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NOTICE OF APPROVAL
AVIS D'APPROBATION

G-109-1

Ottawa, December 19, 1975

FISHER CONTROLS COMPANY
PILOT OPERATED
PRESSURE REGULATORS, TYPE 99 SERIES

This approval supersedes that portion of the Circular G-109 dated May 29, 1975 which deals with the regulators Models 99-2 and 99-43.

Apparatus

Max. inlet pressures	as listed in Tables 1,6,7,& 8
Outlet pressure ranges	as listed in Table 5
Max. flow, 0.6 S.G. gas	as listed in Tables 2,3, & 4
Main orifice diameters, inches:	
(i) Standard sizes	7/8 and 1 1/8
(ii) Restricted orifices	7/8 x 3/8, 7/8 x 1/2, 7/8 x 5/8 and 3/4 x 3/4
Regulator connections:	(a) 2 inch N.P.T. (b) 2 inch ANSI flanged

Approval is hereby granted for the use of the above named pressure regulator in Pressure Factor Measurement installations.

Description

The Series 99 regulator is a pilot operated type, (sometimes referred to as a pilot loaded type). There are two important elements to this type of regulator: the main operating diaphragm and the loading pilot. These are shown in Figure 1 which is a cut-away view of the complete regulator. The pilot senses the downstream (controlled) pressure and uses the upstream pressure of the gas to "load up" the main operating diaphrgam in response to any change in downstream pressure. The complete operating sequence is outlined in detail in the manufacturer's bulletin number 71.2:99 dated March 1973.

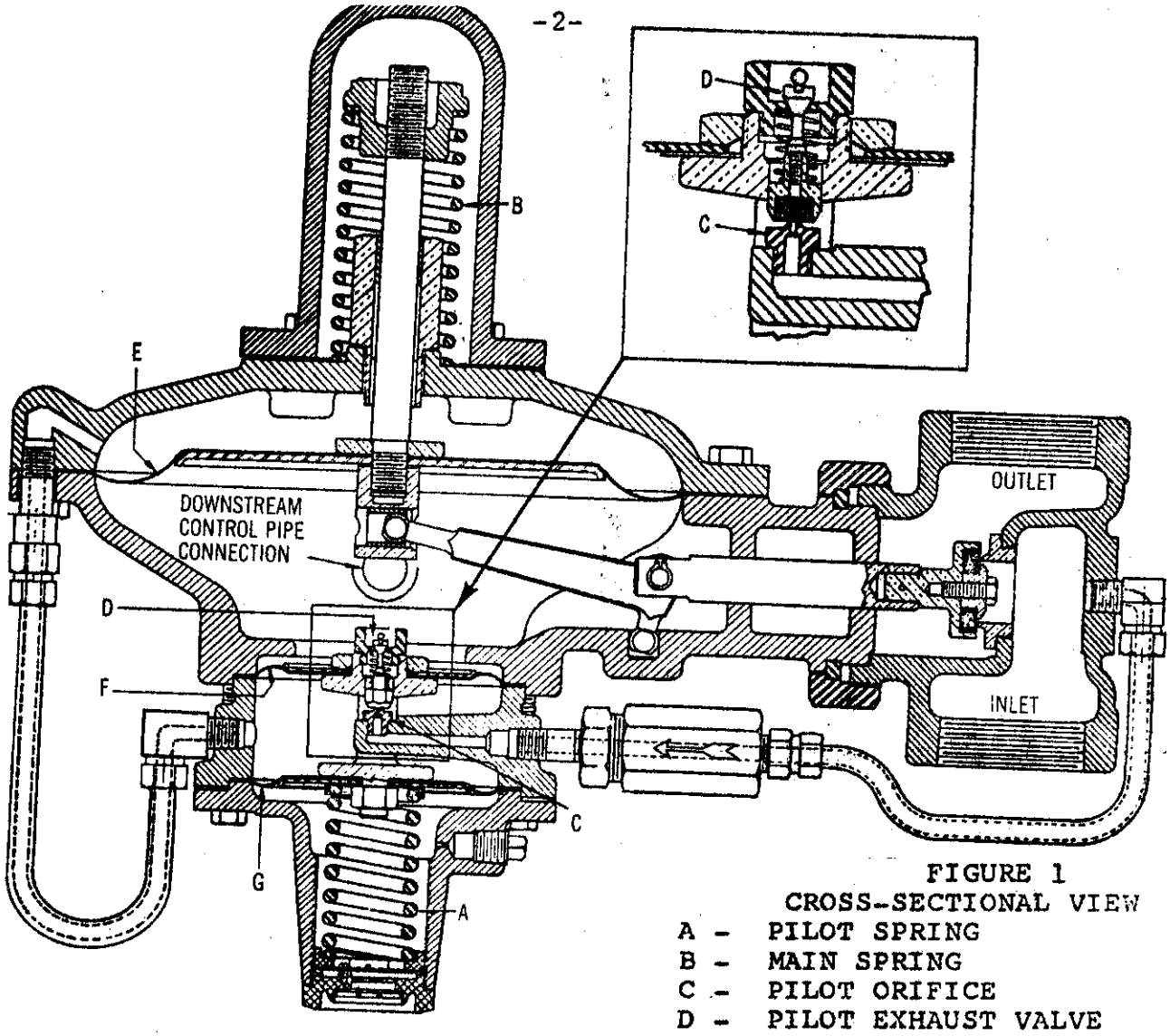


FIGURE 1
CROSS-SECTIONAL VIEW

A - PILOT SPRING
B - MAIN SPRING
C - PILOT ORIFICE
D - PILOT EXHAUST VALVE
E - MAIN DIAPHRAGM
F - PILOT DIAPHRAGM
G - PILOT DIAPHRAGM

The pilot diaphragm assembly consists of diaphragms F and G which are rigidly connected by a yoke.

Diaphragm G acts as a sealing member for the loading chamber and as a balancing member for diaphragm F. Any pressure change in the loading chamber has little effect on the positioning of the pilot valve.

The Series 99 regulator can be equipped with one of three different loading pilots. These pilots have the following three main type designations which are based on the outlet pressure range:

i)	Low Outlet Pressures	Type 61 L
ii)	High Outlet Pressures	Type 61 H
iii)	Extra High Outlet Pressures	Type 99 HH

For a more detailed description of the Pilot Types, the Outlet Pressure Ranges & the Spring Codes refer to Table 5. From this table it is possible to ascertain which pilot is to be used for a given outlet pressure range. Figures 2, 3, and 4 show the internal construction of the three different loading pilots described above.

In addition to the 7/8 inch and 1 1/8 inch main orifices, the Series 99 can be supplied with restricted orifices if the flowrate of the installation is below the standard 7/8 inch orifice capacity. Figure 5 shows the difference between the standard size and the restricted orifices. Table 1 shows the different Seating Methods, Orifice Sizes, Seat Material and Maximum Inlet Pressures which are approved. Refer to this table to determine the correct seating method for the particular maximum inlet pressure of the installation.

Tables 2, 3, and 4 list the capacities of each orifice for 0.6 specific gravity gas at standard conditions. When checking the regulator's capacity at given conditions, the lowest inlet pressure and the maximum capacity of the installation in which the regulator is mounted should be used in conjunction with these capacity tables.

Note that for the Restricted Orifices (Table 2), the capacity data are given in terms of two characteristic valve coefficients which are referred to as C_g and C_1. These coefficients are for the valve face at 100% of its allowable distance away from the orifice seat, i.e. "100% of rated travel" as it is described in the table. This method of giving maximum rated capacities is not as direct as the charts which, of course, are used for the 7/8 inch and 1 1/8 inch orifices. However, when these coefficients are used in the Universal Gas Sizing Equation or in conjunction with the Universal Valve Sizing Slide Rule, they allow the user to determine the maximum capacity at any combination of inlet/outlet pressures. The Equation and Slide Rule mentioned above have been developed by Fisher Controls Company and are approved for use with the coefficient data supplied in this approval notice. For futher instruction on how to use the Slide Rule to determine the maximum capacity of a given orifice, refer to Technical Gas Circular

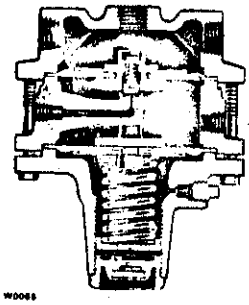


Figure 2. Type 61L Pilot.

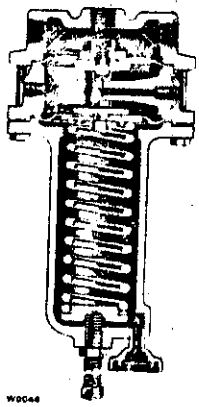


Figure 3. Type 61H Pilot

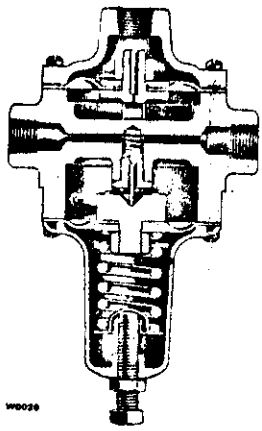


Figure 4. Type 99HH Pilot

Tables 6, 7, and 8 give the manufacturer's Type Numbers for the different end connections and orifice sizes. These tables can also be used to determine the minimum allowable pressure differential for each type number.

For field testing procedure refer to Technical Gas Circular G-75-3.

Approval granted to:

Fisher Controls Company
of Canada Limited
Woodstock, Ontario.

J.L. Armstrong,
Chief, Standards Laboratory,

D.L. Smith,
Chief, Electricity & Gas Division,
Metrology and Laboratory Services.

Ref: GL 1147-57/F206-176

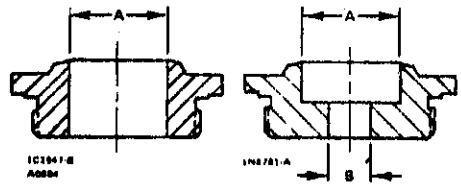
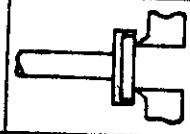
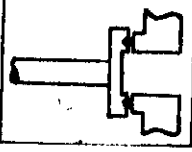


Figure 5. Standard Size and Restricted Orifices. The Standard Orifice Sizes Are Indicated by a Single "A" Dimension; Restricted Orifice by an "A" X "B" Size Designation

Table 1 Seating Methods and Maximum Inlet Pressure Capabilities

Seating Construction	Seating Method	Seating Description	Orifice Size, Inches	Seat Material	Maximum Inlet Pressures, Psig
Type 99 Disc		Composition disc seats against knife-edged seat ring.	7/8, 7/8 x 3/8, 7/8 x 1/2, 7/8 x 5/8 x 3/4 x 3/4	Nitrile	250
				Nylon	400*
			1-1/8	Nitrile	150
				Nylon	300*
Type 99 O-Ring		O-ring seats against flat faced seat ring.	7/8	Nitrile	250
			1-1/8	Nitrile	250*

*With heavy regulator main spring 0W0191 27022

Orifice Size, Inches	Cg Values For 100% Of Rated Travel	C_1 At Rated Travel
7/8 x 3/8	110	29.0
7/8 x 1/2	190	29.0
7/8 x 5/8	280	29.4
3/4 x 3/4	330	35.0
Rated travel is 1/4"		

TABLE 2

Cg & C_1 Values for the restricted orifices at maximum rated travel of the valve face.

Table 3. Capacity (1000 SCFH) for Type 99 with 7/8" Orifice

Inlet Pressure—Psig	Outlet Pressure—Psig																						
	.25	.5	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	45	50	60	75	100
5	7.2	7.2	6.6	6										Type 99 7/8" orifice 1000 SCFH Max. Regulating Cg = 408									
6	7.8	7.8	7.8	7.2	6.6																		
7	9	8.4	8.4	7.8	7.2	6.6																	
8	9.6	9.6	9	8.4	7.8	7.2	6.6																
9	10	10	10	9.6	9	8.4	7.2	6.6															
10	11.4	11.4	10.8	10	9.6	9	8.4	7.8	7.2														
15	14.4	14.4	14.4	14.4	14.4	13.8	13.2	13.2	12	12	11.4	7.8											
20	18.6	18.6	18.6	18.6	18.6	18.6	18	16.8	16.2	15.6	15	14.4	10.8										
25	21	21	21	21	21	21	21	21	21	19.8	19.8	19.2	16.2	12									
30	23	23	23	23	23	23	23	23	23	23	23	23	20	17	12.5								
35	26	26	26	26	26	26	26	26	26	26	26	26	24	21	18	13							
40	28	28	28	28	28	28	28	28	28	28	28	28	28	26	23	19	14.5						
50	34	34	34	34	34	34	34	34	34	34	34	34	34	34	31	28	25	21	15.5				
60	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	37	35	30	27	23			
75	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	45	41	37	30		
100	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	53	44	
125	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	66	48
150	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	72
175	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	93
200	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108
225	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123
250	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132
300	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162	162
360	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188
400	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215

Low Pressure Pilot

High Pressure Pilot

Extra High Pressure Pilot

Table 4. Capacity for Type 99 with 1-1/8" ORIFICE

Inlet Pressure—Psig	Outlet Pressure—Psig																							
	.25	.5	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	45	50	60	75	100
1	5*																						
2	7.5*	7*	6*																				
3	9	9	8.5*																				
4	10	10	9	8.5*																			
5	12	12	11	10	9*																		
6	13	13	13	12	10	9*																	
7	15	14	14	13	12	10	9.5*																
8	16	16	15	14	13	12	11	9.5*															
9	17	17	17	16	15	14	12	11	10*														
10	19	19	18	17	16	15	14	13	12	10*													
15	24	24	24	24	24	23	22	22	20	20	19	13											
20	31	31	31	31	31	31	30	28	27	26	25	24	18										
25	35	35	35	35	35	35	35	35	35	33	33	32	27	20									
30	39	39	39	39	39	39	39	39	39	39	39	39	34	28	21								
35	44	44	44	44	44	44	44	44	44	44	44	44	40	35	30	22							
40	47	47	47	47	47	47	47	47	47	47	47	47	47	43	38	32	24						
50	57	57	57	57	57	57	57	57	57	57	57	57	57	57	52	47	42	36	26				
60	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	62	58	50	46	38			
75	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	74	68	62	50		
100	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	88	74	
125	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	110	80
150	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	120
175	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	155
200	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180
225	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205
250	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
300	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265

Type 99
1-1/8" orifice
1000 SCFH
Max. Regulating Cg = 680

Low Pressure Pilot

High Pressure Pilot

Extra High Pressure Pilot

*Special Series 99 for low differential (3/4 psi min.)

Table 5. Outlet Pressure Ranges

Pilot Types		Outlet Pressure Ranges	Spring Part Number	Spring Color Code
Low Pressure	61L	1 to 5 psig	1J8578 27022	Yellow
		2 to 10 psig	188864 27022	Blue
		5 to 15 psig	1J8579 27142	Brown
		10 to 20 psig	188865 27022	Green
High Pressure	61H	10 to 65 psig	0Y0664 000A2*	Green Stripe
Extra High Pressure	99HH†	35 to 100 psig	1K7485 27202*	Red

*These springs can be adjusted to 0 psig. The reduced pressure range shown is recommended for best performance and ease of adjustment.
†This is a Type 61HH pilot with a special mounting adaptor for use with 99 regulators.

Table 6. Screwed End Connection Bodies

Pilot	Body Mat.	Orifice Size (In.)	Min. Differential (Psi)	Max. Inlet (Psig)	Seat Constr.	Type No. 99-
Low Press.	Bronze	7/8	3	250	Comp. Disc	4
			3	250	O-Ring	8
			3	250	Comp. Disc	12
			3	250	O-Ring	20
		1-1/8	3	150	Comp. Disc	3
			3	150	O-Ring	7
			10	250[1]	O-Ring	15
	Iron	7/8	3/4	25	Comp. Disc	16
			3	250	Comp. Disc	2
			3	250	O-Ring	6
			3	250	Comp. Disc	11
			10	400	Nylon Disc	17
		1-1/8	3/4	25	Comp. Disc	13
			1-1/2	50	Comp. Disc	19
			3	100	Comp. Disc	9
			3	150	Comp. Disc	1
			3	150	O-Ring	5
			3	150	Comp. Disc	10
			10	250[1]	O-Ring	14
			10	300	Nylon Disc	18
	Bronze	7/8	3	250	Comp. Disc	84
			3	250	O-Ring	88
		1-1/8	3	150	Comp. Disc	83
			3	150	O-Ring	87
			10	250[1]	O-Ring	90
High Press.	Iron	7/8	3	250	Comp. Disc	82
			3	250	O-Ring	86
			10	400	Nylon Disc	91
		1-1/8	3	150	Comp. Disc	81
			3	150	O-Ring	85
			10	250[1]	O-Ring	89
	Steel	7/8	3	250	Comp. Disc	92
		1-1/8	10	250	O-Ring	94
	Bronze	7/8	3	250	Comp. Disc	124
			3	250	O-Ring	128
		1-1/8	3	150	Comp. Disc	123
			3	150	O-Ring	127
			10	250[1]	O-Ring	130
Extra High Press.	Iron	7/8	3	250	Comp. Disc	122
			3	250	O-Ring	126
			10	400	Nylon Disc	131
		1-1/8	3	150	Comp. Disc	121
			3	150	O-Ring	125
			10	250[1]	O-Ring	129
	Steel	7/8	10	400	Nylon Disc	132

[1] 400 psig temporary or emergency inlet pressure allowable
†Inches of water column
*Psi

Table 7 Flanged Cast Iron Bodies

Pilot	Orifice Size (In.)	Min. Differ. ential (Psi)	Max. Inlet (Psig)	Seat Constr.	Type No. 99-
125 lb. ANSI					
Low Press.	7/8	3	175	Comp. Disc	45
		3	175	O-Ring	54
		3	175	Comp. Disc	50
	1-1/8	3/4	25	Comp. Disc	53
		3	100	Comp. Disc	48
		3	150	Comp. Disc	41
		3	150	O-Ring	44
		3	150	O-Ring	57
		3	150	Comp. Disc	49
High Press.	7/8	3	175	Comp. Disc	105
	1-1/8	3	150	Comp. Disc	101
		3	150	O-Ring	104
		10	175	O-Ring	115
Extra High Press.	1-1/8	3	150	Comp. Disc	141
		3	150	O-Ring	144
250 lb. ANSI					
Low Press.	7/8	3	250	Comp. Disc	43
		3	250	O-Ring	47
		3	250	Comp. Disc	52
		10	400	Nylon Disc	56
	1-1/8	3	150	Comp. Disc	42
		3	150	O-Ring	46
		3	150	Comp. Disc	51
		10	250[1]	O-Ring	55
High Press.	7/8	3	250	Comp. Disc	103
		3	250	O-Ring	107
		10	400	Nylon Disc	109
	1-1/8	3	150	Comp. Disc	102
		3	150	O-Ring	106
		10	250[1]	O-Ring	108
		10	300	Nylon Disc	110
Extra High Press.	7/8	3	250	Comp. Disc	143
		3	250	O-Ring	146
		10	400	Nylon Disc	148
	1-1/8	3	150	Comp. Disc	142
		3	150	O-Ring	145
		10	250[1]	O-Ring	147

[1] 400 psig temporary or emergency inlet pressure allowable.

Table 8. Flanged Steel Bodies

Pilot	Orifice Size (In.)	Min. Differential (Psi)	Max. Inlet (Psig)	Seat Constr.	Type No. 99-
		150 lb. ANSI			
High Press.	1-1/8	3	150	Comp. Disc	111
Extra High Press.	7/8	3	250	Comp. Disc	151
	1-1/8	10	275	Nylon Disc	152
		300 lb. ANSI			
Low Press.	7/8	3	250	O-Ring	58
	1-1/8	3	150	O-Ring	59
		10	250	O-Ring	60
High Press.	7/8	3	250	Comp. Disc	114
		3	250	O-Ring	112
		10	400	Comp. Disc	116
	1-1/8	3	150	O-Ring	113
Extra High Press.	1-1/8	10	250[1]	O-Ring	140
		10	250	O-Ring	150[2]

[1] 400 psig temporary or emergency inlet pressure allowable.
[2] Bronze body