Public Input No. 18-NFPA 291-2019 [Global Input]

Suggest the TC expand its scope and develop text for the document on the utilization of water distribution system models in place of field flow tests. More jurisdictions are developing and utilizing water distribution system hydraulic models to provide data on water supply availability from a water distribution system. Ensuring that an AHJ, designer or contractor is provided accurate information from a hydraulic model is imperative. As an example, utilizing an Average Daily Flow condition vs a Maximum Daily Flow or Peak Hourly Flow condition in the model can create dramatically different outcomes fire flow availability. This type of guidance should be included in document to guide the users that are now relying on a hydraulic water distribution system model.

Statement of Problem and Substantiation for Public Input

Suggest the TC expand its scope and develop text for the document on the utilization of water distribution system models in place of field flow tests. More jurisdictions are developing and utilizing water distribution system hydraulic models to provide data on water supply availability from a water distribution system. Ensuring that an AHJ, designer or contractor is provided accurate information from a hydraulic model is imperative. As an example, utilizing an Average Daily Flow condition vs a Maximum Daily Flow or Peak Hourly Flow condition in the model can create dramatically different outcomes fire flow availability. This type of guidance should be included in document to guide the users that are now relying on a hydraulic water distribution system model.

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Submittal Date: Fri Jan 11 07:09:27 EST 2019
Committee:

Public Input No. 40-NFPA 291-2019 [Chapter 1]

Add and asterix to 1.2 and revise the document Title and the Committee Scope Statement plus Sections 1.1, 1.2 and 1.3 as follows:

Title: Recommended Practice for ~~Fire~~ Water Flow Testing and Marking of Hydrants

Committee Scope: This Committee shall have the primary responsibility for documents on private piping systems supplying water for fire protection and for hydrants, hose houses, and valves. The Committee is also responsible for documents on ~~fire~~ water flow testing and marking of hydrants.

Chapter 1 Administration

1.1 Scope.

The scope of this document is ~~fire~~ water flow testing and marking of hydrants.

1.2 * Purpose.

~~Fire~~ Water flow tests are conducted on water distribution systems to determine the rate of flow available at various locations for fire ~~-fighting~~ protection purposes.

1.3 Application.

A certain residual pressure in the mains is specified at which the rate of flow should be available. Additional benefit is derived from ~~fire~~ water flow tests by the indication of possible deficiencies, such as tuberculation of piping or closed valves or both, which could be corrected to ensure adequate ~~fire flows~~ water supplies as needed.

Also add a new A. 1. 2 as follows:

A.1.2 This document deals with water flow testing on municipal mains or private water service mains utilizing fire hydrants for purposes such as determining water supplies for sprinkler system design or to confirm fire flow rates for fire-fighting purposes. Other water flow testing, such as for fire pump installations or for standpipe systems, can be conducted utilizing much of the information provided herein.

1. 4 Units.

Metric units of measurement in this recommended practice are in accordance with the modernized metric system known as the International System of Units (SI). Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection. These units are listed in Table 1.4 with conversion factors.

Table 1.4 SI Units and Conversion Factors

Unit Name	Unit Symbol	Conversion Factor
Liter	L	1 gal = 3.785 L
Liter per minute per square meter	(L/min)/m^2	1 gpm ft^2 = (40.746 L/min)/m^2
Cubic decimeter	dm^3	1 gal = 3.785 dm^3
Pascal	Pa	1 psi = 6894.757 Pa
Bar	bar	1 psi = 0.0689 bar
Bar	bar	1 bar = 10^5 Pa

Note: For additional conversions and information, see IEEE/ASTM-SI-10, *Standard for Use of the International System of Units (SI): The Modern Metric System,* 2010.

1.4.1

If a value for measurement as given in this recommended practice is followed by an equivalent value in other units, the first value stated is to be regarded as the recommendation. A given equivalent value might be approximate.

Statement of Problem and Substantiation for Public Input

This proposal offered to clarify that the subject matter of NFPA 291 is not exclusively about testing for “fire flow” for “fire-fighting”. The fire flow required for actual fire-fighting purposes is the subject matter for building and fire codes.

When NFPA 291 currently speaks to “fire flow testing” the subject matter is really just providing a method for conducting water flow tests for fire protection purposes, be it to determine the available water supply for things such as a sprinkler system design or a NFPA 25 requirement, or to actually confirm the water supply relative to a facility’s fire flow requirement.

The proposed annex text is offered to clarify the type of water flow testing dealt with by NFPA 291 vs. other types of flow testing, such as for fire pump installations or for standpipe systems.

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Submittal Date: Sun Mar 17 16:35:14 EDT 2019

Committee: AUT-PRI

Public Input No. 7-NFPA 291-2018 [Section No. 1.3]

A. 1.3 – Application. 2

A certain residual pressure in the mains is specified at which the rate of flow should be available. Additional benefit is derived from fire flow tests by the indication of possible deficiencies, such as tuberculation of piping or closed valves or both, which could be corrected to ensure adequate fire flows as needed.

1.3 The application of this document is to the flow testing and marking of both public and private fire hydrants.

A.1.3 The application includes fire hydrants owned by a public utility, private utility and hydrants owned by entities other than utilities.

Statement of Problem and Substantiation for Public Input

The current "application" language in section 1.3 is not application of the document language. It appears to be much more of a reason for doing flow testing. Therefore, it is more appropriate as potentially annex text to the 1.2 purpose. This PI relocates the language to that location.

A new application language is added along with annex text to clarify the intended application of this document to both public and private fire hydrants.

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Submittal Date: Wed Dec 12 07:14:14 EST 2018
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Public Input No. 3-NFPA 291-2018 [New Section after 3.3]

Insert a new definition as follows:

3.3.X Maximum Daily Demand. The maximum total amount of water used during any 24-hour period.

A.3.3.X The water utility can be consulted to see when maximum daily demand typically occurs and what the system demand differences are between the average daily demand and the maximum daily demand.

Statement of Problem and Substantiation for Public Input

Definition for term utilized in PI-2.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2-NFPA 291-2018 [Section No. 4.2.1]	Definition for term utilized in PI - 2.
Public Input No. 2-NFPA 291-2018 [Section No. 4.2.1]	

Submitter Information Verification

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Public Input No. 41-NFPA 291-2019 [New Section after 3.3.3]

TITLE OF NEW CONTENT

Add a new hydrant definition section 3.4 as follows:

3.4 Fire Hydrant. A valved connection on a water supply system having one or more outlets and that is used to supply hose and fire department pumpers with water. [NFPA 1141:3.3.13]

3.4.1* Dry Barrel Hydrant (Frostproof Hydrant). A type of hydrant with the main control valve below the frost line between the foot piece and the barrel. [NFPA 24:3.4.1.1]

3.4.2 Flow Hydrant. The hydrant that is used for the flow and flow measurement of water during a flow test. [NFPA 24:3.4.1.2]

3.4.3 Flush Hydrant (Below Ground Hydrant). A type of hydrant that is installed below the ground level that is intended for use in congested urban areas or aircraft movement areas.

3.4.4 Private Fire Hydrant. A valved connection on a water supply system having one or more outlets that is used to supply hose and fire department pumpers with water on private property. [NFPA 24:3.4.1.3]

3.4.5 Public Hydrant. A valved connection on a water supply system having one or more outlets that is used to supply hose and fire department pumpers with water. [NFPA 24:3.4.1.4]

3.4.6 Residual Hydrant. The hydrant that is used for measuring static and residual pressures during a flow test. [NFPA 24:3.4.1.5]

3.4.7* Wall Hydrant. A hydrant mounted on the outside of a wall of a building, fed from interior piping, and equipped with control valves located inside the building that normally are key-operated from the building's exterior. [NFPA 25: 3.3.12.3]

3.4.8* Wet Barrel Hydrant. A type of hydrant that is intended for use where there is no danger of freezing weather and where each outlet is provided with a valve and an outlet. [NFPA 24:3.4.1.6]

Also insert a new Figure A.4.4.1, a new Figure A.3.4.7 and a new Figure A.3.4.8 (extracts from NFPA 25) as follows:

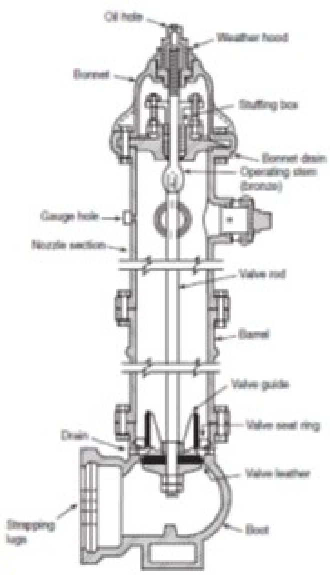

Figure A.3.4.1 Dry Barrel Hydrant [NFPA 25:A.3.3.12.1]

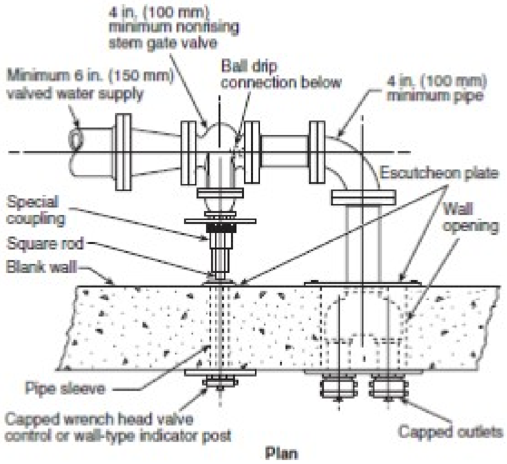

Figure A.3.4.7 Wall Hydrant [NFPA 25:A.3.3.12.3]

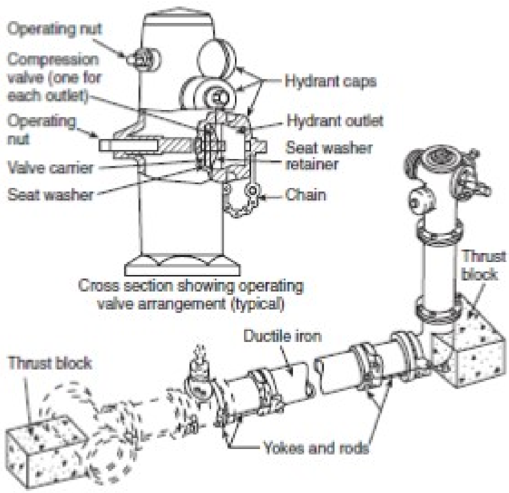

Figure A.3.4.8 Wet Barrel Hydrant [NFPA 25: A.3.3.12.4]

Statement of Problem and Substantiation for Public Input

This proposal is to provide definitions and illustrations for the various types of hydrants. Since this document is about hydrant flow testing and references different types of hydrants, it would be beneficial to include this information.

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Public Input No. 38-NFPA 291-2019 [Section No. 4.1]

4.1 – **Insert New Section 4.1**

4.1 Flow Testing Purposes

4.1.1 Many flow tests are conducted to determine the available water supply for fire protection systems.

4.1.2 Flow tests may be conducted to determine the flow available from a fire hydrant during and emergency.

4.1.3 Flow tests may be conducted to determine the status of the water supply distribution system.

Renumber and Revise Section as follows

4.2 Rating Pressure.

4.1 2 .1

For the purpose of uniform marking of fire hydrants, the ratings should be based on the flow available at the hydrant outlet at a residual pressure of 20 psi (1.4 bar) for all hydrants having a static pressure in excess of 40 psi (2.7 bar).

4.1 2 .2

Hydrants having a static pressure of less than 40 psi (2.7 bar) should be rated at the flow available at the hydrant outlet at one-half of the static pressure.

4.1 2 .3

It is generally recommended that a minimum residual pressure of 20 psi (1.4 bar) should be maintained at hydrants when delivering the fire flow. Fire department pumpers can be operated where hydrant pressures are less, but with difficulty.

4.1 2 .4

Where hydrants are well distributed and of the proper size and type (so that friction losses in the hydrant and suction line are not excessive), it might be possible to set a lesser pressure as the minimum pressure.

4.1 2 .5

A primary concern should be the ability to maintain sufficient residual pressure to prevent developing a negative pressure at any point in the street mains, which could result in the collapse of the mains or other water system components or back-siphonage of polluted water from some other interconnected source.

4.1 2 .6

It should be noted that the use of residual pressures of less than 20 psi (1.4 bar) is not permitted by many state health departments.

Additional Proposed Changes

File Name	Description	Approved
NFPA_291_Revised_Sections_021419.docx	This document contains all or the proposed changes related to marking hydrants in one document and is intended to assist in reviewing the proposed changes.	

Statement of Problem and Substantiation for Public Input

NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking.

In general, flow tests conducted with a static / residual hydrant(s) and a flow hydrant(s) show the water available in the underground water main at the static / residual hydrant. Friction loss calculations between the flow test and the fire protection system are required to determine the water available at the fire protection system. Likewise a friction loss calculation is required to determine the flow available at the hydrant outlet. As NFPA 291 is currently written, the flow used for marking hydrants is actually the flow available in the underground main, and not the flow available at the hydrant outlet. The proposed changes correct this deficiency.

Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	Complementary
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	Complementary
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	Complementary
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	Complementary
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	Complementary
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	Complementary
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	Complementary
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	Complementary
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	

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Chapter 4 Flow Testing

Insert New Section 4.1

4.1 Flow Testing Purposes

4.1.1 Many flow tests are conducted to determine the available water supply for fire protection systems.

4.1.2 Flow tests may be conducted to determine the flow available from a fire hydrant during and emergency.

4.1.3 Flow tests may be conducted to determine the status of the water supply distribution system.

SUBSTANTIATION: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking.

In general, flow tests conducted with a static / residual hydrant(s) and a flow hydrant(s) show the water available in the underground water main at the static / residual hydrant. Friction loss calculations between the flow test and the fire protection system are required to determine the water available at the fire protection system. Likewise a friction loss calculation is required to determine the flow available at the hydrant outlet. As NFPA 291 is currently written, the flow used for marking hydrants is actually the flow available in the underground main, and not the flow available at the hydrant outlet. The proposed changes correct this deficiency.

Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

4.1 Rating Pressure.

4.1.1 For the purpose of uniform marking of fire hydrants, the ratings should be based on the flow rate available at the hydrant outlet at a residual pressure of 20 psi (1.4 bar) for all hydrants having a static pressure in excess of 40 psi (2.7 bar).

4.1.2 Hydrants having a static pressure of less than 40 psi (2.7 bar) should be rated at the flow available at the hydrant outlet at a residual pressure of one-half of the static pressure.

STANTIATION: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

4.1.3 It is generally recommended that a minimum residual pressure of 20 psi (1.4 bar) should be maintained at hydrants when delivering the fire flow. Fire department pumpers can be operated where hydrant pressures are less, but with difficulty.

4.1.4 Where hydrants are well distributed and of the proper size and type (so that friction losses in the hydrant and suction line are not excessive), it might be possible to set a lesser pressure as the minimum pressure.

4.1.5 A primary concern should be the ability to maintain sufficient residual pressure to prevent developing a negative pressure at any point in the street mains, which could result in the collapse of the mains or other water system components or back-siphonage of polluted water from some other interconnected source.

4.1.6 It should be noted that the use of residual pressures of less than 20 psi (1.4 bar) is not permitted by many state health departments.

4.2 Procedure.

4.2.1 Tests should be made during a period of ordinary or high demand.

Substantiation: A fire may occur during times of high usage and the fire protection system design should be based on reasonably anticipated worse case water supply conditions. Additional guidance is needed to identify issues that should be accounted for when determining the water supply characteristics that supply a fire protection system.

4.2.2 The procedure consists of discharging water at a measured rate of flow from the system at a given location and observing the corresponding pressure drop in the mains.

Insert new section 4.3 after 4.2.2

4.3 Layout of Test and Test Procedure To Evaluate the Available Flow Through a Fire Hydrant.

4.3.1 When the purpose of a flow test is to determine the available flow through a fire hydrant, the static and residual pressures should be taken at the flow hydrant(s), i.e. the flow hydrant is also the static / residual hydrant.

4.3.1.1 A pressure gauge (or other pressure measuring device) is located on one of the 2½ hydrant outlets (see 4.5.1(5)).

4.3.1.2 A closed control valve connected to a discharge nozzle(s) is located on one of the other hydrant outlets.

4.3.1.3 , due consideration should be given to potential interference with traffic flow patterns, damage to surroundings (e.g., roadways, sidewalks, landscapes, vehicles, and pedestrians), and potential flooding problems both local and remote from the test site.

4.3.1.4 The test procedures in 4.5 for venting air and taking static /residual readings and 4.6 for taking pitot readings should be followed.

4.3.1.5 The static pressure is recorded before the hydrant is opened.

4.3.1.6 The control valve on the other hydrant outlet is opened, and the residual pressure and pitot reading are taken and recorded.

Substantiation: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test than determines the flow available out of a hydrant nozzle.

<u>4.4 </u>~~4.3~~ Layout of Test <u>to determine Available Flow in Mains</u>.

Substantiation: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test than determines the flow available out of a hydrant nozzle.

4.3.1 After the location where the test is to be run has been determined, a group of test hydrants in the vicinity is selected.

4.3.2 Once selected, due consideration should be given to potential interference with traffic flow patterns, damage to surroundings (e.g., roadways, sidewalks, landscapes, vehicles, and pedestrians), and potential flooding problems both local and remote from the test site.

4.3.3 One hydrant, designated the residual hydrant, is chosen to be the hydrant where the normal static pressure will be observed with the other hydrants in the group closed, and where the residual pressure will be observed with the other hydrants flowing.

4.3.4 This hydrant is chosen so it will be located between the hydrant to be flowed and the large mains that constitute the immediate sources of water supply in the area. In Figure 4.3.4, test layouts are indicated showing the residual hydrant designated with the letter R and hydrants to be flowed with the letter F.

FIGURE 4.3.4 Suggested Test Layout for Hydrants.

4.3.5 The number of hydrants to be used in any test depends upon the strength of the distribution system in the vicinity of the test location.

4.3.6 To obtain satisfactory test results of theoretical calculation of expected flows or rated capacities, sufficient discharge should be achieved to cause a drop in pressure at the residual hydrant of at least 25 percent, or to flow the total demand necessary for fire-fighting purposes.

4.3.7 If the mains are small and the system weak, only one or two hydrants need to be flowed.

4.4 Equipment.

4.4.1 The equipment necessary for field work consists of the following:

(1) A single 200 psi (14 bar) bourdon pressure gauge with 1 psi (0.07 bar) graduations

(2) A number of pitot tubes

(3) Hydrant wrenches

(4) 50 or 60 psi (3.4 or 4.1 bar) bourdon pressure gauges with 1 psi (0.07 bar) graduations, and scales with 1⁄16 in. (1.6 mm) graduations [one pitot tube, a 50 or 60 psi (3.4 or 4.1 bar) gauge, a hydrant wrench, a scale for each hydrant to be flowed]

(5) A special hydrant cap tapped with a hole into which is fitted a short length of 1⁄4 in. (6 mm) brass pipe provided with a T connection for the 200 psi (14 bar) gauge and a cock at the end for relieving air pressure

4.4.2 All pressure gauges should be calibrated at least every 12 months, or more frequently depending on use.

4.4.3 When more than one hydrant is flowed, it is desirable and could be necessary to use portable radios to facilitate communication between team members.

4.4.4 It is preferred to use stream straightener with a known coefficient of discharge when testing hydrants due to a more streamlined flow and more accurate pitot reading.

4.5 Test Procedure To Determine Available Flow in Mains.

Substantiation: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test than determines the flow available out of a hydrant nozzle.

4.5.1 In a typical test, the 200 psi (14 bar) gauge is attached to one of the 2½ in. (65 mm) outlets of the residual hydrant using the special cap.

4.5.2 The cock on the gauge piping is opened, and the hydrant valve is opened full.

4.5.3 As soon as the air is exhausted from the barrel, the cock is closed.

4.5.4 A reading (static pressure) is taken when the needle comes to rest.

4.5.5 At a given signal, each of the other hydrants is opened in succession, with discharge taking place directly from the open hydrant butts.

4.5.6 Hydrants should be opened one at a time.

4.5.7 With all hydrants flowing, water should be allowed to flow for a sufficient time to clear all debris and foreign substances from the stream(s).

4.5.8 At that time, a signal is given to the people at the hydrants to read the pitot pressure of the streams simultaneously while the residual pressure is being read.

4.5.9 The final magnitude of the pressure drop can be controlled by the number of hydrants used and the number of outlets opened on each.

4.5.10 After the readings have been taken, hydrants should be shut down slowly, one at a time, to prevent undue surges in the system.

4.6 Pitot Readings.

4.6.1 When measuring discharge from open hydrant butts, it is always preferable from the standpoint of accuracy to use 2½ in. (65 mm) outlets rather than pumper outlets.

4.6.2 In practically all cases, the 2½ in. (65 mm) outlets are filled across the entire cross-section during flow, while in the case of the larger outlets there is very frequently a void near the bottom.

4.6.3 When measuring the pitot pressure of a stream of practically uniform velocity, the orifice in the pitot tube is held down-stream approximately one-half the diameter of the hydrant outlet or nozzle opening, and in the center of the stream.

4.6.4 The center line of the orifice should be at right angles to the plane of the face of the hydrant outlet.

4.6.5 The air chamber on the pitot tube should be kept elevated.

4.6.6 Pitot readings of less than 10 psi (0.7 bar) and more than 30 psi (2.1 bar) should be avoided, if possible.

4.6.7 Opening additional hydrant outlets will aid in controlling the pitot reading.

4.6.8 With dry barrel hydrants, the hydrant valve should be wide open to minimize problems with underground drain valves.

4.6.9 With wet barrel hydrants, the valve for the flowing outlet should be wide open to give a more streamlined flow and a more accurate pitot reading. (See Figure 4.6.9.)

4.7 Determination of Discharge.

4.7.1 At the hydrants used for flow during the test, the discharges from the open butts are determined from measurements of the diameter of the outlets flowed, the pitot pressure (velocity head) of the streams as indicated by the pitot gauge readings, and the coefficient of the outlet being flowed as determined from Figure 4.7.1.

FIGURE 4.7.1 Three General Types of Hydrant Outlets and Their Coefficients of Discharge.

4.7.2 If flow tubes (stream straighteners) are being utilized, a coefficient of 0.95 is suggested unless the coefficient of the tube is known.

4.7.3 The formula used to compute the discharge, Q, in gpm (L/min) from these measurements is as shown in Equations 4.7.3a and 4.7.3b.

$$\mathbf{Q = 29\ 84cd^2\ p^{0.5}}$$

where:

c = coefficient of discharge (see Figure 4.7.1)

d = diameter of the outlet (in.)

p = pitot pressure (velocity head)(psi)

$$\mathbf{Q_M = 0\ 0666cd^2\ p_M^{0.5}}$$

where:

Q_M = flow (L/min)

P_M = pressure (kPa or bar)

4.8 Use of Pumper Outlets.

4.8.1 If it is necessary to use a pumper outlet, and flow tubes (stream straighteners) are not available, the best results are obtained with the pitot pressure (velocity head) maintained between 5 psi and 10 psi (0.34 bar and 0.7 bar).

4.8.2 For pumper outlets, the approximate discharge can be computed from Equations 4.7.3a and 4.7.3b using the pitot pressure (velocity head) at the center of the stream and multiplying the result by one of the coefficients in Table 4.8.2, depending upon the pitot pressure (velocity head).

Δ Table 4.8.2 Pumper Outlet Coefficients

Pitot Pressure (Velocity Head)		
psi	**bar**	**Coefficient**
2	**0.14**	**0.97**
3	**0.21**	**0.92**
4	**0.28**	**0.89**
5	**0.35**	**0.86**
6	**0.41**	**0.84**
7 and over	**0.48 and over**	**0.83**

4.8.3 These coefficients are applied in addition to the coefficient in Equations 4.7.3a and 4.7.3b and are for average-type hydrants.

4.9 Determination of Discharge Without a Pitot.

4.9.1 If a pitot tube is not available for use to measure the hydrant discharge, a 50 or 60 psi (3.4 or 4.1 bar) gauge tapped into a hydrant cap can be used when the flow is through a hydrant outlet or a nozzle attached to a hydrant outlet.

Substantiation: Clarification, the pressure at the hydrant outlet will not be the same when there is fire hose between the hydrant outlet and the flowing nozzle

4.9.2 The hydrant cap with gauge attached is placed on one outlet, and the flow is allowed to take place through the other outlet at the same elevation.

4.9.3 The readings obtained from a gauge so located, and the readings obtained from a gauge on a pitot tube held in the stream, are approximately the same.

4.10 Calculation Results.

Δ 4.10.1 The discharge in gpm (L/min) for each outlet flowed is obtained from Table 4.10.1(a) and Table 4.10.1(b) or by the use of Equations 4.7.3a and 4.7.3b.

4.10.1.1 If more than one outlet is used, the discharges from all are added to obtain the total discharge.

4.10.1.2 The formula that is generally used to compute the ~~discharge~~ available flow in the underground main at the static / residual hydrant, at the specified residual pressure or for any desired pressure drop is Equation 4.10.1.2:

[4.10.1.2]

$$Q_R = Q_F \times \frac{h_r^{0.54}}{h_f^{0.54}} \quad Or \quad Q_R = Q_F \times \left(\frac{P_s - P_r}{P_s - P_f}\right)^{0.54}$$

$$Q_R = Q_F([P_s - P_r]/[P_s - P_f])^{0.54}$$

where:

Q_R = flow predicted in underground main at desired residual pressure

Q_F = total flow measured during test

Q_h = flow predicted from flowing hydrant outlet at desired residual pressure

h_r = pressure drop to desired residual pressure in the underground main

h_f = pressure drop in the underground main (measured at the static / residual hydrant) during test

h_h = pressure drop at the outlet of the flowing hydrant

P_r = residual pressure at the static / residual hydrant

P_s = static pressure at the static / residual hydrant

P_f = desired residual pressure (typically 20 psi for hydrant marking)

P_h = residual pressure at the flowing hydrant (pitot reading if the flow is directly from the hydrant)

Substantiation: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

4.10.1.3 The formula that is generally used to compute the available flow through the flowng hydrant at the specified residual pressure or for any desired pressure drop is Equation 4.10.1.3:

$$Q_R = Q_F(h_r/h_h)^{0.54} \quad or \quad Q_R = Q_F([P_s - P_r]/[P_s - P_h])^{0.54} \qquad [4.10.1.3]$$

$$Q_R = Q_F \times \frac{h_r^{0.54}}{h_h^{0.54}} \quad Or \quad Q_R = Q_F \times \left(\frac{P_s - P_r}{P_s - P_h}\right)^{0.54}$$

Substantiation: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

~~**4.10.1.3**~~ 4.10.1.4 In Equations 4.10.1.2 and 4.10.1.3, any units of discharge or pressure drop can be used as long as the same units are used for each value of the same variable.

Substantiation: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

~~**4.10.1. 4**~~ 4.10.1.5 In other words, if Q_R is expressed in gpm, Q_F must be in gpm, and if h_r is expressed in psi, h_f must be expressed in psi.

~~**4.10.1.5**~~ **4.10.1.6** These are the units that are normally used in applying Equations 4.10.1.2 and 4.10.1.3 to fire flow test computations.

Substantiation: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

4.10.2 Discharge Calculations from Table.

4.10.2.1 One means of solving this equation without the use of logarithms is by using Table 4.10.2.1, which gives the values of the 0.54 power of the numbers from 1 to 175.

4.10.2.2 If the values of h_f, h_r, (or h_h) and Q_F are known, the values of $h_f^{0.54}$ and $h_r^{0.54}$ (or h_h) can be read from Table 4.10.2.1 and Equation 4.10.1.2 solved for Q_R or equation 4.10.1.3 solved for Q_h.

4.10.2.3 Results are usually carried to the nearest 100 gpm (380 L/min) for discharges of 1000 gpm (3800 L/min) or more, and to the nearest 50 gpm (190 L/min) for smaller discharges, which is as close as can be justified by the degree of accuracy of the field observations.

4.10.2.4 The values of $hr^{0.54}$, and $hf^{0.54}$ or $h_h^{0.54}$ (determined from the table) and the value of Q_F are inserted in Equation 4.10.1.2 or 4.10.1.3, and the equation 4.10.1.2 solved for Q_R, or equation 4.10.1.3 solved for Q_h.

Substantiation: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

4.11 Data Sheet.

4.11.1 The data secured during the testing of hydrants for uniform marking can be valuable for other purposes.

4.11.2 With this in mind, it is suggested that the form shown in Figure 4.11.2 be used to record information that is taken.

4.11.3 The back of the form should include a location sketch.

4.11.4 Results of the flow test should be indicated on a hydraulic graph, such as the one shown in
4.11.5 When the tests are complete, the forms should be filed for future reference by interested parties.

4.12 System Corrections.

4.12.1 In the Hazen Williams formula used for friction loss calculations in water distribution systems the friction loss is proportional to the flow rate to the 1.85 power, i.e. if the friction loss is known at one flow rate, the friction loss at a different flow rate is the known friction loss times a ratio of the flow rates to the 1.85 power.

4.12.1.1 Residual pressure at different flow rates can be calculated for water distribution systems that have a constant supply pressure and no flows elsewhere in the system.

4.12.1.2 If the flow test is conducted during peak usage, it is generally accepted practice to ignore other flows in the water distribution system and calculation residual pressure based on the Hazen Williams formula.

4.12.1.3 Flow tests conducted during less than peak usage should be adjusted to account for the lower available flow that may occur during peak usage.

4.12.1.4 Flow tests conducted when the water storage level is above the minimum should be adjusted to the lowest water storage level.

4.12.1.5 Residual pressures higher than the static pressure may occur when opening a hydrant causes a pump to come on during the test.

4.12.1.6 When a Flow tests that cause a pump to come on during the test should not be extrapolated.

4.10.1.7 Flow tests should achieve a flow equal to or greater than the system demand.

4.12.1.8 Extrapolation of flow test results should be limited to systems that maintain a relatively constant pressure at the source, and do not have water usage significantly above the usage during the flow test.

4.12.1.8 Flow test do not provide an indication of the duration of the available flow rate.

4.12.1.9 The ability of the water source to provide the required duration must be evaluated separately from the flow test.

Substantiation: A fire may occur during times of high usage and the sire protection system design should be based on reasonably anticipated worse case water supply conditions. Additional guidance is needed to identify issues that should be accounted for when determining the water supply characteristics that supply a fire protection system.

4.12.1 It must be remembered that flow test results show the strength of the distribution system and do not necessarily indicate the degree of adequacy of the entire water works system.

4.12.2 Consider a system supplied by pumps at one location and having no elevated storage.

4.12.3 If the pressure at the pump station drops during the test, it is an indication that the distribution system is capable of delivering more than the pumps can deliver at their normal operating pressure.

4.12.4 It is necessary to use a value for the drop in pressure for the test that is equal to the actual drop obtained in the field during the test, minus the drop in discharge pressure at the pumping station.

4.12.5 If sufficient pumping capacity is available at the station and the discharge pressure could be maintained by operating additional pumps, the water system as a whole could deliver the computed quantity. Figure 4.11.4.

4.12.6 If, however, additional pumping units are not available, the distribution system would be capable of delivering the computed quantity, but the water system as a whole would be limited by the pumping capacity.

4.12.7 The portion of the pressure drop for which a correction can be made for tests on systems with storage is generally estimated upon the basis of a study of all the tests made and the pressure drops observed on the recording gauge at the station for each.

4.12.8 The corrections may vary from very substantial portions of the observed pressure drops for tests near the pumping station, to zero for tests remote from the station.

Chapter 5 Marking of Hydrants

5.1 Classifcation of Hydrants. Hydrants should be classified in accordance with their rated capacities based on flow available at the hydrant outlet (formula 4.10.1.3) ~~[~~at 20 psi (1.4 bar) residual pressure or other designated value] as follows:

(1) Class AA — Rated capacity of 1500 gpm (5700 L/min) or greater

(2) Class A — Rated capacity of 1000–1499 gpm (3800–5699 L/min)

(3) Class B — Rated capacity of 500–999 gpm (1900–3799 L/ min)

(4) Class C — Rated capacity of less than 500 gpm (1900 L/ min)

SUBSTANTIATION: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking.

In general, flow tests conducted with a static / residual hydrant(s) and a flow hydrant(s) show the water available in the underground water main at the static / residual hydrant. Friction loss calculations between the flow test and the fire protection system are required to determine the water available at the fire protection system. Likewise a friction loss calculation is required to determine the flow available at the hydrant outlet. As NFPA 291 is currently written, the flow used for marking hydrants is actually the flow available in the underground main, and not the flow available at the hydrant outlet. The proposed changes correct this deficiency.

Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

Public Input No. 8-NFPA 291-2018 [Section No. 4.1.2]

4.1.2

Hydrants having a static pressure of less than 40 psi (2.7 bar) should be rated at a residual pressure that is one-half of the static pressure.

Statement of Problem and Substantiation for Public Input

This PI clarifies that the rating is intended to be the residual pressure.

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Submittal Date: Wed Dec 12 07:33:20 EST 2018

Committee: AUT-PRI

Public Input No. 10-NFPA 291-2018 [Section No. 4.1.4]

~~**4.1.4**~~ –

~~Where hydrants are well distributed and of the proper size and type (so that friction losses in the hydrant and suction line are not excessive), it might be possible to set a lesser pressure as the minimum pressure.~~

Statement of Problem and Substantiation for Public Input

It is unclear why the distribution, size and type of fire hydrants, along with the suction line, has an impact on setting a lower residual pressure. Lower residual pressures could be established based on the strength of the water underling water distribution system...pumping capacity, water main sizes, looping of system, etc. However, the criteria set forth in this section would appear to have little impact or justification the ability to set a lower residual. Therefore, this section is proposed to be deleted.

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Public Input No. 9-NFPA 291-2018 [Section No. 4.1.4]

4.1.4

Where hydrants are well distributed and of the proper size and type (so that friction losses in the hydrant and suction line are not excessive), it might be possible to set a lesser residual pressure as the minimum residual pressure.

Statement of Problem and Substantiation for Public Input

Clarifies the pressure type that is being addressed.

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Public Input No. 2-NFPA 291-2018 [Section No. 4.2.1]

4.2.1

Tests should be made during ~~a period of ordinary demand.~~ periods of maximum daily demand. If water supply testing does not occur during periods of maximum daily demand, then the water supply test results should be adjusted to approximate the impact of maximum daily demand.

A.4.2.1 In accordance with AWWA M31, water distribution systems should be designed utilizing maximum daily demand plus fire flow. Therefore, water supply testing should also occur at the period of maximum daily demand in order to gain accurate results. If such testing cannot occur during periods of maximum daily demand, then the water supply test results should be adjusted to factor in the impact of maximum daily demand over the actual demand during water supply testing.

Statement of Problem and Substantiation for Public Input

The term "ordinary demand" that is currently utilized is undefined and inconsistent with recognized industry terminology. The possible options are "Average Daily Demand", "Maximum Daily Demand" and "Maximum Hourly Demand." (As defined in AWWA M31.) Of these three, Maximum Daily Demand (MDD) is the demand that water distribution systems are designed to function at with fire flow. Therefore, testing should occur as close to the MDD in order to obtain the most accurate results that are consistent with the design standard. When testing cannot occur at MDD, an MDD factor should be applied in order to obtain the most accurate data from fire flow testing.

If it is the TC's intent that MDD should be utilized as the basis for a flow test, then the TC should substitute "Average Daily Demand" for the term "Ordinary Demand" and provide some commentary as to when the flow test should occur during the day. A very different result may occur at 0630 vs 0200 or during lawn watering season vs a wet season. The user should be made of aware of these factors impacting the accuracy of flow test results if we are going to endorse flow tests that are not to the water distribution system design standard.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 3-NFPA 291-2018 [New Section after 3.3]	Definition for term is in PI - 3.
Public Input No. 3-NFPA 291-2018 [New Section after 3.3]	

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Submittal Date: Tue Dec 11 08:15:12 EST 2018
Committee: AUT-PRI

Public Input No. 23-NFPA 291-2019 [Section No. 4.2.1]

4.2.1

Tests should be made during a period of ordinary or high demand.

Statement of Problem and Substantiation for Public Input

A fire may occur during times of high usage and the sire protection system design should be based on reasonably anticipated worse case water supply conditions.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 34-NFPA 291-2019 [New Section after 4.12]	Complementary
Public Input No. 34-NFPA 291-2019 [New Section after 4.12]	

Submitter Information Verification

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Committee: AUT-PRI

Public Input No. 11-NFPA 291-2018 [New Section after 4.2.2]

4.2.3 The fire hydrant and the area around the fire hydrant should be visually inspected for safety concerns prior to conducting the flow test.

A.4.2.3 Some safety items that should be considered as part of a visual inspection prior to conducting a flow test include:

(1) Visual damage to the fire hydrant

(2) Excessive corrosion on flange bolts of the fire hydrant

(3) Indications the fire hydrant may be under pressure

(4) Indications of water leaks on the hydrant and in the surrounding ground

(5) The terrain around the fire hydrant for awareness of hazards such as standing water, ice, traffic and elevation changes

Statement of Problem and Substantiation for Public Input

Safety should be a concerns of those conducting the flow test and included as guidance within the document. The items addressed are some basic items that an individual conducting a flow test should look for prior to operating the fire hydrant to ensure the operator's safety. If the TC wishes to add to or revise the list, the PI proponent would encourage that. The key is the issue of visual inspection for safety should occur.

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Committee: AUT-PRI

Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]

TITLE OF NEW CONTENT

Type your content here ...

Insert new section 4.3 after 4.2.2

4.3 Layout of Test and Test Procedure To Evaluate the Available Flow Through a Fire Hydrant.

4.3.1 When the purpose of a flow test is to determine the available flow through a fire hydrant, the static and residual pressures should be taken at the flow hydrant(s), i.e. the flow hydrant is also the static / residual hydrant.

4.3.1.1 A pressure gauge (or other pressure measuring device) is located on one of the 2½ hydrant outlets (see 4.5.1(5)).

4.3.1.2 A closed control valve connected to a discharge nozzle(s) is located on one of the other hydrant outlets.

4.3.1.3 , due consideration should be given to potential interference with traffic flow patterns, damage to surroundings (e.g., roadways, sidewalks, landscapes, vehicles, and pedestrians), and potential flooding problems both local and remote from the test site.

4.3.1.4 The test procedures in 4.5 for venting air and taking static /residual readings and 4.6 for taking pitot readings should be followed.

4.3.1.5 The static pressure is recorded before the hydrant is opened.

4.3.1.6 The control valve on the other hydrant outlet is opened, and the residual pressure and pitot reading are taken and recorded.

Statement of Problem and Substantiation for Public Input

Substantiation: NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test than determines the flow available out of a hydrant nozzle.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	Complementary
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	Complementary
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	Complementary
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	Complementary
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	Complementary
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	Complementary
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	Complementary
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	Complementary
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	

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Committee:	AUT-PRI

Public Input No. 25-NFPA 291-2019 [Section No. 4.3]

4.3 Layout of Test to Determine Available Flow in Mains .

4.3.1

After the location where the test is to be run has been determined, a group of test hydrants in the vicinity is selected.

4.3.2

Once selected, due consideration should be given to potential interference with traffic flow patterns, damage to surroundings (e.g., roadways, sidewalks, landscapes, vehicles, and pedestrians), and potential flooding problems both local and remote from the test site.

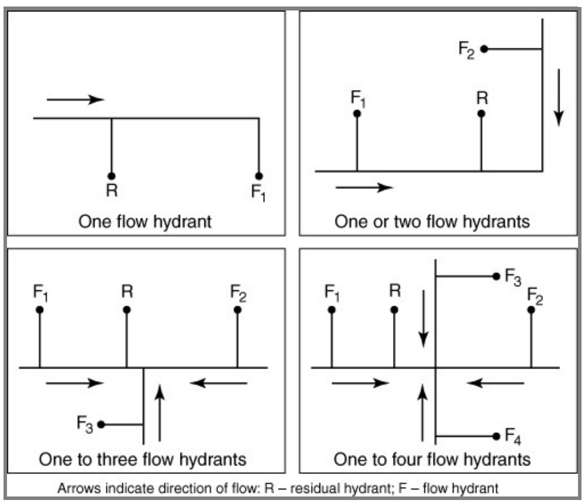
4.3.3

One hydrant, designated the residual hydrant, is chosen to be the hydrant where the normal static pressure will be observed with the other hydrants in the group closed, and where the residual pressure will be observed with the other hydrants flowing.

4.3.4

This hydrant is chosen so it will be located between the hydrant to be flowed and the large mains that constitute the immediate sources of water supply in the area. In Figure 4.3.4, test layouts are indicated showing the residual hydrant designated with the letter R and hydrants to be flowed with the letter F.

Figure 4.3.4 Suggested Test Layout for Hydrants.



4.3.5

The number of hydrants to be used in any test depends upon the strength of the distribution system in the vicinity of the test location.

4.3.6

To obtain satisfactory test results of theoretical calculation of expected flows or rated capacities, sufficient discharge should be achieved to cause a drop in pressure at the residual hydrant of at least 25 percent, or to flow the total demand necessary for fire-fighting purposes.

4.3.7

If the mains are small and the system weak, only one or two hydrants need to be flowed.

4.3.8

If, on the other hand, the mains are large and the system strong, it may be necessary to flow as many as seven or eight hydrants.

Statement of Problem and Substantiation for Public Input

NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test than determines the flow available out of a hydrant nozzle.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	Complementary
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	Complementary
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	Complementary
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	Complementary
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	Complementary
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	Complementary
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	Complementary
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	Complementary
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	Complementary
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	

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Public Input No. 12-NFPA 291-2018 [Section No. 4.3.6]

4.3.6

To obtain satisfactory test results of theoretical calculation of expected flows or rated capacities, sufficient discharge should be achieved to cause a drop in pressure at the residual hydrant of at least 25 percent~~, or to flow the total demand necessary for fire-fighting purposes~~ .

Statement of Problem and Substantiation for Public Input

The last part of this sentence conflicts with the first part. If the intent is to determine satisfactory test results of the the expected flows, that is a very different intent than to test to the exact flow demand for fire-fighting purposes. As an example, if the NFF per NFPA is 750 GPM and the water distribution system is strong with large mains, a 750 GPM fire flow generated during the test could cause only a 10% or less drop in residual pressure. That type of result will indicate very little regarding the actual available fire flow at 20 psi residual.

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Committee: AUT-PRI

Public Input No. 42-NFPA 291-2019 [Section No. 4.3.6]

4.3.6

To obtain satisfactory test results of theoretical calculation of expected flows or rated capacities, sufficient discharge should be achieved to cause a drop in pressure at the residual hydrant of at least 25 percent, or to flow the total demand necessary for fire ~~-fighting~~ protection purposes.

Statement of Problem and Substantiation for Public Input

This proposal offered to clarify that the subject matter of NFPA 291 is not exclusively about flow testing for “fire-fighting”. The fire flow required for actual fire-fighting purposes is the subject matter for building and fire codes.

NFPA 291 currently is really just providing a method for conducting water flow tests for fire protection purposes, be it to determine the available water supply for things such as a sprinkler system design or a NFPA 25 requirement, or to actually confirm the water supply relative to a facility’s fire flow requirement.

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Submittal Date: Sun Mar 17 17:11:41 EDT 2019

Committee: AUT-PRI

Public Input No. 13-NFPA 291-2018 [Section No. 4.3.7]

4.3.7

If the water mains are small ~~and~~ , on dead ends or the pumping capacity of the system weak, only one or two hydrants will need to be flowed to achieve the 25% minimum drop in residual pressure .

Statement of Problem and Substantiation for Public Input

Provide better clarity to the intent and includes language on dead end which has a significant impact.

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Committee: AUT-PRI

Public Input No. 43-NFPA 291-2019 [Sections 4.3.7, 4.3.8]

Delete Sections 4.3.7, 4.3.8

~~4.3.7~~ –

~~If the mains are small and the system weak, only one or two hydrants need to be flowed.~~

~~4.3.8~~ –

~~If, on the other hand, the mains are large and the system strong, it may be necessary to flow as many as seven or eight hydrants.~~

Statement of Problem and Substantiation for Public Input

These two sections should be deleted, because the information they relate is not accurate.

Regarding Section 4.3.7, the stronger the water supply, the more water can be discharged from a hydrant. Often, the water supply, for a facility's fire flow or for the water supply for a sprinkler system design, can confirmed with the flow from just one hydrant.

Regarding Section 4.3.8 if the water supply is strong and the mains are large, it would be unnecessary to flow 7 or 8 hydrants. It would take a lot of personnel and coordinated effort to flow 7 or 8 hydrants, and it is not a practical proposition.

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Committee: AUT-PRI

Public Input No. 14-NFPA 291-2018 [Section No. 4.3.8]

4.3.8

If ~~, on the other hand, the~~ the water mains are large ~~and the system~~ , looped or the water distribution system pumping capacity is strong, it may be necessary to flow as many as seven or eight hydrants in order to achieve the 25% minimum drop in residual pressure .

Statement of Problem and Substantiation for Public Input

Provides for better readability and addressed the looping condition as a factor.

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Committee: AUT-PRI

Public Input No. 44-NFPA 291-2019 [Section No. 4.4]

4.4 Equipment.

4.4.1

The equipment necessary for field work consists of the following:

(1) A single 200 psi (14 bar) bourdon pressure gauge with 1 psi (0.07 bar) graduations

(2) A number of pitot tubes

(3) Hydrant wrenches

(4) 50 or 60 psi (3.4 or 4.1 bar) bourdon pressure gauges with 1 psi (0.07 bar) graduations, and scales with 1⁄16 in. (1.6 mm) graduations [one pitot tube, a 50 or 60 psi (3.4 or 4.1 bar) gauge, a hydrant wrench, a scale for each hydrant to be flowed]

(5) A special hydrant cap tapped with a hole into which is fitted a short length of 1⁄4 in. (6 mm) brass pipe provided with a T connection for the 200 psi (14 bar) gauge and a cock at the end for relieving air pressure

(6) * Playpipes, stream straighteners, or other specially designed flow test outlets with known coefficients of discharge

4.4. 2 It is preferred to use playpipes or stream straighteners or other specially designed flow test outlets with known coefficients of discharge when testing hydrants due to more streamlined flows and more accurate pitot readings. 4.4. 2

4.4.3 All pressure gauges should be calibrated at least every 12 months, or more frequently depending on use.

4.4.3 – 4

When more than one hydrant is flowed, it is desirable and could be necessary to use portable radios to facilitate communication between team members.

Also add a new A. 4.4. 1 (6) as follows:

A. 4

~~It is preferred to use stream straightener with a known coefficient of discharge when testing hydrants due to a more streamlined flow and more accurate pitot reading~~

.4.1 (6) Discharge can be measured directly from hydrant butts, but results are generally more accurate when specially designed flow test outlets are used .

Statement of Problem and Substantiation for Public Input

This proposal is to edit Section 4.4 for better flow of the information provided and to add the specially designed flow test outlets to the list of flow testing equipment. Since these devices are preferred, they should be added to the list.

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Committee:	AUT-PRI

Public Input No. 15-NFPA 291-2018 [Section No. 4.4.1]

4.4.1

The equipment necessary for field work consists of the following:

(1) A single 100 psi or 200 psi (14 bar) bourdon pressure gauge with gauge with 1 psi (0.07 bar) graduations fixed into a hydrant threaded cap (If the static pressure on the system is greater than 100 psi, the 200 psi gauge will be required.)

(2) A sufficent number of pitot tubes

(3) Hydrant wrenches

50 or 60 psi

(4) for the number of hydrants to be simultaneously flow tested or 100 psi (3.4 or 4.1 bar) bourdon pressure gauges with 1 psi (0.07 bar) graduations

, and scales with 1/16 in. (1.6 mm) graduations [one pitot tube, a 50 or 60 psi (3.4 or 4.1 bar) gauge, a hydrant wrench, a scale for each hydrant to be flowed] A special hydrant cap tapped with a hole into which is fitted a short length of 1/4 in. (6 mm) brass pipe provided with a T connection for the 200 psi (14 bar) gauge and a cock at the end for relieving air pressure

(5) fixed into a hydrant threaded cap

(6) A sufficent number of hydrant wrenches to operate the hydrants simultaneously

Statement of Problem and Substantiation for Public Input

The following items are addressed by this PI. Note that TerraView produced incorrect formatting.

1. Most water distribution systems operate at a psi of less than 100. Therefore a static pressure gauge of 100 psi would be acceptable.
2. A number of pitot tubes is not sufficient guidance. It should equal the number of hydrants to be flowed.
3. The current 4 and 5 confuse the issues of piot tubes and caps with gauges.
4. The current #5 does not indicate where this is to be used in the subsequent paragraphs. There also does not seem to be a need for it with a pressure gauge if the sole point is to be able to relief pressure from hydrant once static is determined.
5. The current #1 only specifies a gauge. Why would someone bring just a gauge without it being attached to a hydrant cap or pitot tube.

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Committee: AUT-PRI

Public Input No. 26-NFPA 291-2019 [Section No. 4.5]

4.5 Test Procedure to Determine Available Flow in Mains .

4.5.1

In a typical test, the 200 psi (14 bar) gauge is attached to one of the 2½ in. (65 mm) outlets of the residual hydrant using the special cap.

4.5.2

The cock on the gauge piping is opened, and the hydrant valve is opened full.

4.5.3

As soon as the air is exhausted from the barrel, the cock is closed.

4.5.4

A reading (static pressure) is taken when the needle comes to rest.

4.5.5

At a given signal, each of the other hydrants is opened in succession, with discharge taking place directly from the open hydrant butts.

4.5.6

Hydrants should be opened one at a time.

4.5.7

With all hydrants flowing, water should be allowed to flow for a sufficient time to clear all debris and foreign substances from the stream(s).

4.5.8

At that time, a signal is given to the people at the hydrants to read the pitot pressure of the streams simultaneously while the residual pressure is being read.

4.5.9

The final magnitude of the pressure drop can be controlled by the number of hydrants used and the number of outlets opened on each.

4.5.10

After the readings have been taken, hydrants should be shut down slowly, one at a time, to prevent undue surges in the system.

Statement of Problem and Substantiation for Public Input

NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test than determines the flow available out of a hydrant nozzle.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	Complementary
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	Complementary
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	Complementary
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	Complementary
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	Complementary
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	Complementary
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	Complementary
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	Complementary

Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	Complementary
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	

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Committee:	AUT-PRI

Public Input No. 45-NFPA 291-2019 [Sections 4.6.3, 4.6.4, 4.6.5, 4.6.6, 4.6.7, 4.6.8, 4.6.9]

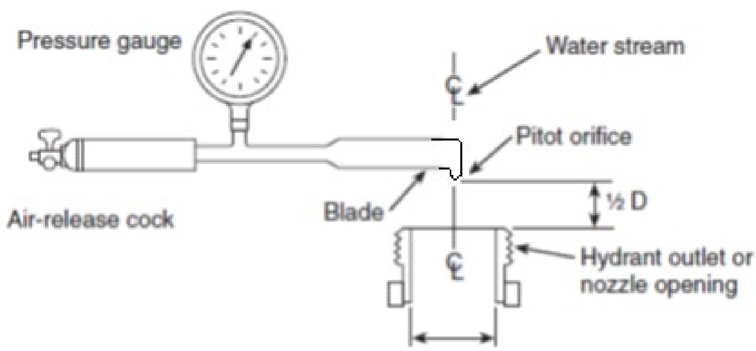
Sections 4.6.3, 4.6.4, 4.6.5, 4.6.6, 4.6.7, 4.6.8, 4.6.9

4.6.3

When measuring the pitot pressure of a stream of practically uniform velocity, the orifice in the pitot tube is held downstream approximately one-half the diameter of the hydrant outlet or nozzle opening, and in the center of the stream. *(see Figure 4.6.3.)*

Delete the existing Figure 4.6. 9 and replace it with the following new Figure 4 .6.3:

Figure 4.6.3 Pitot Tube Position.



4.6.4

The center line of the orifice should be at right angles to the plane of the face of the hydrant outlet.

4.6.5

The air chamber on the pitot tube should be kept elevated.

4.6.6

Pitot readings of less than 10 psi (0.7 bar) and more than 30 psi (2.1 bar) should be avoided, if possible.

4.6.7

Opening additional hydrant outlets will aid in controlling the pitot reading.

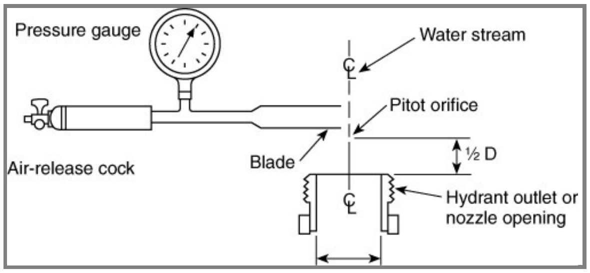
4.6.8

With dry barrel hydrants, the hydrant valve should be wide open to minimize problems with underground drain valves.

4.6.9

With wet barrel hydrants, the valve for the flowing outlet should be wide open to give a more streamlined flow and a more accurate pitot reading. ~~(See Figure 4.6.9 .)~~

~~**Figure 4.6.9 Pitot Tube Position.**~~



Statement of Problem and Substantiation for Public Input

The existing Figure 4.6.9 is incomplete and does not show the tip of the pitot tube. The new illustration corrects this omission.

Additionally, the illustration is provided with the text about wet barrel hydrant flow, whereas the subject of pitot tube position is applicable to many types of discharge outlets, so the illustration should be relocated to the more applicable Section 6.4.3.

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Committee: AUT-PRI

Public Input No. 16-NFPA 291-2018 [Section No. 4.6.6]

4.6.6

Pitot readings of less than 10 psi (0.7 bar) ~~and more than 30 psi (2.1 bar)~~ _ should be avoided, if possible.

Statement of Problem and Substantiation for Public Input

The proponent of this PI is unable to locate any technical reference that specifies the 30 PSI cap recommendation in the document. If the TC wishes to keep a recommended cap, then the proponent would suggest 60 psi...only because of the increased difficulty that occurs when one takes a hand pitot reading at higher pressures. (Now, one may not get a 25% drop in residual if the pitot reading is that high but, that is covered in another section and should not be mixed with this section.)

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Submittal Date: Wed Dec 12 10:32:42 EST 2018

Committee: AUT-PRI

Public Input No. 46-NFPA 291-2019 [Section No. 4.7.3]

4.7.3

~~The formula used to compute the discharge, *Q*, in gpm (L/min) from these measurements is as shown in Equations 4.7.3a and 4.7.3b.~~

$$Q = 29.84cd^2\sqrt{p} \quad \text{[4.7.3a]}$$

~~where:~~

~~*c* = coefficient of discharge (*see Figure 4.7.1*)~~

~~*d* = diameter of the outlet (in.)~~

~~*p* = pitot pressure (velocity head)(psi)~~

$$Q_M = 0.0666cd^2\sqrt{p_M} \quad \text{[4.7.3b]}$$

~~where:~~

~~Q_M = flow (L/min)~~

~~P_M = pressure (kPa or bar)~~

Revise Sction 4.7.3 to correspond with the changes introduced in TIA 19-1 *(TIA Log #1141)* - See attached:

Additional Proposed Changes

File Name	Description	Approved
TIA_291_19_1.pdf	TIA 19-1	

Statement of Problem and Substantiation for Public Input

This proposal is to follow TIA 19-1 ((TIA Log #1411) and seeks to rectify a discrepancy that was introduced during the Second Draft, when as per SR3 the metric version of the formula for determining the water flow rate was introduced.

As currently printed, the parameter PM is said to be for the units for pitot pressure of either kiloPascals (kPa) or bars, but the formula provided QM = 0.0666 c d²√PM is only applicable to kPa. Since 1 bar = 100 kPa, the formula when PM is expressed in bars should be QM = 0.666 c d²√PM.

For the Sprinkler Project, the NFPA 13 Technical Committees elected to use the bar rather than the kPa. Therefore, for consistency Equation 4.7.3b should also be expressed with the bar as the unit of pressure.

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Submittal Date: Sun Mar 17 18:02:05 EDT 2019

Committee: AUT-PRI

Tentative Interim Amendment

NFPA® 291

Recommended Practice for Fire Flow Testing and Marking of Hydrants

2019 Edition

Reference: 4.7.3 Equations a and b
TIA 19-1
(TIA Log #1411)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 291, *Recommended Practice for Fire Flow Testing and Marking of Hydrants*, 2019 edition. The TIA was processed by the Technical Committee on Private Water Supply Piping Systems and the Correlating Committee on Automatic Sprinkler Systems, and was issued by the Standards Council on February 28, 2019, with an effective date of March 20, 2019.

A Tentative Interim Amendment is tentative because it has not been processed through the entire standards-making procedures. It is interim because it is effective only between editions of the standard. A TIA automatically becomes a public input of the proponent for the next edition of the standard; as such, it then is subject to all of the procedures of the standards-making process.

1. Revise 4.7.3 Equations a and b to read as follows:

4.7.3 The formula used to compute the discharge, Q, in gpm (L/min) from these measurements is as shown in Equations 4.7.3a and 4.7.3b:

[4.7.3a]

$$Q = 29.84\, cd^2\sqrt{p}$$

where:
Q = flow (gpm)
c = coefficient of discharge *(see Figure 4.7.1)*
d = diameter of the outlet (in.)
p = pitot pressure (velocity head) (psi)

[4.7.3b]

~~$Q_M = 0.0666\, c\, d^2\sqrt{P_M}$~~ $Q_M = 0.666\, cd^2\sqrt{p_M}$

where:
Q_M = flow (L/min)
c = coefficient of discharge *(see Figure 4.7.1)*
d = diameter of the outlet (mm)
p_M = pitot pressure (velocity head) (~~kPa or~~ bar)

Issue Date: February 28, 2019
Effective Date: March 20, 2019

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Public Input No. 52-NFPA 291-2019 [Section No. 4.7.3]

4.7.3

The formula used to compute the discharge, *Q*, in gpm (L/min) from these measurements is as shown in Equations 4.7.3a and 4.7.3b.

$$Q = 29.84cd^2\sqrt{p} \quad [4.7.3a]$$

where:

Q = flow (gpm)

c = coefficient of discharge (*see Figure 4.7.1*)

d = diameter of the outlet (in.)

p = pitot pressure (velocity head) (psi)

$$Q_M = 0.666cd^2\sqrt{p_M} \quad [4.7.3b]$$

where:

Q_M = flow (L/min)

c = coefficient of discharge (*see Figure 4.7.1*)

d = diameter of the outlet (mm)

p_M = pitot pressure (velocity head) (bar)

Additional Proposed Changes

File Name	Description	Approved
Issued_TIA_291-19-1_Final.pdf	NFPA TIA 291-19-1 Log# 1411	

Statement of Problem and Substantiation for Public Input

NOTE: This public input originates from Tentative Interim Amendment No. 19-1 (Log 1411) issued by the Standards Council on February 28, 2019 and per the NFPA Regs., needs to be reconsidered by the Technical Committee for the next edition of the Document.

This TIA seeks to rectify a discrepancy that was introduced during the Second Draft, when as per SR3 the metric version of the formula for determining the water flow rate was introduced.
As currently printed, the parameter PM is said to be for the units for pitot pressure of either kiloPascals (kPa) or bars, but the formula provided QM = 0.0666 c d²√PM is only applicable to kPa. Since 1 bar = 100 kPa, the formula when PM is expressed in bars should be QM = 0.666 cd²√PM. For the Sprinkler Project, the NFPA 13 Technical Committees elected to use the bar rather than the kPa. Therefore, for consistency Equation 4.7.3b should also be expressed with the bar as the unit of pressure.

Additionally, as currently printed, the two equations define only some of the parameters. The formula for US Customary units does not define the Q as representing the flow rate. The metric formula does not define the Flow Coefficient c or the Outlet Diameter d. These discrepancies need correction, to avoid errors in determining flow test results.

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Submittal Date: Tue Apr 09 12:56:16 EDT 2019
Committee: AUT-PRI

Tentative Interim Amendment

NFPA® 291

Recommended Practice for Fire Flow Testing and Marking of Hydrants

2019 Edition

Reference: 4.7.3 Equations a and b
TIA 19-1
(TIA Log #1411)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 291, *Recommended Practice for Fire Flow Testing and Marking of Hydrants*, 2019 edition. The TIA was processed by the Technical Committee on Private Water Supply Piping Systems and the Correlating Committee on Automatic Sprinkler Systems, and was issued by the Standards Council on February 28, 2019, with an effective date of March 20, 2019.

A Tentative Interim Amendment is tentative because it has not been processed through the entire standards-making procedures. It is interim because it is effective only between editions of the standard. A TIA automatically becomes a public input of the proponent for the next edition of the standard; as such, it then is subject to all of the procedures of the standards-making process.

1. Revise 4.7.3 Equations a and b to read as follows:

4.7.3 The formula used to compute the discharge, Q, in gpm (L/min) from these measurements is as shown in Equations 4.7.3a and 4.7.3b:

[4.7.3a]

$$Q = 29.84\, cd^2\sqrt{p}$$

where:
Q = flow (gpm)
c = coefficient of discharge *(see Figure 4.7.1)*
d = diameter of the outlet (in.)
p = pitot pressure (velocity head) (psi)

[4.7.3b]

~~$Q_M = 0.0666\, c\, d^2\sqrt{P_M}$~~ $Q_M = 0.666\, cd^2\sqrt{p_M}$

where:
Q_M = flow (L/min)
c = coefficient of discharge *(see Figure 4.7.1)*
d = diameter of the outlet (mm)
p_M = pitot pressure (velocity head) (~~kPa or~~ bar)

Issue Date: February 28, 2019
Effective Date: March 20, 2019

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Public Input No. 17-NFPA 291-2018 [Section No. 4.9.1]

4.9.1

If a pitot tube is not available for use to measure the hydrant discharge, a ~~50 or 60 psi~~ 100 psi (3.4 or 4.1 bar) gauge tapped into a hydrant cap can be used.

Statement of Problem and Substantiation for Public Input

As previously discussed, many water distribution system may provide flow pressures greater than 50 psi from a 2 1/2" port. A 100 PSI gauge is more appropriate for the broadest cross section of use. The calculation chart in this document goes to 136 psi so it is clear the TC wanted to acknowledge pitot readings greater than those readable on a 50 psi gauge.

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Submittal Date: Wed Dec 12 10:40:20 EST 2018

Committee: AUT-PRI

Public Input No. 27-NFPA 291-2019 [Section No. 4.9.1]

4.9.1

If a pitot tube is not available for use to measure the hydrant discharge, a 50 or 60 psi (3.4 or 4.1 bar) gauge tapped into a hydrant cap can be used when the flow is through a hydrant outlet or a nozzle attached to a hydrant outlet .

Statement of Problem and Substantiation for Public Input

Clarification, the pressure at the hydrant outlet will not be the same when there is fire hose between the hydrant outlet and the flowing nozzle.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	

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Submittal Date: Fri Feb 15 11:26:27 EST 2019
Committee: AUT-PRI

Public Input No. 47-NFPA 291-2019 [Section No. 4.10.1 [Excluding any Sub-Sections]]

The discharge in gpm (L/min) for each outlet flowed is obtained from Table 4.10.1(a) and Table 4.10.1(b) or by the use of Equations 4.7.3a and 4.7.3b.

Delete the current Figure 4.10.1(a) and Figure 4.10.1(b) replace it with the attached revised tables:

Table 4.10.1(a) Theoretical Discharge Through Circular Orifices (U.S. Gallons of Water per Minute)

Pitot Pressure (psi)	- Feet	2	Velocity Discharge (ft/sec)	Orifice Size (in.)										
				2.25	2.375	2.5	2.625	2.75	3	3.25	3.5	3.75	4	4.5
1	2.31	12.20	119	151	168	187	206	226	269	315	366	420	477	604
2	4.61	17.25	169	214	238	264	291	319	380	446	517	593	675	855
3	6.92	21.13	207	262	292	323	356	391	465	546	633	727	827	1047
4	9.23	24.39	239	302	337	373	411	451	537	630	731	839	955	1209
5	11.54	27.26	267	338	376	417	460	505	601	705	817	938	1068	1351
6	13.84	29.87	292	370	412	457	504	553	658	772	895	1028	1169	1480
7	16.15	32.26	316	400	445	493	544	597	711	834	967	1110	1263	1599
8	18.46	34.49	338	427	476	528	582	638	760	891	1034	1187	1350	1709
9	20.76	36.58	358	453	505	560	617	677	806	946	1097	1259	1432	1813
10	23.07	38.56	377	478	532	590	650	714	849	997	1156	1327	1510	1911
11	25.38	40.45	396	501	558	619	682	748	891	1045	1212	1392	1583	2004
12	27.68	42.24	413	523	583	646	712	782	930	1092	1266	1454	1654	2093
13	29.99	43.97	430	545	607	672	741	814	968	1136	1318	1513	1721	2179
14	32.30	45.63	447	565	630	698	769	844	1005	1179	1368	1570	1786	2261
15	34.61	47.22	462	585	652	722	796	874	1040	1221	1416	1625	1849	2340
16	36.91	48.78	477	604	673	746	822	903	1074	1261	1462	1679	1910	2417
17	39.22	50.28	492	623	694	769	848	930	1107	1300	1507	1730	1969	2491
18	41.53	51.73	506	641	714	791	872	957	1139	1337	1551	1780	2026	2564
19	43.83	53.15	520	658	734	813	896	984	1171	1374	1593	1829	2081	2634
20	46.14	54.54	534	676	753	834	920	1009	1201	1410	1635	1877	2135	2702
22	50.75	57.19	560	709	789	875	964	1058	1260	1478	1715	1968	2239	2834
24	55.37	59.74	585	740	825	914	1007	1106	1316	1544	1791	2056	2339	2960
26	59.98	62.18	609	770	858	951	1048	1151	1369	1607	1864	2140	2434	3081
28	64.60	64.52	632	799	891	987	1088	1194	1421	1668	1934	2220	2526	3197
30	69.21	66.79	654	827	922	1022	1126	1236	1471	1726	2002	2298	2615	3310
32	73.82	68.98	675	855	952	1055	1163	1277	1519	1783	2068	2374	2701	3418
34	78.44	71.10	696	881	981	1087	1199	1316	1566	1838	2131	2447	2784	3523
36	83.05	73.16	716	906	1010	1119	1234	1354	1611	1891	2193	2518	2865	3626
38	87.67	75.17	736	931	1038	1150	1268	1391	1656	1943	2253	2587	2943	3725
40	92.28	77.11	755	955	1065	1180	1300	1427	1699	1993	2312	2654	3020	3822
42	96.89	79.03	774	979	1091	1209	1333	1462	1740	2043	2369	2719	3094	3916
44	101.51	80.88	792	1002	1116	1237	1364	1497	1781	2091	2425	2783	3167	4008
46	106.12	82.70	810	1025	1142	1265	1395	1531	1821	2138	2479	2846	3238	4098
48	110.74	84.48	827	1047	1166	1292	1425	1563	1861	2184	2533	2907	3308	4186
50	115.35	86.22	844	1068	1190	1319	1454	1596	1899	2229	2585	2967	3376	4273
52	119.96	87.93	861	1089	1214	1345	1483	1627	1937	2273	2636	3026	3443	4357
54	124.58	89.61	877	1110	1237	1370	1511	1658	1974	2316	2686	3084	3508	4440
56	129.19	91.20	893	1130	1260	1396	1539	1689	2010	2359	2735	3140	3573	4522
58	133.81	92.87	909	1150	1282	1420	1566	1719	2045	2400	2784	3196	3636	4602
60	138.42	94.45	925	1170	1304	1445	1593	1748	2080	2441	2831	3250	3698	4681
62	143.03	96.01	940	1189	1325	1469	1619	1777	2115	2482	2878	3304	3759	4758

Pitot Pressure (psi)	- Feet	2	Velocity Discharge (ft/sec)	Orifice Size (in.)										
				2.25	2.375	2.5	2.625	2.75	3	3.25	3.5	3.75	4	4.5
64	147.65	97.55	955	1209	1347	1492	1645	1805	2148	2521	2924	3357	3820	4834
66	152.26	99.07	970	1227	1367	1515	1670	1833	2182	2561	2970	3409	3879	4909
68	156.88	100.55	984	1246	1388	1538	1696	1861	2215	2599	3014	3460	3937	4983
70	161.49	102.03	999	1264	1408	1560	1720	1888	2247	2637	3058	3511	3995	5056
72	166.10	103.47	1013	1282	1428	1583	1745	1915	2279	2674	3102	3561	4051	5127
74	170.72	104.90	1027	1300	1448	1604	1769	1941	2310	2711	3144	3610	4107	5198
76	175.33	106.30	1041	1317	1467	1626	1793	1967	2341	2748	3187	3658	4162	5268
78	179.95	107.69	1054	1334	1487	1647	1816	1993	2372	2784	3228	3706	4217	5337
80	184.56	109.08	1068	1351	1505	1668	1839	2018	2402	2819	3269	3753	4270	5405
82	189.17	110.42	1081	1368	1524	1689	1862	2043	2432	2854	3310	3800	4323	5472
84	193.79	111.76	1094	1385	1543	1709	1885	2068	2461	2889	3350	3846	4376	5538
86	198.40	113.08	1107	1401	1561	1730	1907	2093	2491	2923	3390	3891	4428	5604
88	203.02	114.39	1120	1417	1579	1750	1929	2117	2519	2957	3429	3936	4479	5668
90	207.63	115.68	1132	1433	1597	1769	1951	2141	2548	2990	3468	3981	4529	5733
92	212.24	116.96	1145	1449	1614	1789	1972	2165	2576	3023	3506	4025	4579	5796
94	216.86	118.23	1157	1465	1632	1808	1994	2188	2604	3056	3544	4068	4629	5859
96	221.47	119.48	1169	1480	1649	1827	2015	2211	2631	3088	3582	4111	4678	5921
98	226.09	120.71	1182	1495	1666	1846	2035	2234	2659	3120	3619	4154	4726	5982
100	230.70	121.94	1194	1511	1683	1865	2056	2257	2686	3152	3655	4196	4774	6043
102	235.31	123.15	1205	1526	1700	1884	2077	2279	2712	3183	3692	4238	4822	6103
104	239.93	124.35	1217	1541	1716	1902	2097	2301	2739	3214	3728	4279	4869	6162
106	244.54	125.55	1229	1555	1733	1920	2117	2323	2765	3245	3763	4320	4916	6221
108	249.16	126.73	1240	1570	1749	1938	2137	2345	2791	3275	3799	4361	4962	6280
110	253.77	127.89	1252	1584	1765	1956	2157	2367	2817	3306	3834	4401	5007	6338
112	258.38	129.05	1263	1599	1781	1974	2176	2388	2842	3336	3869	4441	5053	6395
114	263.00	130.20	1274	1613	1797	1991	2195	2409	2867	3365	3903	4480	5098	6452
116	267.61	131.33	1286	1627	1813	2009	2215	2430	2892	3395	3937	4519	5142	6508
118	272.23	132.46	1297	1641	1828	2026	2234	2451	2917	3424	3971	4558	5186	6564
120	276.84	133.57	1308	1655	1844	2043	2252	2472	2942	3453	4004	4597	5230	6619
122	281.45	134.69	1318	1669	1859	2060	2271	2493	2966	3481	4038	4635	5273	6674
124	286.07	135.79	1329	1682	1874	2077	2290	2513	2991	3510	4070	4673	5317	6729
126	290.68	136.88	1340	1696	1889	2093	2308	2533	3015	3538	4103	4710	5359	6783
128	295.30	137.96	1350	1709	1904	2110	2326	2553	3038	3566	4136	4748	5402	6836
130	299.91	139.03	1361	1722	1919	2126	2344	2573	3062	3594	4168	4784	5444	6890
132	304.52	140.10	1371	1736	1934	2143	2362	2593	3086	3621	4200	4821	5485	6942
134	309.14	141.16	1382	1749	1948	2159	2380	2612	3109	3649	4231	4858	5527	6995
136	313.75	142.21	1392	1762	1963	2175	2398	2632	3132	3676	4263	4894	5568	7047

Notes:

(1) This table is computed from the formula $Q = 29.84cd^2\sqrt{p}$, with *c* = 1.00. The theoretical discharge of seawater, as from fireboat nozzles, can be found by subtracting 1 percent from the figures in Table 4.10.2.1, or from the formula $Q = 29.84cd^2\sqrt{p}$.

(2) Appropriate coefficient should be applied where it is read from hydrant outlet. Where more accurate results are required, a coefficient appropriate on the particular nozzle must be selected and applied to the figures of the table. The discharge from circular openings of sizes other than those in the table can readily be computed by applying the principle that quantity discharged under a given head varies as the square of

the diameter of the opening.

Table 4.10.1(b) Theoretical Discharge Through Circular Orifices (Liters of Water per Minute)

Pitot Pressure (kPa)	Pitot Pressure (bar)	Meters (m)	Velocity Discharge (m/sec)	Orifice Size (mm)										
				51	57	60	65	67	70	76	83	89	95	102
5	0.1	0.51	3.16	387	484	536	629	669	730	860	1026	1180	1344	1549
10	0.1	1.02	4.47	548	684	758	890	945	1032	1216	1451	1668	1901	2191
15	0.2	1.53	5.48	671	838	929	1090	1158	1264	1490	1777	2043	2328	2684
20	0.2	2.04	6.33	775	968	1072	1258	1337	1459	1720	2052	2359	2688	3099
25	0.3	2.55	7.07	866	1082	1199	1407	1495	1632	1923	2294	2638	3005	3465
30	0.3	3.06	7.75	949	1185	1313	1541	1638	1787	2107	2513	2889	3292	3795
35	0.4	3.57	8.37	1025	1280	1418	1665	1769	1931	2276	2714	3121	3556	4099
40	0.4	4.08	8.95	1096	1369	1516	1780	1891	2064	2433	2902	3336	3801	4382
45	0.5	4.59	9.49	1162	1452	1608	1888	2006	2189	2581	3078	3539	4032	4648
50	0.5	5.1	10.00	1225	1530	1695	1990	2114	2308	2720	3244	3730	4250	4900
55	0.6	5.61	10.49	1285	1605	1778	2087	2217	2420	2853	3403	3912	4458	5139
60	0.6	6.12	10.96	1342	1676	1857	2180	2316	2528	2980	3554	4086	4656	5367
65	0.7	6.63	11.41	1397	1745	1933	2269	2410	2631	3101	3699	4253	4846	5586
70	0.7	7.14	11.84	1449	1810	2006	2354	2501	2730	3218	3839	4414	5029	5797
75	0.8	7.65	12.25	1500	1874	2076	2437	2589	2826	3331	3973	4569	5205	6001
80	0.8	8.16	12.65	1549	1935	2144	2517	2674	2919	3441	4104	4718	5376	6198
85	0.9	8.67	13.04	1597	1995	2210	2594	2756	3009	3547	4230	4864	5542	6388
90	0.9	9.18	13.42	1643	2053	2275	2669	2836	3096	3649	4353	5005	5702	6573
95	1.0	9.69	13.79	1688	2109	2337	2743	2914	3181	3749	4472	5142	5858	6754
100	1.0	10.2	14.15	1732	2164	2398	2814	2990	3263	3847	4588	5275	6011	6929
105	1.1	10.71	14.50	1775	2217	2457	2883	3064	3344	3942	4701	5406	6159	7100
110	1.1	11.22	14.84	1817	2269	2515	2951	3136	3423	4035	4812	5533	6304	7267
115	1.2	11.73	15.17	1858	2320	2571	3018	3206	3500	4125	4920	5657	6446	7431
120	1.2	12.24	15.50	1898	2370	2626	3082	3275	3575	4214	5026	5779	6584	7590
125	1.3	12.75	15.82	1937	2419	2681	3146	3343	3649	4301	5130	5898	6720	7747
130	1.3	13.26	16.13	1975	2467	2734	3208	3409	3721	4386	5231	6015	6853	7900
140	1.4	14.28	16.74	2050	2560	2837	3329	3537	3861	4552	5429	6242	7112	8199
150	1.5	15.3	17.33	2122	2650	2936	3446	3662	3997	4711	5619	6461	7362	8486
160	1.6	16.32	17.89	2191	2737	3033	3559	3782	4128	4866	5804	6673	7603	8765
170	1.7	17.34	18.44	2259	2821	3126	3669	3898	4255	5016	5982	6878	7837	9034
180	1.8	18.36	18.98	2324	2903	3217	3775	4011	4378	5161	6156	7078	8064	9296
190	1.9	19.38	19.50	2388	2983	3305	3879	4121	4498	5302	6324	7272	8285	9551
200	2.0	20.4	20.01	2450	3060	3391	3979	4228	4615	5440	6489	7461	8500	9799
210	2.1	21.42	20.50	2510	3136	3474	4078	4332	4729	5575	6649	7645	8710	10041
220	2.2	22.44	20.98	2569	3209	3556	4174	4434	4840	5706	6805	7825	8915	10277
230	2.3	23.46	21.45	2627	3282	3636	4267	4534	4949	5834	6958	8001	9116	10508
240	2.4	24.48	21.92	2684	3352	3714	4359	4632	5056	5959	7108	8173	9312	10734
250	2.5	25.5	22.37	2739	3421	3791	4449	4727	5160	6082	7254	8341	9504	10956
260	2.6	26.52	22.81	2793	3489	3866	4537	4821	5262	6203	7398	8506	9692	11173
270	2.7	27.54	23.25	2846	3556	3940	4624	4913	5362	6321	7539	8668	9877	11386
285	2.9	29.07	23.88	2924	3653	4048	4750	5047	5509	6494	7746	8906	10147	11698
300	3.0	30.6	24.50	3000	3748	4153	4874	5178	5652	6663	7947	9137	10411	12001
315	3.2	32.13	25.11	3074	3840	4255	4994	5306	5792	6827	8143	9363	10668	12298

Pitot Pressure (kPa)	Pitot Pressure (bar)	Meters (m)	Velocity Discharge (m/sec)	Orifice Size (mm)										
				51	57	60	65	67	70	76	83	89	95	102
330	3.3	33.66	25.70	3147	3931	4355	5112	5431	5928	6988	8335	9583	10919	12587
345	3.5	35.19	26.28	3218	4019	4453	5226	5553	6061	7145	8522	9799	11164	12870
360	3.6	36.72	26.84	3287	4106	4549	5339	5673	6192	7299	8705	10009	11404	13147
375	3.8	38.25	27.39	3355	4190	4643	5449	5789	6320	7449	8885	10216	11640	13418
390	3.9	39.78	27.94	3421	4273	4735	5557	5904	6445	7597	9061	10418	11870	13684
405	4.1	41.31	28.47	3486	4355	4825	5663	6017	6567	7742	9233	10617	12096	13944
420	4.2	42.84	28.99	3550	4435	4914	5767	6127	6688	7884	9403	10811	12318	14200
435	4.4	44.37	29.50	3613	4513	5001	5869	6235	6806	8023	9569	11003	12536	14452
450	4.5	45.9	30.01	3675	4590	5086	5969	6342	6923	8160	9733	11191	12751	14699
465	4.7	47.43	30.51	3735	4666	5170	6068	6447	7037	8295	9894	11376	12961	14942
480	4.8	48.96	30.99	3795	4741	5253	6165	6550	7150	8428	10052	11558	13169	15181
495	5.0	50.49	31.47	3854	4814	5334	6260	6652	7261	8559	10208	11737	13373	15416
510	5.1	52.02	31.95	3912	4887	5415	6355	6752	7370	8687	10361	11913	13574	15648
525	5.3	53.55	32.41	3969	4958	5494	6447	6850	7477	8814	10513	12087	13772	15876
540	5.4	55.08	32.87	4025	5028	5572	6539	6947	7583	8939	10662	12259	13967	16102
555	5.6	56.61	33.33	4081	5098	5648	6629	7043	7688	9062	10809	12428	14160	16324
570	5.7	58.14	33.77	4136	5166	5724	6718	7138	7791	9184	10954	12595	14350	16543
585	5.9	59.67	34.22	4190	5234	5799	6806	7231	7893	9304	11097	12759	14538	16759
600	6.0	61.2	34.65	4243	5300	5873	6892	7323	7994	9423	11238	12922	14723	16973
615	6.2	62.73	35.08	4296	5366	5946	6978	7414	8093	9540	11378	13083	14906	17184
630	6.3	64.26	35.51	4348	5431	6018	7063	7504	8191	9655	11516	13241	15087	17392
645	6.5	65.79	35.93	4399	5495	6089	7146	7593	8288	9770	11652	13398	15265	17598
660	6.6	67.32	36.34	4450	5559	6160	7229	7681	8384	9883	11787	13553	15442	17801
675	6.8	68.85	36.75	4501	5622	6229	7311	7767	8479	9994	11920	13706	15616	18002
690	6.9	70.38	37.16	4550	5684	6298	7391	7853	8572	10105	12052	13857	15789	18201
705	7.1	71.91	37.56	4599	5745	6366	7471	7938	8665	10214	12182	14007	15959	18398
720	7.2	73.44	37.96	4648	5806	6433	7550	8022	8757	10322	12311	14155	16128	18593
735	7.4	74.97	38.35	4696	5866	6500	7629	8105	8847	10429	12439	14302	16295	18785
750	7.5	76.5	38.74	4744	5926	6566	7706	8188	8937	10535	12565	14447	16461	18976
765	7.7	78.03	39.13	4791	5985	6631	7783	8269	9026	10640	12690	14591	16625	19165
780	7.8	79.56	39.51	4838	6043	6696	7859	8350	9114	10744	12814	14733	16787	19352
795	8.0	81.09	39.89	4884	6101	6760	7934	8430	9201	10846	12936	14874	16947	19537
810	8.1	82.62	40.26	4930	6158	6824	8008	8509	9288	10948	13058	15014	17107	19720
825	8.3	84.15	40.63	4976	6215	6887	8082	8587	9373	11049	13178	15152	17264	19902
840	8.4	85.68	41.00	5021	6271	6949	8155	8665	9458	11149	13298	15290	17421	20082
855	8.6	87.21	41.36	5065	6327	7011	8228	8742	9542	11248	13416	15425	17575	20261
870	8.7	88.74	41.73	5109	6382	7072	8300	8818	9626	11346	13533	15560	17729	20438
885	8.9	90.27	42.08	5153	6437	7133	8371	8894	9708	11444	13649	15694	17881	20613
900	9.0	91.8	42.44	5197	6492	7193	8442	8969	9790	11540	13764	15826	18032	20787
915	9.2	93.33	42.79	5240	6545	7252	8512	9043	9871	11636	13878	15957	18182	20960
930	9.3	94.86	43.14	5283	6599	7312	8581	9117	9952	11731	13992	16088	18330	21131
945	9.5	96.39	43.49	5325	6652	7370	8650	9191	10032	11825	14104	16217	18477	21301

Notes:

(1) This table is computed from the formula $Q_m = 0.0666cd^2\sqrt{P_m}$, with *c* = 1.00. The theoretical discharge of seawater, as from fireboat nozzles, can be found by subtracting 1 percent from the

figures in Table 4.10.2.1, or from the formula $Q_m = 0.065cd^2\sqrt{P_m}$.

(2) Appropriate coefficient should be applied where it is read from the hydrant outlet. Where more accurate results are required, a coefficient appropriate on the particular nozzle must be selected and applied to the figures of the table. The discharge from circular openings of sizes other than those in the table can readily be computed by applying the principle that quantity discharged under a given head varies as the square of the diameter of the opening.

Additional Proposed Changes

File Name	Description	Approved
NFPA_291_Table_4_10_1_a.xlsx	Revised Table 4.10.1(a)	
NFPA_291_Table_4_10_1_b.xlsx	Revised Table 4.10.1(b)	

Statement of Problem and Substantiation for Public Input

This proposal is to rectify a mistake in the current Table 4.10.1(a) and Table 4.10.1(b).

The columns that report the Velocity Discharge should be deleted, because, while it does not say so in the table, the values reported are only for the 2 inch (50.8 mm) Orifice Size. For each of the larger Orifice Sizes in the Table, other/lesser velocities would be available. Also, the Velocity is not used in the determination of the flow rate, so the columns serves no purpose in the Tables.

In place of the Velocity Discharge column, a new column for flow rates from a 1¾ (1.75) inch (44.5 mm) Orifice Size is offered. This Orifice Size is common to many flow test devices, such as from an Underwriter's Playpipe, which are still frequently used in hydrant flow testing, as well as fire pump flow testing.

This proposal is also to This proposal is to follow proposed TIA Log #1412 and seeks to rectify a discrepancy that was introduced during the Second Draft, with the introduction of Table 4.10.1(b) to provide a table of flow rates based on metric units. After conversion from the corresponding Orifice Sizes expressed in inches from Table 4.10.1(a) the metric equivalent values the metric Orifice Sizes in Table 4.10.1(b) were rounded to whole numbers incorrectly.

Rounding to utilize just whole numbers introduced an error into the corresponding flow rates. Because an inch equals 25.4 millimeters (mm), the 1st decimal point becomes a significant figure in the metric units.

For example, from Table 4.10.1(a), for a pressure of 100 psi through a 2" orifice a flow of 1194 gpm was determined.
Converting to metric units, 100 psi = 690 kPa, so from Table 4.10.1(b) for a pressure of 690 kPa through a 51 mm orifice, a flow of 4550 L/min is reported. Converting this flow back to gpm on the basis of 1 gpm = 3.785 L/min results in 1202 gpm.
However, computing the flow based on 2" x 25.4 mm/inch = 50.8 mm Orifice Size results in a flow of 4515 L/min which converts back to 1193 gpm, which overall represents a much more accurate determination.

For the equivalent of a 2½ inch orifice the current Table 4.10.1(b) reports a 65 mm metric equivalent. However, for proper accuracy, the value should be 2.5 x 25.4 = 63.5 mm, so flow computed at 65 mm introduces an even more significant error.

For an example of this, from Table 4.10.1(a), for a pressure of 50 psi through a 2½" orifice a flow of 1319 gpm was determined.
Converting to metric units, 50 psi = 345 kPa, so from Table 4.10.1(b) for a pressure of 345 kPa through a 65 mm orifice, a flow of 5226 L/min is reported. Converting this flow back to gpm on the basis of 1 gpm = 3.785 L/min results in 1381 gpm.

However, computing the flow based on 2.5" x 25.4 mm/inch = 63.5 mm Orifice Size results in a flow of 4988 L/min which converts back to 1318 gpm, which again, represents a much more accurate determination.
Additionally, the column that reports the Velocity Discharge should be deleted, because, while it does not say so in the table, the values reported are only for the 51 mm Orifice Size. For each of the larger Orifice Sizes in the Table, other/lesser velocities would be available. Also, the Velocity is not used in the determination of the flow rate, so the column serves no purpose in the Table.

Submitter Information Verification

Submitter Full Name: Larry Keeping
Organization: PLC Fire Safety Solutions
Street Address:
City:
State:
Zip:
Submittal Date: Sun Mar 17 19:11:31 EDT 2019
Committee: AUT-PRI

Table 4.10.1 (a) Theoretical Discharge Through Circular Orifices (US Gallons of Water per Minute)

Pitot Pressure (psi)	Feet	Orifice Size (in.)												
		1.75	2	2.25	2.375	2.5	2.625	2.75	3	3.25	3.5	3.75	4	4.5
1	2.31	91	119	151	168	187	206	226	269	315	366	420	477	604
2	4.61	129	169	214	238	264	291	319	380	446	517	593	675	855
3	6.92	158	207	262	292	323	356	391	465	546	633	727	827	1047
4	9.23	183	239	302	337	373	411	451	537	630	731	839	955	1209
5	11.54	204	267	338	376	417	460	505	601	705	817	938	1068	1351
6	13.84	224	292	370	412	457	504	553	658	772	895	1028	1169	1480
7	16.15	242	316	400	445	493	544	597	711	834	967	1110	1263	1599
8	18.46	258	338	427	476	528	582	638	760	891	1034	1187	1350	1709
9	20.76	274	358	453	505	560	617	677	806	946	1097	1259	1432	1813
10	23.07	289	377	478	532	590	650	714	849	997	1156	1327	1510	1911
11	25.38	303	396	501	558	619	682	748	891	1045	1212	1392	1583	2004
12	27.68	317	413	523	583	646	712	782	930	1092	1266	1454	1654	2093
13	29.99	329	430	545	607	672	741	814	968	1136	1318	1513	1721	2179
14	32.30	342	447	565	630	698	769	844	1005	1179	1368	1570	1786	2261
15	34.61	354	462	585	652	722	796	874	1040	1221	1416	1625	1849	2340
16	36.91	366	477	604	673	746	822	903	1074	1261	1462	1679	1910	2417
17	39.22	377	492	623	694	769	848	930	1107	1300	1507	1730	1969	2491
18	41.53	388	506	641	714	791	872	957	1139	1337	1551	1780	2026	2564
19	43.83	398	520	658	734	813	896	984	1171	1374	1593	1829	2081	2634
20	46.14	409	534	676	753	834	920	1009	1201	1410	1635	1877	2135	2702
22	50.75	429	560	709	789	875	964	1058	1260	1478	1715	1968	2239	2834
24	55.37	448	585	740	825	914	1007	1106	1316	1544	1791	2056	2339	2960
26	59.98	466	609	770	858	951	1048	1151	1369	1607	1864	2140	2434	3081
28	64.60	484	632	799	891	987	1088	1194	1421	1668	1934	2220	2526	3197
30	69.21	501	654	827	922	1022	1126	1236	1471	1726	2002	2298	2615	3310
32	73.82	517	675	855	952	1055	1163	1277	1519	1783	2068	2374	2701	3418
34	78.44	533	696	881	981	1087	1199	1316	1566	1838	2131	2447	2784	3523
36	83.05	548	716	906	1010	1119	1234	1354	1611	1891	2193	2518	2865	3626
38	87.67	563	736	931	1038	1150	1268	1391	1656	1943	2253	2587	2943	3725
40	92.28	578	755	955	1065	1180	1300	1427	1699	1993	2312	2654	3020	3822
42	96.89	592	774	979	1091	1209	1333	1462	1740	2043	2369	2719	3094	3916
44	101.51	606	792	1002	1116	1237	1364	1497	1781	2091	2425	2783	3167	4008
46	106.12	620	810	1025	1142	1265	1395	1531	1821	2138	2479	2846	3238	4098

Table 4.10.1 (a) **Theoretical Discharge Through Circular Orifices (US Gallons of Water per Minute)**

Pitot Pressure (psi)	Feet	Orifice Size (in.)												
		1.75	2	2.25	2.375	2.5	2.625	2.75	3	3.25	3.5	3.75	4	4.5
48	110.74	633	827	1047	1166	1292	1425	1563	1861	2184	2533	2907	3308	4186
50	115.35	646	844	1068	1190	1319	1454	1596	1899	2229	2585	2967	3376	4273
52	119.96	659	861	1089	1214	1345	1483	1627	1937	2273	2636	3026	3443	4357
54	124.58	672	877	1110	1237	1370	1511	1658	1974	2316	2686	3084	3508	4440
56	129.19	684	893	1130	1260	1396	1539	1689	2010	2359	2735	3140	3573	4522
58	133.81	696	909	1150	1282	1420	1566	1719	2045	2400	2784	3196	3636	4602
60	138.42	708	925	1170	1304	1445	1593	1748	2080	2441	2831	3250	3698	4681
62	143.03	720	940	1189	1325	1469	1619	1777	2115	2482	2878	3304	3759	4758
64	147.65	731	955	1209	1347	1492	1645	1805	2148	2521	2924	3357	3820	4834
66	152.26	742	970	1227	1367	1515	1670	1833	2182	2561	2970	3409	3879	4909
68	156.88	754	984	1246	1388	1538	1696	1861	2215	2599	3014	3460	3937	4983
70	161.49	765	999	1264	1408	1560	1720	1888	2247	2637	3058	3511	3995	5056
72	166.10	775	1013	1282	1428	1583	1745	1915	2279	2674	3102	3561	4051	5127
74	170.72	786	1027	1300	1448	1604	1769	1941	2310	2711	3144	3610	4107	5198
76	175.33	797	1041	1317	1467	1626	1793	1967	2341	2748	3187	3658	4162	5268
78	179.95	807	1054	1334	1487	1647	1816	1993	2372	2784	3228	3706	4217	5337
80	184.56	817	1068	1351	1505	1668	1839	2018	2402	2819	3269	3753	4270	5405
82	189.17	828	1081	1368	1524	1689	1862	2043	2432	2854	3310	3800	4323	5472
84	193.79	838	1094	1385	1543	1709	1885	2068	2461	2889	3350	3846	4376	5538
86	198.40	847	1107	1401	1561	1730	1907	2093	2491	2923	3390	3891	4428	5604
88	203.02	857	1120	1417	1579	1750	1929	2117	2519	2957	3429	3936	4479	5668
90	207.63	867	1132	1433	1597	1769	1951	2141	2548	2990	3468	3981	4529	5733
92	212.24	877	1145	1449	1614	1789	1972	2165	2576	3023	3506	4025	4579	5796
94	216.86	886	1157	1465	1632	1808	1994	2188	2604	3056	3544	4068	4629	5859
96	221.47	895	1169	1480	1649	1827	2015	2211	2631	3088	3582	4111	4678	5921
98	226.09	905	1182	1495	1666	1846	2035	2234	2659	3120	3619	4154	4726	5982
100	230.70	914	1194	1511	1683	1865	2056	2257	2686	3152	3655	4196	4774	6043
102	235.31	923	1205	1526	1700	1884	2077	2279	2712	3183	3692	4238	4822	6103
104	239.93	932	1217	1541	1716	1902	2097	2301	2739	3214	3728	4279	4869	6162
106	244.54	941	1229	1555	1733	1920	2117	2323	2765	3245	3763	4320	4916	6221
108	249.16	950	1240	1570	1749	1938	2137	2345	2791	3275	3799	4361	4962	6280
110	253.77	958	1252	1584	1765	1956	2157	2367	2817	3306	3834	4401	5007	6338
112	258.38	967	1263	1599	1781	1974	2176	2388	2842	3336	3869	4441	5053	6395
114	263.00	976	1274	1613	1797	1991	2195	2409	2867	3365	3903	4480	5098	6452

Table 4.10.1 (a) Theoretical Discharge Through Circular Orifices (US Gallons of Water per Minute)

Pitot Pressure (psi)	Feet	Orifice Size (in.)												
		1.75	**2**	**2.25**	**2.375**	**2.5**	**2.625**	**2.75**	**3**	**3.25**	**3.5**	**3.75**	**4**	**4.5**
116	267.61	984	1286	1627	1813	2009	2215	2430	2892	3395	3937	4519	5142	6508
118	272.23	993	1297	1641	1828	2026	2234	2451	2917	3424	3971	4558	5186	6564
120	276.84	1001	1308	1655	1844	2043	2252	2472	2942	3453	4004	4597	5230	6619
122	281.45	1009	1318	1669	1859	2060	2271	2493	2966	3481	4038	4635	5273	6674
124	286.07	1018	1329	1682	1874	2077	2290	2513	2991	3510	4070	4673	5317	6729
126	290.68	1026	1340	1696	1889	2093	2308	2533	3015	3538	4103	4710	5359	6783
128	295.30	1034	1350	1709	1904	2110	2326	2553	3038	3566	4136	4748	5402	6836
130	299.91	1042	1361	1722	1919	2126	2344	2573	3062	3594	4168	4784	5444	6890
132	304.52	1050	1371	1736	1934	2143	2362	2593	3086	3621	4200	4821	5485	6942
134	309.14	1058	1382	1749	1948	2159	2380	2612	3109	3649	4231	4858	5527	6995
136	313.75	1066	1392	1762	1963	2175	2398	2632	3132	3676	4263	4894	5568	7047

Notes:

(1) This table is computed from the formula $Q = 29.84cd^2 \sqrt{P}$, with c = 1.00. The theoretical discharge of seawater, as from fireboat nozzles, can be found by subtracting 1 percent from the figures in Table 4.10.2.1, or from the formula $Q = 29.84cd^2 \sqrt{P}$.

(2) Appropriate coefficient should be applied where it is read from the hydrant outlet. Where more accurate results are required, a coefficient appropriate on the particular nozzle must be selected and applied to the figures of the table. The discharge from circular openings of sizes other than those in the table can readily be computed by applying the principle that quantity discharged under a given head varies as the square of the diameter of the opening.

Table 4.10.1 (b) Theoretical Discharge Through Circular Orifices (Liters of Water per Minute)

Pitot Pressure (kPa)	Pitot Pressure (bar)	Meters (m)	Orifice Size (mm) 44.5	50.8	57.2	60.3	63.5	66.7	69.9	76.2	82.6	88.9	95.3	101.6	114.3
5	0.05	0.51	295	384	487	541	600	663	728	865	1016	1177	1353	1537	1946
10	0.10	1.02	417	544	689	766	849	937	1029	1223	1437	1664	1913	2174	2751
15	0.15	1.53	511	666	844	938	1040	1148	1260	1498	1760	2039	2343	2663	3370
20	0.20	2.04	590	769	974	1083	1201	1325	1455	1729	2032	2354	2705	3075	3891
25	0.25	2.55	659	859	1090	1211	1343	1481	1627	1934	2272	2632	3024	3437	4350
30	0.30	3.06	722	941	1194	1326	1471	1623	1782	2118	2489	2883	3313	3765	4766
35	0.35	3.57	780	1017	1289	1433	1589	1753	1925	2288	2688	3114	3578	4067	5148
40	0.40	4.08	834	1087	1378	1532	1698	1874	2058	2446	2874	3329	3826	4348	5503
45	0.45	4.59	885	1153	1462	1624	1801	1988	2183	2594	3048	3531	4058	4612	5837
50	0.50	5.10	933	1215	1541	1712	1899	2095	2301	2734	3213	3722	4277	4861	6153
55	0.55	5.61	978	1275	1616	1796	1992	2197	2413	2868	3370	3904	4486	5099	6453
60	0.60	6.12	1022	1331	1688	1876	2080	2295	2521	2995	3520	4077	4685	5325	6740
65	0.65	6.63	1063	1386	1757	1952	2165	2389	2624	3118	3663	4244	4877	5543	7015
70	0.70	7.14	1103	1438	1823	2026	2247	2479	2723	3235	3802	4404	5061	5752	7280
75	0.75	7.65	1142	1488	1887	2097	2326	2566	2818	3349	3935	4558	5238	5954	7535
80	0.80	8.16	1180	1537	1949	2166	2402	2650	2911	3459	4064	4708	5410	6149	7782
85	0.85	8.67	1216	1585	2009	2233	2476	2732	3000	3565	4189	4853	5577	6338	8022
90	0.90	9.18	1251	1631	2067	2297	2548	2811	3087	3669	4311	4993	5738	6522	8254
95	0.95	9.69	1285	1675	2124	2360	2617	2888	3172	3769	4429	5130	5896	6701	8481
100	1.00	10.20	1319	1719	2179	2422	2685	2963	3254	3867	4544	5264	6049	6875	8701
105	1.05	10.71	1351	1761	2233	2481	2752	3036	3334	3963	4656	5394	6198	7045	8916
110	1.10	11.22	1383	1803	2285	2540	2817	3108	3413	4056	4766	5520	6344	7210	9126
115	1.15	11.73	1414	1843	2337	2597	2880	3177	3490	4147	4873	5645	6486	7372	9331
120	1.20	12.24	1445	1883	2387	2653	2942	3246	3565	4236	4978	5766	6626	7531	9531
125	1.25	12.75	1475	1922	2436	2707	3002	3313	3638	4324	5080	5885	6763	7686	9728
130	1.30	13.26	1504	1960	2484	2761	3062	3378	3710	4409	5181	6001	6897	7839	9921
140	1.40	14.28	1560	2034	2578	2865	3178	3506	3850	4576	5376	6228	7157	8134	10295
150	1.50	15.30	1615	2105	2669	2966	3289	3629	3985	4736	5565	6446	7408	8420	10656
160	1.60	16.32	1668	2174	2756	3063	3397	3748	4116	4892	5748	6658	7651	8696	11006
170	1.70	17.34	1720	2241	2841	3157	3501	3863	4243	5042	5925	6863	7887	8964	11345
180	1.80	18.36	1769	2306	2923	3249	3603	3975	4366	5188	6096	7062	8115	9224	11674
190	1.90	19.38	1818	2369	3004	3338	3702	4084	4485	5330	6263	7255	8338	9476	11993
200	2.00	20.40	1865	2431	3082	3425	3798	4190	4602	5469	6426	7444	8554	9722	12305

Table 4.10.1 (b) Theoretical Discharge Through Circular Orifices (Liters of Water per Minute)

Pitot Pressure (kPa)	Pitot Pressure (bar)	Meters (m)	Orifice Size (mm)												
			44.5	50.8	57.2	60.3	63.5	66.7	69.9	76.2	82.6	88.9	95.3	101.6	114.3
210	2.10	21.42	1911	2491	3158	3509	3892	4294	4716	5604	6585	7628	8765	9963	12609
220	2.20	22.44	1956	2549	3232	3592	3983	4395	4827	5736	6740	7807	8972	10197	12906
230	2.30	23.46	2000	2607	3305	3673	4073	4494	4935	5865	6891	7983	9173	10426	13196
240	2.40	24.48	2043	2663	3376	3752	4160	4590	5041	5991	7039	8154	9371	10650	13479
250	2.50	25.50	2085	2718	3445	3829	4246	4685	5145	6114	7185	8322	9564	10870	13757
260	2.60	26.52	2127	2771	3514	3905	4330	4778	5247	6235	7327	8487	9753	11085	14030
270	2.70	27.54	2167	2824	3581	3979	4413	4869	5347	6354	7466	8649	9939	11296	14297
285	2.85	29.07	2226	2902	3679	4088	4534	5002	5494	6528	7671	8886	10211	11606	14689
300	3.00	30.60	2284	2977	3774	4194	4651	5132	5636	6698	7870	9117	10477	11908	15070
315	3.15	32.13	2341	3050	3867	4298	4766	5259	5775	6863	8065	9342	10735	12202	15443
330	3.30	33.66	2396	3122	3958	4399	4878	5382	5911	7025	8255	9562	10988	12489	15806
345	3.45	35.19	2450	3192	4047	4498	4988	5503	6044	7183	8440	9777	11235	12769	16161
360	3.60	36.72	2502	3261	4134	4595	5095	5622	6174	7337	8622	9987	11477	13044	16509
375	3.75	38.25	2554	3328	4220	4689	5200	5738	6302	7489	8799	10193	11713	13313	16849
390	3.90	39.78	2605	3394	4303	4782	5303	5851	6426	7637	8974	10395	11945	13577	17183
405	4.05	41.31	2654	3459	4385	4873	5404	5963	6549	7782	9145	10593	12173	13835	17510
420	4.20	42.84	2703	3522	4466	4963	5504	6072	6669	7925	9312	10787	12396	14089	17832
435	4.35	44.37	2751	3585	4545	5051	5601	6180	6787	8065	9477	10978	12616	14339	18147
450	4.50	45.90	2798	3646	4622	5137	5697	6285	6903	8203	9639	11166	12831	14584	18458
465	4.65	47.43	2844	3706	4699	5222	5791	6389	7017	8339	9799	11350	13043	14825	18763
480	4.80	48.96	2889	3765	4774	5306	5884	6492	7129	8472	9955	11532	13252	15062	19063
495	4.95	50.49	2934	3824	4848	5388	5975	6592	7240	8604	10110	11711	13457	15296	19358
510	5.10	52.02	2978	3881	4921	5469	6065	6691	7349	8733	10262	11887	13660	15526	19650
525	5.25	53.55	3022	3938	4993	5549	6153	6789	7456	8861	10412	12060	13859	15752	19936
540	5.40	55.08	3065	3994	5064	5627	6240	6885	7562	8986	10559	12231	14056	15976	20219
555	5.55	56.61	3107	4049	5133	5705	6327	6980	7666	9110	10705	12400	14250	16196	20498
570	5.70	58.14	3149	4103	5202	5782	6411	7074	7769	9233	10849	12567	14441	16413	20773
585	5.85	59.67	3190	4157	5270	5857	6495	7166	7871	9353	10990	12731	14630	16628	21045
600	6.00	61.20	3231	4210	5338	5932	6578	7258	7971	9472	11130	12893	14816	16840	21313
615	6.15	62.73	3271	4262	5404	6005	6660	7348	8070	9590	11269	13053	15000	17049	21578
630	6.30	64.26	3310	4314	5469	6078	6740	7437	8168	9706	11405	13211	15182	17256	21839
645	6.45	65.79	3349	4365	5534	6150	6820	7525	8264	9821	11540	13368	15362	17460	22098
660	6.60	67.32	3388	4415	5598	6221	6899	7612	8360	9935	11674	13522	15539	17662	22353
675	6.75	68.85	3426	4465	5661	6292	6977	7698	8454	10047	11806	13675	15715	17861	22606

Table 4.10.1 (b) Theoretical Discharge Through Circular Orifices (Liters of Water per Minute)

Pitot Pressure (kPa)	Pitot Pressure (bar)	Meters (m)	Orifice Size (mm)												
			44.5	**50.8**	**57.2**	**60.3**	**63.5**	**66.7**	**69.9**	**76.2**	**82.6**	**88.9**	**95.3**	**101.6**	**114.3**
690	6.90	70.38	3464	4515	5724	6361	7054	7783	8548	10158	11936	13826	15889	18059	22856
705	7.05	71.91	3502	4563	5786	6430	7130	7867	8640	10268	12065	13976	16060	18254	23103
720	7.20	73.44	3539	4612	5847	6498	7206	7950	8732	10376	12193	14124	16230	18447	23347
735	7.35	74.97	3576	4660	5908	6565	7281	8033	8822	10484	12319	14270	16398	18638	23589
750	7.50	76.50	3612	4707	5968	6632	7354	8114	8912	10590	12444	14415	16565	18827	23829
765	7.65	78.03	3648	4754	6027	6698	7428	8195	9000	10696	12568	14558	16730	19015	24066
780	7.80	79.56	3683	4800	6086	6763	7500	8275	9088	10800	12691	14700	16893	19200	24300
795	7.95	81.09	3719	4846	6144	6828	7572	8354	9175	10904	12812	14841	17055	19384	24533
810	8.10	82.62	3754	4892	6202	6892	7643	8433	9261	11006	12932	14980	17215	19566	24763
825	8.25	84.15	3788	4937	6259	6956	7713	8510	9347	11107	13052	15118	17373	19746	24992
840	8.40	85.68	3822	4981	6315	7019	7783	8587	9431	11208	13170	15255	17531	19925	25218
855	8.55	87.21	3856	5026	6372	7081	7852	8664	9515	11308	13287	15391	17687	20102	25442
870	8.70	88.74	3890	5069	6427	7143	7921	8739	9598	11406	13403	15525	17841	20278	25664
885	8.85	90.27	3923	5113	6482	7204	7989	8814	9681	11504	13518	15658	17994	20452	25884
900	9.00	91.80	3957	5156	6537	7265	8056	8889	9762	11601	13632	15791	18146	20624	26103
915	9.15	93.33	3989	5199	6591	7325	8123	8963	9843	11698	13745	15922	18297	20796	26319
930	9.30	94.86	4022	5241	6645	7385	8190	9036	9924	11793	13857	16052	18446	20965	26534
945	9.45	96.39	4054	5283	6699	7444	8255	9108	10003	11888	13969	16181	18594	21134	26747

Notes:

(1) This table is computed from the formula $Q_m = 0.0666cd^2 \sqrt{P_m}$, with c = 1.00. The theoretical discharge of seawater, as from fireboat nozzles, can be found by subtracting 1 percent from the figures in Table 4.10.2.1, or from the formula $Q_m = 0.065cd^2 \sqrt{P_m}$.

(2) Appropriate coefficient should be applied where it is read from the hydrant outlet. Where more accurate results are required, a coefficient appropriate on the particular nozzle must be selected and applied to the figures of the table. The discharge from circular openings of sizes other than those in the table can readily be computed by applying the principle that quantity discharged under a given head varies as the square of the diameter of the opening.

Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]

4.10.1.2

The formula that is generally used to compute the ~~discharge~~ flow in the underground main at the static/residual hydrant at the specified residual pressure or for any desired pressure drop is Equation 4.10.1.2:

$$Q_R = Q_F \times \frac{h_r^{0.54}}{h_f^{0.54}}$$

[4.10.1.2]

or $Q_R = Q_F([P_s - P_r]/[P_s - P_f])^{0.54}$

where:

Q_R

~~=~~

~~flow predicted in underground main at minimum desired residual pressure~~

~~Q_F~~

~~=~~

~~total flow measured during test~~

~~h_r~~

~~=~~

~~pressure drop to desired residual pressure in the underground main~~

h_f = pressure drop in the underground main (measured at the static / residual hydrant) during test

P_r = residual pressure at the static / residual hydrant

P_s = static pressure at the static / residual hydrant

P_f = desired residual pressure (typically 20 psi for hydrant marking)

4.10.1.3 The formula that is generally used to compute the available flow through the flowng hydrant at the specified residual pressure or for any desired pressure drop is Equation 4.10.1.3:

$Q_{HR} = Q_f (h_{hf}/h_{hr})^{0.54}$ or $Q_{HR} = Q_F([P_{hs} - P_{hf}]/[P_{hs} - P_{hr}])^{0.54}$ **[4.10.1**

where:

Q_{HR} = flow predicted from flowing hydrant outlet at desired residual pressure at the flowing hydrant

Q_F = total flow measured during test (typically one hydrant flow for marking hydrants)

h_{hr} = pressure drop at the outlet of the flowing hydrant

h_{hf} = pressure drop to minimum desired residual pressure at the flowing hydrant outlet.

P_{hs} = static pressure at the flowing hydrant

P_{hr} = residual pressure at the hydrant outlet on the flowing hydrant (pitot reading if the flow is directly from the hydrant)

P_{hf} = minimum desired residual pressure at the flowing hydrant (typically 20 psi for hydrant marking)

Statement of Problem and Substantiation for Public Input

NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test than determines the flow available out of a hydrant nozzle.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	Complementary
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	Complementary
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	Complementary
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	Complementary
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	Complementary
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	Complementary
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	Complementary
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	Complementary
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	Complementary
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	

Submitter Information Verification

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Submittal Date: Fri Feb 15 11:46:12 EST 2019
Committee: AUT-PRI

Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]

TITLE OF NEW CONTENT

Type your content here ...

4.10.1.3 The formula that is generally used to compute the available flow through the flowng hydrant at the specified residual pressure or for any desired pressure drop is Equation 4.10.1.3:

$$Q_R = Q_F(h_r/h_h)^{0.54} \text{ or } Q_R = Q_F([P_s - P_r]/[P_s - P_h])^{0.54} \quad [4.10.1.3]$$

Statement of Problem and Substantiation for Public Input

NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	Complementary
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	Complementary
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	Complementary
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	Complementary
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	Complementary
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	Complementary
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	Complementary
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	Complementary
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	Complementary
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	

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Committee: AUT-PRI

Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]

4.10.1.3

In ~~Equation~~ Equations 4.10.1.2,and 4.10.1.3 any units of discharge or pressure drop can be used as long as the same units are used for each value of the same variable.

Statement of Problem and Substantiation for Public Input

NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	

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Submittal Date: Fri Feb 15 12:17:56 EST 2019
Committee: AUT-PRI

Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]

4.10.1.5

These are the units that are normally used in applying ~~Equation~~ Equations 4.10.1.2 and 4.10.1.3 to fire flow test computations.

Statement of Problem and Substantiation for Public Input

NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	Complementary
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	Complementary
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	Complementary
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	Complementary
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	Complementary
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	Complementary
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	Complementary
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	Complementary
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	Complementary
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	

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Committee: AUT-PRI

Public Input No. 48-NFPA 291-2019 [Section No. 4.10.2]

~~**4.10.2.2**~~ –

~~If the values of h_f, h_r,~~

Delete Section 4.10.2 – ~~Discharge Calculations from Table.~~

~~**4.10.2.1**~~ –

~~One means of solving this equation without the use of logarithms is by using Table 4.10.2.1 , which gives the values of the 0.54 power of the numbers from 1 to 175.~~

~~Table 4.10.2.1 Values of *h* to the 0.54 Power~~

~~**h h** 0.54 **h h** 0.54 **h h** 0.54 **h h** 0.54 **h h** 0.54 – 1 1.00 36 6.93 71 9.99 106 12.41 141 14.47 –~~
~~2 1.45 37 7.03 72 10.07 107 12.47 142 14.53 – 3 1.81 38 7.13 73 10.14 108 12.53 143 14.58 –~~
~~4 2.11 39 7.23 74 10.22 109 12.60 144 14.64 – 5 2.39 40 7.33 75 10.29 110 12.66 145 14.69 –~~
~~6 2.63 41 7.43 76 10.37 111 12.72 146 14.75 – 7 2.86 42 7.53 77 10.44 112 12.78 147 14.80 –~~
~~8 3.07 43 7.62 78 10.51 113 12.84 148 14.86 –~~
~~9 3.28 44 7.72 79 10.59 114 12.90 149 14.91 10 3.47 45 7.81 80 10.66 115 12.96 150 14.97 11 3.65 46 7.91 81 10~~

~~**and**~~

~~Q_F are known, the values of $h_f^{0.54}$ and $h_r^{0.54}$ can be read from~~

~~**Table 4.10.2.1**~~

~~and Equation 4.10.1.2 solved for Q_R .~~

~~**4.10.2.3**~~ –

~~Results are usually carried to the nearest 100 gpm (380 L/min) for discharges of 1000 gpm (3800 L/min) or more, and to the nearest 50 gpm (190 L/min) for smaller discharges, which is as close as can be justified by the degree of accuracy of the field observations.~~

~~**4.10.2.4**~~ –

~~The values of $h_r^{0.54}$ and $h_f^{0.54}$ (determined from the table) and the value of Q_F are inserted in Equation 4.10.1.2, and the equation solved for Q_R .~~

:

Statement of Problem and Substantiation for Public Input

This proposal is to delete Section 4.10.2 and Table 4.10.2.1, because the table only goes to h = 175 (psi), whereas with metric values, h could be up to 1200 (kPa). With this and with the use of modern calculators, personal computers and tablets, the table is seldom utilized and the explanations on how to deduce the values of hr^0.54 and hf0^.54 are no longer needed.

Submitter Information Verification

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Submittal Date: Sun Mar 17 19:31:42 EDT 2019

Committee: AUT-PRI

Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]

Sections 4.10.2.2, 4.10.2.3, 4.10.2.4

4.10.2.2

If the values of h_f, h_r, (or h_h) and Q_F are known, the values of $h_f^{0.54}$ and $h_r^{0.54}$ (or $h_h^{0.54}$) can be read from Table 4.10.2.1 and Equation 4.10.1.2 solved for Q_R or equation 4.10.1.3 solved for Q_h.

4.10.2.3

Results are usually carried to the nearest 100 gpm (380 L/min) for discharges of 1000 gpm (3800 L/min) or more, and to the nearest 50 gpm (190 L/min) for smaller discharges, which is as close as can be justified by the degree of accuracy of the field observations.

4.10.2.4

The values of $h_r^{0.54}$ and $h_f^{0.54}$ (or $h_h^{0.54}$) (determined from the table) and the value of Q_F are inserted in Equation 4.10.1.2, (or Equation 4.10.1.3) and the equation 4.10.1.2 solved for Q_R or equation 4.10.1.3 solved for Q_h.

Statement of Problem and Substantiation for Public Input

NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	Complementary
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	Complementary
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	Complementary
Public Input No. 27-NFPA 291-2019 [Section No. 4.9.1]	Complementary
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	Complementary
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	Complementary
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	Complementary
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	Complementary
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	Complementary
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	
Public Input No. 35-NFPA 291-2019 [Section No. 5.1]	
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	

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Submittal Date: Fri Feb 15 12:29:46 EST 2019
Committee: AUT-PRI

Public Input No. 49-NFPA 291-2019 [Section No. 4.11.2]

4.11.2

With this in mind, it is suggested that the form shown in Figure 4.11.2 be used to record information that is taken.

Delete the current Figure 4.11.2 and replace it with the following illustration:

Figure 4.11.2 Sample Report of a Hydrant Flow Test.

Water Flow Test Report

NFPA®

Location: ____________________ Test By: ____________________

Address: ____________________ Date: ____________________

____________________ Time: ____________________

System Data

Size of Main: _______ Dead End: _______ Looped: _______

Comments: ____

Test Data

Location of Test Hydrants: Residual Hydrant: ____________________

Flow Hydrant A: ____________________

Flow Hydrant B: ____________________

Static Pressure: ____________

Test No.	No. of Outlets	Orifice Size (in.)	Orifice Coeff.	Residual Pressure (psig)	Pitot Pressure (psig)	Flow (USgpm)	Comments
1							
2							
3							
4							
5							

Projected results @ 20 psi: ____________

Sketch of Test Configuration

Figure 4.11.2 Sample Report of a Hydrant Flow Test.

Hydrant Flow Test Report

Location ______________________ Date ________

Test made by ______________________ Time ________

Representative of ______________________

Witness ______________________

State purpose of test ______________________

____

Consumption rate during test ______________________

If pumps affect test, indicate pumps operating ______________________

Flow hydrants: ________ A_1 ________ A_2 ________ A_3 ________ A_4

Size nozzle ______________________

Pitot reading ______________________

Discharge coefficient ______________________ Total gpm

gpm ______________________

Static B ____________ psi Residual B ____________ psi

Projected results @20 psi Residual ____ gpm; or @ ____ psi Residual ____ gpm

Remarks ______________________

____

____

____

Location map: Show line sizes and distance to next cross-connected line. Show valves and hydrant branch size. Indicate north. Show flowing hydrants – Label A_1, A_2, A_3, A_4. Show location of static and residual – Label B.

Indicate B Hydrant ______ Sprinkler ______ Other (identify) ______________

Additional Proposed Changes

File Name	Description	Approved
Water_Flow_Test_Results_Form.doc	Water Flow Test Report Form	

Statement of Problem and Substantiation for Public Input

This proposal is offered to provide a better version of a water flow test report form.

Submitter Information Verification

Submitter Full Name:	Larry Keeping
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Street Address:	
City:	
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Zip:	
Submittal Date:	Sun Mar 17 19:47:27 EDT 2019
Committee:	AUT-PRI

Water Flow Test Report

Location: ______________________________ Test By: ______________________________

Address: ______________________________ Date: ______________________________

______________________________ Time: ______________________________

System Data

Size of Main: _______ Dead End: _______ Looped: _______

Comments: ____

Test Data

Location of Test Hydrants: Residual Hydrant: ______________________________

Flow Hydrant A: ______________________________

Flow Hydrant B: ______________________________

Static Pressure: ______________

Test No.	No. of Outlets	Orifice Size (in.)	Orifice Coeff.	Residual Pressure (psig)	Pitot Pressure (psig)	Flow (USgpm)	Comments
1							
2							
3							
4							
5							

Projected results @ 20 psi: ______________

Sketch of Test Configuration

Public Input No. 50-NFPA 291-2019 [Section No. 4.11.4]

4.11.4

Results of the flow test should be indicated on a hydraulic graph, such as the one shown in Figure 4.11.4.

Delete the current Figure 4.11.4 and replace it with the following illustration:

Figure 4.11.4 Sample Graph Sheet.

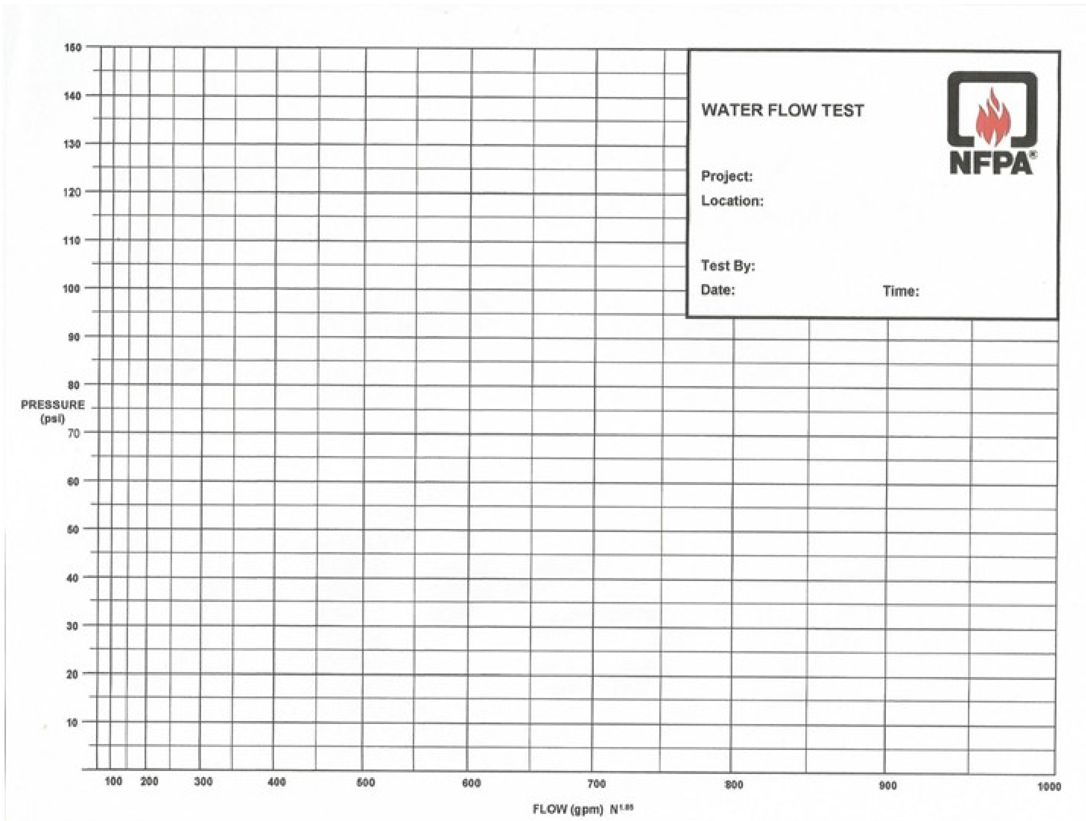
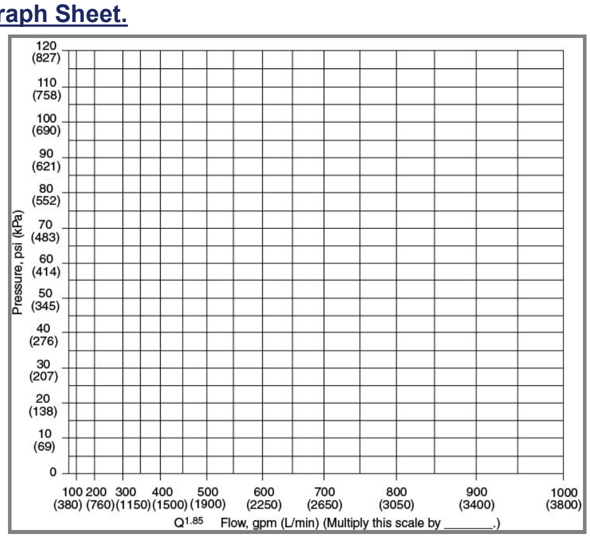


Figure 4.11.4 Sample Graph Sheet.



Additional Proposed Changes

File Name	Description	Approved
FLOW_TEST_GRAPH.doc	Water Flow Test Graph	

Statement of Problem and Substantiation for Public Input

This proposal is offered to provide a better version of a water flow test graph sheet.

Submitter Information Verification

Submitter Full Name: Larry Keeping
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Street Address:
City:
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Zip:
Submittal Date: Sun Mar 17 21:33:37 EDT 2019
Committee: AUT-PRI

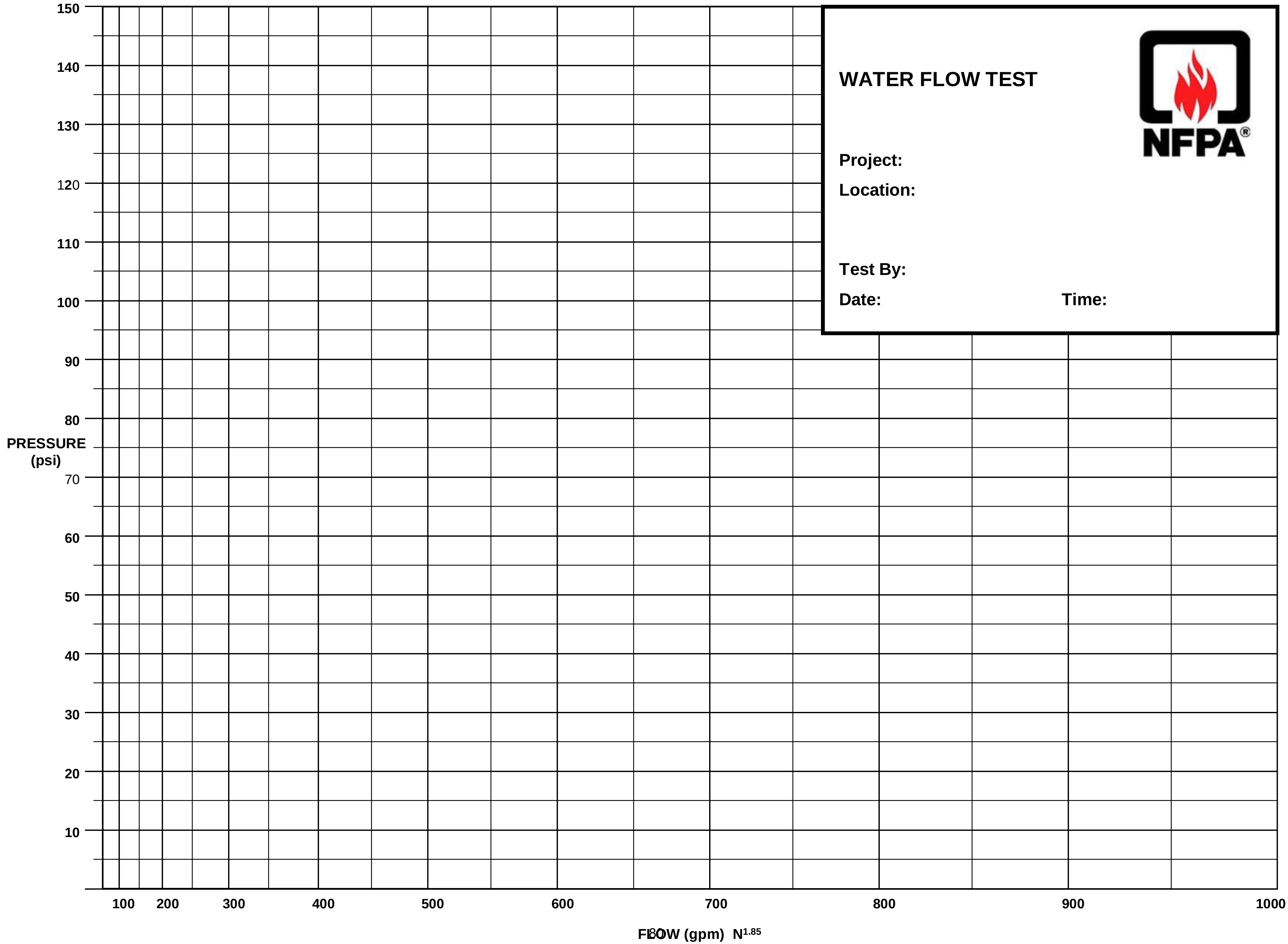
WATER FLOW TEST

Project:

Location:

Test By:

Date: **Time:**



Public Input No. 34-NFPA 291-2019 [New Section after 4.12]

TITLE OF NEW CONTENT

Type your content here ...

4.12.1 In the Hazen Williams formula used for friction loss calculations in water distribution systems the friction loss is proportional to the flow rate to the 1.85 power, i.e. if the friction loss is known at one flow rate, the friction loss at a different flow rate is the known friction loss times a ratio of the flow rates to the 1.85 power.

4.12.1.1 Residual pressure at different flow rates can be calculated for water distribution systems that have a constant supply pressure and no flows elsewhere in the system.

4.12.1.2 If the flow test is conducted during peak usage, it is generally accepted practice to ignore other flows in the water distribution system and calculation residual pressure based on the Hazen Williams formula.

4.12.1.3 Flow tests conducted during less than peak usage should be adjusted to account for the lower available flow that may occur during peak usage.

4.12.1.4 Flow tests conducted when the water storage level is above the minimum should be adjusted to the lowest water storage level.

4.12.1.5 Residual pressures higher than the static pressure may occur when opening a hydrant causes a pump to come on during the test.

4.12.1.6 When a Flow tests that cause a pump to come on during the test should not be extrapolated.

4.10.1.7 Flow tests should achieve a flow equal to or greater than the system demand.

4.12.1.8 Extrapolation of flow test results should be limited to systems that maintain a relatively constant pressure at the source, and do not have water usage significantly above the usage during the flow test.

4.12.1.8 Flow test do not provide an indication of the duration of the available flow rate.

4.12.1.9 The ability of the water source to provide the required duration must be evaluated separately from the flow test.

Statement of Problem and Substantiation for Public Input

A fire may occur during times of high usage and the sire protection system design should be based on reasonably anticipated worse case water supply conditions. Additional guidance is needed to identify issues that should be accounted for when determining the water supply characteristics that supply a fire protection system.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 23-NFPA 291-2019 [Section No. 4.2.1]	Complementary
Public Input No. 23-NFPA 291-2019 [Section No. 4.2.1]	

Submitter Information Verification

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Submittal Date: Fri Feb 15 12:42:01 EST 2019

Committee:	AUT-PRI

Public Input No. 4-NFPA 291-2018 [Section No. 4.12.1]

4.12.1

It must be remembered that flow test results show the strength of the distribution system ~~and do~~ at the time and date of he testing. It does not necessarily indicate the degree of adequacy of the entire water works system. If the testing does not occur during a period of peak demand, such as at Maximum Daily Demand or Maximum Hourly Demand, then the flow test results may not provide an accurate representation of the water available during those peak periods.

Statement of Problem and Substantiation for Public Input

The standard should give the user guidance as to the impact of the background demand on the water distribution system on the flow test results. Time of day and day of the year can have significant impacts on the flow test results.

Submitter Information Verification

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Submittal Date: Tue Dec 11 08:56:38 EST 2018

Committee: AUT-PRI

Public Input No. 19-NFPA 291-2019 [Section No. 4.12.2]

~~**4.12.2**~~ –

~~Consider a system supplied by pumps at one location and having no elevated storage.~~

Statement of Problem and Substantiation for Public Input

The proponent PI is not sure what the intent of "Consider a system supplied by pumps at one location and having no elevated storage" is in providing guidance to the user of the document. The statement does not appear to convey a complete thought or lead the user to direction. Therefore, the section is proposed to be deleted.

If this section is intended to be lead into the subsequent sections setting the stage for thought experiment, then this section and the subsequent sections should be combined into one paragraph and moved into Annex text.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 20-NFPA 291-2019 [Sections 4.12.2, 4.12.3, 4.12.4, 4.12.5, 4.12.6, 4.12.7, 4....]	

Submitter Information Verification

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Committee: AUT-PRI

Public Input No. 20-NFPA 291-2019 [Sections 4.12.2, 4.12.3, 4.12.4, 4.12.5, 4.12.6, 4.12.7, 4....]

~~**Sections 4.12.2, 4.12.3, 4.12.4, 4.12.5, 4.12.6, 4.12.7, 4.12.8**~~

~~**4.12.2**~~ –

~~Consider a system supplied by pumps at one location and having no elevated storage.~~

~~**4.12.3**~~ –

~~If the pressure at the pump station drops during the test, it is an indication that the distribution system is capable of delivering more than the pumps can deliver at their normal operating pressure.~~

~~**4.12.4**~~ –

~~It is necessary to use a value for the drop in pressure for the test that is equal to the actual drop obtained in the field during the test, minus the drop in discharge pressure at the pumping station.~~

~~**4.12.5**~~ –

~~If sufficient pumping capacity is available at the station and the discharge pressure could be maintained by operating additional pumps, the water system as a whole could deliver the computed quantity.~~

~~**4.12.6**~~ –

~~If, however, additional pumping units are not available, the distribution system would be capable of delivering the computed quantity, but the water system as a whole would be limited by the pumping capacity.~~

~~**4.12.7**~~ –

~~The portion of the pressure drop for which a correction can be made for tests on systems with storage is generally estimated upon the basis of a study of all the tests made and the pressure drops observed on the recording gauge at the station for each.~~

~~**4.12.8**~~ –

~~The corrections may vary from very substantial portions of the observed pressure drops for tests near the pumping station, to zero for tests remote from the station.~~

Statement of Problem and Substantiation for Public Input

See the substantiation on PI 19. These sections also suffer from the same issue as PI 19. These sections are very difficult to determine what the intent really is to the end user conducting a flow test and what actions should be taken....especially in the current format of being broken down by sections. These sections should be deleted or, at the very least, relocated as a singular commentary paragraph to the Annex as there is really no solid guidance here to the end user.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 19-NFPA 291-2019 [Section No. 4.12.2]	Similar issue.

Submitter Information Verification

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Submittal Date: Fri Jan 11 07:42:20 EST 2019

Committee:	AUT-PRI

Public Input No. 1-NFPA 291-2018 [Section No. 4.13]

4.13 Public Hydrant Inspection, Testing, Maintenance and Flushing.

4.13.1*

Public fire hydrants should be flow tested every 5 years to verify capacity and marking of the hydrant.

4.13.2

Public fire hydrants should be flushed at least annually to verify operation, address repairs, and verify reliability.

4.13.3

Public fire hydrants should be inspected at least annually for damage, corrosion and needed repairs.

Statement of Problem and Substantiation for Public Input

Inspection and maintenance are actions that are beyond flushing of a fire hydrant. Inspection, Testing and Maintenance are separate components as called out in NFPA 25 and should be addressed in a similar manner within this document.

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Public Input No. 35-NFPA 291-2019 [Section No. 5.1]

5.1 Classification of Hydrants.

Hydrants should be classified in accordance with their rated capacities based on the flow available at the hydrant outlet (formula 4.10.1.3) [at 20 psi (1.4 bar) residual pressure or other designated value] as follows:

(1) Class AA — Rated capacity of 1500 gpm (5700 L/min) or greater

(2) Class A — Rated capacity of 1000–1499 gpm (3800–5699 L/min)

(3) Class B — Rated capacity of 500–999 gpm (1900–3799 L/min)

(4) Class C — Rated capacity of less than 500 gpm (1900 L/min)

Statement of Problem and Substantiation for Public Input

NFPA 291 provides guidance for hydrant marking but incorrectly uses a flow test that determines the flow available in the underground main for hydrant marking. Additional changes are proposed to utilize a flow test that determines the flow available out of a hydrant nozzle.

In general, flow tests conducted with a static / residual hydrant(s) and a flow hydrant(s) show the water available in the underground water main at the static / residual hydrant. Friction loss calculations between the flow test and the fire protection system are required to determine the water available at the fire protection system. Likewise a friction loss calculation is required to determine the flow available at the hydrant outlet. As NFPA 291 is currently written, the flow used for marking hydrants is actually the flow available in the underground main, and not the flow available at the hydrant outlet. The proposed changes correct this deficiency.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	
Public Input No. 33-NFPA 291-2019 [Sections 4.10.2.2, 4.10.2.3, 4.10.2.4]	
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	
Public Input No. 24-NFPA 291-2019 [New Section after 4.2.2]	
Public Input No. 25-NFPA 291-2019 [Section No. 4.3]	
Public Input No. 26-NFPA 291-2019 [Section No. 4.5]	
Public Input No. 29-NFPA 291-2019 [Section No. 4.10.1.2]	
Public Input No. 30-NFPA 291-2019 [New Section after 4.10.1.3]	
Public Input No. 31-NFPA 291-2019 [Section No. 4.10.1.3]	
Public Input No. 32-NFPA 291-2019 [Section No. 4.10.1.5]	
Public Input No. 38-NFPA 291-2019 [Section No. 4.1]	

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Public Input No. 51-NFPA 291-2019 [Sections 5.1, 5.2]

Sections 5.1, 5.2

5.1 Classification of Hydrants.

Hydrants should be classified in accordance with their rated capacities [at 20 psi (1.4 bar) residual pressure or other designated value] as ~~follows:~~

(1) ~~Class AA — Rated capacity of 1500 gpm (5700 L/min) or greater~~

(2) ~~Class A — Rated capacity of 1000–1499 gpm (3800–5699 L/min)~~

(3) ~~Class B — Rated capacity of 500–999 gpm (1900–3799 L/min)~~

(4) ~~Class C — Rated capacity of less than 500 gpm (1900 L/min)~~

shown in Table 5.1:

Table 5.1 Classification and Marking of Hydrants

Hydrant Classification	Color Scheme	Hydrant Capacity (gpm)	Hydrant Capacity (L/min)
AA	Light Blue	> 1500	> 5700
A	Green	1000 - 1499	3800 - 5699
B	Orange	500 - 999	1900 - 3799
C	Red	< 500	< 1900

5.2 Marking of Hydrants.

5.2.1 Public Hydrants.

5.2.1.1

All barrels are to be chrome yellow except in cases where another color has already been adopted.

5.2.1.2

The tops and nozzle caps should be painted with the following capacity-indicating color ~~scheme~~ scheme shown in Table 5.1 to provide simplicity and consistency with colors used in signal work for safety, danger, and intermediate condition:

- ~~Class AA — Light blue~~
- ~~Class A — Green~~
- ~~Class B — Orange~~
- ~~Class C — Red~~

5.2.1.3

For rapid identification at night, it is recommended that the capacity colors be of a reflective-type paint.

5.2.1.4

Hydrants rated at less than 20 psi (1.4 bar) should have the rated pressure stenciled in black on the hydrant top.

5.2.1.5

In addition to the painted top and nozzle caps, it can be advantageous to stencil the rated capacity of high-volume hydrants on the top.

5.2.1.6

The classification and marking of hydrants provided for in this chapter anticipate determination based on individual flow test.

5.2.1.7

Where a group of hydrants can be used at the time of a fire, some special marking designating group-flow capacity may be desirable.

5.2.1.8

Marking on private hydrants within private enclosures is to be done at the owner's discretion.

5.2.1.9

When private hydrants are located on public streets, they should be painted red or another color to distinguish them from public hydrants.

5. 2.2 Permanently Inoperative Hydrants.

Fire hydrants that are permanently inoperative or unusable should be removed.

5.2.3 Temporarily Inoperative Hydrants.

Fire hydrants that are temporarily inoperative or unusable should be wrapped or otherwise provided with temporary indication of their condition.

5.2.4 Flush Hydrants.

Location markers for flush hydrants should carry the same background color as stated above for class indication, with such other data stenciled thereon as deemed necessary.

5.2.5 Private Hydrants.

5.2.5.1

Marking on private hydrants within private enclosures is to be at the owner’s discretion.

5.2.5.2

When private hydrants are located on public streets, they should be painted red or some other color to distinguish them from public hydrants.

Statement of Problem and Substantiation for Public Input

No technical change is proposed for Section 5.1 or for Section 5.2.1.2. This input is offered primarily as editorial. In lieu of the existing text, the proposed table provides a better way to indicate the classifications and the marking colors, with the hydrant capacities shown adjacent to both.

Regarding the text of 5.2.1.8 and 5.2.1.9 it is proposed for deletion because it is redundant. The identical instructions are provided in Sections 5.2.5.1 and 5.2.5.2.

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Submittal Date: Sun Mar 17 22:11:54 EDT 2019
Committee: AUT-PRI

Public Input No. 6-NFPA 291-2018 [Section No. 5.2]

5.2 Marking of Hydrants.

5.2.1 Public Hydrants.

5.2.1.1

All barrels are to be chrome yellow except in cases where another color has already been adopted.

5.2.1.2

The tops and nozzle caps should be painted with the following capacity-indicating color scheme to provide simplicity and consistency with colors used in signal work for safety, danger, and intermediate condition:

(1) Class AA — Light blue

(2) Class A — Green

(3) Class B — Orange

(4) Class C — Red

5.2.1.3

For rapid identification at night, it is recommended that the capacity colors be of a reflective-type paint.

5.2.1.4

Hydrants rated at less than 20 psi (1.4 bar) should have the rated pressure stenciled in black on the hydrant top.

5.2.1.5

In addition to the painted top and nozzle caps, it can be advantageous to stencil the rated capacity of high-volume hydrants on the top.

5.2.1.6

The classification and marking of hydrants provided for in this chapter anticipate determination based on individual flow test.

5.2.1.7

Where a group of hydrants can be used at the time of a fire, some special marking designating group-flow capacity may be desirable.

5.2.~~1.8~~ –

~~Marking on private hydrants within private enclosures is to be done at the owner's discretion.~~

~~5.~~ 2.~~1.9~~

~~When private hydrants are located on public streets, they should be painted red or another color to distinguish them from public hydrants.~~

~~5.2.2~~ – Permanently Inoperative Hydrants.

Fire hydrants that are permanently inoperative or unusable should be removed.

5.2.3 Temporarily Inoperative Hydrants.

Fire hydrants that are temporarily inoperative or unusable should be wrapped or otherwise provided with temporary indication of their condition.

5.2.4 Flush Hydrants.

Location markers for flush hydrants should carry the same background color as stated above for class indication, with such other data stenciled thereon as deemed necessary.

5.2.5 Private Hydrants.

5.2.5.1

~~Marking on private hydrants within private enclosures is to be at the owner's discretion~~

All barrels are to be red except in cases where another color has already been adopted.

5.2.5.2

The tops and nozzle caps should be painted with the following capacity-indicating color scheme to provide simplicity and consistency with colors used in signal work for safety, danger, and intermediate condition:

(1) Class AA — Light blue

(2) Class A — Green

(3) Class B — Orange

(4) Class C — Red

5.2.5.3

For rapid identification at night, it is recommended that the capacity colors be of a reflective-type paint .

5.2.5. 4

Hydrants rated at less than 20 psi (1.4 bar) should have the rated pressure stenciled in black on the hydrant top.

5. 2 .5.5

In addition to the painted top and nozzle caps, it can be advantageous to stencil the rated capacity of high-volume hydrants on the top.

5.2.5.6

The classification and marking of hydrants provided for in this chapter anticipate determination based on individual flow test.

5.2.5.7

Where a group of hydrants can be used at the time of a fire, some special marking designating group-flow capacity may be desirable.

5.2.5.8

When private hydrants are located on public streets, they should be painted red or

~~some other~~

another color to distinguish them from public hydrants.

Statement of Problem and Substantiation for Public Input

Currently, the standard differentiates between marking of public hydrant and the marking of private hydrants in the application of section 5.2. If a hydrant marking system is valuable to public fire hydrants, this proponent fails to see why it would not also be applicable and valuable to private systems. Therefore, this PI treats public and private hydrants the same with respect to flow marking. The only differentiating the the barrel color is specified as red for private as opposed to yellow for public. This does allow operational crews to differentiate between public and private hydrants.

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Public Input No. 5-NFPA 291-2018 [Section No. 5.2.1.8]

~~**5.2.1.8**~~ –

~~Marking on private hydrants within private enclosures is to be done at the owner's discretion.~~

Statement of Problem and Substantiation for Public Input

Section 5.2.1 is Public Hydrants. Section 5.2.5 is Private Hydrants. The language proposed to be deleted covers private hydrants but it under the public hydrants section. The language already exists in 5.2.5.1 and is more appropriate for that section.

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