HYDRAULIC CALCULATION GUIDE

SAVE TIME AND MONEY DESIGNING FIRE PROTECTION SYSTEMS

BlazeMaster®
FIRE SPRINKLER SYSTEMS

BLAZEMASTER® FIRE SPRINKLER SYSTEMS

HYDRAULIC CALCULATION IS THE MOST ACCURATE AND PREFERRED DESIGN METHOD THAT WORKS FOR ALL TYPES OF SYSTEMS AND PIPE MATERIALS.

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SYSTEM DESIGN

There are two methods for designing fire sprinkler systems. The first, the Pipe Schedule System, is based on building occupancy classification and the number of sprinklers that can be supplied from specific sizes of pipe. It can result in using pipe that is larger than needed and many different sizes of pipe, which increases labor and material costs.

The more accurate and preferred method is Hydraulic Calculation. This is based on actual pressure loss caused by internal pipe friction and ensures required coverage and adequate flow. It can mean using smaller pipe and fewer sizes of pipe, which saves on labor and material.

BlazeMaster CPVC Pipe can be installed with hand tools and without electricity, which means faster and easier installation on job sites without power or when the electricity has been shut off.

The Hydraulic Calculation method is preferred by the National Fire Protection Association (NFPA). The NFPA 13 Handbook, 2016 edition, states: “A sprinkler system designed using hydraulic (calculation) is preferable over those systems designed using a pipe schedule approach.”

Hydraulic Calculation works for all types of systems and pipe materials.

HAZEN-WILLIAMS FORMULA

The Hazen-Williams Formula is the mathematical equation used in the Hydraulic Calculation method to determine the appropriate size of pipe and sprinklers to be used in a fire sprinkler system. It's preferable to the Pipe Schedule System method because it determines actual pressure loss based on the length of pipe and internal friction loss.

FRICTION LOSS THROUGH PIPING

$$P_m = \frac{6.05x10^5 \, Q^{1.85}}{C^{1.85} \, d_m^{4.87}}$$

$P_m =$ **bar**
friction loss per meter of pipe in **bar**
(Note: (1 bar = 100 kPa)

$Q_m =$ **lpm**
flow in **lpm**

$C =$ friction loss coefficient for pipe wall roughness

$d_m =$ **mm**
interior pipe diameter in **mm**

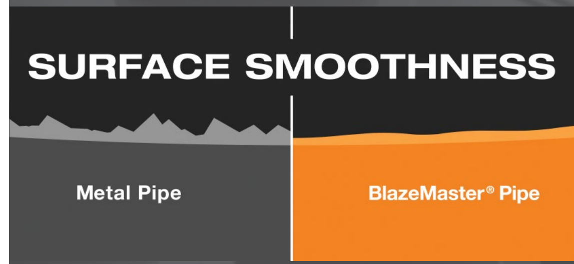
In the above formula, the higher the value for C (friction loss coefficient for pipe wall roughness), the narrower the internal pipe diameter can be to achieve the equivalent flow rate. C ranges from 100 for unlined cast iron and dry steel systems to a high of 150 for BlazeMaster® CPVC Pipe. BlazeMaster pipe is smoother than most metal pipes which means less internal friction and pressure loss.

Hazen-Williams Online Calculators

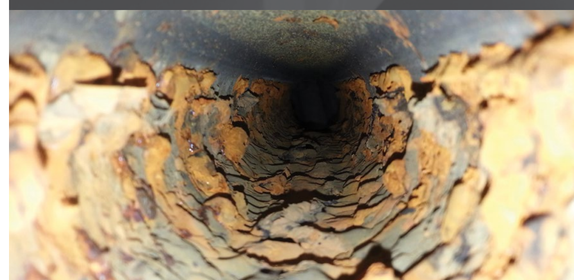
easycalculation.com/physics/fluid-mechanics/hazen-williams-rate.php
lmnoeng.com/hazenwilliams.php
engineeringtoolbox.com/hazen-williams-water-d_797.html

CPVC ADVANTAGES

Because the interior surface of BlazeMaster CPVC Pipe is smoother than most metal pipes, it causes less friction to interfere with water flow.



This best-in-class hydraulics performance makes BlazeMaster CPVC Pipe ideally suited for hydraulically calculated designs. BlazeMaster pipe has other advantages over metal pipe, as well:



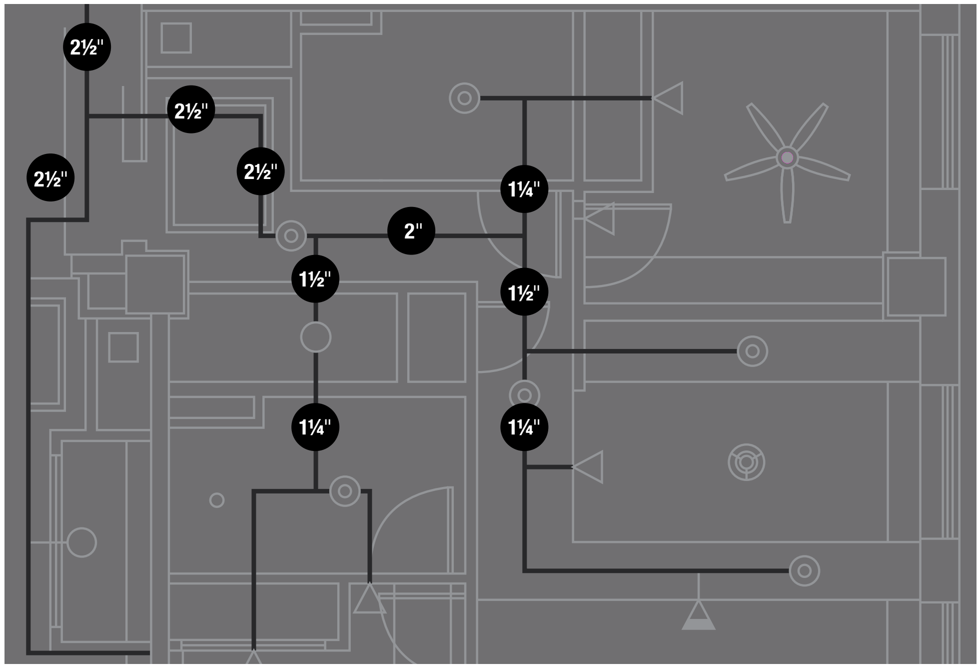
- Metal pipe corrodes. CPVC pipe does not.
- CPVC pipe is lighter and easier to handle than metal pipe.
- CPVC pipe can be cut on site using hand tools, resulting in up to 30% total install cost savings; metal pipe cannot.
- CPVC pipe can be installed without electricity.
- CPVC pipe is faster and easier to install than metal pipe.

SPRINKCAD SOFTWARE SUITE

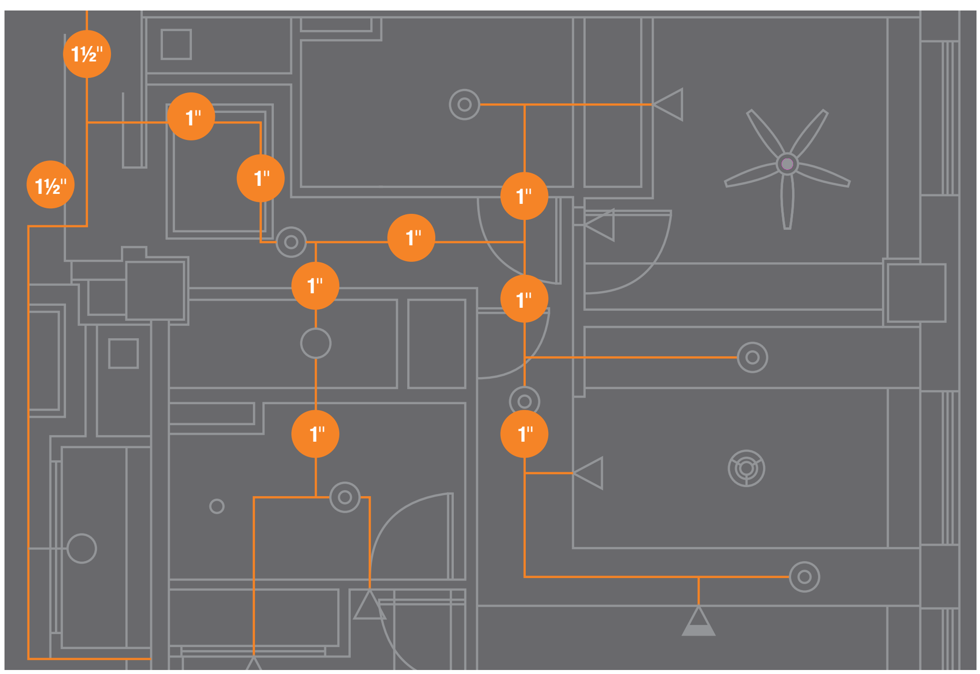
The SprinkCAD software suite includes the tools necessary for sprinkler system design, hydraulic calculation, fluid delivery time calculation and more. This Johnson Controls product makes it easy to design and calculate a fire sprinkler system using BlazeMaster® Pipe & Fittings.

sprinkcad.com

PIPE SCHEDULE VS. HYDRAULIC CALCULATION



Pipe Schedule
The outdated Pipe Schedule System can result in using pipe that is larger than needed and many different sizes of pipe, increasing labor and material costs.



Hydraulic Calculation
Hydraulic Calculation is based on actual pressure loss and ensures required coverage and adequate flow. It can mean using smaller pipe and fewer sizes of pipe, saving time and money.

HYDRAULIC CALCULATION

SAVES TIME AND MONEY ON HIGH-RISE BUILDING

PROJECT SNAPSHOT
D' University Place
PROJECT:
High-rise condominium tower
LOCATION:
Manila, Philippines
CONTRACTOR:
Sogecoa Construction Corp.
YEAR: 2014
SPRINKLER SYSTEM:
Developers used the Hydraulic Calculation method and BlazeMaster® Pipe & Fittings.
SAVINGS:
28% savings over black iron system using Pipe Scheduling

The builders of D' University Place, a luxury high-rise condo tower in Manila, Philippines, wanted to provide the best possible fire protection for tenants while being as efficient as possible with construction and costs.

They designed the fire sprinkler system for the 39-story tower using Hydraulic Calculation, the preferred method of the National Fire Protection Association. It's more accurate than the outdated Pipe Scheduling system because Hydraulic Calculation is based on actual pressure loss caused by internal pipe friction so it ensures required coverage and adequate flow.

It also can mean using smaller pipe and fewer sizes of pipe, which saves on labor and material. The builders chose BlazeMaster Pipe & Fittings, which are faster and easier to install than metal pipe.

The result? The builders saved 28% compared to a black iron system designed with the Pipe Scheduling method.

BlazeMaster® Fire Sprinkler Systems is approved for high-rise and Light Hazard commercial and institutional applications, including this 39-story condominium tower in Manila, Philippines. By using BlazeMaster pipe and the Hydraulic Calculation system, the builders saved 28% compared to the initial design using black iron and the Pipe Scheduling method.

BLACK IRON PIPE

MATERIALS	
Item Description	**Amount**
BI PIPE SCH 40	2,882,763.00
G.I. FITTINGS	1,709,789.00
VALVES	1,598,687.00
WATERFLOW	245,685.00
FIRE HOSE CAB	891,000.00
PORT F.E. (10LBS)	510,950.00
WHEELED TYPE	101,075.00
SPRINKLER HEADS	1,619,896.00
SUB TOTAL:	9,559,845.00

PUMP	
153 HP (PHP 25,000.00/HP)	3,825,000.00

CONSUMABLES	
CONSUMABLES	1,008,984.50

LABOR	
LABOR (45%) OF MATERIALS	4,301,930.25
INSTALLATION OF PUMPS	530,000.00
SUB TOTAL	4,831,930.25

PROFIT	
PROFIT (12% ON MATERIALS)	1,147,181.40
GRAND TOTAL	20,372,941.15

BLAZEMASTER

MATERIALS	
Item Description	**Amount**
CPVC PIPE	2,565,659.07
CPVC FITTINGS	1,521,712.21
VALVES	1,598,687.00
WATERFLOW	245,685.00
FIRE HOSE CAB	891,000.00
PORT F.E. (10LBS)	510,950.00
WHEELED TYPE	101,075.00
SPRINKLER HEADS	1,619,896.00
SUB TOTAL:	9,054,664.28

PUMP	
60 HP (PHP 25,000.00/HP)	987,500.00

CONSUMABLES	
CONSUMABLES	908,086.05

LABOR	
LABOR OF MATERIALS	2,446,695.96
INSTALLATION OF PUMPS	200,000.00
SUB TOTAL	2,646,695.96

PROFIT	
PROFIT (12% ON MATERIALS)	1,086,559.71
GRAND TOTAL	14,683,506.00

Item Description	BI	BlazeMaster	Savings	
MATERIALS	9,559,845.00	9,054,664.28	505,180.72	5.28%
PUMP	3,825,000.00	987,500.00	2,837,500.00	74.18%
CONSUMABLES	1,008,984.50	908,086.05	100,898.45	10.00%
LABOR	4,831,930.25	2,646,695.96	2,185,234.29	45.22%
PROFIT	1,147,181.40	1,086,559.71	60,621.69	5.28%
GRAND TOTAL	20,372,941.15	14,683,506.00	5,689,435.15	27.93%

HISTORY

Hydraulic Calculation is not new, but has been a proven, reliable method for designing fire sprinkler systems for decades.

Since the 1970s, NFPA 13 – *Installation of Sprinkler Systems* has allowed the use of hydraulic calculations.

Beginning in 1991, NFPA 13 began to allow the use of the Pipe Schedule System only for small systems or additions to existing systems unless a very strong water supply was available.

"THE PURPOSE OF FIRE PROTECTION HYDRAULIC CALCULATIONS IS TO ENABLE THE FIRE TO BE EXTINGUISHED WITH THE MAXIMUM EFFICIENCY, WITH A MINIMUM COST OF PIPING, APPARATUS, AND SUPPLY OF EXTINGUISHING MEDIUM."

– Clyde M. Wood, CE ***Automatic Sprinkler Hydraulic Data, 1964***

BlazeMaster®
FIRE SPRINKLER SYSTEMS

Visit **LubrizolCPVC.com** or call **1-855-735-1431** to learn more.

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