QUICKSET
QUICK FACTS

A TECHNICAL PRIMER

F-4213A
11/99

GRISWOLD CONTROLS

CONTENTS

THE *QUICKSET* DESIGN

The *Quickset* balancing valve is a versatile, multi-function device designed for hydronic systems. It performs three functions: It reads the flow, adjusts the flow, and is used as a shut-off valve for isolation.

The *Quickset* is composed of two sections: a metering section and a flow adjustment section.

The *Quickset* is designed to provide a high Pressure Differential (ΔP) signal proportional to the flow and to provide the means of adjusting that flow.

FEATURES AND BENEFITS

Material

- **Forged Brass or Fabricated Steel Valve Body**. Forged brass (1/2” to 2”) provides HVAC pressure and temperature rating for the housing. Fabricated steel used for the larger models (2-1/2” to 14”) is manufactured by certified ASME code fabricators.

Metering

- **Venturi-Based Metering Function** is highly accurate (1% accuracy) and has low permanent pressure drop. The complete readout system has an accuracy of 3% or better. Venturi meters have the lowest permanent loss of any orifice type balancing valve.
- **“The Laminizer”** (on 2-1/2” to 14” sizes) for higher accuracy, reduced upstream clearances, reduced need for long upstream straight runs and increased versatility for tight space installation. The Laminizer stops flow rotation and turbulence, developing a uniform velocity profile and more predictable output. This new advancement means only one pipe diameter clearance is necessary for accurate flow regulation.
- **Piezo-Ring Pressure Averaging Taps** at the throat for negating uneven upstream incoming flow patterns. The Piezo-Ring averages the velocity profile from four points, instead of one or three.

Adjustment

- **“The Optimizer”** for Enhanced Flow Adjustment and QUIETER throttling. Because of its parabolic shape, the Optimizer avoids the “dead band” areas associated with handle rotation in other ball valve designs. **No other Manual Balancing Valve has this feature.**

Versatility

- **Two Styles for Isolation.** The 1/2" - 2" forged brass valves provide an integrated ball valve with optional handle extension for shut-off and isolation. The 2-1/2" - 14" *Quicksets* feature Butterfly valves to provide shut-off for isolation.
- **End Connections.** The 1/2" - 2" valves include a union section on the inlet to the venturi for easy access to system components. The 2-1/2" - 14" valves are available in Flanged, Grooved or Beveled-for-Weld styles.

METERING

The idea of a metering device is to take a comparative reading from two locations on the valve (See Readout Devices section for device options). The flow passage is restricted to generate a localized higher pressure, which in turn generates a pressure signal, measured in inches of water. The low pressure reading is subtracted from the high pressure reading to yield the **Pressure Differential, or ΔP**. In a differential producer like the *Quickset* venturi, the ΔP is proportional to the square of the flow rate:

$$Q = k\sqrt{\Delta P}$$

where k is the flow coefficient constant
Q is the Flow rate
and ΔP is the pressure differential

CLEARANCE

As shown in Figure 1, piping systems are full of convoluted bends and twists, all of which add to the rotation of the fluid they contain. Rotation and swirling result in inaccurate readings. Piping system design must include enough clearance to allow the flow to straighten.

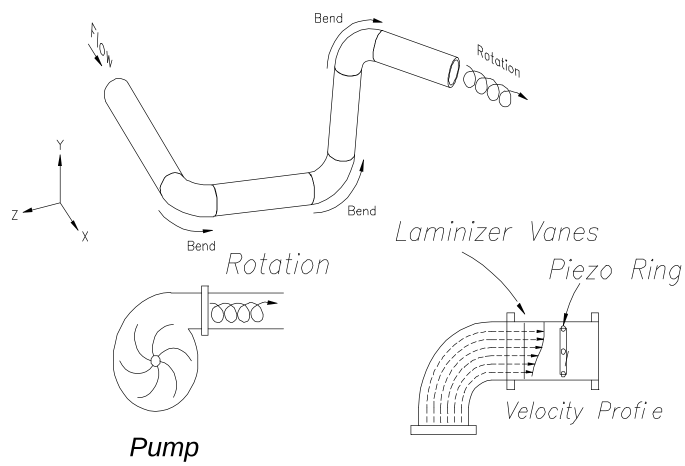

Figure 1 Metering Functions

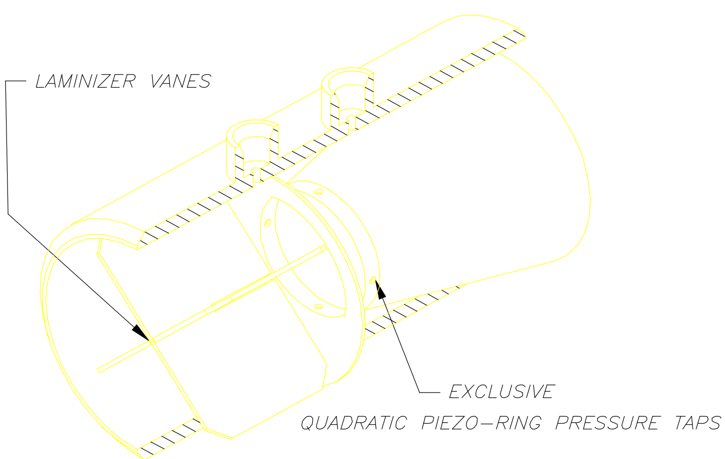

Figure 2 Quickset Cutaway

In 1/2 to 2 inch sizes, sufficient upstream clearance is built into the valve housing to straighten the flow of fluid and avoid this inaccuracy. In the 2-1/2 to 14 inch sizes, the flow **Laminizer** and the Quadratic Piezo-Ring pressure taps (Figure 2) help to reduce the upstream clearance and increase accuracy. The **Laminizer** consists of perpendicular vanes, **equivalent in length to one diameter of the valve body**. When this element is added upstream of the valve, the smooth vanes channel and straighten the flow in the piping system.

READOUT DEVICES

Griswold offers three choices for taking readings across the venturi. Each device has been carefully selected and tested by Griswold engineering.

Metering Kit & Overlays

Direct reading gauges and overlays for both the 0-100 inch range and the 0-300 inch ranges (Figure 3). These gauges are high precision and have large 6 inch dial faces with 270° pointer rotation. The measurement system includes bypass valve manifold and isolation valves on the color-coded hoses.

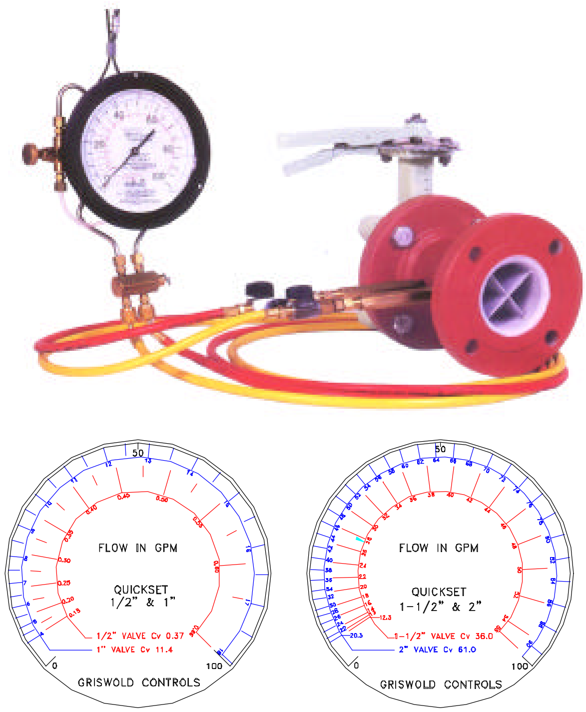

Figure 3 Metering Kit & Overlays

CONNECTION & USE

1. Open the balance control valve at the bottom of the meter kit face.
2. Connect the High pressure hose to the *Quickset* port marked H.
3. Connect the Low pressure hose to the *Quickest* port marked L.
4. The gauge should show a pressure reading.
5. Open and close the Bleed Valves to release any air trapped in the hoses and gauge assembly.
6. Close the balance control valve on the meter kit face.
7. The meter is now ready to take accurate differential pressure readings.

SETTING THE QUICKSET

1. Select the correct overlay for the *Quickset* size and Cv and align it on the gauge face.
2. Adjust the *Quickset* handle to the required flow rate (gpm).
3. Set the memory stop on the *Quickset* handle against the body tap to preserve flow setting.

TRANSPARENT OVERLAYS

The overlays (Figure 3) convert the 0-100 or 0-300 in/$H_2$0 gauge (meter kit) reading to direct read in gpm. Each overlay is scaled for the recommended flow range for the venturi listed.

1. Select the correct overlay by reading the Cv noted on the valve tag (under the valve handle) and matching it with the venturi Cv noted on the overlay. Cv's are also separated by valve body size, which is noted on the overlay.

2. Place the correct overlay on the gauge face, using the 0 (zero) & 100 black markings to align it with the gauge face markings.

3. The flow rate may now be read directly on the gauge.

Digital Manometer

The *Quickset* digital manometer with dual scale (Figure 4) is a precise digital display with accuracy of 0.5% of full scale (includes 3-way valve manifold, hoses and probes). The direct pressure reading is immediately displayed, enabling many readings in a short period of time. The manometer is available in three different readout unit combinations:

- Head Feet / Head Inches
- Head Feet / psi
- psi / Head Inches

Pressure Range is 0-500 inches W.C. (Water Column). The pressure can also be read in feet W.C. or psi. The manometer is intended for use where ΔP does not exceed 25 psi. It is battery operated with low power consumption to extend battery life.

Figure 4 Digital Manometer Kit

Transducer

The Electronic Output Transducer (Figure 5)[1] is an excellent readout device choice for use with a remote monitoring interface, as in an Energy Management System (EMS) or remote computer control. The transducer has a 4 to 20 mA current output range and is calibrated for maximum flow of the individual valve. This device provides a link between the control system and the physical components of the HVAC system.

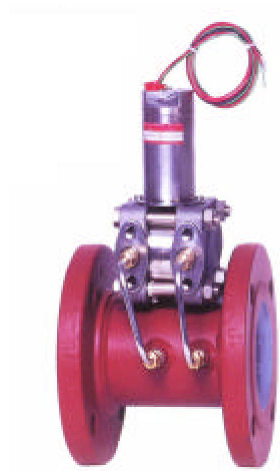

Figure 5 Quickset with Electronic Output

[1] Figure is representational only. Actual design and shape of transducer may vary.

OPERATION

The Transducer takes its ΔP readings through the use of a Differential Pressure Transmitter (Figure 6). Essentially, two measuring diaphragms are attached to a flexing beam which flexes according to the amount of differential pressure. This flexion is in turn measured by a strain gauge. The stressing of this strain gauge alters its electrical resistance, which is seen as a change in voltage from the sensing element. The resulting change in voltage is monitored by an amplifier via a temperature compensating network and converted to a DC signal proportional to the applied pressure.

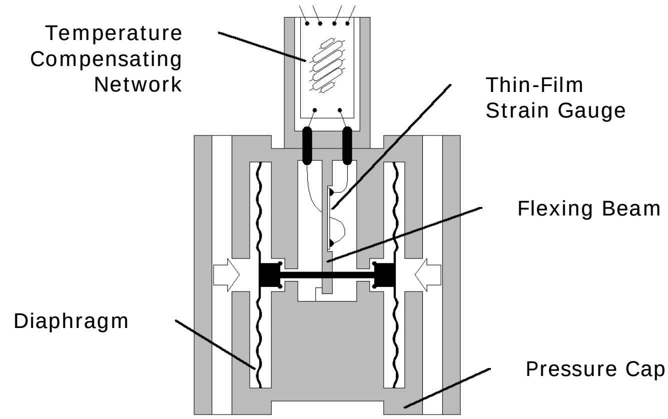

Figure 6 Differential Pressure Transmitter

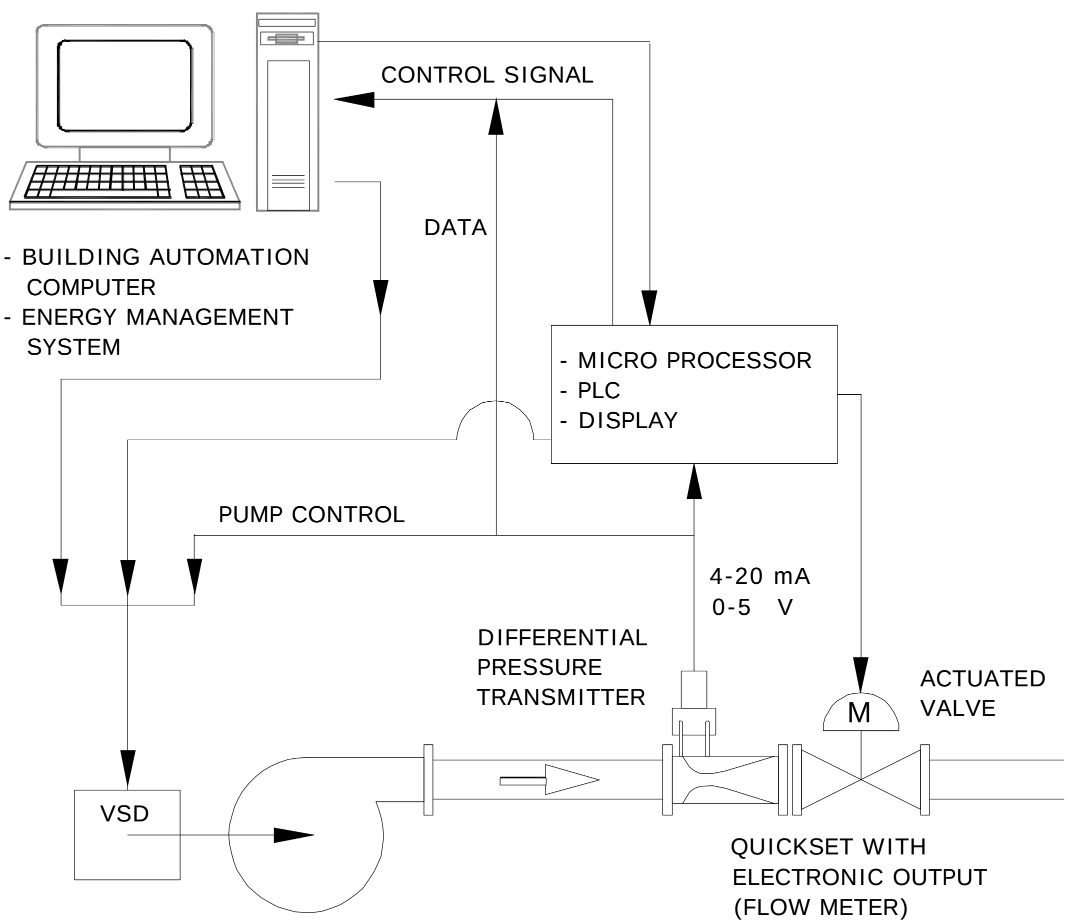

Figure 7 Transducer Signal Diagram Example

PERMANENT LOSS

Each component in a piping system costs the system permanent loss (e.g. elbow joints, metering stations, etc.) Permanent loss is the pressure cost suffered by the entire system. In other words, permanent loss is any pressure loss that the pump must compensate for, adding to the pump's workload. The pump's workload can be expressed in terms of energy cost, or the extra energy required to compensate for this permanent loss. The higher permanent loss associated with orifice type metering elements is brought about by a larger localized pressure drop. Localized pressure drop is synonymous with pressure differential (ΔP in Figure 8). A signal is created by flow through the metering element, and the resulting permanent loss is the fraction of this signal that must be compensated for by the pump. This localized pressure drop is a transitory function generated for metering purposes only. However, some permanent loss is an unavoidable side effect of metering.

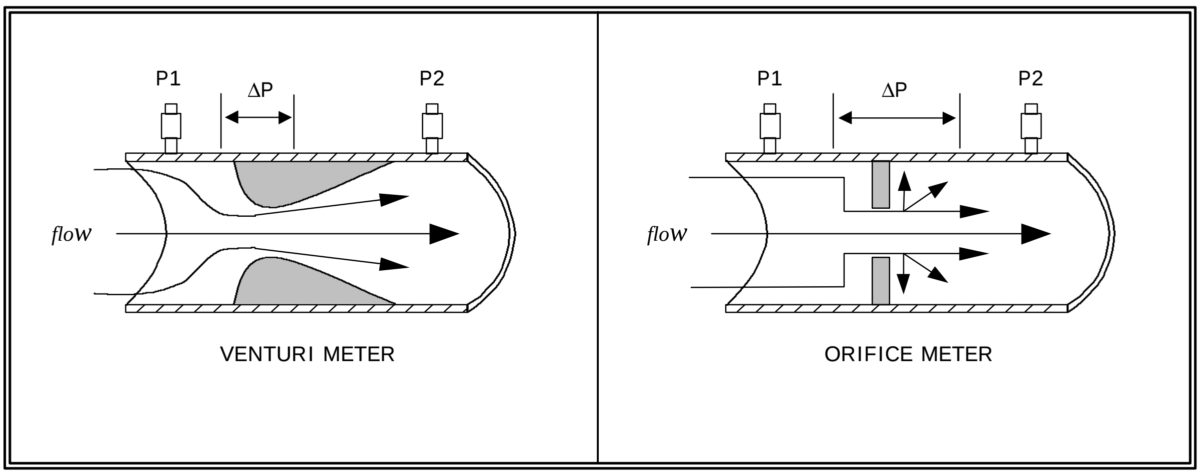

Figure 8 Venturi Meter vs. Orifice Meter

The venturi features a rounded, concentric flow passage that channels fluid smoothly and evenly. Orifice type meters feature a flat orifice plate. The flat plate diverts the flow from the intended direction once it passes through the orifice, creating turbulence (Figure 8). This turbulence results in higher permanent loss because extra pump energy is required to streamline the turbulent flow.

If, for example, a 100 inch signal is generated through both a venturi and an orifice type meter, 75 inches of permanent loss would occur in the orifice type, while in the venturi, there would be only up to about 20 inches of permanent loss. Since the orifice meter suffers about 4 times the permanent loss of the venturi, it can be concluded that use of an orifice meter will result in 4 times the energy cost of the venturi. The pump will have to generate 4 times the extra pressure, resulting in the consumption of this extra energy

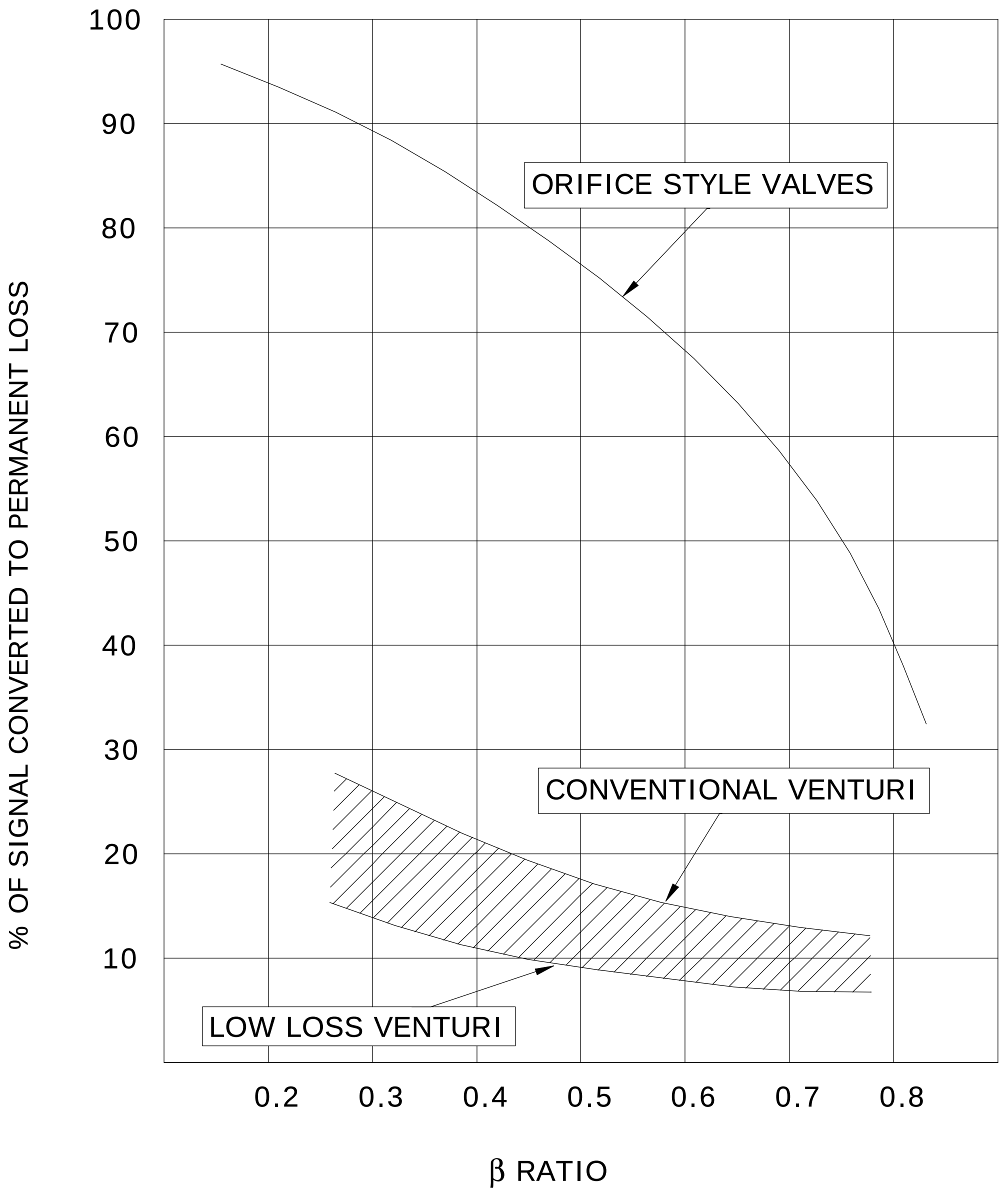

Figure 9 Permanent Loss (ASME Fluid Meter Handbook)

Figure 9 shows the permanent loss (pressure drop) of orifice type valves versus venturi types. The shaded area represents the performance of various sorts of venturi designs. The β ratio is the ratio of the diameter of the orifice to the diameter of the incoming fluid. In other words, it is the factor by which the flow passage is restricted to create the pressure necessary to produce the signal. The permanent loss for venturi designs is markedly less than for orifice style valves.

ADJUSTING -- THE OPTIMIZER

OPTIMIZED PERFORMANCE

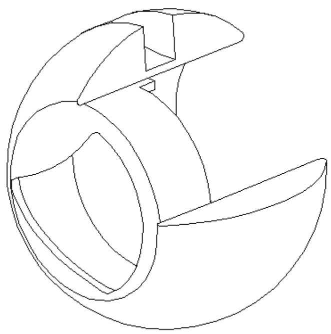

Figure 10 Optimizer Profile

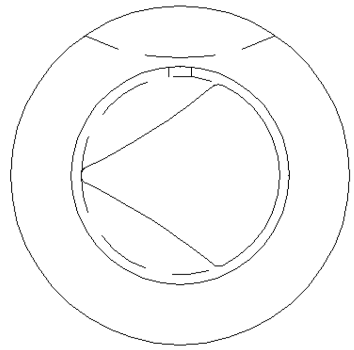

Figure 11 Ball and Installed Optimizer

The adjustment precision of the 1/2 through 2 inch *Quickset* is enhanced by means of a FLOW OPTIMIZER (Figures 10 and 11, above). When this component is added to the ball section, it creates a precise, equal percentage relationship between handle rotation and flow balancing. It also greatly reduces the "dead band" associated with all other ball valve based manual balancing valves. This dead band means that the handle must move 30% from the fully open position before the flow rate shows any change, effectively reducing the usable range of the handle rotation by 30%. Without the Optimizer, the shape of the control curve created by the ball rotation is steeper for the remaining effective rotation. Figure 12 shows the improvement with the Optimizer. Figure 12 also shows the "dead bands" associated with a ball valve alone in flow balancing.

The Optimizer has a parabolic, engineered passage profile based on the design of the Griswold Automatic Flow Control valves. This profile has been proven to reliably produce a smooth, responsive flow curve during valve handle rotation.

Precision Handle Control during flow adjustment saves time and money and affects the outcome of the balancing/commissioning process. It ensures that the design flow requirements are properly met at each location. Approximately 50% more handle rotation response range is achieved by eliminating the "dead bands" of other types of ball valves (0-30% and 80-100% closed in Figure 12).

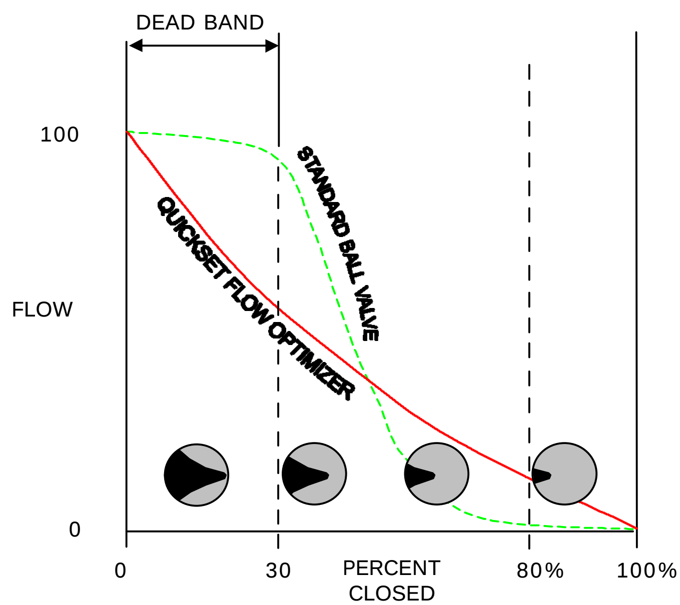

Figure 12 Improvement With Optimizer

MATERIAL

The Optimizer is made from molded, engineered thermoplastic from the Noryl family of plastics. It is a blend of a polyamide with reinforced modified polymer PPE for added mechanical strength. This technology in reinforcement also contributes to the retention of the mechanical properties, chemical resistance and dimensional stability. Noryl plastic compares very favorably with the brass used by other manufacturers. Plastic is inherently unaffected by erosion, because it is a homogeneous material whereas brass is an alloy. Noryl also has superior strength and longevity to brass.

The Optimizer is very stable in environments where extreme temperature variations occur, such as in hydronic heating and cooling systems. The Optimizer has superior hydrolytic stability, which means that this material retains its physical properties when exposed to water. The Optimizer has the lowest water absorption rate of any thermoplastic material. The Optimizer's mechanical strength and hardness values are higher than other thermoplastic materials such as Delrin, Nylon, ABS, and PVC. These materials have been successfully used for fluid handling components like ball valves, pipe fittings and pump impellers in irrigation, swimming pool and chemical industries. Because its characteristics are even better than these materials, Noryl is regularly selected for use in pump impellers for HVAC systems.

MECHANICAL PROPERTIES

Material	**Noryl**	Delrin	Nylon	ABS	PVC
Tensile Strength, PSI	22000	14000	12600	7000	6800
Hardness, Rockwell[2] R	120	120	120	115	100

CHEMICAL RESISTANCE

GOOD

- Alcohols
- Alkalis (Bases)
- Cooling system liquids (220°F any concentration)
  - Ethylene Glycol
  - Propylene Glycol
- Chlorinated water
- Detergents/Cleaners
  - Inhibitors
  - Emulsifiers
  - Dispersants
  - Oxygen Reducers
  - Water Softeners
- Heating system liquids
  - Glycols (50% concentration)
  - Water (240°F)

POOR

- Acids (high concentration)
- Hydrocarbons
- Ketones
- Phenols

[2] The Rockwell-R scale is a hardness scale which is used for measurement of plastics.

PRODUCT SELECTION

When selecting the appropriate *Quickset* model for your application needs, you must first know the flow rate for that location. Once this is known, the next step is to choose a valve model with the desired flow range. Care must be taken to select a valve which produces a readable signal at that flow rate, while creating the lowest permanent pressure drop for the piping system. To ensure a readable signal, choose a valve with a Cv value that will keep the control signal between 5 and 300 inches W.C. (Water Column). A signal of at least 12 inches is desirable. The signal is typically measured by a 0-100" or 0-300" differential pressure gauge. We offer gauges with both of these ranges (see Readout Devices Section). Also note that the maximum flow velocity of the selected valve should be within ASHRAE recommended limits (see Figure 13).

FLOW RANGES

The *Quickset* line is available in two size groups. Group One includes 1/2 to 2 inch Forged Brass Housings and Group Two includes 2-1/2 to 14 inch Fabricated Steel Valves.

Group 1

The 1/2 through 2 inch valves are made with forged brass housings. These housings provide pressure and temperature ratings excellent for HVAC applications. This group is available in sweat, male and female NPT connections. Table 1 shows the flow ranges by size.

Table 1 1/2 to 2 inch Flow Ranges

Size (inches)	Model (Cv)	FLOW RANGE (gpm) 5-100 inch signal (Max flow velocity in fps)	FLOW RANGE (gpm) 5-300 inch signal (Max flow velocity in fps)
1/2	Very Low Flow (0.37)	0.15 – 0.66 (0.7 fps)	0.15 – 1.2 (1.3 fps)
	Low Flow (0.80)	0.3 – 1.4 (1.5 fps)	0.3 – 2.5 (2.6 fps)
	Medium Flow (1.70)	0.6 – 2.8 (3 fps)	0.6 – 4.9 (5.2 fps)
	High Flow (3.50)	1.25 – 5.7 (6 fps)	1.3 – 9.8 (10.3 fps)
3/4	Very Low Flow (0.80)	0.3 – 1.4 (0.8 fps)	0.3 – 2.5 (1.5 fps)
	Low Flow (1.70)	0.6 – 2.8 (1.7 fps)	0.6 – 4.9 (2.9 fps)
	Medium Flow (3.50)	1.25 – 5.7 (3.4 fps)	1.3 – 9.8 (5.9 fps)
	High Flow (7.50)	2.5 – 11.4 (6.9 fps)	2.5 – 19.7 (11.8 fps)
1	Very Low Flow (1.60)	0.6 – 2.8 (1 fps)	0.6 – 4.9 (1.8 fps)
	Low Flow (3.30)	1.25 – 5.7 (2.1 fps)	1.3 – 9.8 (3.6 fps)
	Medium Flow (7.00)	2.5 – 11.4 (4.2 fps)	2.5 – 19.7 (7.3 fps)
	High Flow (11.40)	4.0 – 18.0 (6.7 fps)	4.0 – 31.3 (11.6 fps)
1-1/4	Low Flow (9.00)	3.4 – 15.0 (3.2 fps)	3.4 – 26.3 (5.6 fps)
	High Flow (19.80)	6.8 – 30.4 (6.5 fps)	6.8 – 52.6 (11.2 fps)
1-1/2	Low Flow (19.20)	3.4 – 15.0 (2.4 fps)	3.4 – 26.3 (4.1 fps)
	Medium Flow (36.00)	6.8 – 30.4 (4.8 fps)	6.8 – 52.6 (8.3 fps)
2	Medium Flow (61.00)	20.3 – 91.2 (8.7 fps)	20.3 – 157.9 (15.1 fps)

Group 2

Valves for 2-1/2 to 14 inch pipe sizes are fabricated steel. Flanged, Grooved and Beveled-for-Weld styles are available. Table 2 shows the full range of sizes, styles and flow ranges.

Table 2 2-1/2" to 14 inch Flow Ranges

Size (inches)	Model (Cv)	FLOW RANGE (gpm)	
		5-100 inch signal (Max flow velocity in fps)	5-300 inch signal (Max flow velocity in fps)
2-1/2	Flanged / Grooved / Beveled-For-Weld (165)	20.5 - 92 (6.2 fps)	20.5 - 159 (10.6 fps)
3	Flanged / Grooved / Beveled-For-Weld (251)	32.4 - 145 (6.3 fps)	32.4 - 251 (10.9 fps)
4	Flanged / Grooved / Beveled-For-Weld (432)	58.6 - 262 (6.6 fps)	58.6 - 454 (11.4 fps)
5	Flanged / Grooved / Beveled-For-Weld (627)	84.1 - 376 (6.0 fps)	84.1 - 651 (11.4 fps)
6	Flanged / Grooved / Beveled-For-Weld (1037)	139.1 - 622 (6.9 fps)	139.1 - 1077 (12.0 fps)
8	Flanged / Grooved / Beveled-For-Weld (3133)	269 - 1203 (7.7 fps)	269 - 2103 (13.5 fps)
10	Flanged / Grooved / Beveled-For-Weld (3200)	425 - 1890 (7.7 fps)	425 - 3291 (13.5 fps)
12	Flanged / Grooved / Beveled-For-Weld (5325)	716 - 3200 (9.2 fps)	716 - 5542 (15.9 fps)
14	Flanged / Grooved / Beveled-For-Weld (7156)	961 - 4300 (10.2 fps)	961 - 7447 (17.7 fps)

FLOW VELOCITY

The flow velocity for the system's piping must also be considered. Hydronic system piping, per ASHRAE guidelines, would generally have maximum flow rates of 4 feet per second in small pipe sizes and 4 feet per 100 feet of pipe length for larger sizes (see Figure 13). The maximum flow velocity for each size *Quickset* is shown in Tables 1 and 2.

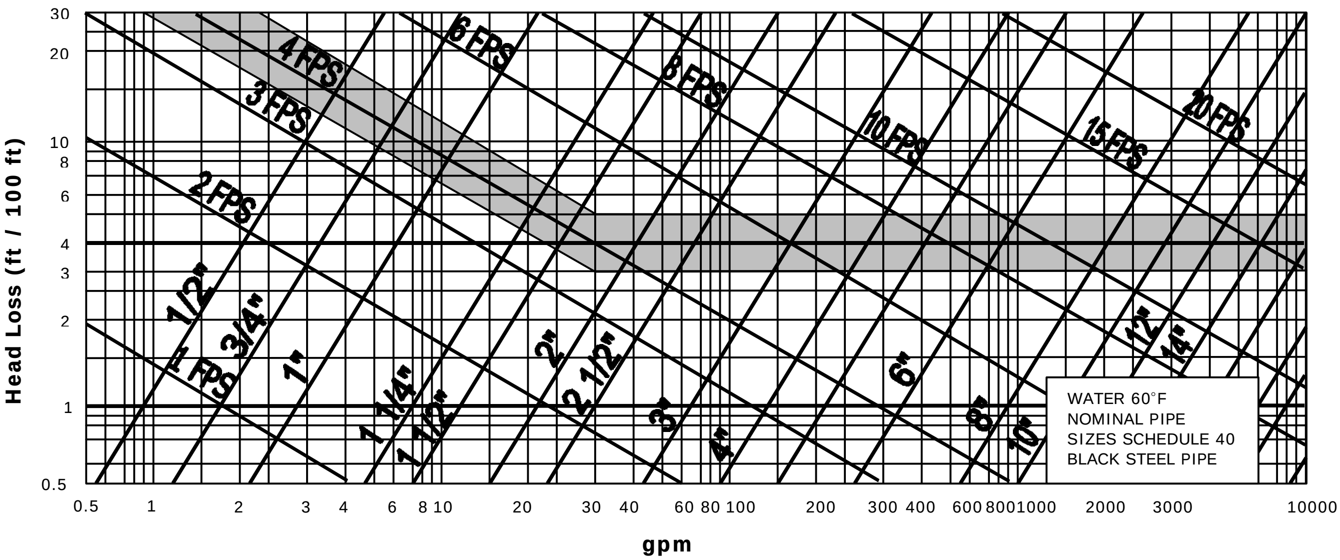

Figure 13 Shaded Area Indicates Recommended Flow Rates Per Pipe Size (ASHRAE Handbook)

QUICKSET VENTURI SIGNALS

Tables 3-8 show the signal range for each model venturi offered. The valves shown in boldface represent the typical acceptable range to be used for the indicated *Quickset*. Multiple Cv's may offer a suitable signal. If there is a choice between several sizes for a given flow, then choose the size that produces the lowest signal (signal should be at least 12 inches for easy reading on most HVAC instruments).

Table 3 1/2 inch *Quickset* Venturi Signals

Signal (inches W.C.)

Cv	0.37	0.8	1.7	3.5
Flow (gpm)	$DP=226.286*Flow^2$	$DP=49.28*Flow^2$	$DP=12.32*Flow^2$	$DP=3.08*Flow^2$
0.1	2.3			
0.2	9.1			
0.3	**20.4**	4.4		
0.4	**36.2**	7.9		
0.5	**56.6**	**12.3**		
0.6	**81.5**	**17.7**	4.4	
0.7	**110.9**	**24.1**	6.0	
0.8	**144.8**	**31.5**	7.9	
0.9	**183.3**	**39.9**	10.0	
1	**226.3**	**49.3**	**12.3**	
1.1	**273.8**	**59.6**	**14.9**	
1.2	325.9	**71.0**	**17.7**	4.4
1.3	382.4	**83.3**	**20.8**	5.2
1.4		**96.6**	**24.1**	6.0
1.5		**110.9**	**27.7**	6.9
1.6		**126.2**	**31.5**	7.9
1.7		**142.4**	**35.6**	8.9
1.8		**159.7**	**39.9**	10.0
1.9		**177.9**	**44.5**	11.1
2		**197.1**	**49.3**	**12.3**
2.2		**238.5**	**59.6**	**14.9**
2.4		**283.9**	**71.0**	**17.7**
2.6		333.1	**83.3**	**20.8**
2.8		386.4	**96.6**	**24.1**
3			**110.9**	**27.7**
3.5			**150.9**	**37.7**
4			**197.1**	**49.3**
4.5			**249.5**	**62.4**
5			308.0	**77.0**
5.5			372.7	**93.2**
6				**110.9**
6.5				**130.1**
7				**150.9**
7.5				**173.3**
8				**197.1**
8.5				**222.5**
9				**249.5**
9.5				**278.0**
10				308.0
10.5				339.6
11				372.7

Table 4 3/4 inch *Quickset* Venturi Signals

	Signal (inches W.C.)			
Cv	0.8	1.7	3.5	7.5
Flow (gpm)	DP=49.28*Flow^2	DP=12.32*Flow^2	DP=3.08*Flow^2	DP=0.77*Flow^2
0.2	2.0			
0.4	7.9			
0.6	**17.7**	4.4		
0.8	**31.5**	7.9		
1	**49.3**	**12.3**		
1.2	**71.0**	**17.7**	4.4	
1.4	**96.6**	**24.1**	6.0	
1.6	**126.2**	**31.5**	7.9	
1.8	**159.7**	**39.9**	10.0	
2	**197.1**	**49.3**	**12.3**	
2.2	**238.5**	**59.6**	**14.9**	
2.4	**283.9**	**71.0**	**17.7**	4.4
2.6	333.1	**83.3**	**20.8**	5.2
2.8	386.4	**96.6**	**24.1**	6.0
3		**110.9**	**27.7**	6.9
3.2		**126.2**	**31.5**	7.9
3.4		**142.4**	**35.6**	8.9
3.6		**159.7**	**39.9**	10.0
3.8		**177.9**	**44.5**	11.1
4		**197.1**	**49.3**	**12.3**
4.5		**249.5**	**62.4**	**15.6**
5		308.0	**77.0**	**19.3**
5.5		372.7	**93.2**	**23.3**
6			**110.9**	**27.7**
7			**150.9**	**37.7**
8			**197.1**	**49.3**
9			**249.5**	**62.4**
10			308.0	**77.0**
11			372.7	**93.2**
12				**110.9**
13				**130.1**
14				**150.9**
15				**173.3**
16				**197.1**
17				**222.5**
18				**249.5**
19				**278.0**
20				308.0
21				339.6
22				372.7

Table 5 1 inch *Quickset* Venturi Signals

Signal (Inches W.C.)

Cv	1.6	3.3	7	11.35
Flow (gpm)	DP=12.32*Flow^2	DP=3.08*Flow^2	DP=0.77*Flow^2	DP=.307*Flow^2
0.6	4.4			
0.8	7.9			
1	**12.3**	3.1		
1.2	**17.7**	4.4		
1.4	**24.1**	6.0		
1.6	**31.5**	7.9		
1.8	**39.9**	10.0		
2	**49.3**	**12.3**		
2.2	**59.6**	**14.9**		
2.4	**71.0**	**17.7**	4.4	
2.6	**83.3**	**20.8**	5.2	
2.8	**96.6**	**24.1**	6.0	
3	**110.9**	**27.7**	6.9	
3.5	**150.9**	**37.7**	9.4	
4	**197.1**	**49.3**	**12.3**	4.9
4.5	**249.5**	**62.4**	**15.6**	6.2
5	308.0	**77.0**	**19.3**	7.7
5.5	372.7	**93.2**	**23.3**	9.3
6		**110.9**	**27.7**	11.1
6.5		**130.1**	**32.5**	**13.0**
7		**150.9**	**37.7**	**15.1**
7.5		**173.3**	**43.3**	**17.3**
8		**197.1**	**49.3**	**19.7**
8.5		**222.5**	**55.6**	**22.2**
9		**249.5**	**62.4**	**24.9**
10		308.0	**77.0**	**30.7**
11		372.7	**93.2**	**37.2**
12			**110.9**	**44.2**
13			**130.1**	**51.9**
14			**150.9**	**60.2**
15			**173.3**	**69.1**
16			**197.1**	**78.6**
17			**222.5**	**88.8**
18			**249.5**	**99.5**
19			**278.0**	**110.9**
20			308.0	**122.9**
22			372.7	**148.7**
24				**176.9**
26				**207.6**
28				**240.8**
30				**276.4**
32				314.5
34				355.1

Table 6 1-1/4 To 2 inch *Quickset* Venturi Signals

Signal (Inches W.C.)

	Size 1-1/4"		Size 1-1/2"		Size 2"
Cv	9	19.8	19.2	36	61
Flow (gpm)	DP=0.433*Flow^2	DP=0.108*Flow^2	DP=0.108*Flow^2	DP=.033*Flow^2	DP=.012*Flow^2
3	3.9				
4	6.9				
5	10.8				
6	**15.6**	3.9	3.9		
7	**21.2**	5.3	5.3		
8	**27.7**	6.9	6.9		
9	**35.1**	8.8	8.8		
10	**43.3**	10.8	10.8		
12	**62.4**	**15.6**	**15.6**	4.7	
14	**84.9**	**21.2**	**21.2**	6.5	
16	**110.9**	**27.7**	**27.7**	8.4	
18	**140.3**	**35.1**	**35.1**	10.7	3.9
20	**173.3**	**43.3**	**43.3**	**13.2**	4.8
22	**209.6**	**52.4**	**52.4**	**16.0**	5.8
24	**249.5**	**62.4**	**62.4**	**19.0**	6.9
26	**292.8**	**73.2**	**73.2**	**22.3**	8.1
28	339.6	**84.9**	**84.9**	**25.8**	9.4
30	389.8	**97.5**	**97.5**	**29.7**	10.8
35		**132.6**	**132.6**	**40.4**	**14.7**
40		**173.3**	**173.3**	**52.7**	**19.3**
45		**219.3**	**219.3**	**66.7**	**24.4**
50		**270.7**	**270.7**	**82.4**	**30.1**
55		327.6	327.6	**99.7**	**36.4**
60		389.8	389.8	**118.7**	**43.3**
65				**139.3**	**50.8**
70				**161.5**	**59.0**
75				**185.4**	**67.7**
80				**210.9**	**77.0**
85				**238.1**	**86.9**
90				**267.0**	**97.5**
95				**297.5**	**108.6**
100				329.6	**120.3**
110				398.8	**145.6**
120					**173.3**
130					**203.3**
140					**235.8**
150					**270.7**
160					308.0
170					347.7
180					389.8

Table 7 2-1/2 to 6 inch *Quickset* Venturi Signals

Signal (Inches W.C.)

	Size 2-1/2"	Size 3"	Size 4"	Size 5"	Size 6"
Cv	165	251	432	627	1037
Flow (gpm)	$DP=(Flow/9.22)^2$	$DP=(Flow/14.5)^2$	$DP=(Flow/26.2)^2$	$DP=(Flow/37.6)^2$	$DP=(Flow/62.2)^2$
20	4.7				
25	7.4				
30	10.6	4.3			
35	**14.4**	5.8			
40	**18.8**	7.6			
45	**23.8**	9.7			
50	**29.4**	11.9	3.6		
60	**42.4**	**17.2**	5.2		
70	**57.7**	**23.4**	7.1		
80	**75.3**	**30.5**	9.3	4.5	
90	**95.3**	**38.6**	11.8	5.7	
100	**117.7**	**47.7**	**14.5**	7.1	
120	**169.5**	**68.6**	**20.9**	10.2	3.7
140	**230.7**	**93.4**	**28.4**	**13.9**	5.1
160	301.3	**122.0**	**37.1**	**18.1**	6.6
180	381.4	**154.4**	**47.0**	**22.9**	8.4
200		**190.6**	**58.0**	**28.3**	10.3
220		**230.7**	**70.2**	**34.2**	**12.5**
240		**274.5**	**83.6**	**40.8**	**14.9**
260		322.2	**98.1**	**47.8**	**17.5**
280		373.7	**113.7**	**55.5**	**20.3**
300			**130.6**	**63.7**	**23.3**
350			**177.7**	**86.7**	**31.7**
400			**232.1**	**113.2**	**41.4**
450			**293.8**	**143.3**	**52.4**
500			362.7	**176.9**	**64.7**
550				**214.0**	**78.3**
600				**254.7**	**93.1**
650				**298.9**	**109.3**
700				346.7	**126.8**
750				398.0	**145.5**
800					**165.6**
850					**186.9**
900					**209.5**
950					**233.5**
1000					**258.7**
1050					**285.2**
1100					313.0
1150					342.1
1200					372.5

Table 8 8 to 14 inch *Quickset* Venturi Signals

Signal (Inches W.C.)

	Size 8"	Size 10"	Size 12"	Size 14"
Cv	3133	3200	5325	7156
Flow (gpm)	$DP=(Flow/120.3)^2$	$DP=(Flow/155.2)^2$	$DP=(Flow/267.1)^2$	$DP=(Flow/347.4)^2$
200	2.8			
300	6.2	3.7		
400	11.0	6.6		
500	**17.3**	10.4	3.5	
600	**24.9**	**14.9**	5.0	
700	**33.8**	**20.3**	6.9	4.1
800	**44.2**	**26.6**	9.0	5.3
900	**55.9**	**33.6**	11.4	6.7
1000	**69.1**	**41.5**	**14.0**	8.3
1200	**99.4**	**59.8**	**20.2**	11.9
1400	**135.3**	**81.3**	**27.5**	**16.2**
1600	**176.8**	**106.2**	**35.9**	**21.2**
1800	**223.7**	**134.4**	**45.4**	**26.8**
2000	**276.2**	**166.0**	**56.1**	**33.1**
2200	334.2	**200.8**	**67.9**	**40.1**
2400	397.7	**239.0**	**80.8**	**47.7**
2600		**280.5**	**94.8**	**56.0**
2800		325.3	**109.9**	**65.0**
3000		373.5	**126.2**	**74.6**
3200			**143.6**	**84.8**
3400			**162.1**	**95.8**
3600			**181.7**	**107.4**
3800			**202.4**	**119.6**
4000			**224.3**	**132.6**
4200			**247.3**	**146.2**
4400			**271.4**	**160.4**
4600			**296.7**	**175.3**
4800			323.0	**190.9**
5000			350.5	**207.1**
5200				**224.1**
5400				**241.6**
5600				**259.8**
5800				**278.7**
6000				**298.3**
6200				318.5
6400				339.4
6600				360.9

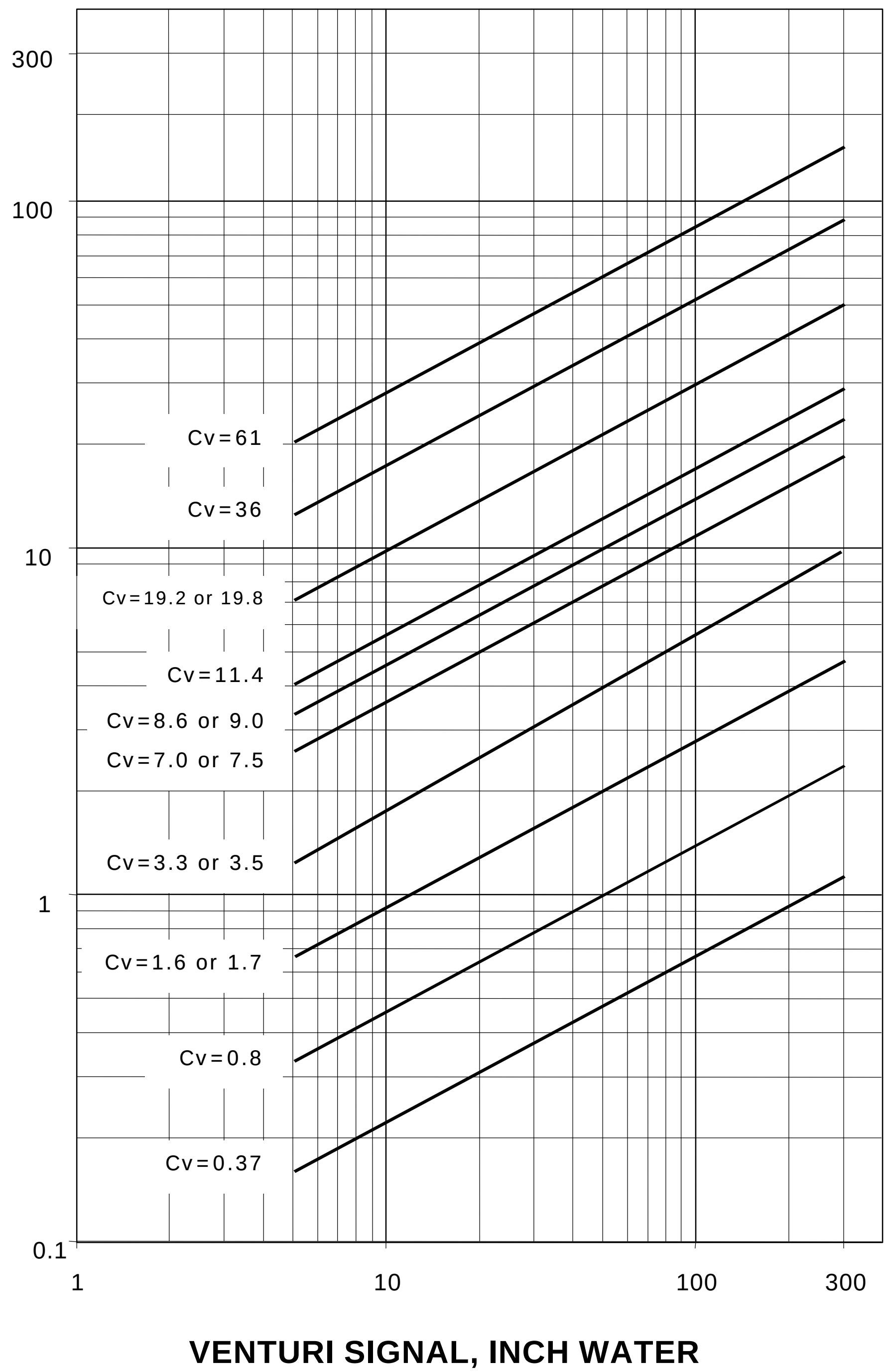

Figure 14 1/2” to 2” Valve Size Flow Graph

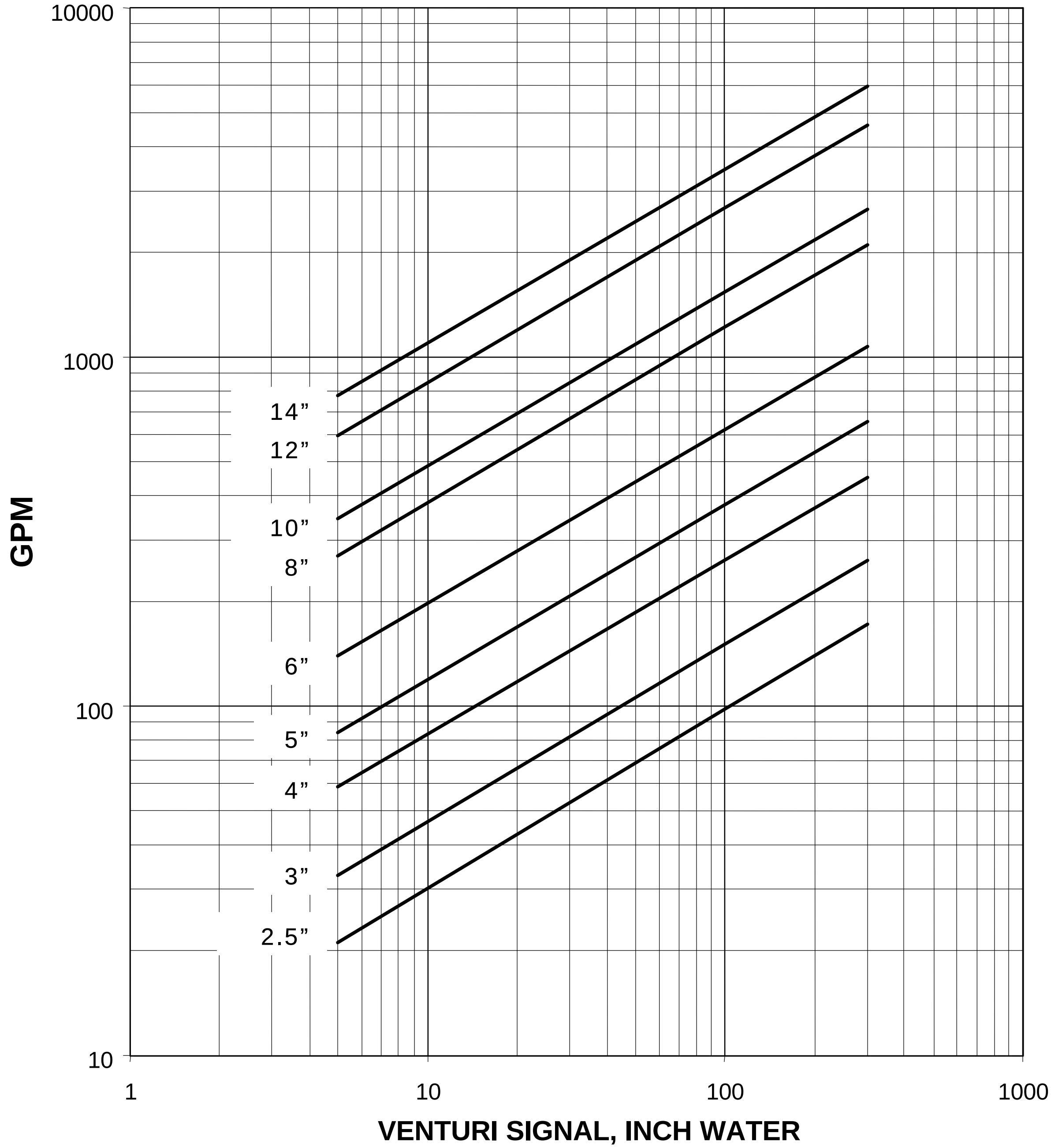

Figure 15   2-1/2” to 14” Valve Size Flow Graph

FLOW CONSTANT

To easily calculate the exact flow rate for each valve, we have determined a ***FLOW CONSTANT (FC)*** for each of the venturis. This Flow Constant allows direct calculation of flow rate in gpm from the signal in inches obtained from the device. The flow equation is defined by:

$$Q = FC\sqrt{\Delta P}$$

where: **Q** is the flow rate in gpm
Δ**P** is the pressure differential in actual inches of differential as measured at the venturi (between high and low pressure points)

Table 9 Flow Constants

Size (inches)	Cv	Model	Flow Constant
1/2	.37	Very Low Flow	0.0665
	0.8	Low Flow	0.1425
	1.7	Medium Flow	0.2849
	3.5	High Flow	0.5698
3/4	.8	Very Low Flow	0.1425
	1.7	Low Flow	0.2849
	3.5	Medium Flow	0.5698
	7.5	High Flow	1.1396
1	1.6	Very Low Flow	0.2849
	3.3	Low Flow	0.5698
	7.0	Medium Flow	1.1396
	11.4	High Flow	1.8044
1-1/4	9.0	Low Flow	1.5195
	19.8	High Flow	3.0389
1-1/2	19.2	Low Flow	1.5195
	36.0	High Flow	5.5081
2	61	Medium Flow	9.1168
2-1/2	165	Flanged/Grooved/Beveled-for-Weld	9.20
3	251	Flanged/Grooved/Beveled-for-Weld	14.50
4	432	Flanged/Grooved/Beveled-for-Weld	26.20
5	627	Flanged/Grooved/Beveled-for-Weld	37.60
6	1037	Flanged/Grooved/Beveled-for-Weld	62.20
8	3133	Flanged/Grooved/Beveled-for-Weld	120.30
10	3200	Flanged/Grooved/Beveled-for-Weld	189.00
12	5325	Flanged/Grooved/Beveled-for-Weld	320.00
14	7156	Flanged/Grooved/Beveled-for-Weld	430.00

Examples:

A) Calculate the flow rate inside a 1 inch, Low Flow *Quickset* (Cv = 3.3) Valve when the measured signal ΔP (Pressure Differential) at the valve is 50 inches.

Solution: from Table 9, the Flow Constant (FC) for this valve is 0.5698

$$Q = FC\sqrt{\Delta P} = 0.5698 \times \sqrt{50} = 4 \text{ gpm}$$

B) Calculate the expected signal from a 3/4 inch, Medium Flow *Quickset* (Cv = 3.5) Valve with a flow rate of 9 gpm.

Solution: from Table 9, the FC for this valve is 0.5698

$$\Delta P = \left(\frac{Q}{FC}\right)^2 = \left(\frac{9}{0.5698}\right)^2 = 250 \text{ inches}$$

"*QUICKSET* CALCULATOR" PROGRAM

To aid in the product selection process, Griswold Controls has developed a new computer selection program, the "*Quickset* Calculator". The designer need enter only the desired Flow Rate in gpm and select the product type, and the program will calculate the expected signal in inches W.C. and the permanent pressure loss in psid[3]. The objective is to pick products with Cv values that keep the control signal between 5 and 300 inches W.C. (Water Column). If the generated signal is below or above these limits, a red/green warning sign will appear, indicating that the readable signal is out of range. The selection program generates a schedule in MS Excel[4], saving the customer time in both calculation and processing steps[5].

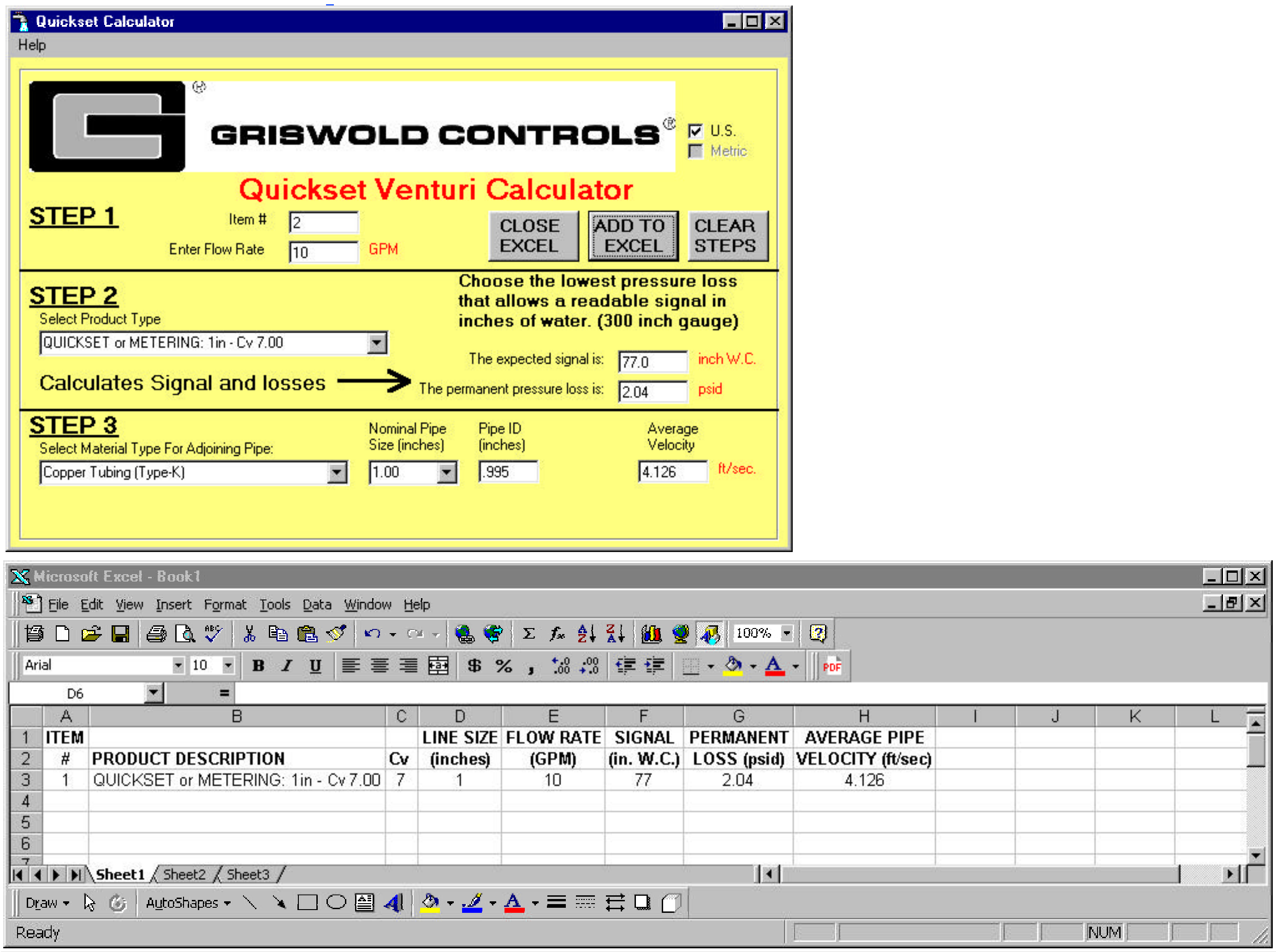

Figure 16 *Quickset* Calculator Program

[3] Units in U.S. or Metric format

[4] MS Excel is a registered trademark of Microsoft Corporation

[5] You MUST have MS Excel installed on your computer to use the schedule generation feature.

VALVE OPTIONS

The last step of valve selection is to put the finishing touches on your valve. Both Groups 1 and 2 have options available to customize your valve to your needs.

Group 1 (1/2" - 2") Options

Accessory Packages
- 2 Pressure Temperature Ports
- 2 Pressure Temperature Ports & 1 Manual Air Vent
- 2 Pressure Temperature Ports, 1 Manual Air Vent & 1 Drain Valve
- 2 Pressure Temperature Ports & 1 Drain Valve

Extensions
- 1-1/4” Handle Extension & 2 1/4” x 1-1/4” PT Extensions
- 1-1/4” Handle Extension & 3 1/4” x 1-1/4” PT Extensions
- 1-1/4” Handle Extension & 4 1/4” x 1-1/4” PT Extensions

Identification
- Optional 3” x 3” Metal Hanging ID Tag

Group 2 (2-1/2" - 14") Options

Extensions
- 2 1/4” x 1-1/4” PT Extensions

Identification
- Optional 3” x 3” Metal Hanging ID Tag

APPLICATIONS

The system must be well equipped with point-of-flow verification stations. These stations may or may not be flow balancing points. There are critical locations in a hydronic system where the flow rates must be measured to be able to properly balance and troubleshoot flow problems. Figure 17 shows a typical system layout. Depending on the system layout, these points may include:

- Pump discharge header
- Branch take-offs
- Primary-Secondary loop crossovers
- Riser take-offs
- Zone take-offs
- Terminal Balance locations

Whether the system is a direct return or reverse return design, flow verification and balancing need to be performed. Constant-speed pumping systems are particularly well-suited to flow balancing. In variable speed pumping systems, due to the dynamic nature of the flow vs. head that the pumps generate, a static balancing device such as the *Quickset* is not recommended. For these systems Griswold Controls offers many Automatic Flow Limiting options.

INSTALLATION

Griswold recommends installing manual balance valves on coils, risers, branches and pump discharge. In addition, measuring stations need to be installed in primary-secondary loop crossovers. Proportional balancing requires the ability to measure and adjust the flow in the entire hydronic system at these locations.

- At coils where a temperature control valve is installed, the balancing valve should be installed downstream of the control valve.
- At pumping packages, the balancing/measuring stations should be installed in the discharge header.
- At branch/riser take-offs, the balancing/measuring stations should be installed at the bottom (base) of the take-offs.
- At the zone take-offs, the balancing/measuring stations should be installed at the beginning of the zone lines.
- At the condenser pumps and cooling tower pumps, the balancing/measuring stations should be installed on the pump discharge and cooling tower supply lines.

PROPORTIONAL BALANCING

Manual balancing of hydronic systems is typically performed by balancing contractors. The process is commonly known as **Commissioning**. There are several methods and approaches to the commissioning process. ASHRAE, NEBB, SMACNA and ABCC (professional associations) have addressed these procedures in detail in many of their publications.

The purpose of balancing is to distribute the fluid to all coils (points of use) in the system at the pressure and gpm required, and to do this with the minimum pumping energy cost per gpm delivered. This requires that the controlling elements in the system be selected at the minimum pressure drop. Venturi-based manual balancing valves, by design, have the lowest pressure drop of any balancing device (the valve's pressure drop is calculated by using the C_V values in Tables 1 and 2). This makes the venturi design the right choice for easy and effective balancing. The *Quickset* flow tables listed in this booklet allow calculation of the flow signal from a known flow rate. In general, choose a valve size that produces at least 12 inches of flow signal at the fully open position. If there is a choice between several sizes for a given flow, then choose the size that produces the lowest signal that is at least 12 inches.

The proportional balancing method provides the most efficient results and produces the lowest amount of horsepower (kW) consumed per gpm delivered. In this method one path to the hydraulically farthest unit (point of use) is set wide open, with no throttling. This is because the farthest unit requires the most pumping energy to deliver the flow to the point of use. In a tall building, the hydraulically farthest unit would be the highest unit vertically. In a long, flat building, this unit would be the farthest distance along the ground horizontally. In particularly complex piping situations, thorough engineering analysis should be performed to determine the farthest unit (the "least-favored" path).

This wide-open path will be the determining criteria for the pump head for the entire system. If there is sufficient pump head and flow for this path, then all other paths are capable of being satisfied. The wide-open path has many piping components, all contributing to the total path pressure drop. Among these components are the manual balancing valves and flow verification stations. Thus, as the pressure drop of the manual balancing valve lowers, the path's pressure drop will also lower.

Once this path has been determined, it becomes the reference path. In this reference path there is a combination of header, raiser, branch and terminal sections. The terminal unit is called the "INDEX" circuit.

The flow through the index circuit is measured and the ratio of the actual flow to the design flow is recorded. Then, based on the procedure, flow of the next circuit to the index circuit is measured and adjusted to match the ratio of the index circuit. This measurement and adjustment is performed for all the units in the path. This process is usually repeated 3 times for optimum efficiency.

Once proportioning of flow is accomplished for all the units in all the paths, then the total flow can be adjusted at the pump to bring all the units to the specified design flow. Once this is determined, the pump impeller can usually be trimmed to obtain the most efficient point of operation for the pump.

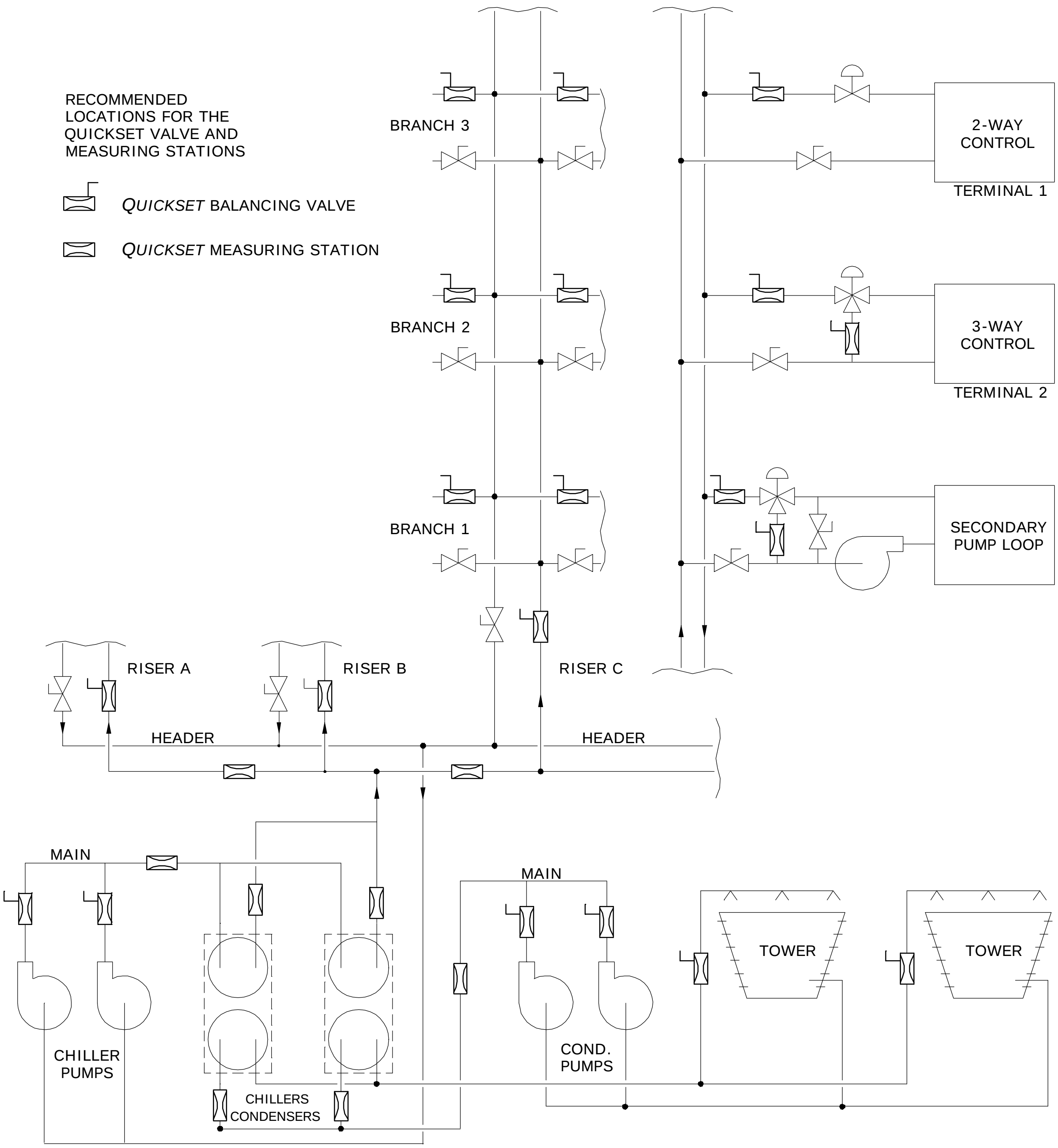

Figure 16 Typical System Layout

SUMMARY

Quickset from Griswold Controls makes balancing accurate and easy every time. The accuracy of any balancing procedure depends on the following parameters:

- **Flow metering element accuracy**

Quickset has a precisely machined, venturi-based flow metering design that produces a venturi section accurate to within 1%.

- **Method of flow meter ΔP measurement**

Griswold's direct gpm readout GAUGE KIT provides standard 1-3/4% full-scale accuracy with optional 1/2% accuracy mechanical gauge. Electronic digital gauges (1/2% accuracy) and calibrated transducers are also available with 1/4% accuracy at full scale.

- **Accuracy of the adjusting mechanism**

In 1/2 to 2 inch sizes, *Quickset*'s integral ball valve with the Optimizer provides responsive handle movement to affect flow adjusting. The Optimizer doubles the range of a regular ball valve. The graduated memory stop plate provides a solid record of the handle position for documentation purposes. A butterfly valve with an infinitely adjustable handle provides accurate flow variation for large *Quicksets*.

- **Effect of installation on the flow meter element**

Upstream flow disturbances such as Elbows, Pumps and ATCs all adversely affect the accuracy of any flow meter. The 1/2 through 2 inch units have a built-in straight run incorporated in the valve housing. The Laminizer flow vanes and the Quadratic Piezo-Ring design of the *Quickset* greatly reduces the need for long and costly straight runs of pipe. Generally one pipe diameter is all that is needed in front of the large *Quicksets*. Under this guideline, an overall accuracy of better than 3% will be maintained. There are no downstream clearance requirements for the *Quickset* venturis.

- **The system should be clean and flushed**

Proper installation, maintenance and operation of strainers and air vents are highly recommended. Strainers must be inspected, cleaned and in place. All air must be removed from the system. Manual and automatic air vents must be installed and their operation verified.

Dirty strainers add pressure drop to the system, resulting in higher total energy input/gpm delivered to the point of use. Air in the system will cause inaccuracy when measuring ΔP across the flow elements. Air can also affect the coil's thermal performance during fluid/air heat balance procedure.

- **Cooperation with Contractors**

Balancing must be performed by a professional certified balancing entity. They must be familiar with the hydronic system and the operational characteristics of each component. Input from the balancing professionals is recommended during all phases of the project (i.e. initial design, component selection, etc). *Griswold Controls works closely with the balancing contractors to provide any technical and field support needed during commissioning and startup periods*.