

“THE NEXT GENERATION”



FLOW SAFE, INC

“Environmental Performance for Industry”

F84L SERIES
LIQUID SERVICE
RELIEF VALVES
CONVENTIONAL-STYLE, SPRING OPERATED
“HIGH PERFORMANCE”



CATALOG: F84L1296REVAO400

“ADVANCED TECHNOLOGY FOR THE NEW MILLENIUM”

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The policy of FLOW SAFE and its authorized assemblers is a commitment to value through:

- Environmentally Compatible Products
- Cost Efficient Design, with Minimal Parts
- Quality Products, Readily Available
- Flexibility, to meet Unique Customer Needs
- “No Hassle” Service

INTRODUCTION AND FEATURES

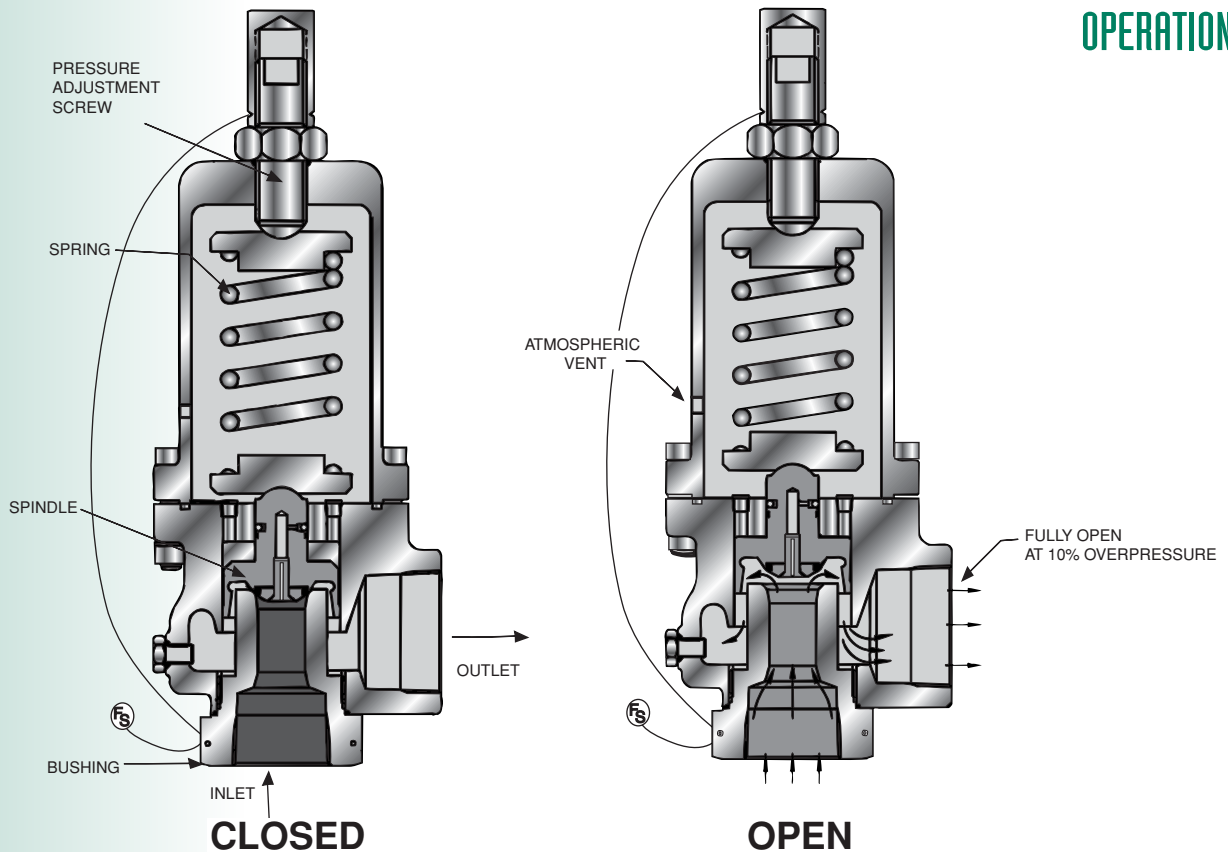
Today’s Process Industries require leaktight safety relief valves to reduce fugitive emissions and to save customer product.

The FLOW SAFE F84L Series “High Performance” relief valves accomplish bubble-tight sealing with accurate and consistent operational characteristics.

F84L design features include:

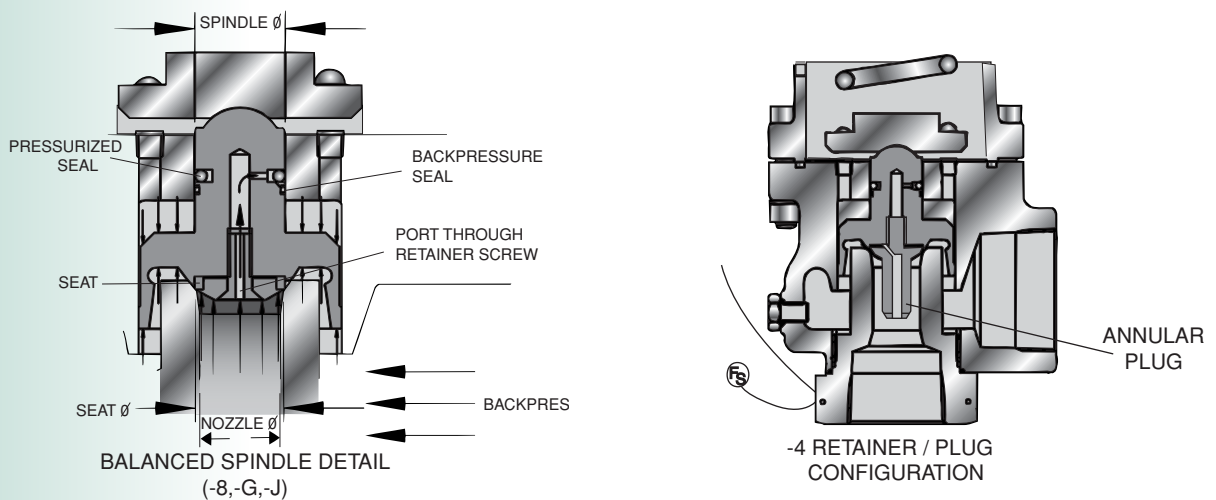
- Strong K_D provides for large flow capacities.
- Stable under all load conditions and is fully open at 10% overpressure.
- The F84L by utilizing a spindle seal, proportionately loaded to the system pressure, stabilizes and balances the valve preventing chatter, thus eliminating valve, system, and piping damage.
- Balanced against the effects of both variable or constant back pressure.
- At full flow the F84L reseats within 20% blowdown with modulation performance when the valve is called to relieve only a small portion of its rated flow.
- The utilization of soft seats provide for bubble tight shut off.
- Standard trim of 316SS provide a high degree of corrosion resistance for a large range of lading fluids.
- The F84L is available in a broad pressure range of 30-4292 psig.
- The F84L is available in a variety of materials and connections including threaded, flanged, SAE, mil spec threads, VCR, Grayloc, etc.





The FLOWSAFE F84L Series Liquid Service Relief valves are designed to provide customers with a stable, non-chattering relief valve providing large capacities. Below the set point, pressure acting upon the valve spindle seat surface generates a lifting force, i.e. $F=P \times A$. This opening force is opposed by the spring closing force. At set point, as the spindle lifts off the valve seat, additional boost force, is created through turbulence within the oversized huddling chamber in the spindle, allowing the valve to achieve full lift within 10% overpressure. Stability is achieved through the use of a pressurized drag ring on the spindle. This ring actually dampens the movement of the spindle, allowing the valve to flow, stable and smooth, in a quiet, non-chatter manner.

The spindle also utilizes a dynamic seal of the same diameter as the seat. This balances the valve against the effects of back pressure, and prevents bonnet leakage when outlet pressure is applied before the inlet pressure. Bellows are not needed. (See picture below). See page 10 for typical lift characteristics.



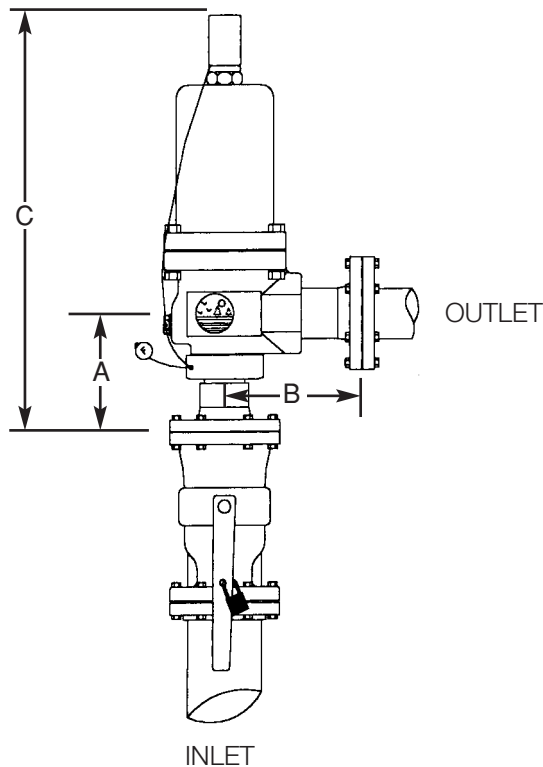
Blowdown is fixed, i.e. non-adjustable, developed by design to be within 20%, typically 15%. At low flow rates, the valve tends to modulate with no blowdown.

APPLICATIONS

Many “incompressible” liquid processes today challenge relief valves to open stably without chatter and to be accurate upon the set point and reseal points particularly when these systems are affected by pulsations and vibrations created by positive displacement pumps. The F84L Series Relief valves excel in these difficult applications. The valve is designed to open and hold stable during a relief cycle because of the pressurized spindle drag ring providing smooth flow performance.

These valves are ideal in handling lube oil systems (including API 614) and seal oil systems. Many F84L valves are serving water including de-ionized water systems and high pressure temper quench systems in the steel industry. FLOWSAFE F84L valves are even protecting equipment in food and chemical processing in handling, in some cases, high viscous fluids.

Many liquid services are closed looped with the relief valve discharge connections, hard piped back to the process or to a pressurized reservoir. The FLOWSAFE F84L relief valve is ideal in these services, as it is balanced against the effects of backpressure. Set point, defined as 93% of the gush point and a reseal pressure within 15-20% of the set point, allows users the opportunity to operate systems close to the nameplate set pressure of FLOWSAFE F84L relief valves. Strong coefficient of discharge K_d valves allow for smaller valves to be utilized lending additional value by reducing the user’s capital costs. For water service over 140°F, a lift lever can be provided,



F84L Valve in lube oil service

F84L Series Typical Installation

See page 7 for A,B, C dimensions

SELECTING RELIEF VALVES FOR LIQUID SERVICE

In addition to the F84L, FLOWSAFE manufactures high performance liquid pilot operated style valves, F7000/8000 Series. The following illustrates general selection considerations on both Series.

F84L (Spring Operated)	F7300/F8300 (Pilot Operated) ⁴ (See page 12)
Competitive, especially in smaller sizes	Generally more expensive except more competitive in larger sizes
10% overpressure standard	4-5 percent overpressure (modulating action)
10–20% blowdown (fixed) ¹	1–2% blowdown maximum
Orifices available: -4, -8, G, J (.115–1.699 sq. in.)	Orifices available: D–T and full bore (.134–112 sq. in.)
Carbon steel valves have all stainless steel wetted parts (except flanges)	Stainless steel pilot, piston, and liners standard
Seats available: Teflon, Kel-F, Vespel	Seats available: Teflon Kel-F, Vespel, BUNA, Viton, other
Seals available: BUNA, Viton, EPR ²	Seals available: BUNA, Viton, EPR ²
Connections: $\frac{3}{4}$ " x 1" to 2" x 3" FNPT $\frac{3}{4}$ " x 1" to 6" x 6" flanged	Connections: 1" x 2" to 1½" x 3" FNPT 1" x 2" to 12" x 16" flanged
Low to Medium Flows	Low to Very High Flows
Pressure Range: 30–4292 psig ³	Pressure Range: 15–1480 psig
Back Pressure Balanced	Back Pressure Balanced
Bubble tight to 95% of set pressure	Bubble tight to 98% of set pressure
Set Pressure: 93% of gush point	Set Pressure: 25% of dome pressure reduction
Fewer parts	More parts and more complex
Action: Snap Action except modulates at very low flows	Action: Modulating Action only
No FTC available	Field Test Connection available
Anti-Chatter Design	Anti-Chatter Design

- 1 Make certain that maximum operating pressure of lube oil system (psig) is 20–25% below valve set pressure.
- 2 Specify BUNA for mineral oils such as ISO32. Specify Viton for all synthetic oils (ML oils).
- 3 4292 psig maximum pressure is available only for -4 orifice. Set pressure is proportionately reduced with increasing orifice area designation.
- 4 For more information on the F7300/F8300 Series POSRV's, see FlowSafe Bulletin F7K.

SERVICE ENVELOPE

ORIFICE SIZE		-4	-8	-G	-J	
ORIFICE DIA (in)		.383 ¹	.574"	.919"	1.471"	
ORIFICE AREA (in ²)		.115	.259	.664	1.699	
MAX SET PRESSURE (psig)	LARGE BODY	BRASS	4292	2600	500	298
		CS	4292	4292	668	298
		SS	4292	4292	668	298
		NACE ²	4292	4292	668	298
	X-LARGE BODY	BRASS	–	–	–	450
		CS	–	–	3705	2700
		SS	–	–	3705	2700
		NACE ²	–	–	3705	2700
SERVICE TEMP RANGE (°F)	BRASS	-65 to 500				
	CS	-20 to 500				
	SS	-65 to 500				
	NACE ²	-65 to 500				

LARGE- BOLTED BONNET FOR IMMEDIATE PRESSURE SERVICE
X-LARGE- BOLTED BONNET FOR HIGH PRESSURE SERVICE

- 1 EQUIVALENT ORIFICE DIAMETER.
- 2 NACE TRIM AVAILABLE IN ACCORDANCE WITH MR-01-75.

SEAT DATA

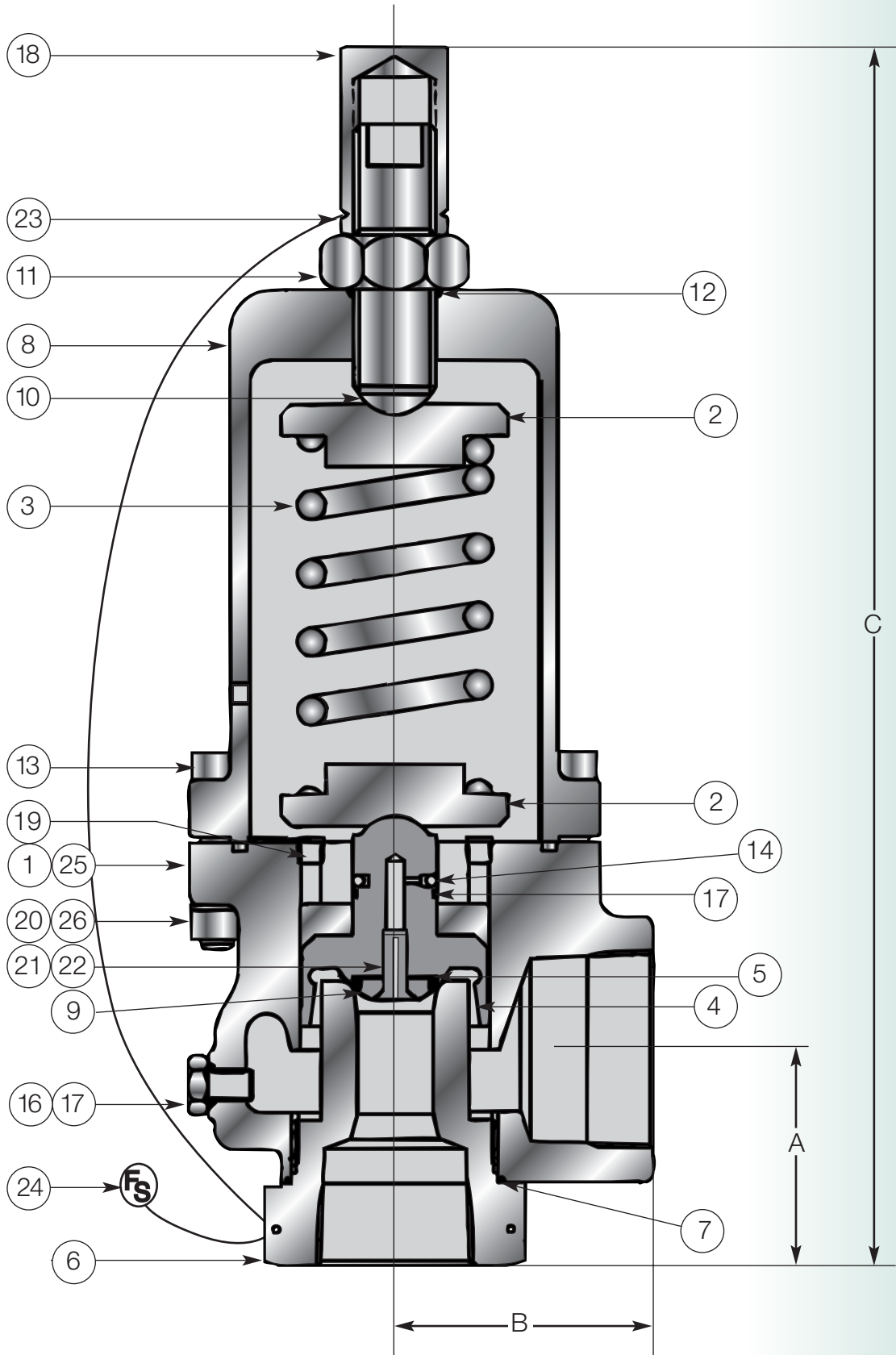
MATERIAL		PROCESS TEMP (°F)		PRESSURE (psig)	
		MAX	MIN	MAX	MIN
PLASTIC SEAT	VESPEL	400	-65	4292	4000
	PEEK	500	0	4292	500
	TEFLON®	400	-65	1000	30
	KEL-F	400	-65	4000	900
	BUNA-N	275	-65	4292	30
ELASTOMER SEAL	VITON®	400	-65	4292	30
	ETHYL PROP	325	-65	4292	30
	KALREZ®	500	0	4292	30

For lower pressures, temperatures, and chemical compatibility, consult FLOW SAFE Engineering.

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CONSTRUCTION

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MATERIALS OF CONSTRUCTION

No.	PART NAME	BRASS	CARBON STEEL	STAINLESS STEEL	NACE
1	BODY	SB-62	SA351 CF8M	SA351 CF8M	SA351 CF8M
2	SPRING WASHER	ASTM B16	1214	A479-316	A479-316
3	SPRING	STAINLESS STEEL	CARBON STEEL	STAINLESS STEEL	STAINLESS STEEL
4	SPINDLE	ASTM B16	A479-316	A479-316	A479-316
5	SEAT	ELASTOMER	ELASTOMER	ELASTOMER	ELASTOMER
6	BUSHING	ASTM B98H	SA479-316	SA479-316	SA479-316
7	BUSHING SEAL	ELASTOMER	ELASTOMER	ELASTOMER	ELASTOMER
8	BONNET	SA351 CF8M	SA351 CF8M	SA351 CF8M	SA351 CF8M
9	RETAINER, SEAT	ASTM B16	A479-316	ASTM B16	ASTM B16
10	PRESSURE ADJ. SCREW	A479-316	CARBON STEEL	A479-316	A479-316
11	LOCK NUT, PA SCREW	A479-316	A479-316	A479-316	A479-316
12	SEAL, PA SCREW	TEFLON	TEFLON	TEFLON	TEFLON
13	FASTENER	304SS	304SS	304SS	304SS
14	SEAL, DAMPENING	ELASTOMER	ELASTOMER	ELASTOMER	ELASTOMER
15	LOCK SCREW	A479-316	A479-316	A479-316	A479-316
16	SEAL, BD SCREW	TEFLON	TEFLON	TEFLON	TEFLON
17	SEAL, BACKPRESSURE	ELASTOMER	ELASTOMER	ELASTOMER	ELASTOMER
18	CAP	ASTM B16	A479-316	A479-316	A479-316
19	PLUG	304SS	304SS	304SS	304SS
20	NUT	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	INCONEL
21	LOCKING INSERT	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	INCONEL
22	RETAINER SCREW ¹	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
23	LOCK WIRE	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
24	SEAL	LEAD	LEAD	LEAD	LEAD
25	NAME PLATE	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL
26	LOCK WASHER	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL	STAINLESS STEEL

1 FOR-4 ORIFICE SIZE, RETAINER SCREW INCLUDES ANNULAR PLUG (see page 3).

DIMENSIONS & WEIGHTS

ORIFICE SIZE	WEIGHT (lbs.)	CONNECTIONS		MAXIMUM DIMENSIONS		
		INLET	OUTLET	A	B	C
THREADED						
-4	11	3/4", 1"FNPT	1"FNPT	1.61	2.07	12.21
-8	11	3/4", 1"FNPT	1"FNPT	1.61	2.07	12.21
-G	33	1-1/2"FNPT	2"FNPT	2.60	3.15	17.80
-J	55	2"FNPT	3"FNPT	2.72	4.25	22.25
FLANGED (Std. Sizes - ANSI 150 Through 2500 Pound Flanges)						
-4	26	3/4", 1"	1"	5.72	6.75	16.30
-8	26	3/4", 1"	1"	5.72	6.75	16.30
-G	57	3/4", 1"	2"	5.87	5.06	21.07
-J	94	2"	3"	6.56	7.00	26.09

SIZING

To size the F84L Series Liquid Service Relief Valve at 10% overpressure, use the formula below.

To select the proper orifice for the particular service conditions, the following information is required:

1. Required flow capacity in U.S. Gallons per minute (GPM)
2. Required set pressure (start of full discharge)
3. Operating Pressure - to assure that it is below the reseal pressure
4. Acceptable Overpressure (10% Maximum)
5. Backpressure
6. Medium properties, including viscosity

$$A_o = \frac{Q \sqrt{G}}{38 K K_C K_V \sqrt{P_1 - P_2}}$$

- A_o = Valve Orifice Area (in²) = .785D_o²
- Q = Required Flow Rate (GPM)
- G = Specific Gravity of Liquid at Temperature (°F)
- V = Viscosity (centipoise or SSU). See pg.9.
- K = Derated Valve Coefficient of Discharge (see chart below)
= .90 x K_d (K_d=Certified Flow Coefficient)
- K_C = Combination Correction factor for installations with a rupture disk upstream of the relief valve
= 1.0, with no rupture
= .90, with rupture disk, installed, and the combination does not have a published value
- K_V = Viscosity Correction Factor. See pg. 9.
- P_1 = Pressure at Valve Inlet During Flow (psig)
= Set Pressure + Overpressure + P_{atm}
- P_2 = Pressure at Discharge (psig)
= Backpressure (psig) + P_{atm}
- P_{atm} = Atmospheric Pressure (psia)
(if unknown, use 14.7)

FLOW CAPACITIES

WATER-U.S. GPM, 70°F, G=1.0
10% OVERPRESSURE, K_v=1.0
ASME PRESSURE VESSEL CODE (UV)

ORIFICE SIZE	-4	-8	-G	-J
FLOW COEFFICIENT K	.831	.798	.798	.798
ORIFICE DIAMETER (in) D _o	.383"	.577"	.919"	1.467"
ORIFICE AREA (in ²) A _o	(.115 in ²)	(.261 in ²)	(.663 in ²)	(1.699 in ²)
SET PRESSURE (psig)	GPM	GPM	GPM	GPM
30	21	45	115	294
50	27	59	149	380
100	38	83	211	537
150	47	102	258	658
200	54	117	298	760
250	60	131	333	849
300	66	144	365	930
350	71	155	394	1005
400	76	166	422	1074
450	81	176	447	1140
500	85	186	471	1201
600	93	203	517	1316
700	101	220	558	1430
800	108	235	596	1519
900	114	247	633	1612
1000	120	262	667	1699
1500	148	321	817	2080
1780	161	350	890	2266
2000	170	371	943	2402
2500	190	415	1054	2686
2700	198	428	1096	2791
3000	209	455	1155	—
3500	225	491	1247	—
3705	232	505	1283	—
4000	241	525	—	—
4300	250	544	—	—

Viscosity Correction Method, per API RP520

When using the method below, first size the valve for non-viscous conditions, to determine a preliminary required orifice area (A_0). Select the next larger orifice and then use that area in determining the Reynold's number (R). Either of the formula below can be used to determine R .

$$R = \frac{Q \times (2800) \times G}{C_p \times \sqrt{A_0}}$$

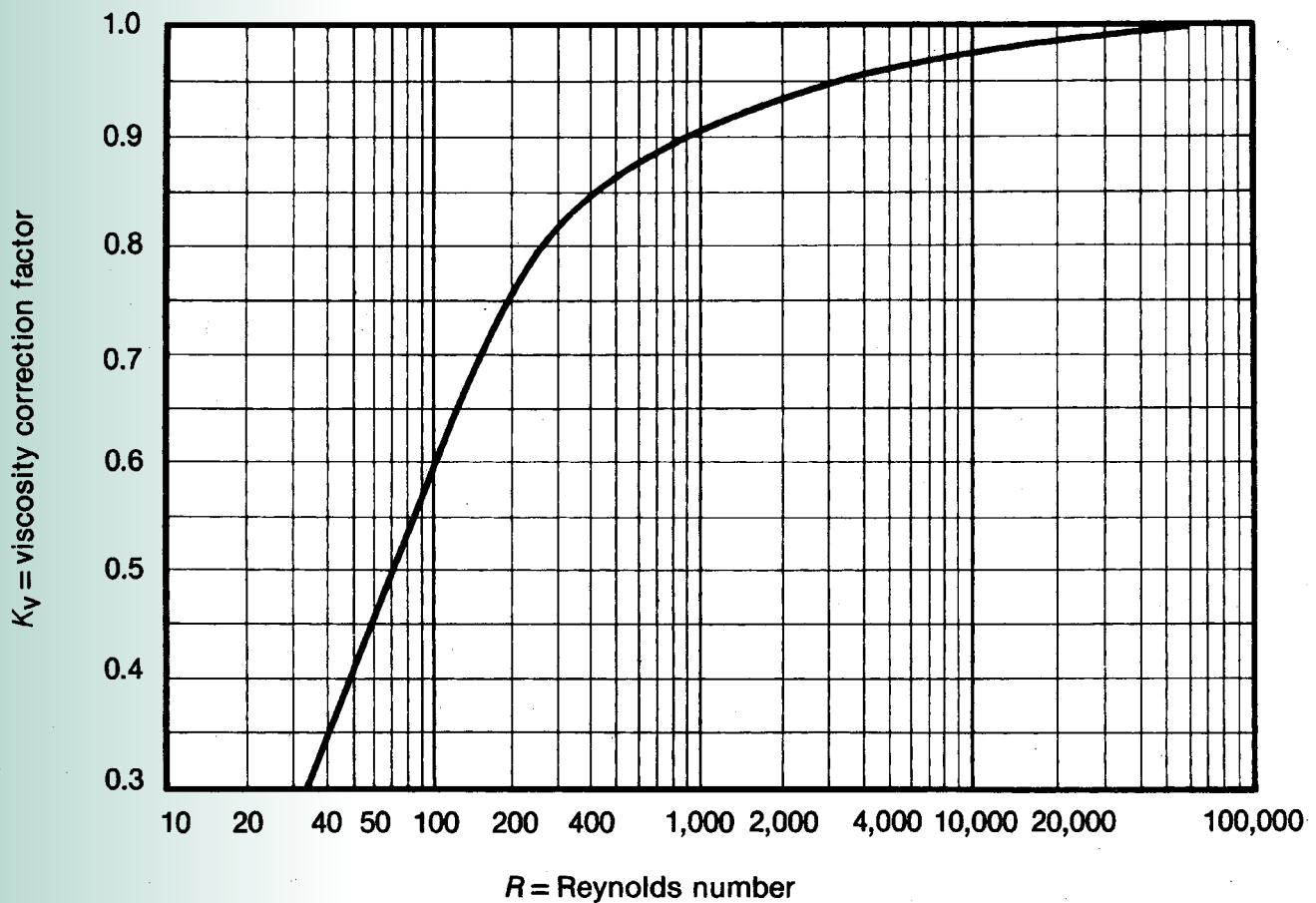
- OR -

$$R = \frac{12700 \times Q}{SSU \times \sqrt{A_0}}$$

- Q = Required flowrate at the flowing temperature, in U.S. gallons per minute.
- G = Specific gravity of the liquid at the flowing temperature. Water: G = 1.0
- C_p = Absolute viscosity at the flowing temperature, in centipoises.
- SSU = Kinematic Viscosity at the flowing temperature, in Saybolt Seconds Universal.

After the value of R is determined, K_v is obtained from the chart below. K_v is then applied to correct the "preliminary required flow area". If the corrected area exceeds the chosen standard orifice area, repeat the above procedure using the next larger orifice size.

Minimum and maximum conditions should be considered when determining the required orifice size, for proper valve operation.



SIZING

Exercise care when sizing liquid relief valves in terms of utilization of the K_v value (viscosity correction factor). The default value for a low viscosity liquid such as water is normally one. However, for high viscosity liquids such as oils and other chemicals, the K_v could be significantly less than one. If so, this will increase the required orifice area and size of the valve.

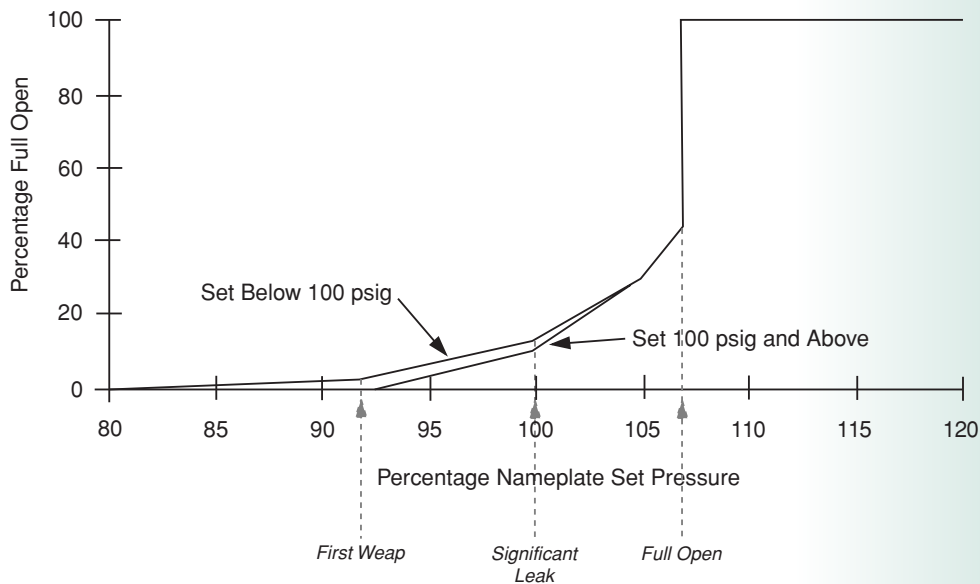
Use the instructions below when sizing a safety relief valve for viscous liquid by either computer or hand calculations. To accurately and quickly size FLOW SAFE valves, use **FLWSIZE** – the FLOW SAFE Relief Valve Sizing Program.

1. Determine orifice area of valve with $K_v=1.0$.
 2. Use either of two formulas from attached to determine the Reynolds number. The Reynolds number is a dimension less number which indicates either turbulent or laminar flow through a pipe or orifice. The higher the velocity and the lower the viscosity of the liquid, will result in a higher Reynolds number.
 3. Use the Reynolds number you have calculated and the graph on page 9 to determine the K_v (viscosity correction factor).
 4. Resize the valve with calculated K_v value.
- Example:

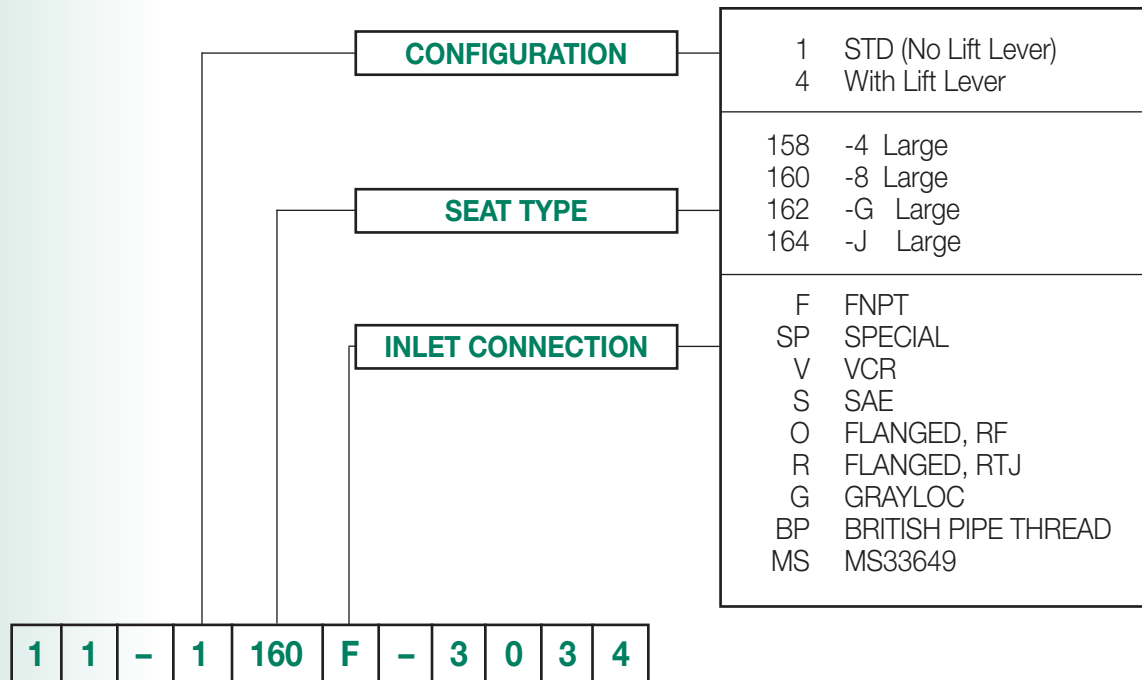
Service: ISO 32 Lube Oil
Viscosity: 650 SSU
Flow: 291 GPM
Orifice Area: G (.663 sq. in.)
 $R = \frac{12,700 (291)}{650 (.663)^{1/2}}$
 $R = 6,983$ (go to graph pg.9)
 $K_v = .965$

As you can see, the K_v value has been reduced from the default value of 1.0 and effectively increased the required valve orifice size by 3.5%.

Typical F84L Lift Characteristics



The following part numbering system is to be used when ordering a FLOW SAFE F84L Pilot Valve:



1 1 - 1 160 F - 3 0 3 4

FLANGED CONNECTIONS(RF) ²			
ORIFICE	CONNECTION No. ¹	INLET	OUTLET
-4 & -8	058021	3/4"-150#	1"-150#
	058031	1"-150#	1"-150#
	108021	3/4"-300#	1"-150#
	108031	1"-300#	1"-150#
	128021	3/4"-600#	1"-150#
	128031	1"-600#	1"-150#
	148021	3/4"-900#	1"-300#
	148031	1"-900#	1"-300#
	168021	3/4"-1500#	1"-300#
	168031	1"-1500#	1"-300#
-G	188021	3/4"-2500#	1"-300#
	188031	1"-2500#	1"-300#
	05G042	1-1/2"-150#	2"-150#
	10G042	1-1/2"-300#	2"-150#
	12G042	1-1/2"-600#	2"-150#
-J	14G042	1-1/2"-900#	2"-300#
	16G042	1-1/2"-1500#	2"-300#
	05J053	2"-150#	3"-150#
	10J053	2"-300#	3"-150#
	12J053	2"-600#	3"-150#
	14J053	2"-900#	3"-300#
	16J053	2"-1500#	3"-300#

¹ Use with Assembly Number
Ex: -4(S/S), 3/4" 150#RF Inlet/1" 150#RF Outlet, A/N=11-1158F-203 C/N=058021

² Other sizes available upon request

NACE ADDER

4	Nace Trim
blank	Non-Nace
S	Special Outlet

MATERIAL

1	Brass
2	Carbon Steel
3	Stainless Steel
6	Monel

SIZE

0	M/MED/LARGE
1	X-LARGE

INLET DIAMETER (in)

2	3/4
3	1
4	1-1/2
5	2

THREADED CONNECTIONS			
ORIFICE	ASSEMBLY No.*	INLET	OUTLET
-4	11-1158F-20X	3/4"FNPT	1"FNPT
	11-1158F-30X	1"FNPT	1"FNPT
-8	11-1160F-20X	3/4"FNPT	1"FNPT
	11-1160F-30X	1"FNPT	1"FNPT
-G	11-1162F-40X	1-1/2"FNPT	2"FNPT
-J	11-1164F-50X	2"FNPT	3"FNPT

*X=1(Brass) 2(C/S) 3(S/S) 4(NACE) 5(Special) 6(Monel)

OTHER PRODUCTS

F7000/8000 Series
Safety Relief Valve –
IM Construction



F84/85 Series
Safety Relief Valve



F70U Series
Unloader Valve



F80M Series with Whistle
(This is not a relief
device as shown)



F70PR Series
Pressure Relief Valve



F84L Series
Liquid Relief Valve



FLOW SAFE, INC
"Environmental Performance for Industry"

S-3865 Taylor Road
Orchard Park, NY 14127

Engineering (716) 667-3640
Sales (716) 662-2585
Fax (716) 662-2580
Internet www.flowsafe.com

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