PRESSURE REDUCING VALVES

GA Industries Inc.

SINCE 1895

MANUFACTURERS OF
GOLDEN ANDERSON© VALVES

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PRESSURE REGULATION

A water pressure regulator, or as we call it a pressure reducing valve has the function of maintaining a constant delivery pressure regardless of its varying inlet pressure. While its function appears straightforward, there are many factors which should be considered before a valve can be properly applied:

These are:

1. Selection and Application.
2. Sizing, Capacities, and Cv Factors.
3. Pressure Differentials and Velocities.
4. Rangeability and Sensitivity.
5. Effects on system head curves.
6. Cavitation and Wiredrawing.
7. Drop in regulators.
8. Flashing fluids.
9. Noise.
10. Waterhammer.
11. Special control features.
12. Bypass and staging Applications.

There are no doubt many other factors and each could be elaborated on at great length. However, this paper will try to basically familiarize the reader with the reducing valve, its application and operation.

Before selecting a water reducing valve, several questions must be answered.

First, what is the maximum and minimum inlet pressure?

Second, what is the desired outlet pressure?

From these first two facts, the differential pressure is determined.

Third, what is the maximum flow rate to be handled?

Although this information seems adequate enough to size a valve, all of the required information has not been evaluated. For example, is there any temperature involved? Fluids flash much more easily at increased temperatures. Will there be a cavitation problem? High pressure reductions with low outlet pressure could indicate a possible severe cavitation condition. Cavitation could result in a high attrition rate with the valve eventually destroyed. What are the minimum and maximum flow demands? Although the valve was sized for the maximum flow, the valve may be required to spend most of its time controlling a very small flow.

There are also other factors to be considered before selecting the valve design such as, the condition of the fluid, is it sandy? Corrosive? Or Toxic? Then the location of the valve must be studied. Is it in a typical distribution system? Or perhaps in a fire system where high reliability is essential, or perhaps it may be installed somewhere where it will be inactive for long periods. Once all of the determining factors have been evaluated, the valve size and type may be chosen.

One of the commonly used systems for selecting valve sizes is the Cv method. By dividing the required GPM by the square root of the differential pressure, the required valve Cv factor is found. Referring this Cv Factor to a valve chart, the required valve size may be found.

A chart labeled "Flow Capacities for GA globe valves" is included. This chart illustrates the **smallest size** valve that can be used at a specified flow and differential conditions. The chart also indicates flow for valves virtually **full open** which is not the normal operating condition.

A practical approach to sizing PRV's would be to determine a valve size based on a flowing velocity of about 15 FPS, then choose the nearest practical valve size. It is not desirable to operate PRV's beyond about 20 FPS.

Installing pressure reducing valves in parallel requires some thought. On many installations, a small PRV is installed adjacent to a large PRV to provide the small flows at a pressure 3 to 5 psi higher than the setting of the large valve. This is a quite common arrangement; however, when installing PRV's of equal diameters in parallel, the individual pressure settings cannot be equal as the valves will not respond equally and one valve will try to do most of the work. Each valve's design flow must be compared with the other valve's headloss and pilot control setting to obtain maximum performance.

Minimum Pressure Differential

Pressure reducing valves are normally required to reduce some higher inlet pressure to a relatively lower outlet pressure. Occasionally there is a requirement to reduce a valve's inlet pressure only slightly. A condition which is significant and inherent to all PRV's and must be considered, is the minimum pressure differential on which the valve will operate.

All PRV's exhaust their pilot control water to the downstream side of the main valve. It is then obvious that the main valve's downstream pressure must be no more than a certain percentage of the valve's inlet pressure. This figure varies with valve types and sizes but is somewhere between 85% to 90%. Large valves are generally more sensitive while small size valves are more affected by seal friction. On critical installations, the valve manufacturer can provide more exact data for the valve size in question.

On differential piston types PRV's should the outlet pressure setting exceed the minimum differential requirements of the valve, the main valve piston will throttle independently to maintain some minimum pressure differential without heeding commands from the control pilot.

Velocities

There is a great deal of confusion regarding velocities through reducing valves, so we will digress for a moment on it.

The velocity of the fluid flow in a pipeline is a function of the quantity of the flowing water and the area of the pipe. Through an orifice, the velocity is a function of the differential pressure. The area is of no consequence since the velocity will be the same regardless of the area. For example, drilling a hole in a storage tank riser pipe with a 100 foot head above it, the velocity of the flow through the center of the orifice will be about 80 ft./sec. Regardless of what size hole is made.

This same effect occurs inside a valve. The velocity across the seat of the valve is a function of the differential pressure while the velocity through the valve inlet and outlet ports is a function of the quantity and area. It would be erroneous for a user to select a larger size valve in the belief that the velocity across the seat is thus lowered and wear rate factor improved. A pressure reducing valve need not be any larger than actually necessary.

Sometimes it is required to place a valve in a large pipeline with the flow requirements not requiring a large valve. For instance, the requirement of placing a PRV in a 20" line with a required flow of 1000 GPM and a differential pressure of 40 psi. Our chart would indicate a 4" valve as adequate, and well it may be with reference to the information supplied. However, this valve size selection would have to be reviewed. The very fact that the main header is so large implies that the 4" valve may not be large enough. Perhaps future demands or fire demands have been provided for in selecting the header size. The proper selection of a reducing valve size should also be made based on all of the special or future considerations.

In locations where a large pressure reducing valve is required to handle small flows, a practice that is quite common is to install a small reducing valve in a bypass around the large reducing valve. The smaller reducing valve, which is adjusted several psi higher than the large reducing valve, will open first and supply the smaller demands. When the demand increases beyond the capacity of the small reducing valve, the discharge pressure will of course drop bringing into action the large reducing valve.

Cavitation

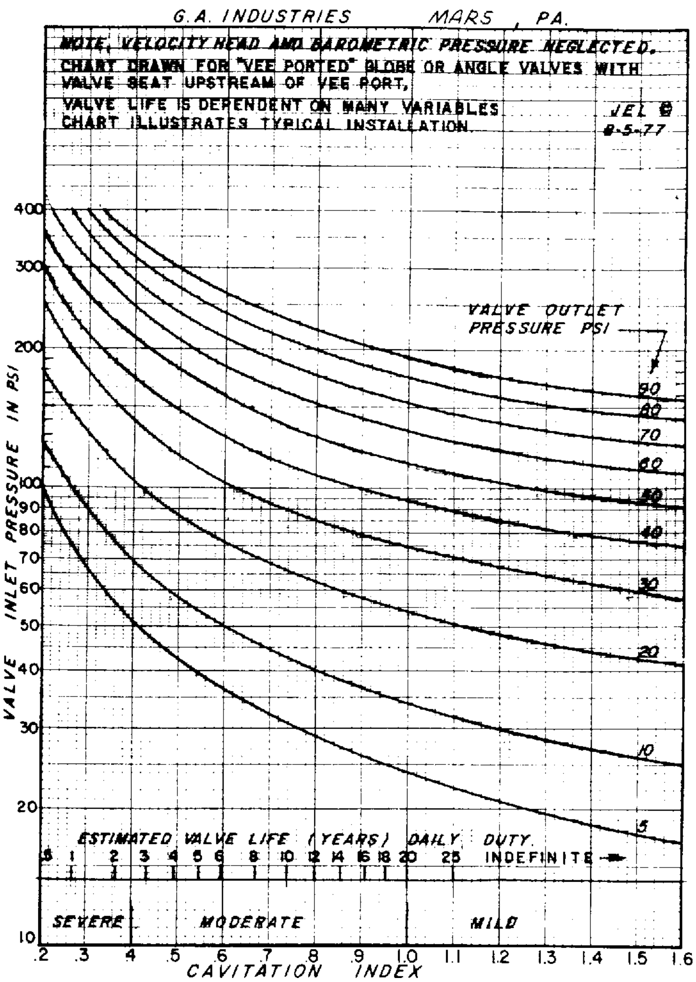
Before discussing valve types, we will discuss briefly on the severe operating conditions to which most any valve will be subjected. That being cavitation damage. Although appearing to some as an erosion or impingement damage, the cavitation damage is the result of a high pressure reduction with a low outlet pressure. For example, dropping pressure from 500 psi to 200 psi is not equivalent to dropping 350 psi to 50 psi even though both pressure drops are 300 psi. The conditions within the valve body are not the same. The conditions within the valve body are not the same. The lower the outlet pressure, the closer the fluid pressure approaches the vapor pressure at which point the cavitation will occur. The valve seat area produces a venture effect which by increasing the velocity, the internal valve pressure is lowered to where cavitation occurs the resulting bubbles thus formed collapse again in higher pressure recovery areas and if in contact with the valve walls at that time the bubbles produce a very very high localized stress which will fatigue the metal causing a pit.

In installations requiring a high pressure reduction, it is possible to drop the pressure down in a series of stages rather than across one valve. This will save wear and tear on the valve by distributing the pressure drop across two or three valves. This application should be discussed with a valve manufacturer experienced in this type of control to properly select the most effective pressure setting as the load would be equally distributed across each valve.

Another method used for high differentials is a valve specifically designed to operate at high pressure drops. Usually, these valves are expensive as they employ special alloys, hard facing, etc. They are usually used where conditions permit just one valve. The arrangement should also be discussed with the valve supplier.

A chart illustrating the effects of continuous pressure reduction on GA Industries "Vee Ported" valves is included. Reading horizontally to the right from the scale representing the valve's outlet pressure, and then vertically downward to a scale denoting the cavitation index number. This number indicates the severity of service for the valve, but does not include velocity head or barometric pressure effects. A second scale is shown which roughly equates the valve's life with severity of service. The valve life scale is to be interpreted as a guide more than exact representation, because there are many factors which affect valve life some of the principle factors are duration, frequency, and mode of operation.

Cavitation damage is only one of four principle types of damage which can occur to a valve. A valve can also sustain abrasive particle damage, impingement erosion, and sometimes a combination of these conditions. Many times impingement erosion is interpreted as cavitation damage. These problems will not be elaborated on at this times.



Most valves throttle with their seats; there are few exceptions. Gate valves, cone valves, ball valves, and butterfly valves for example, all throttle with their seats and a result cannot tolerate cavitation index numbers as low as the GA valve. The "Vee Ports" in a GA Valve are downstream of the valve seat and the "Vee Ports" do the throttling not the valve seat. Cavitation occurs directly downstream of the point of maximum velocity which is the point of smallest opening. Valves which have a "saw tooth," "parabolic," or other characteristic producing devices upstream of the valve seat can experience even earlier valve failure because the cavitation is then applied to the valve seat directly downstream. On the GA "Vee Ported" valve, cavitation which does occur is in the waterway downstream of the "Vee Ports." Any damage that does occur is remote from the vital valve surfaces.

Design

The water pressure reducing valve as manufactured by GA Industries, Inc. is a hydraulically operated, differential piston type valve. The main valve contains just one moving part which is the piston. This piston which is all bronze, rubber seated, has been providing dependable operation for over sixty years. Our spare parts business, being a very minor part of our overall business, is convincing testimony to the durability of the valve design. Our records also indicate that a great number of valves are being used in service conditions generally not recommended by our office, but continue to provide dependable operation.

Optional Features

Other than its ruggedness and simplicity, probably the most significant factor contributing to the great success of the GA Industries water pressure reducing valve is its versatility. It requires no external fluid power supply since it uses the pressure within the pipe for its operation. It is drop tight, easily maintained, comes in the angle or globe designs, may be installed in any position and can easily be made to perform several functions.

The pressure reducing valve while maintaining a uniform discharge pressure can also be provided to sustain a minimum inlet pressure by throttling again if the inlet pressure tries to drop below a specified set point. This is the Figure 4700 valve.

The PRV can be made to open wide if the inlet pressure drops below a specified setting permitting reverse flow or fire flow. Figure 4800.

The PRV can have dual controls figure 4600, or controls for remote control of its settings, Figure 4500-DM. It could easily be opened wide or closed by way of electric solenoid controls. Figure 4050-D.

The PRV can be made into a rate of flow control valve by having its control pilot maintain a differential across an orifice or flow tube, a constant flow rate may be maintained.

These are just some of the more common auxiliary features which can be provided, so whenever a pressure control requirement arises, contacting a valve maker with experience in these techniques will result in more arrangements than you may have realized.

We are at your service anytime.

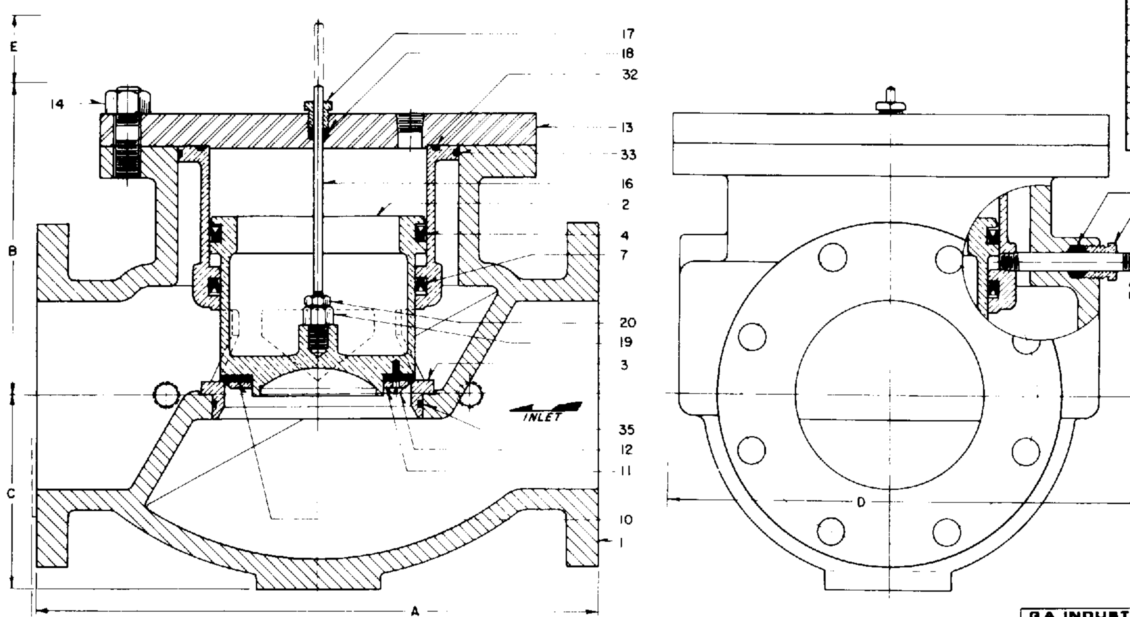
	2½" IN.	2½" MM	3" IN.	3" MM	4" IN.	4" MM	6" IN.	6" MM	8" IN.	8" MM	10" IN.	10" MM
A FACE TO FACE	12	305	12	305	13	330	18	457	24½	622	26	660
B CENTER TO TOP	8	203	8	203	9	229	11	279	14	356	16	406
C CENTER TO BOTTOM	4¼	108	4¼	108	5¼	133	6½	165	8¼	210	9¾	248
D SIDE CLEARANCE	9	229	9	229	10	254	14	356	18	457	24	610
E STROKE	1⅜	35	1⅜	35	1⅝	41	2¼	57	3	76	3¾	95

FLANGES PER ANSI B16.1

NOTE:
WHEN ORDERING PARTS, SPECIFY PART NUMBER, NAME OF PART, SIZE OF VALVE, AND MENTION SHOP SERIAL NUMBER FROM VALVE IDENTIFICATION PLATE

* NOTE: PART NO 3 IS FURNISHED IN TWO PIECES ON 10" SIZE VALVES

PARTS LIST	
1	BODY
2	PISTON
3	LINER *
4	PISTON U CUP
7	LINER U CUP
10	SEAT RING
11	SEAT RING FOLLOWER
12	SEAT RING SCREWS
13	COVER
14	COVER BOLTS
16	INDICATOR ROD
17	INDICATOR GLAND
18	INDICATOR PACKING
19	INDICATOR BUSHING
20	INDICATOR LOCKNUT
22	VENT TUBE
23	VENT GLAND
24	VENT PACKING
32	COVER O RING
33	UPPER LINER O RING
35	LOWER LINER O RING



NOTE: "A" DIMENSION ON VALVES WITH RAISED FACE FLANGES DOES NOT INCLUDE THE RAISED FACE HEIGHT.

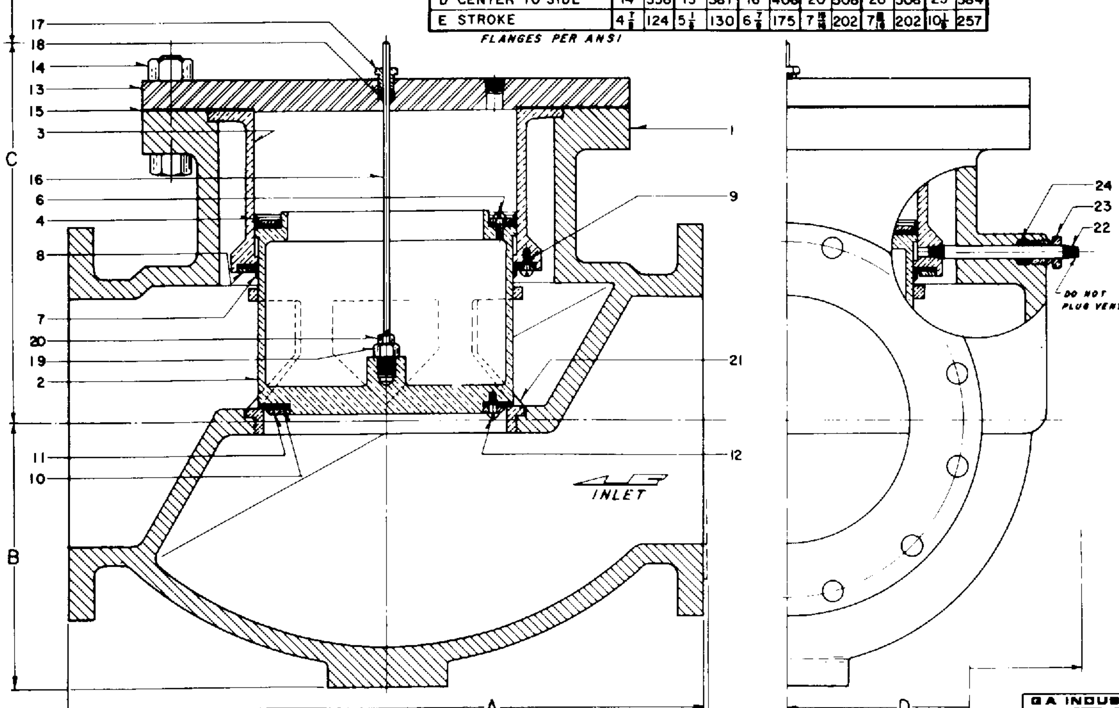
G A INDUSTRIES INC. PITTSBURGH, PA.
2½"- 10" WATER REDUCING GLOBE VALVE BODY ASSEMBLY
BY JEL DATE 2 14 77 SCALE NONE G G-1041

NOTE:
WHEN ORDERING PARTS, SPECIFY PART NUMBER, NAME OF PART, SIZE OF VALVE, AND MENTION SHOP SERIAL NUMBER FROM VALVE IDENTIFICATION PLATE.

	12" IN.	12" MM	14" IN.	14" MM	16" IN.	16" MM	18" IN.	18" MM	20" IN.	20" MM	24" IN.	24" MM
A FACE TO FACE	31	787	33	838	36	914	40	1016	40	1016	48	1219
B CENTER TO BOTTOM	13	330	12¼	311	13½	343	17	432	17	432	21	533
C CENTER TO TOP	18	457	20	508	24	610	27	686	27	686	32	813
D CENTER TO SIDE	14	356	15	381	16	406	20	508	20	508	23	584
E STROKE	4⅞	124	5⅛	130	6⅞	175	7 15/16	202	7 15/16	202	10⅛	257

FLANGES PER ANSI

LIST OF PARTS	
1	BODY
2	PISTON
3	LINER
4	PISTON CUP
5	PISTON CUP FOLLOWER
6	PISTON FOLLOWER SCREWS
7	LINER CUP
8	LINER CUP FOLLOWER
9	LINER FOLLOWER SCREWS
10	SEAT RING
11	SEAT RING FOLLOWER
12	SEAT RING SCREWS
13	COVER
14	COVER BOLTS
15	COVER GASKET
16	INDICATOR ROD
17	INDICATOR GLAND
18	INDICATOR PACKING
19	INDICATOR BUSHING
20	INDICATOR LOCKNUT
21	SEAT CROWN
22	VENT TUBE
23	VENT TUBE GLAND
24	VENT GLAND PACKING



NOTE: "A" DIMENSION ON VALVES WITH RAISED FACE FLANGES DOES NOT INCLUDE THE RAISED FACE HEIGHT.

G A INDUSTRIES INC. PITTSBURGH, PA.
12"-24" GLOBE VALVE BODY ASSEMBLY, WATER REDUCING
BY JEL DATE 1 13 77 SCALE NONE D D-1027

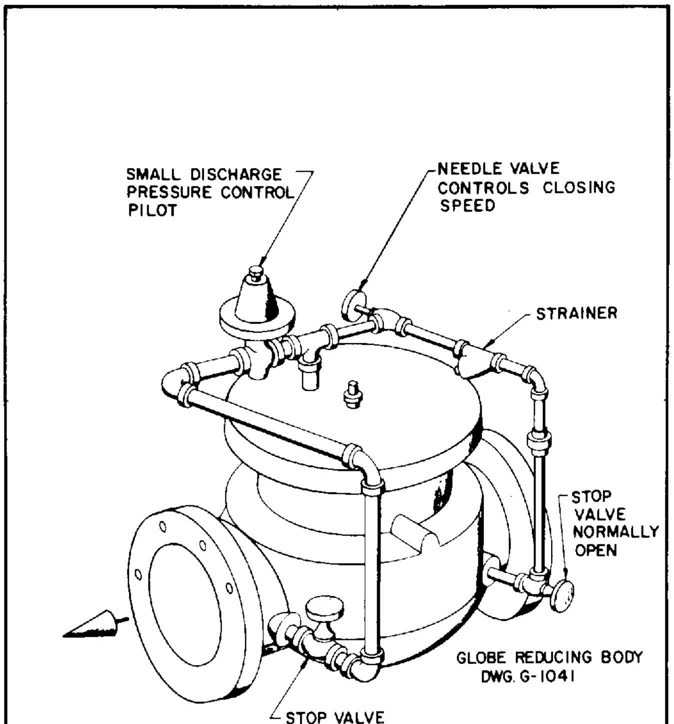
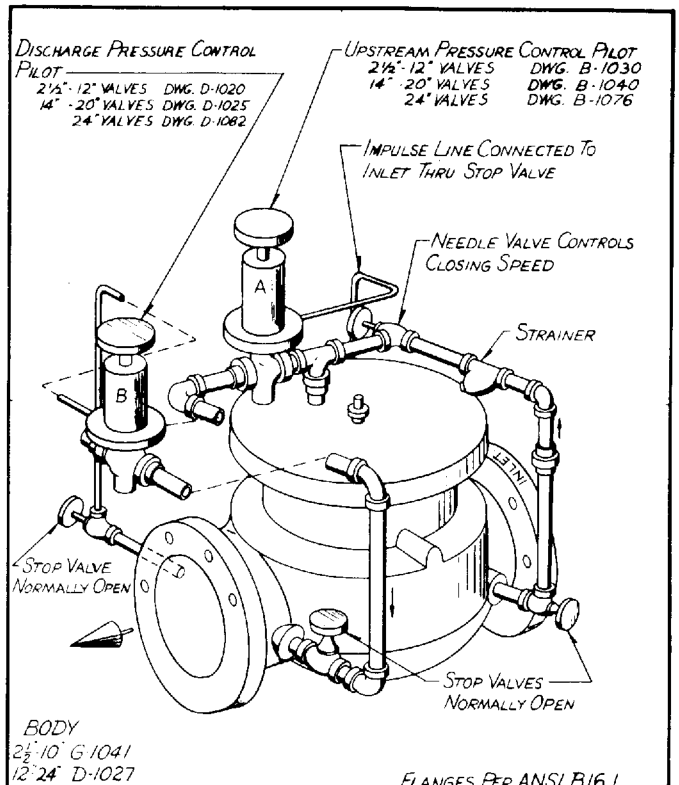


FIG. NO.	FLANGES
4500-D	FF&D 125 ANSI B16.1
4500-U	FF&D 250 ANSI B16.1

GA INDUSTRIES INC. PITTSBURGH, PA

2½"-8" GLOBE PRESSURE REDUCING VALVE

4500D 3-29-77 D-1 D-1032



GA INDUSTRIES INC. PITTSBURGH, PA

2½"-24" Globe Reducing And Back Pressure Sustaining Valve

4700 5-29-78 D-1 D-1041

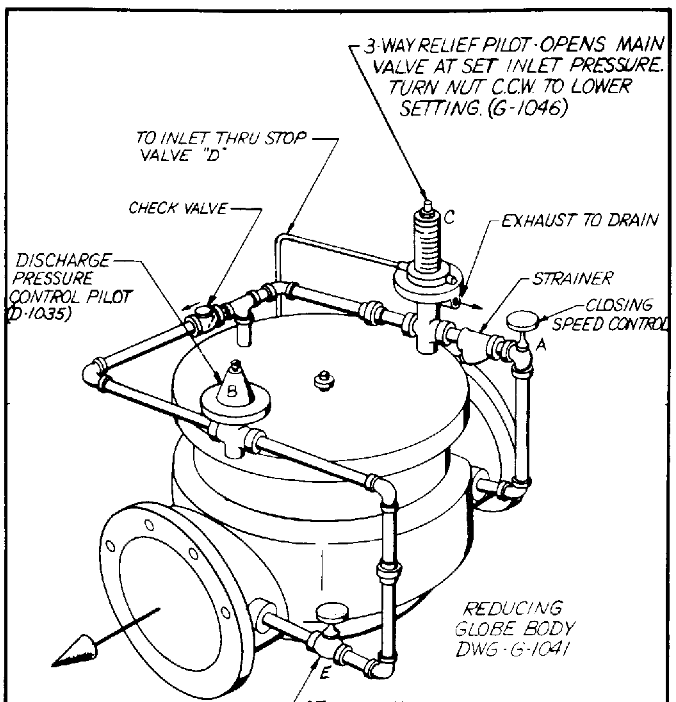
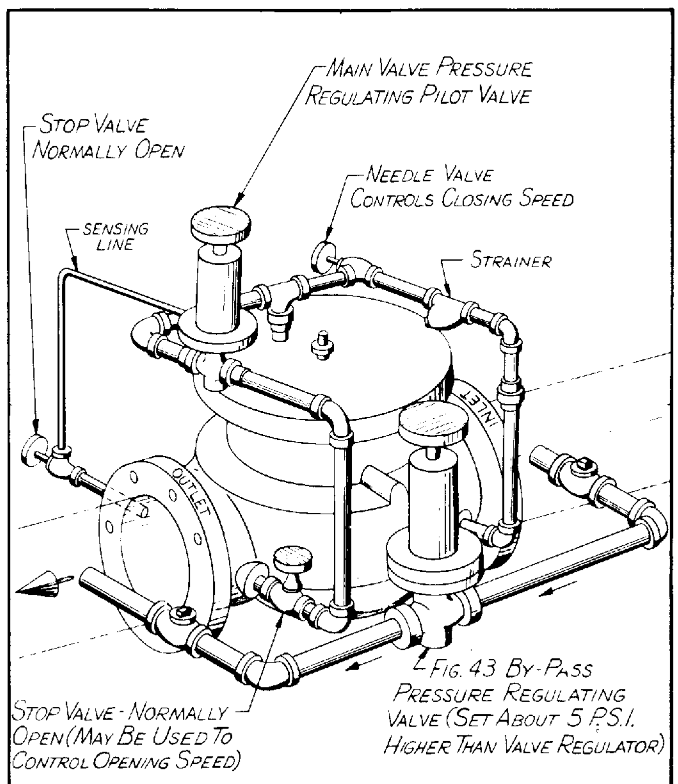


FIG. NO.	FLANGES
4800-D	125 ANSI B16.1
4800-U	250 ANSI B16.1

GA INDUSTRIES INC. PITTSBURGH, PA

2½"-8" PRESSURE REDUCING AND RELIEF VALVE

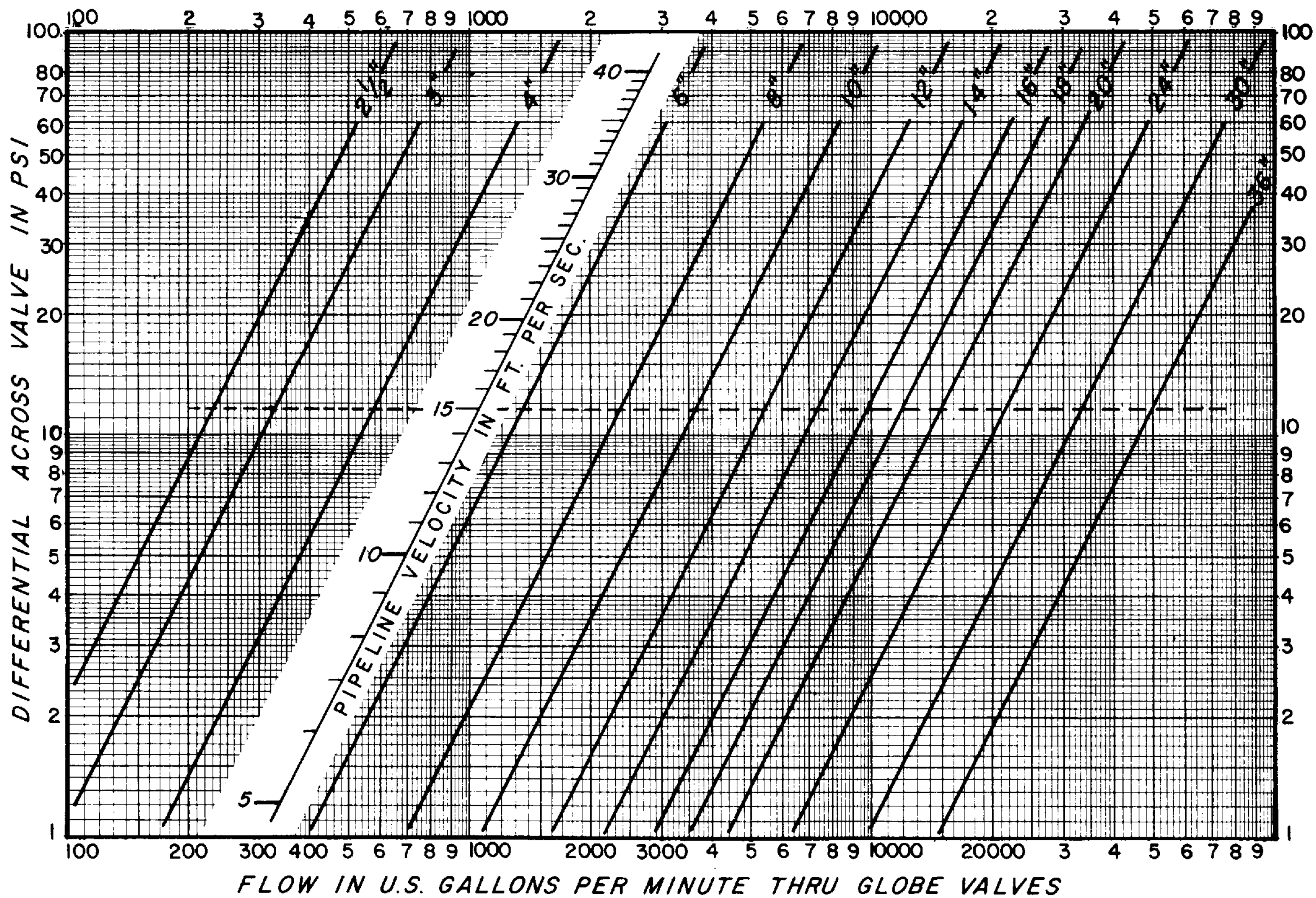
4800 3-28-77 D-1 D-1030



GA INDUSTRIES INC. PITTSBURGH, PA

Pressure Reducing Valve With By-Pass Arrangement

4500/43 8-9-77 D-1 D-1050



THE DIFFERENTIAL VERSUS GPM SCALES INDICATE THE SMALLEST SIZE VALVE, FULL OPEN, REQUIRED TO PASS THE INDICATED FLOW.

GA INDUSTRIES INC. PITTSBURGH, PA.

PRESSURE REDUCING VALVE SIZING AND CAPACITY CHART FOR GLOBE VALVES

BY	JEL		SCALE		FILE	DRAWING NUMBER
DATE	8 4 77		FIG. NO.		H1	H 1024

FOR VALVE SIZING FOR 15 FPS VELOCITY READ VERTICALLY FROM REQUIRED FLOW TO DOTTED LINE WHICH INDICATES APPROXAMATE VALVE SIZE REQUIRED. SELECT CLOSEST LARGER OR SMALLER SIZE VALVE. VELOCITIES MORE THAN 20 FPS ARE NOT RECOMMENDED.