

APPENDIX A

RECOMMENDED RULES FOR SIZING THE WATER SUPPLY SYSTEM

A 101.0 General.

A 101.1 Applicability. This appendix provides a general procedure for sizing a water supply system. Because of the variable conditions encountered, it is impractical to lay down definite detailed rules of procedure for determining the sizes of water supply pipes in an appendix, which shall necessarily be limited in length. For a more adequate understanding of the problems involved, refer to Water-Distributing Systems for Buildings, Report BMS 79 of the National Bureau of Standards; and Plumbing Manual, Report BMS 66, also published by the National Bureau of Standards.

»» A 102.0 Preliminary Information.

»» **A 102.1 Daily Service Pressure.** Obtain the necessary information regarding the minimum daily service pressure in the area where the building is to be located.

»» **A 102.2 Water Meter.** Where the building supply is to be metered, obtain information regarding friction loss relative to the rate of flow for meters in the range of sizes likely to be used. Friction-loss data is capable of being obtained from most manufacturers of water meters. Friction losses for disk-type meters shall be permitted to be obtained from Chart A 102.2.

»» **A 102.3 Local Information.** Obtain available local information regarding the use of different kinds of pipe with respect

both to durability and to decrease in capacity with length of service in the particular water supply.

A 103.0 Demand Load.

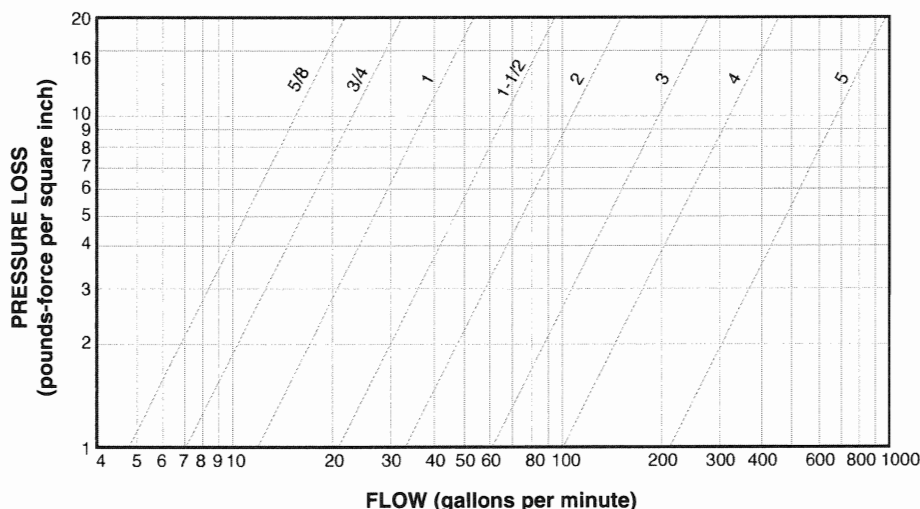
A 103.1 Supply Demand. Estimate the supply demand for the building main, the principal branches and risers of the system by totaling the fixture units on each, Table A 103.1, and then by reading the corresponding ordinate from Chart A 103.1(1) or Chart A 103.1(2), whichever is applicable.

A 103.2 Continuous Supply Demand. Estimate continuous supply demands in gallons per minute (gpm) (L/s) for lawn sprinklers, air conditioners, etc., and add the sum to the total demand for fixtures. The result is the estimated supply demand of the building supply.

A 104.0 Permissible Friction Loss.

A 104.1 Residual Pressure. Decide what is the desirable minimum residual pressure that shall be maintained at the highest fixture in the supply system. Where the highest group of fixtures contains flushometer valves, the residual pressure for the group shall be not less than 15 pounds-force per square inch (psi) (103 kPa). For flush tank supplies, the available residual pressure shall be not less than 8 psi (55 kPa).

CHART A 102.2
FRICTION LOSSES FOR DISK-TYPE WATER METERS



For SI units: 1 inch = 25 mm, 1 pound-force per square inch = 6.8947 kPa, 1 gallon per minute = 0.06 L/s

- » **A 104.2 Elevation.** Determine the elevation of the highest fixture or group of fixtures above the water (street) main. Multiply this difference in elevation by 0.43. The result is the loss in static pressure in psi (kPa).
- » **A 104.3 Available Pressure.** Subtract the sum of loss in static pressure and the residual pressure to be maintained at the highest fixture from the average minimum daily service pressure. The result will be the pressure available for friction loss in the supply pipes, where no water meter is used. Where a meter is to be installed, the friction loss in the meter for the estimated maximum demand should also be subtracted from the service pressure to determine the pressure loss available for friction loss in the supply pipes.
- » **A 104.4 Developed Length.** Determine the developed length of pipe from the water (street) main to the highest fixture. Where close estimates are desired, compute with the aid of Table A 104.4, the equivalent length of pipe for fittings in the line from the water (street) main to the highest fixture and add the sum to the developed length. The pressure available for friction loss in psi (kPa), divided by the developed lengths of pipe from the water (street) main to the highest fixture, times 100, will be the average permissible friction loss per 100 feet (30 480 mm) length of pipe.
- » **A 105.0 Size of Building Supply.**
- » **A 105.1 Diameter.** Knowing the permissible friction loss per 100 feet (30 480 mm) of pipe and the total demand, the diameter of the building supply pipe shall be permitted to be obtained from Chart A 105.1(1), Chart A 105.1(2), Chart A 105.1(3), or Chart A 105.1(4), whichever is applicable. The diameter of pipe on or next above the coordinate point corresponding to the estimated total demand and the permissible friction loss will be the size needed up to the first branch from the building supply pipe.
- » **A 105.2 Copper and Copper Alloy Piping.** Where copper tubing or copper alloy pipe is to be used for the supply piping and where the character of the water is such that slight changes in the hydraulic characteristics are expected, Chart A 105.1(1) shall be permitted to be used.
- » **A 105.3 Hard Water.** Chart A 105.1(2) shall be used for ferrous pipe with the most favorable water supply in regards to corrosion and caking. Where the water is hard or corrosive, Chart A 105.1(3) or Chart A 105.1(4) will be applicable. For extremely hard water, it will be advisable to make additional allowances for the reduction of capacity of hot-water lines in service.
- » **A 106.0 Size of Principal Branches and Risers.**
- » **A 106.1 Size.** The required size of branches and risers shall be permitted to be obtained in the same manner as the building supply, by obtaining the demand load on each branch or riser and using the permissible friction loss computed in Section A 104.0.
- » **A 106.2 Branches.** Where fixture branches to the building supply are sized for the same permissible friction loss per 100 feet (30 480 mm) of pipe as the branches and risers to the highest level in the building, and lead to inadequate

water supply to the upper floor of a building, one of the following shall be provided:

- (1) Selecting the sizes of pipe for the different branches so that the total friction loss in each lower branch is approximately equal to the total loss in the riser, including both friction loss and loss in static pressure.
- (2) Throttling each such branch by means of a valve until the preceding balance is obtained.
- (3) Increasing the size of the building supply and risers above the minimum required to meet the maximum permissible friction loss.

A 106.3 Water Closets. The size of branches and mains serving flushometer tanks shall be consistent with sizing procedures for flush tank water closets. <<

A 107.0 General. <<

A 107.1 Velocities. Velocities shall not exceed 10 feet per second (ft/s) (3 m/s), except as otherwise approved by the Authority Having Jurisdiction. <<

A 107.2 Pressure-Reducing Valves. Where a pressure-reducing valve is used in the building supply, the developed length of supply piping and the permissible friction loss shall be computed from the building side of the valve. <<

A 107.3 Fittings. The allowances in Table A 104.4 for fittings are based on non-recessed threaded fittings. For recessed threaded fittings and streamlined soldered fittings, one-half of the allowances given in the table will be ample. <<

**TABLE A 103.1
WATER SUPPLY FIXTURE UNITS (WSFU) AND MINIMUM FIXTURE BRANCH PIPE SIZES³**

APPLIANCES, APPURTENANCES, OR FIXTURES ²	MINIMUM FIXTURE BRANCH PIPE SIZE ^{1,4} (inches)	PRIVATE	PUBLIC	ASSEMBLY ⁶
Bathtub or Combination Bath/Shower (fill)	½	4.0	4.0	–
¾ inch Bathtub Fill Valve	¾	10.0	10.0	–
Bidet	½	1.0	–	–
Clothes Washer	½	4.0	4.0	–
Dental Unit, cuspidor	½	–	1.0	–
Dishwasher, domestic	½	1.5	1.5	–
Drinking Fountain or Water Cooler	½	0.5	0.5	0.75
Hose Bibb	½	2.5	2.5	–
Hose Bibb, each additional ⁷	½	1.0	1.0	–
Lavatory	½	1.0	1.0	1.0
Lawn Sprinkler, each head ⁵	–	1.0	1.0	–
Mobile Home, each (minimum)	–	12.0	–	–
Sinks	–	–	–	–
Bar	½	1.0	2.0	–
Clinical Faucet	½	–	3.0	–
Clinical Flushometer Valve with or without faucet	1	–	8.0	–
Kitchen, domestic	½	1.5	1.5	–
Laundry	½	1.5	1.5	–
Service or Mop Basin	½	1.5	3.0	–
Washup, each set of faucets	½	–	2.0	–
Shower per head	½	2.0	2.0	–
Urinal, 1.0 GPF Flushometer Valve	¾	3.0	4.0	5.0
Urinal, greater than 1.0 GPF Flushometer Valve	¾	4.0	5.0	6.0
Urinal, flush tank	½	2.0	2.0	3.0
Wash Fountain, circular spray	¾	–	4.0	–
Water Closet, 1.6 GPF Gravity Tank	½	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Tank	½	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Valve	1	5.0	5.0	8.0
Water Closet, greater than 1.6 GPF Gravity Tank	½	3.0	5.5	7.0
Water Closet, greater than 1.6 GPF Flushometer Valve	1	7.0	8.0	10.0

For SI units: 1 inch = 25 mm

Notes:

¹ Size of the cold branch pipe, or both the hot and cold branch pipes.

² Appliances, appurtenances, or fixtures not included in this table shall be permitted to be sized by reference to fixtures having a similar flow rate and frequency of use.

³ The listed fixture unit values represent their total load on the cold water building supply. The separate cold water and hot water fixture unit value for fixtures having both cold and hot water connections shall be permitted to each be taken as three-quarters of the listed total value of the fixture.

⁴ The listed minimum supply branch pipe sizes for individual fixtures are the nominal (I.D.) pipe size.

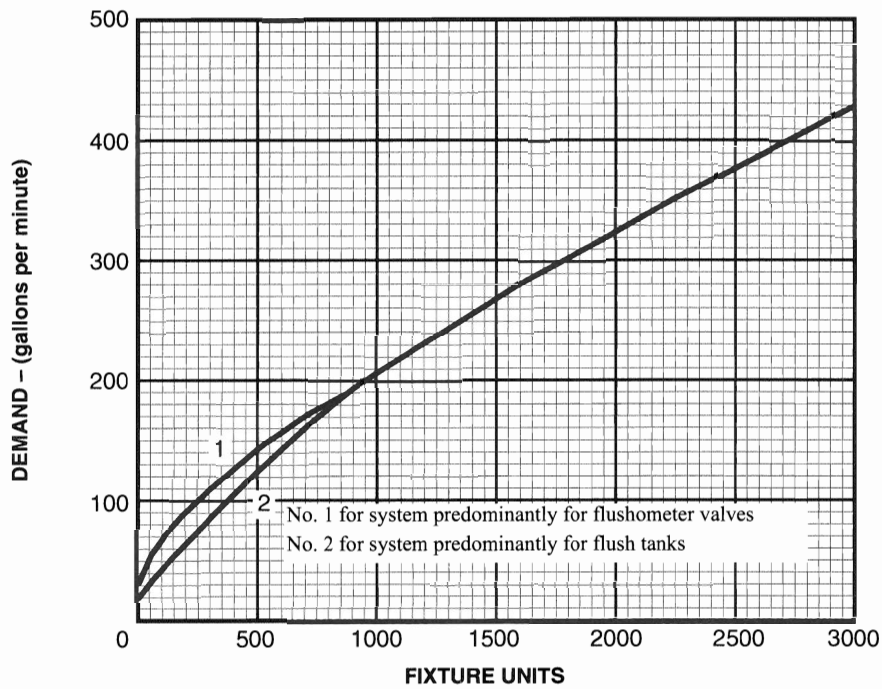
⁵ For fixtures or supply connections likely to impose continuous flow demands, determine the required flow in gallons per minute (gpm) (L/s) and add it separately to the demand in gpm (L/s) for the distribution system or portions thereof.

⁶ Assembly [Public Use (see Table 422.1)].

⁷ Reduced fixture unit loading for additional hose bibbs is to be used where sizing total building demand and for pipe sizing where more than one hose bibb is supplied by a segment of water distribution pipe. The fixture branch to each hose bibb shall be sized on the basis of 2.5 fixture units.



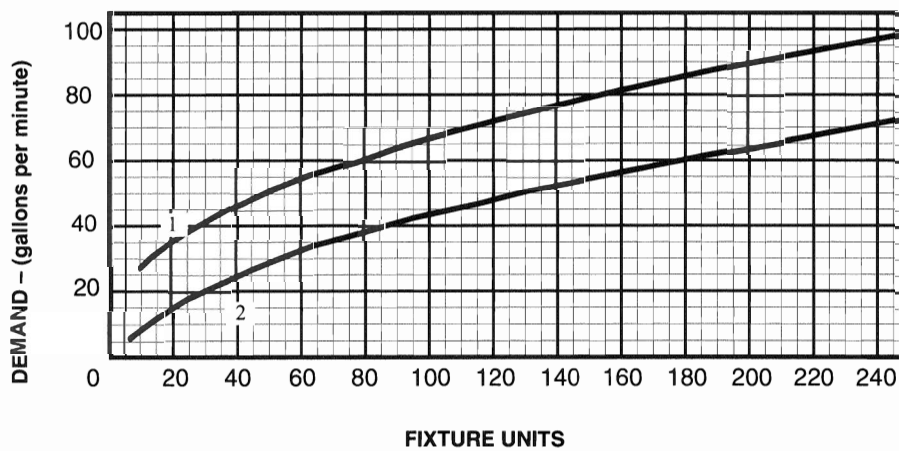
CHART A 103.1(1)
ESTIMATE CURVES FOR DEMAND LOAD



For SI units: 1 gallon per minute = 0.06 L/s



CHART A 103.1(2)
ENLARGED SCALE DEMAND LOAD



For SI units: 1 gallon per minute = 0.06 L/s



**TABLE A 104.4
ALLOWANCE IN EQUIVALENT LENGTH OF PIPE FOR FRICTION LOSS IN VALVES AND THREADED FITTINGS*
EQUIVALENT LENGTH OF PIPE FOR VARIOUS FITTINGS**

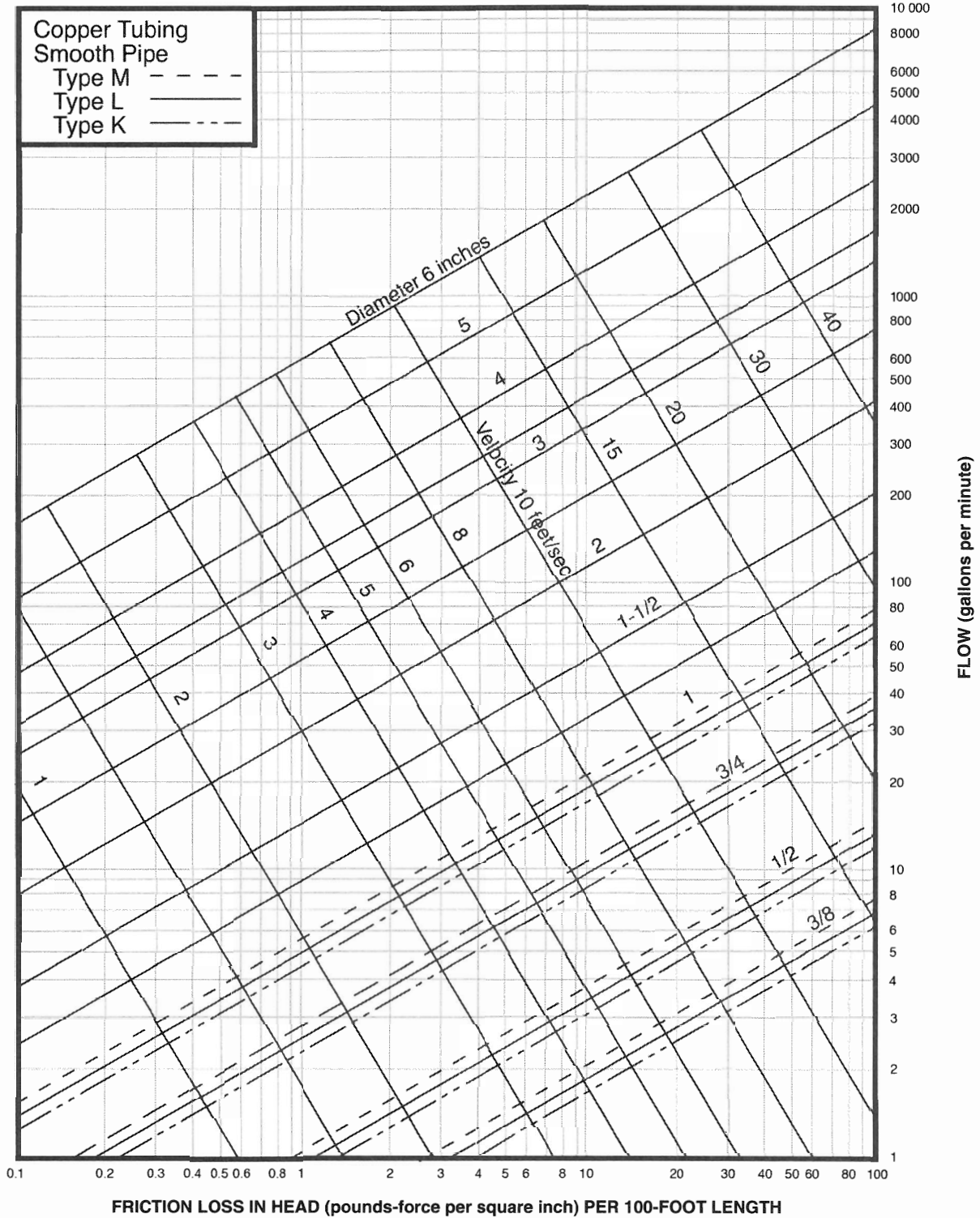
DIAMETER OF FITTING (inches)	90° STANDARD ELBOW (feet)	45° STANDARD ELBOW (feet)	90° STANDARD TEE (feet)	COUPLING OR STRAIGHT RUN OF TEE (feet)	GATE VALVE (feet)	GLOBE VALVE (feet)	ANGLE VALVE (feet)
3/8	1.0	0.6	1.5	0.3	0.2	8	4
1/2	2.0	1.2	3.0	0.6	0.4	15	8
3/4	2.5	1.5	4.0	0.8	0.5	20	12
1	3.0	1.8	5.0	0.9	0.6	25	15
1 1/4	4.0	2.4	6.0	1.2	0.8	35	18
1 1/2	5.0	3.0	7.0	1.5	1.0	45	22
2	7.0	4.0	10.0	2.0	1.3	55	28
2 1/2	8.0	5.0	12.0	2.5	1.6	65	34
3	10.0	6.0	15.0	3.0	2.0	80	40
4	14.0	8.0	21.0	4.0	2.7	125	55
5	17.0	10.0	25.0	5.0	3.3	140	70
6	20.0	12.0	30.0	6.0	4.0	165	80

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm, 1 degree = 0.017 rad

* Allowances are based on nonrecessed threaded fittings. Use one-half the allowances for recessed threaded fittings or streamlined solder fittings.



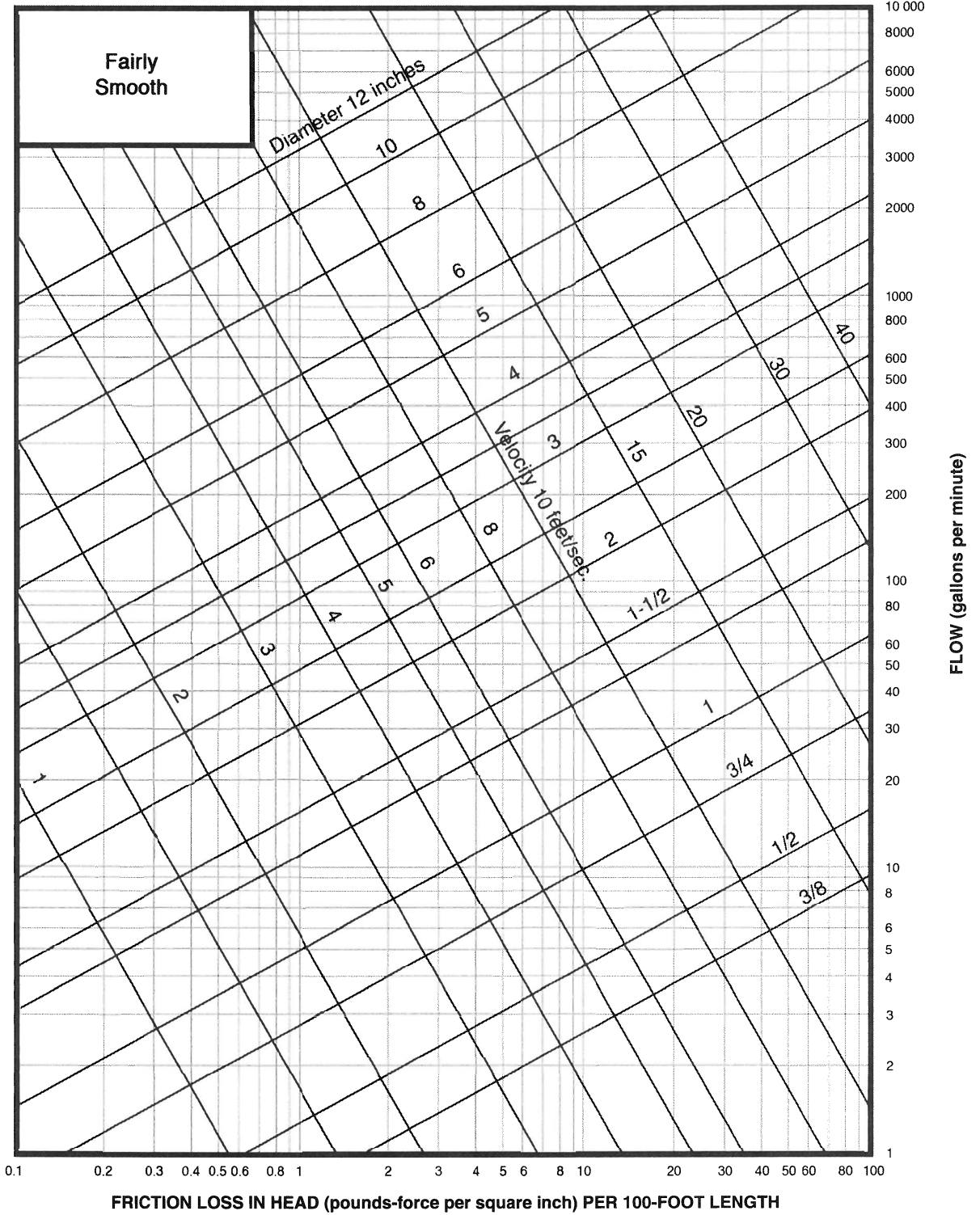
CHART A 105.1(1)



For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s



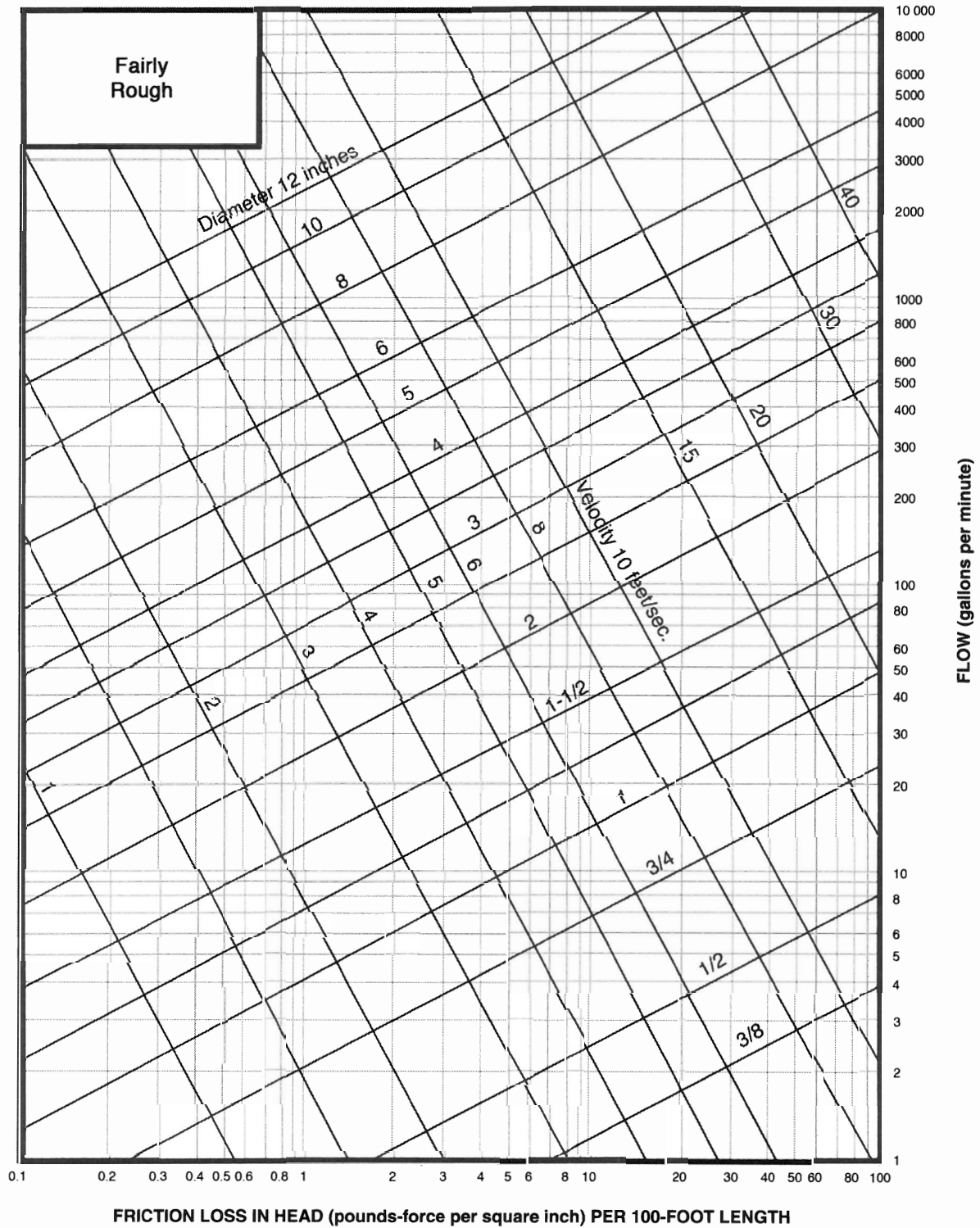
CHART A 105.1(2)



For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s



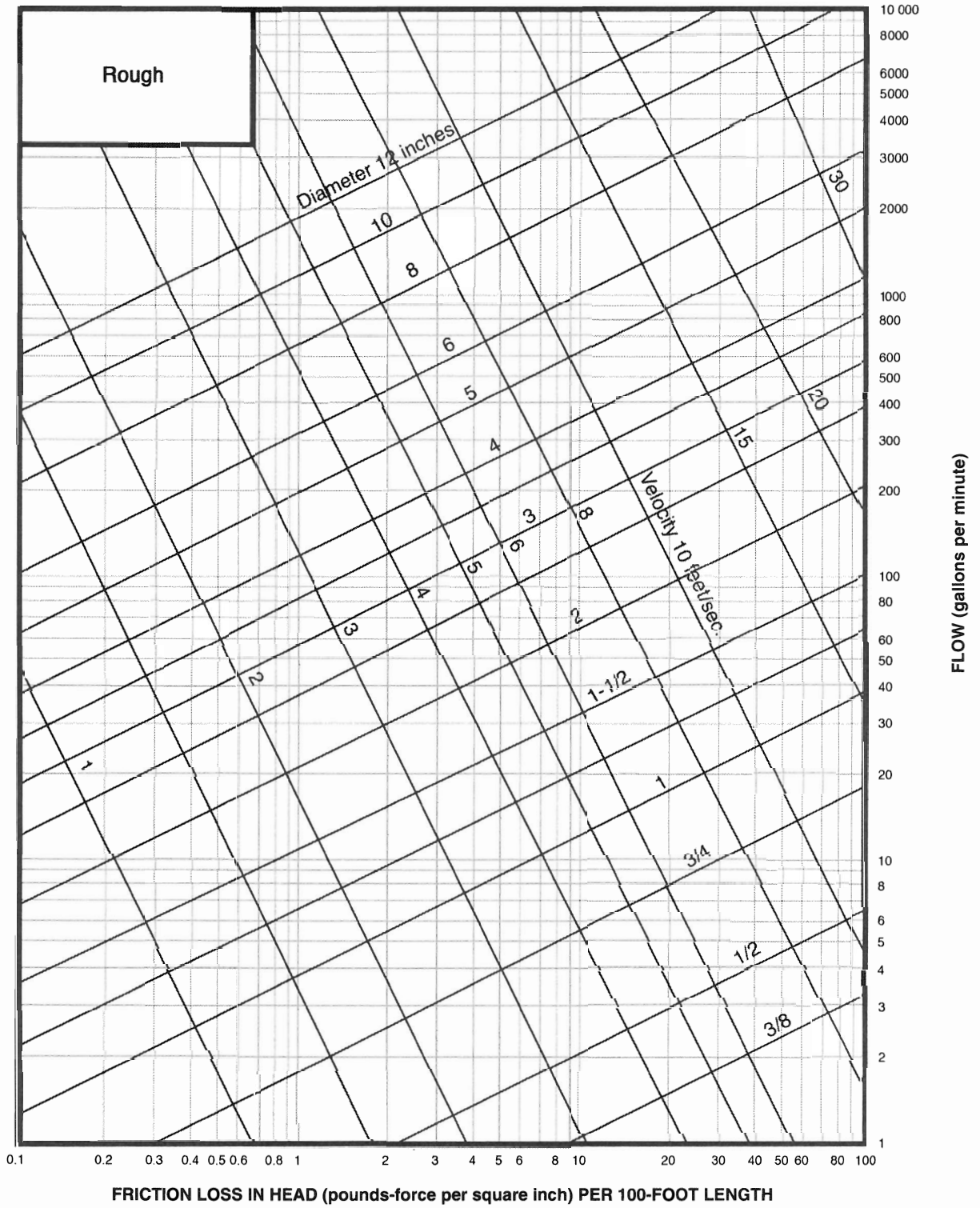
CHART A 105.1(3)



For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s



CHART A 105.1(4)



For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

APPENDIX A

» **A 108.0 Sizing.**

» **A 108.1 Example.** Assume an office building of four stories and basement; pressure on the building side of the pressure-reducing valve of 55 psi (379 kPa) (after an allowance for reduced pressure falloff at peak demand); an elevation of highest fixture above the pressure-reducing valve of 45 feet (13 716 mm); a developed length of pipe from the pressure-reducing valve to the most distant fixture of 200 feet (60 960 mm); and fixtures to be installed with flush valves for water closets and stall urinals as follows:

Where the pipe material and water supply are such that Chart A 105.1(2) applies, the required diameter of the building supply is 3½ inches (90 mm) and the required diameter of the branch to the hot-water heater is 1½ inches (40 mm).

The sizes of the various branches and risers shall be permitted to be determined in the same manner as the size of the building supply or the branch to the hot-water system, by estimating the demand for the riser or branch from Chart A 103.1(1) or Chart A 103.1(2) and applying the total demand estimate from the branch, riser, or section thereof to the appropriate flowchart.



A 108.1 EXAMPLE

FIXTURE UNITS AND ESTIMATED DEMANDS							
BUILDING SUPPLY DEMAND				BRANCH TO HOT WATER SYSTEM			
KIND OF FIXTURES	NUMBER OF FIXTURES	FIXTURE UNIT DEMAND	TOTAL UNITS	BUILDING SUPPLY DEMAND (gallons per minute)	NUMBER OF FIXTURES	FIXTURE UNIT DEMAND CALCULATION	DEMAND (gallons per minute)
Water Closets	130	8.0	1040	–	–	–	–
Urinals	30	4.0	120	–	–	–	–
Showerheads	12	2.0	24	–	12	12 x 2 x ¾ = 18	–
Lavatories	100	1.0	100	–	100	100 x 1 x ¾ = 75	–
Service Sinks	27	3.0	81	–	27	27 x 3 x ¾ = 61	–
Total	–	–	1365	252	–	154	55

For SI units: 1 gallon per minute = 0.06 L/s, 1 pound-force per square foot = 6.8947 kPa

Allowing for 15 psi (103 kPa) at the highest fixture under the maximum demand of 252 gallons per minute (15.88 L/s), the pressure available for friction loss is found by the following:

$$55 - [15 + (45 \times 0.43)] = 20.65 \text{ psi (142.38 kPa)}$$

The allowable friction loss per 100 feet (30 480 mm) of pipe is therefore:

$$100 \times 20.65 \div 200 = 10.32 \text{ psi (71.15 kPa)}$$

CALIFORNIA PLUMBING CODE – MATRIX ADOPTION TABLE
APPENDIX B - EXPLANATORY NOTES ON COMBINATION WASTE AND VENT SYSTEMS

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the code user. See Chapter 1 for state agency authority and building applications.)

Adopting Agency	BSC	BSC- CG	SFM	HCD				DSA			OSHPD				BSCC	DPH	AGR	DWR	CA	CEC	SL	SLC
				1	2	1-AC	AC	SS	SS/C	1	2	3	4									
Adopt Entire Chapter	X							X	X	X	X	X	X									
Adopt Entire Chapter as amended (amended sections listed below)																						
Adopt only those sections that are listed below																						
Chapter/Section																						

This state agency does not adopt sections identified with the following symbol: †

The Office of the State Fire Marshal's adoption of this chapter or individual sections is applicable to structures regulated by other state agencies pursuant to Section 1.11.