# Section 5 – Fire Flow Testing

# *Fire Flow Testing*

- Fire flow testing is done to ensure the water system will provide enough water to effectively fight a fire
- Insurance rates for individuals and organizations are dependent on the level of fire protection provided.
- Fire flow testing is also required for new construction or changes to the existing water system
- Requires the same equipment and set up as doing a conventional flushing program but extra data collection is required

# *Fire Underwriters Survey*

- For fire protection the minimum water system size must be able to provide 1000 L/min (265 usgpm) for 2 hours or 2000 L/min (530 usgpm) for 1 hour
- Minimum water storage for these flows is 120,000 Liters (31,700 gallons)
- Actual required flow is to be calculated using formula found in the Fire Underwriters Survey
- What is available to the fire department is the critical test for fire protection

# Fire Underwriters Survey

- A system is considered to be adequate if it can deliver the required amount of water, for the required duration, at any point in the water system.
- Required flows and volumes are to be calculated taking into account the highest consumption day for the system
- Cities with populations over 250,000 must calculate flows based on two large fires happening at the same time

# Pressure

- Water systems must be able to provide at least 150 kPa (20 psi) throughout the system during fire flow
- This is the minimum pressure that can safely be supplied to sprinkler systems or pumper trucks
- If a system has fire pumps installed in it they should be run for fire flow testing
- System pressures over 500 kPa (72psi) can assist fire protection

# *Valve and Hydrant Locations*

- Isolation valves should be located:
  - Every 400m on arterial mains
  - Every 250m in resdiential areas
  - Every 150m in commercial areas
- Hydrants should be located at areas that are convenient for use:
  - Intersections
  - Middle of the block
  - End of dead end mains
- Hydrant spacing should be:
  - 180m in single family residential areas
  - 90m in commercial or multi family residential areas

# Hydrants

- Hydrants should be supplied from 150mm mains as a minimum
- Hydrants should have at least two 65mm outlets.
- If the required flow is calculated to be greater than 5000 L/min (1320 usgpm), the hydrants should be equipped with a large pumper outlet.

# Required Fire Flow

- The required fire flow for a building can be calculated by the formula:

$$F = 220\ x\ C\ x\ \sqrt{A}$$

- F = required flow in liters per minute
- C = construction coefficient
- A = Total floor area of the building in square meters
  - Not including basements at least 50% below grade

# Construction Coefficient

| C Value | Construction Type |
|---|---|
| 0.6 | Fire resistive construction (fully protected frame, floors, roof) |
| 0.8 | Non combustible construction (masonry walls, metal structure) |
| 1.0 | Ordinary construction (masonry walls but combustible floors and roof) |
| 1.5 | Wood frame construction |

# Content Adjustment

- The total flow requirement for a building can be adjusted depending on the contents of the building
- The required flow after adjustment must not go below 2,000 L/min

| % Adjustment | Content Asessment | Examples |
|---|---|---|
| -25% | Non Combustible | |
| -15% | Limited Combustible | Office buildings, museums |
| No Adjustment | Combustible | Regular dwellings |
| +15% | Free Burning | Paint shops, cloth manufacturing |
| +25% | Rapid Burning | Woodoworking with flammable finishing |

# Sprinkler Systems

- A further adjustment to the required flow can be made I the building has a sprinkler system
- -30% or a system that has been designed and built to meet NFPA 13
- An additional -10% if the water system is standard for both the sprinklers and the fire department hoses
- An additional -10% if the system is fully supervised with low flow and control valve alarming

# Exposure Adjustment

- A final adjustment to the flow is required depending on the exposure of the building to other buildings that may be on fire
- A adjustment is required for each side of the building but the total adjustment should not be over 75%

| % Adjustment | Seperation |
|---|---|
| 25% | 0 – 3m |
| 20% | 3.1 – 10m |
| 15% | 10.1 – 20m |
| 10% | 20.1 – 30m |
| 5% | 30.1 – 45m |

# Required Flow Calculation Summary

A. Determine the type of construction
B. Determine the ground floor area
C. Determine the height in storeys
D. Using the fire flow formula determine the required flow to the nearest 1,000 L/min
E. Determine the occupancy adjustment and apply that to the answer obtained in D. Do not round off.
F. Determine the decrease for a sprinkler system. Do not round off.
G. Determine the total increase for exposures. Do not round off.
H. To the answer obtained in step E, subtract the value obtained in F and add the value obtained in G
I. Round off the answer to the nearest 1,000 L/min

# Shortcut Formula

- For groupings of detached single or multi family dwellings that do not exceed two storeys in height the shortcut formula can be used

| Exposure Distance | Wood Frame | Masonry or Brick |
|---|---|---|
| Less than 3m | | 6,000 L/min |
| 3 – 10m | 4,000 L/min<br>1,056 usgpm | 4,000 L/min<br>1,056 usgpm |
| 10.1 – 30m | 3,000 L/min<br>793 usgpm | 3,000 L/min<br>793 usgpm |
| Over 30m | 2,000 L/min<br>528 usgpm | 2,000 L/min<br>528 usgpm |

# Final Adjustments

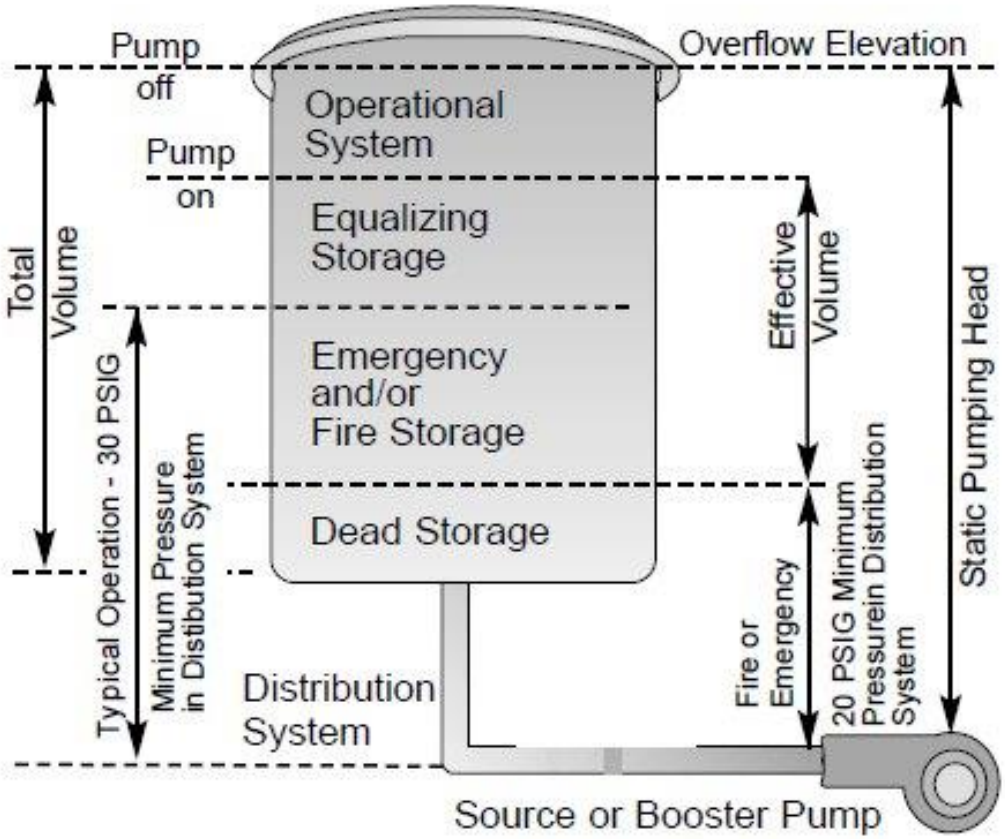
- If wood frame homes are built with exposures less than 3m, the buildings are to be considered one fire area and the regular formula used
- Contiguous buildings require a minimum flow of 8,000 L/min
- Homes with wood shingle or shake roofs will have an additional 2,000 – 4,000 L/min flow requirement in accordance to extent and condition

# *Required Fire Flow*

- Using the worksheet, calculate the required fire flow for the building you are in.

# Required Fire Flow

- The required fire flow can then be used to calculate the required hydrant density
- Minimum duration that the fire flow must be maintained is also dependant on the required fire flow
- These numbers can be used to calculate the minimum required fire storage in the water system



# Actual Fire Flow

- The actual fire flow can then be measured for the hydrants nearest to the calculated building
- Multiple hydrants may have to be used to reach fire flow requirements
- Actual fire flow numbers can be used to:
  - Update hydraulic modeling
  - Group hydrants
  - Direct changes to the water system infrastructure

# *Hydrant Capacity vs Main Capacity*

- The hydrant capacity is the measured flow at any one hydrant in the system.  This can be measured during normal flushing using flow gauges attached to diffusers or with pitot gauges

- The main capacity is what we are measuring to compare to the required fire flow numbers

- The main capacity test requires use of multiple hydrants and then uses a calculation to predict the flow at 20psi in the system.  This is also called the fire flow test.

# *Fire Flow Test*

- When doing a fire flow test the same procedures and equipment used for system flushing should be followed.
  - Planning
  - Equipment
  - Notification
  - Direction of discharge
  - Flow pattern of water
  - Availability of water from reservoirs
  - Dechlorination

- Flows may only have to be done for 1-2 minutes to get the required readings

# Fire Flow Test

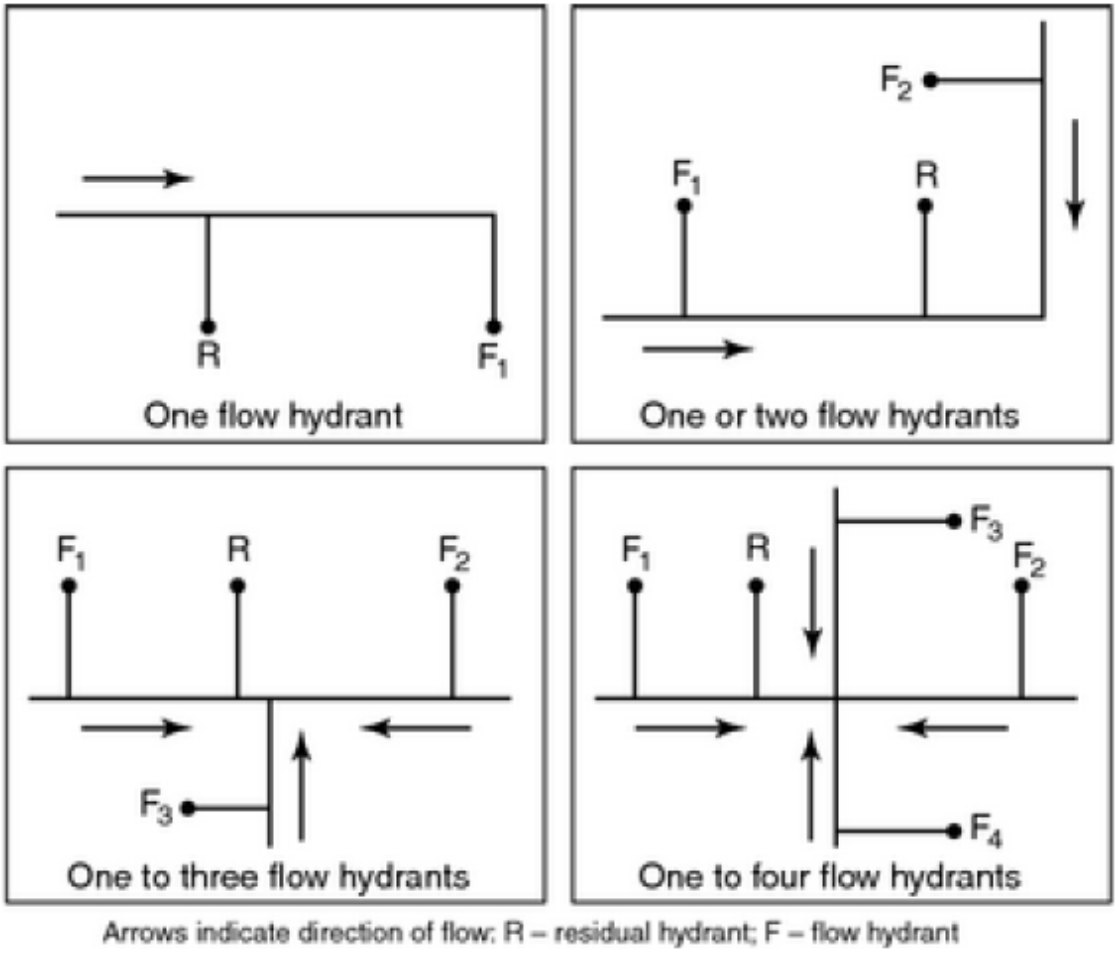
- Fire flow testing uses a minimum of two hydrants. They are designated as the test hydrant and the flow hydrant.
- Test hydrant can also be called the pressure hydrant, static hydrant, or residual hydrant
- The flow hydrant requires measurement of the hydrant flow. Measurements should be taken at the time of fire flow testing even if the hydrant has a recorded flow from flushing.
- Procedures should follow NFPA 291 – Recommended Practice for Fire Flow Testing and Markings of Hydrants

# Fire Flow Test

- The fire flow test in its simplest form has the following steps:
  - Designate a test hydrant and a flow hydrant
  - Measure the static pressure at the test hydrant
  - Record the required information from the flow hydrant
    - Main size
    - Inner Diameter of hydrant nozzle
    - Hydrant nozzle smoothness
  - Open the flow hydrant fully and measure the flow with
    - Flow meter
    - Pitot gauge
  - Record the residual pressure at the test hydrant
  - Calculate the fire flow at 20psi

# Test Hydrant

- The test hydrant requires accurate measurement of static and residual pressure.
- The test hydrant should be located between the flow hydrant and the larger mains where the flow is coming from.
- One test hydrant can be used for flow testing numerous hydrants




Arrows indicate direction of flow: R – residual hydrant; F – flow hydrant

# Test Hydrant

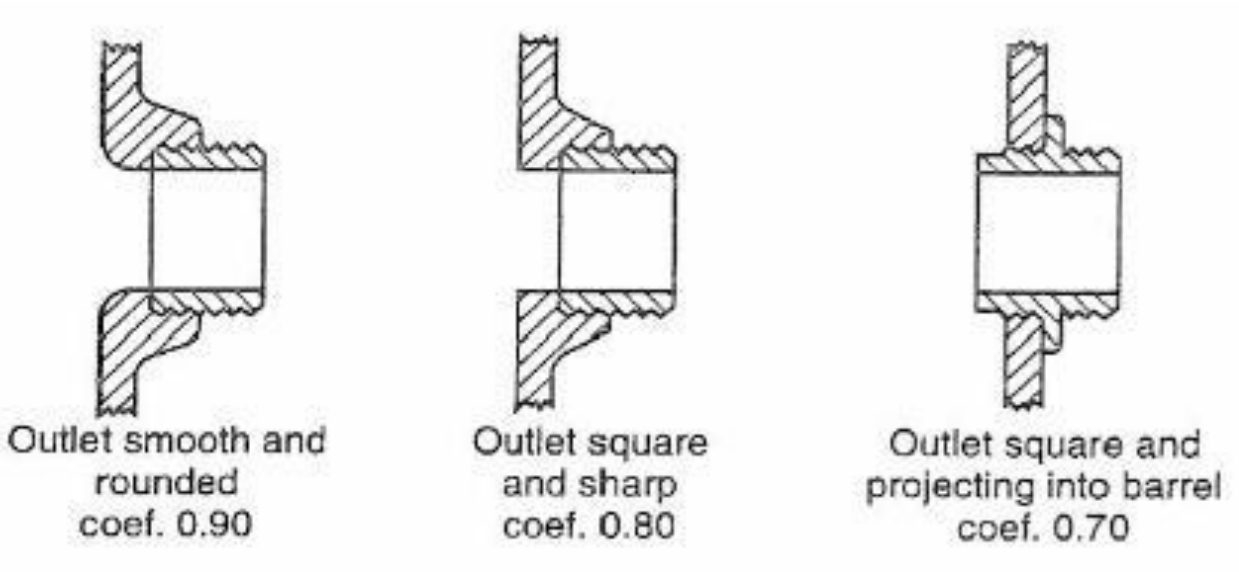
- Someone must be present at the test hydrant to take readings
- Communication protocols between the people doing different parts of the testing should be worked out to ensure the proper data is recorded for each flow hydrant
- A pressure logger can be used if accurate time measurements are taken at the flow hydrants

# Test Hydrant

- To be a valid test the pressure at the test hydrant must drop by at least 25% of the static reading.
- If the pressure drop is not sufficient, additional hydrants may have to be opened
- The pressure should also remain above 150 kPa (20 psi)
- Pressures below the recommended minimum should be noted and mapped out.

# Nozzle Co-efficient

- The flow hydrant requires information to be recorded before the hydrant flow begins. This includes:
  - Main size and construction type
  - Hydrant identification number or location
  - Inner Diameter of the nozzle used for the test
  - Determination of the outlet nozzle coefficient



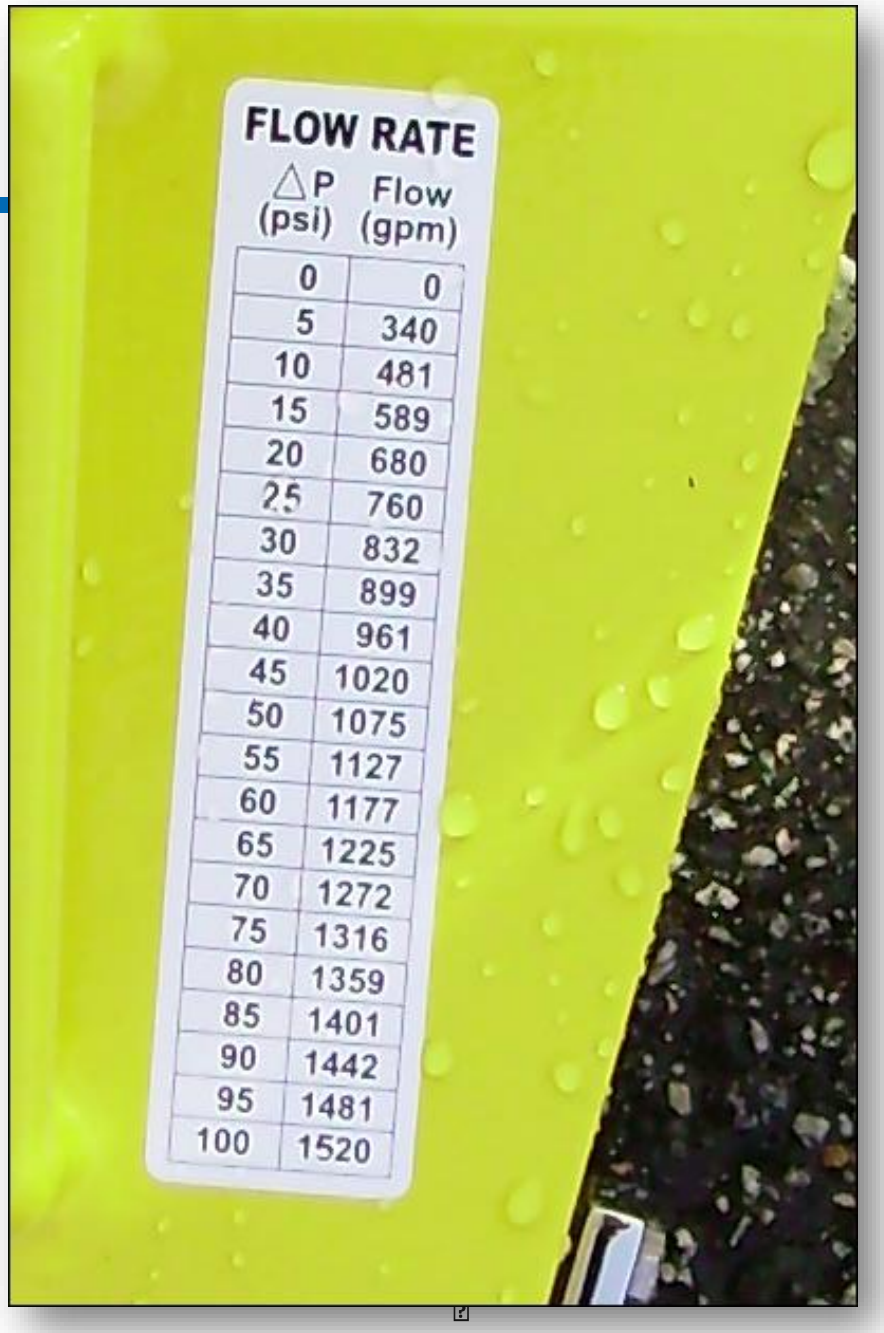
# Measuring Hydrant Flow

- The flow hydrant is then opened fully and the flow at this hydrant measured
- Readings can be taken by:
  - Flow gauges
  - Pitot tubes
  - Residual pressure gauge
- Follow manufactures procedure for the gauge type you are using

# Flow Hydrant


# Flow Hydrant

- The flow from a hydrant can also be calculated by measuring the pressure drop at the hydrant.
- Measure the static pressure at the hydrant and then leave the pressure gauge on the hydrant while it is flowing
- Measure the residual pressure at the hydrant and then compare the difference in pressure to the appropriate chart



# Fire Flow Test - Metric

- If a pitot gauge or residual pressure gauge is used at the flow hydrant the flow can me calculated using charts or by the formula:

$$Q = 0.0666 \; x \; c \; x \; d^2 \; x \; \sqrt{kPa}$$

  - Q = flow at discharge nozzle in L/min
  - c = coefficient of discharge
  - d = diameter of outlet in mm
  - kPa = pressure measured during test

# Fire Flow Test - Imperial

- If a pitot gauge or residual pressure gauge is used at the flow hydrant the flow can me calculated using charts or by the formula:

$$Q = 29.84 \; x \; c \; x \; d^2 \; x \; \sqrt{psi}$$

  - Q = flow at discharge nozzle in gpm
  - c = coefficient of discharge
  - d = diameter of outlet in inches
  - Psi = pressure measured during test

# Fire Flow Test

- The predicted flow at 138 kPa (20 psi) can then be calculated using charts or with the formula:

$$Q_r = Qf \; x \frac{{h_r}^{0{\cdot}54}}{{h_f}^{0{\cdot}54}}$$

  - $Q_r$ = flow predicted at desired residual pressure
  - $Q_f$ = Total flow measured during test
  - $h_r$ = pressure drop to desired residual pressure
  - $h_f$ = pressure drop measured during test

# *Fire Flow Test*

- What is the calculated fire flow given the following information:
  - Static pressure at test hydrant = 585 kPa
  - Residual pressure at test hydrant = 413 kPa
  - Flow at flow hydrant measured at = 3,900 Lpm

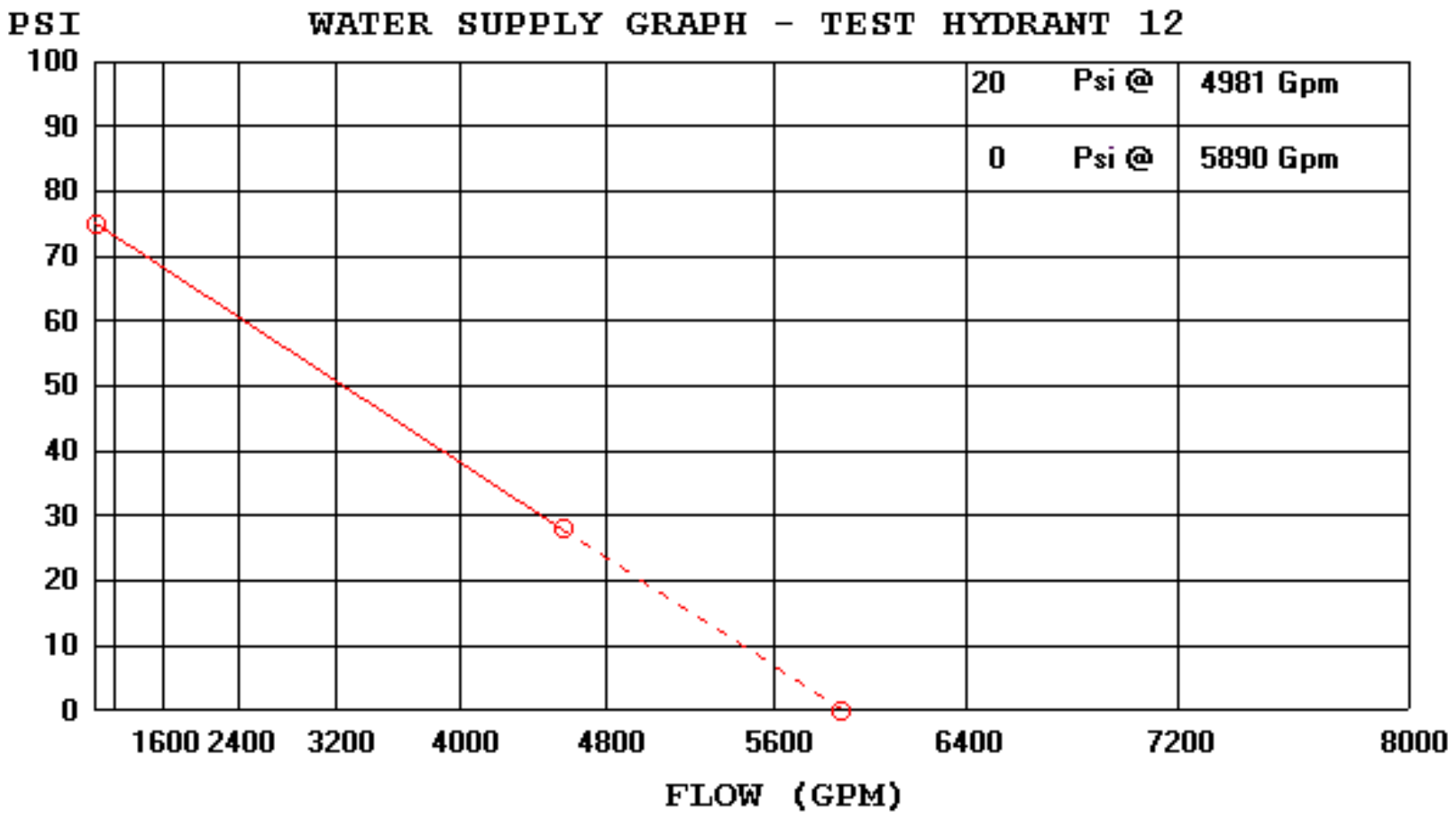
# *Fire Flow Test*

- What is the calculated fire flow given the following information:
  - Static pressure at test hydrant = 85 psi
  - Residual pressure at test hydrant = 60 psi
  - Flow at flow hydrant measured at = 1,007 gpm

# *Fire Flow Test Results*

- Data collected while fire flow testing can be entered into spreadsheet that will calculate the predicted fire flow
- GIS systems can be updated with the information and improve hydraulic modelling
- Software packages can be purchased to customize the data collection and presentation to the end user

# Fire Flow Test Results



# Flow Identification

- Hydrants can be classed and/or colour coded depending on the calculated fire flow at the location

| Class | Flow L/min | Flow usgpm | Top and Nozzle Colour |
|---|---|---|---|
| AA | 5680 or greater | 1,500 or greater | Light Blue |
| A | 3785 – 5675 | 1,000 – 1,499 | Green |
| B | 1900 – 3784 | 500 - 999 | Orange |
| C | 0 – 1899 | 0 - 500 | Red |

# Flow Identification

# Flow Identification

Safety Media
Fire & Life Safety Essentials

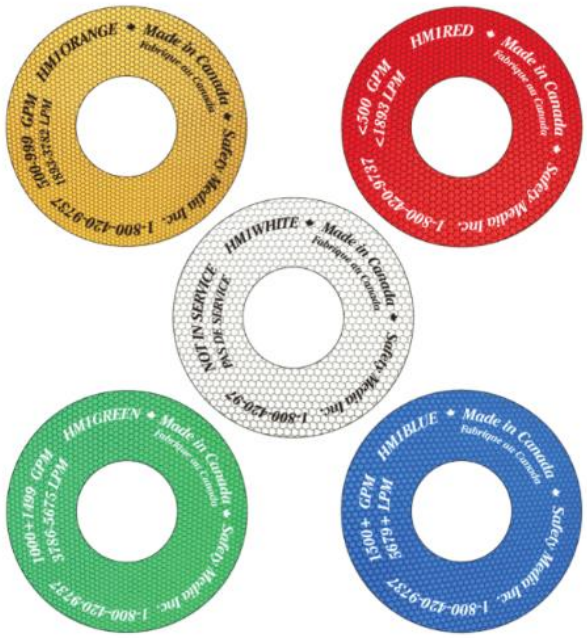
Search

SHOP

Our Services | Customer Service | Blog

Home / Fire Protection Equipment & Signs / Water Supply Equip: Hoses, Nozzles, Caps & Latches / Hydrant Flow Identification Disks

- Products of The Month
- Custom Building Signage Solutions
- Occupational Safety & Fire Safety Planning
- Log Books, Compliance & Codes
- Fire Protection Equipment & Signs
  - Fire Extinguishers
  - Pull Station Covers & Accessories
  - Fire Extinguisher Signs




## Hydrant Flow Identification Disks

**$14.87**

**SKU:** HM1
**Product:** Hydrant Flow Identification Disks
**Highlights:**
Use these highly reflective Hydrant Flow Identification Disks on hydrants. It is made of durable high-density polyethylene (HDPE) and prismatic reflective vinyl that are unaffected by abusive treatment or severe temperature changes. .
**Brand Name:** Safety Media
**Selector Reference:** Colour
**Availability:** Ships within 1-3 Business days

**Colour:** * Blue | Green | Orange | Red | White

# Flow Identification

# Section 5 Review

- Fire Underwriters Survey
- Flow Calculation
- System Adjustments
- Field Measurements
- Hydrant flow calculation
- Fire flow calculation