for the sprinkler. The sprinkler with the greatest loss is the most demanding.

Once you have determined the most demanding sprinkler, the combined gpm from the two sprinklers can be used to determine the loss from the water service, water meter and piping upstream. Continue by filling in the Segment columns that include the balance of the piping back to the building control valve or an appliance or device that creates an additional pressure loss.

Line (g) Add the loss from each Segment from line (c). Include only the Segments.
Line (h) Enter pressure required by the most demanding sprinkler. From line (f), Sprinkler 1 or Sprinkler 2.
Line (i) Add line (g) and line (h). The result is the pressure required at the building control valve or after an appliance or other device that creates an additional pressure loss.

CALCULATE WATER SERVICE PRESSURE LOSS

Line 1. Place an "X" to indicate the number of design sprinklers, 1 sprinkler or 2 sprinklers. Also place an "X" if the project is a 2 family dwelling. Write in the gpm demand from the design sprinklers (maximum of 2) and any additional as a result of serving a 2 family dwelling. It will be used for determining the pressure loss through the water service and water meter.

Line 5. Determine the low pressure at the main or an external pressure tank. You may need to contact the water purveyor for this information. If the system is being served by a well with an internal pressure tank, enter the low pressure at the internal pressure tank in line 8.

Continue to fill in lines 6 through line 12.

Line (j) Enter the remaining pressure from line 12.