YARWAY 9100 SERIES ARC® VALVE

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

Before installation, these instructions must be read carefully and understood.

GENERAL

The 9100 Series ARC® Valve is an automatic, modulating, recirculation control valve for protection of centrifugal pumps and high speed pumps against overheating and possible unstable operation during low-load periods. With only three moving parts (disc, seal and spring), the valve functions simultaneously as: (1) check valve – to prevent flow through the pump and function as a flow sensor and (2) bypass control valve – to maintain the minimum pump flow and provide pressure letdown.

FEATURES

1. Five separate functions in a single valve body without external power source: (a) reverse flow prevention, (b) low flow detection, (c) modulating bypass flow control, (d) bypass flow pressure reduction, and (e) back pressure regulation of bypass flow (as required).
2. Compact, self-contained design that eliminates divided installation responsibility occurring with systems involving combinations of pneumatic, thermal and mechanical devices.
3. Minimum wear on vital parts during pressure reduction of bypass flow.
4. Quiet pressure drop provided by a bypass that dissipates the energy effectively. For high pressure drop capability and/ or increased cavitation resistance a back pressure regulator is available. External bypass regulators are available for mounting in down stream piping.
5. Corrosion resistant surfacing of disc seat.
6. Steel or stainless steel body available. Elastomer seals allow usage to 475°F [246°C]. Service exceeding these temperatures use the extreme temperature valve design. Refer to separate manual supplement for information.
7. Available with materials covered by NACE. Standard MR0175 (sulfide stress cracking resistant metallic material for oil field equipment).
8. All connections flanged.
9. Field Replaceable flow element (seat insert) for ease of maintenance and ability to modify flow characteristics as system requirements change.

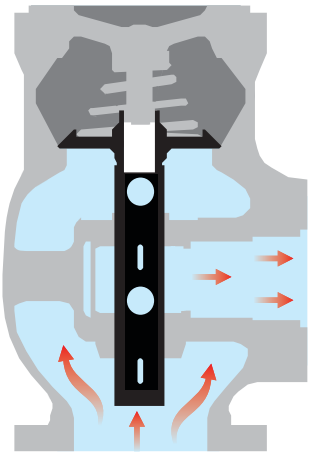
Engineering Doc. #965849 Rev. H

OPERATION

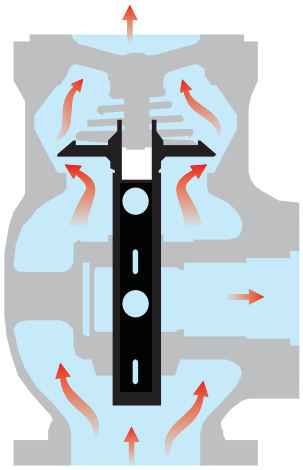
Flow through the check valve overcomes the spring force to open the main check valve element. As the disc lifts in response to an increase in main flow, the connected bypass element reduces the bypass flow. Conversely, as the pump flow is reduced, the check valve assembly moves downward and at a point starts to uncover ports in the bypass element allowing bypass flow to begin. Further reduction in main flow increases the opening in the bypass element resulting in increased bypass flow. The sizing of the check valve disc and bypass element is such that the bypass flow starts before the main flow is reduced below the specified minimum pump flow, and the combined main and bypass flow provide a total greater than the pump minimum flow requirement.

Bypass flow enters the bypass element at the bottom of the bypass stem. The flow is then controlled by the port openings in the side of the bypass stem. The flow continues through the annulus in the bypass bushing and is directed to the outlet of the valve. For applications where a back pressure regulator is used, the regulator maintains an approximate back pressure from 50 psi [3.5 bar] to 500 psi [34.5 bar] above the receiver vessel pressure on the bypass element (as determined by Emerson). The back pressure regulator is available for mounting in downstream piping. The controlled fit between the disc assembly, stem and bypass bushing permits a small amount of bypass flow with the check valve fully open.

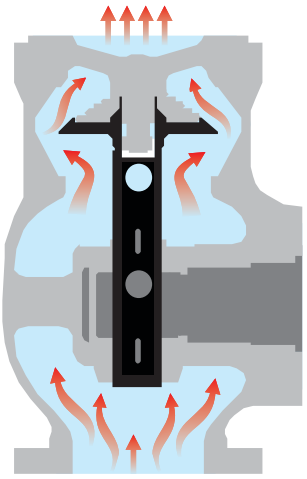
Pump Startup/Shutdown



Pump approaching Normal Operation



Pump at Normal Operation



OPERATIONAL CHECK

When the valve is properly installed the combined main and bypass flows should equal or exceed that of the specified minimum pump flow. If operational checks indicate a deviation from the original specifications and field adjustments are necessary, contact the Emerson for additional information.

VALVE CARE

Except for periodic operational checks the valve requires little maintenance. The disc assembly, spring and bypass bushing should be inspected coincident with the other annual inspections. Inspection of the valve's internal components may be necessary more often if the valve is cycled often or remains in bypass mode for extended periods. The mechanism is easily removed whenever the main flow is stopped. Make certain that all pressure is relieved and the pipeline is secured against pressurization before attempting disassembly for inspection purposes.

Typical installation

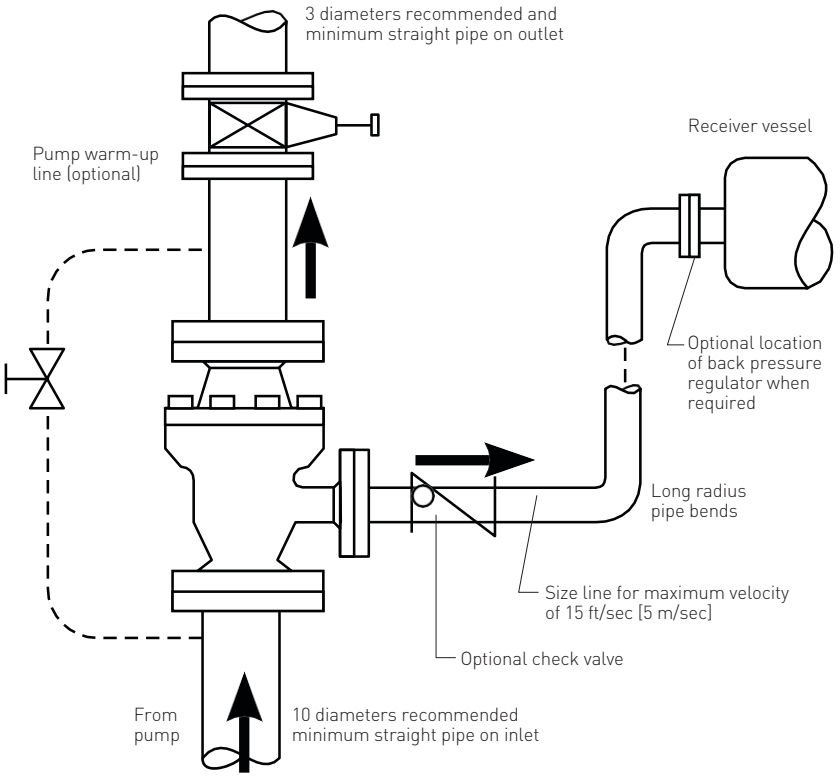


TABLE 1 – INTEGRAL BACK PRESSURE REGULATOR DRAW BOLT AND WASHER

Valve Size		BPR Size		Bolt Thread	Bolt Length		Minimum Thread Length		Washer OD		Washer ID		Washer Thickness	
in.	[mm]	in.	[mm]	in.	in.	[mm]	in.	[mm]	in.	[mm]	in.	[mm]	in.	[mm]
2	[50]	1½	[40]	10 - 24	3½	[90]	1½	[38]	1 1/16	[27]	7/32	[6]	1/16	[1.5]
3	[80]	2	[50]	¼ - 20	4	[102]	1½	[38]	1⅜	[35]	9/32	[7]	1/16	[1.5]
4	[100]	3	[80]	¼ - 20	5½	[140]	1¾	[45]	2 1/16	[52]	9/32	[7]	⅛	[3]
6	[150]	4	[100]	5/16 - 18	7	[178]	2¼	[57]	2⅞	[73]	11/32	[9]	⅛	[3]
8	[200]	6	[150]	⅜ - 16	8¾	[222]	3	[76]	4¾	[121]	13/32	[10]	⅛	[3]

CAUTION
The back pressure regulator has an integral spring and if the draw bolt is removed, it should be done carefully. See separate instructions for external back pressure regulator.

DISASSEMBLY

2" to 8" [50 to 200 mm] valve sizes

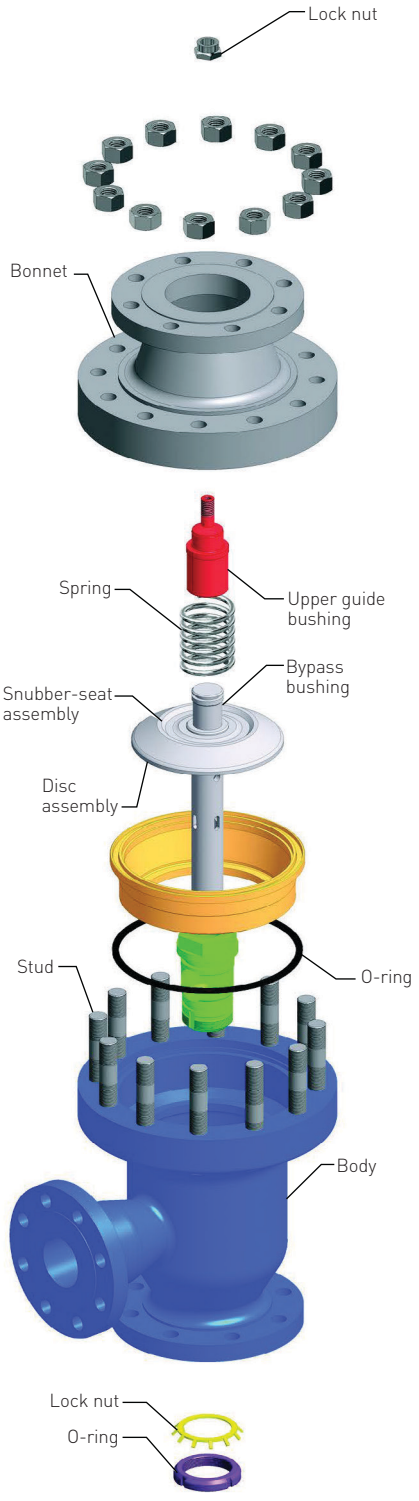
1. For disassembly and inspection remove the valve from the line. Match-mark the body and bonnet to facilitate reassembly.
2. Remove the nuts attaching the valve bonnet to the body.
3. Carefully lift straight up on the bonnet to clear engagement of the disc stem.
4. The spring and disc assembly are now exposed for easy removal.
5. Normally there is no need to remove the bypass bushing. Should the bushing be damaged, it may be removed by straightening the lock washer tab. Remove nut and lock washer. If necessary lightly tap the bushing with a hammer and soft metal rod. Be careful not to damage the threads and bushing bore.
6. If the valve is fitted with an integral back pressure regulator and the unit needs to be replaced, carefully drill out the stake mark in the plunger guide with a small drill. Install draw bolt and washer (see Table 1 for sizes) and tighten until "snug." Torque = 5 to 10 ft./lb. [6.8 - 13.6 N•m]. Loosen the remaining ring (clockwise) approximately one turn and remove the spiral ring. Partially remove the draw bolt. Pry under the head of the draw bolt to remove the regulator capsule.
7. If the valve is fitted with a flow conditioner (31), it can be removed by pencil grinding the tack welds and lifting the worn part from the body (1).

1" to 1½" [25 to 40 mm] valve sizes

1. Follow Disassembly, step 1 for 2" to 8" valves.
2. Remove the nuts attaching the valve bonnet to the body, remove the bonnet.
3. Remove the bypass tube as follows: Drill out the stake mark with a small drill. Use a spanner wrench in the tube slots and turn counterclockwise to remove. A 1" x 2" x ⅛" [25 x 50 x 3 mm] thick steel plate and an adjustable wrench may be used if a suitable spanner wrench is not available.
4. Remove the disc-bypass bushing assembly (Items 33, 34, 36, 37, 38, 39, 40, and 42) by applying force to the bottom of the disc as follows: Push on the bottom of the disc with a 1" [25 mm] diameter bar until the spring is fully compressed. Tap on the bar with a mallet if additional force is required.
5. Lay the disc-bypass bushing assembly on a flat surface with the bottom of the disc up. Push down on the spring retainer (36) until the spiral ring (38) is exposed. Remove the spiral ring by inserting a screwdriver into the ring removal notch and uncoiling the ring over the shaft end. The assembly can now be taken apart.
6. The main check flow element (29) does not normally require maintenance. Should there be a need to remove the flow element, lift flow element evenly to prevent jamming within the body. Light tapping around the I.D. of the Flow element may be necessary to free the part.

REPAIR AND INSPECTION

Inspect the condition of the body to bonnet seal. Sealing surfaces must be free of defects. Replace the elastomer seal each time the valve is disassembled.
Examine the snubber-seal assembly for wear. The snubber should project slightly beyond guide diameter and with finger pressure should compress and expand.
Examine the check valve seat for evidence of wear. The surface can be reconditioned by lapping (see Reassembly, step 6).
Supply the following information when ordering spare parts:
(1) Figure Number
(2) Serial Number
(3) Type of fluid



REASSEMBLY – ALL CLASSES

2" to 8" [50 to 200 mm] valve sizes

1. All parts must be clean prior to reassembly.
2. Torque the upper guide bushing nut to the following values (Table 2) Do not lubricate.

TABLE 2 – UPPER GUIDE BUSHING

Valve Size		Nut Size	Torque	
in.	[mm]	in.	ft/lb	[N•m]
2	[50]	7/16 - 20	30 - 35	[41 - 48]
3	[80]	½ - 13	45 - 50	[61 - 68]
4	[100]	⅝ - 11	90 - 110	[122 - 149]
6	[150]	¾ - 10	160 - 200	[217 - 271]
8	[200]	1 - 8	305 - 355	[414 - 481]

3. Install new O-rings on the bypass bushing (use O-ring lube).
4. **Important:** The hole in the bypass bushing must line up with the bypass port. Use a soft metal rod to maintain the hole location when torquing the bearing nut.
5. Torque the bearing nut to the bypassing bushing using the torque values listed in Table 3 (use anti-seize on threads). Bend the lockwasher tab in the slot of the locknut.

LUBRICANTS

Use the following lubricants or their equivalents:
Anti-seize – Loctite 116737 (food grade anti-sieze).
O-ring – Silicone lubricant or liquid soap.

TABLE 3 – BYPASS BUSHING NUT

Valve Size		Nut Size	Torque	
in.	[mm]	in.	ft/lb	[N•m]
2	[50]	1⅛ - 18 N-06	40 - 60	[54 - 81]
3	[80]	1¾ - 18 N-09	150 - 190	[203 - 258]
4	[100]	2⅜ - 18 N-12	250 - 300	[339 - 407]
6	[150]	2¾ - 18 N-14	300 - 350	[407 - 474]
8	[200]	4⅜ - 12 AN-22	480 - 550	[651 - 746]

6. Lap the disc to the body. First use 180 grit (medium coarse) and repeat with 360 grit (fine). The finished surface should be 360 degrees and a minimum of ½ the available seat width. Clean thoroughly after each lapping operation.
7. Install the snubber seal assembly in the groove on the disc assembly using O-ring lube. (O-ring first, followed by Glyd ring.) Heat Glyd ring 140 to 212°F [60 to 100°C] water prior to installation. Resize ring with hose clamp and shim stock after seal is in groove. Allow to cool 10-20 minutes to resize.
8. Install the stem/disc assembly into the valve body. Place the spring on the disc. Place bonnet seal O-ring into the insert O-ring groove. Lower the bonnet, with matchmarks aligned, into place using care not to damage the snubber seal.
9. Coat studs with anti-seize lubricant prior to assembly. Torque to the values in Table 4.

TABLE 4 – BODY BONNET NUTS

Valve Size		Nut Size	Torque	
in.	[mm]	in.	ft/lb	[N•m]
1 - 1½	[25 - 40]	9/16 - 12	65 - 70	[88 - 95]
2	[50]	5/8 - 11	70 - 80	[95 - 109]
3	[80]	3/4 - 10	120 - 140	[163 - 190]
4	[100]	7/8 - 9	180 - 220	[244 - 298]
6	[150]	1 1/8 - 8	450 - 500	[610 - 678]
8	[200]	1 1/4 - 8	600 - 660	[814 - 895]

10. Check valve stroke by pushing the bottom of the bypass stem with wood or soft metal rod. The disc assembly must move freely (against spring load) for the entire stroke length. The stroke length must be as follows:

TABLE 5 – DISC STROKE

Valve Size		Stroke Length	
in.	[mm]	in.	[mm]
1 - 1½	[25 - 40]	7/16	[11]
2	[50]	5/8	[16]
3	[80]	1 5/16	[24]
4	[100]	1 1/4	[32]
6	[150]	1 1/2	[38]
8	[200]	2	[50]

11. For valves with an integral back pressure regulator:
    a. Install new regulator capsule, if defective. Lube the O-ring with O-ring lubricant and install the back pressure regulator capsule into the body.
    b. Install the spiral ring into the body groove (lubricate bottom side with Anti-Seize).
    c. Coat exposed threads with a thread locking adhesive appropriate for the valve service temperatures. Back the retaining ring out to load the back pressure regulator capsule with the required torque as shown in Table 6. Remove and discard the draw bolt and washer (used to hold the capsule assembly together.) Stake the plunger guide into the retaining ring. Do not stake toward the centerline of the back pressure regulator.

TABLE 6 – BPR RETAINING RING (spanner nut)

Regulator Size		Nut Size	Torque	
in.	[mm]	in.	ft/lb	[N•m]
1½	[40]	1 1/8 - 12	20 - 25	[27 - 34]
2	[50]	1 7/16 - 12	45 - 55	[61 - 75]
3	[80]	2 1/8 - 12	100 - 120	[136 - 163]
4	[100]	2 7/8 - 12	180 - 220	[244 - 298]
6	[150]	4 3/4 - 12	300 - 340	[406 - 460]

12. For valves with a flow conditioner (31), a replacement can be installed and tack welded in place. Weld four places, 90 degrees apart. See Table 7 for weld size and width.

TABLE 7

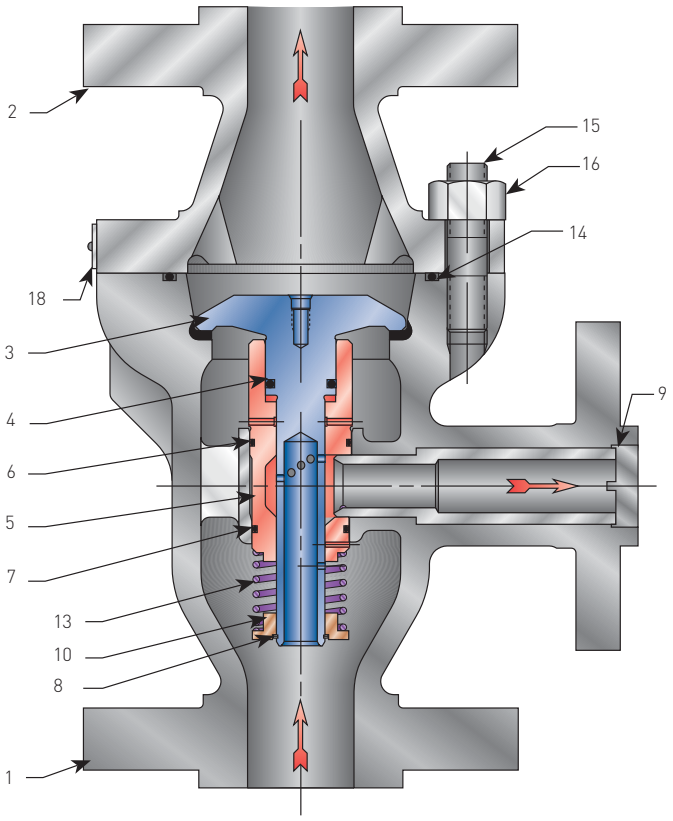
Valve Size		Weld Size		Weld Width	
in.	[mm]	in.	[mm]	in.	[mm]
2	[50]	1/8	[3]	3/16	[5]
3	[80]	1/8	[3]	1/4	[6]
4	[100]	1/8	[3]	3/8	[10]
6	[150]	1/4	[6]	1/2	[13]
8	[200]	1/4	[6]	5/8	[16]

1" to 1 ½" [25 to 40 mm] valve sizes

1. All parts must be clean prior to reassembly.
2. Insert the bypass bushing without the O-ring in the valve body to guide the disc during the lapping. Lap the disc to the body per step 6 above.
3. Install the snubber seal assembly (42) in the groove on the disc (33) per step 7 above.
4. Assemble the disc-bypass bushing parts (Items 33, 34, 36, 37, 38, 39, 40, and 42) as follows. Assemble all parts except the spiral ring (38) and lay the assembly on a flat surface with the bottom of the disc up. Compress the spring by pushing down on the spring retainer until the groove in the bottom of the disc is exposed. Install the spiral ring (38) by separating the coils and inserting one end of ring into groove and spiral each turn progressively over the shaft. Slowly release the load on the retainer.
5. To prepare the disc-bypass bushing assembly for installation in the valve body, the spring (37) must be compressed and restrained. There are two spring restraining methods, one uses a tool and the other a dowel pin. Using the disc-bypass bushing assembly illustrations as a guide, visually compare the parts to the illustrations and determine if the provisions are for the old or new method. The old method has a hole in both the disc and bypass bushing to accept a tool. The new method has only a hole in the disc for a dowel pin. Both types of spring restrainers will be held in place by the spring load. Prepare the disc-bypass bushing assembly for installation in the valve body as described by 5a or 5b below as applicable.
   a. For the old restraining method, a tool must be fashioned by bending a metal rod as shown. Compress and rotate the disc and bypass bushing together to align the assembly holes. Insert the spring restrainer tool in the assembly holes and release the spring load.
   b. For the new restraining method, provide the dowel pin as shown. Compress the disc and bypass bushing together until the pin assembly hole is exposed. Insert the spring restrainer pin in the assembly hole and release the spring load.
6. Visually align the centerline of the threaded outlet hole in the bypass bushing (34) with the body bypass outlet hole centerline. Insert the disc-bypass bushing in the body carefully so as not to knock the spring restrainer loose.
7. Rotate and push or pull on the disc to accurately align the bypass outlet holes. Shine a light in the bottom of the disc hole while looking through the body bypass outlet to check alignment.
8. Install the bypass tube (35) into the body outlet, threaded end first. Thread the tube into the bypass bushing (34) and tighten to approximately 20 ft/lbs [27 N•m] torque using a spanner wrench or a 1" x 2" x ⅛" [25 x 50 x 3 mm] thick steel plate. Stake the body into the bypass tube slots.
9. Remove spring restrainer, tool or dowel as applicable, by pushing on the bottom of the disc to release the spring load. The tool should become loose for removal. The pin should fall out. Ensure restrainer pin either falls out or is removed from the valve body before placing the valve back in service.
10. Lubricate, assemble, and check valve stroke per steps 9 and 10 under the 2" - 8" instructions.

All surfaces in contact with one another should be completely coated with a modurate amount of lubricant. Instert the O-ring into the groove of the body and completely seat the insert into the body. If binding occurs, remove the insert and determine the area of obstruction. Take steps necessary to clear the obstruction.

Disc-bypass bushing assembly
1" to 1½" [25 to 40 mm] valves



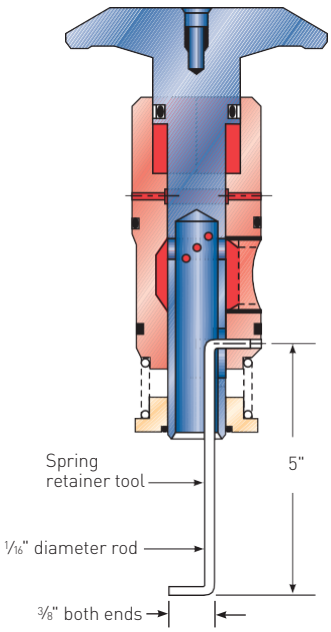
PARTS AND MATERIALS

Item	Part	Material
1	Body	ASTM A351 type CF8M (J92900)
2	Bonnet	ASTM A351 type CF8M (J92900)
3[2]	Disc	ASTM A479 type S21800A (Nitronic 60 bar)
4[1][2]	Snubber-seal assembly	Turcite 51 (Glyd ring) and TFE/Propylene (O-ring)
5[2]	Bypass bushing	ASME SA564 Grade 630 (17-4 PH Bar) Condition SA (S17400)
6[1][2]	O-ring	TFE/Propylene
7[1][2]	O-ring	TFE/Propylene
8[1][2]	Spiral ring	Inconel X-750
9[1][2]	Bypass tube	ASTM A312 type 304
10	Spring retainer	ASME SA479 type 316
13[2]	Spring	17-7 PH Condition CH-900
14[1][2]	O-ring	TFE/Propylene
15	Stud	ASTM A193 Grade B7 (G41400)
16	Nut	ASTM A194 Grade 2H (K04002)
18	Nameplate	300 series stainless steel

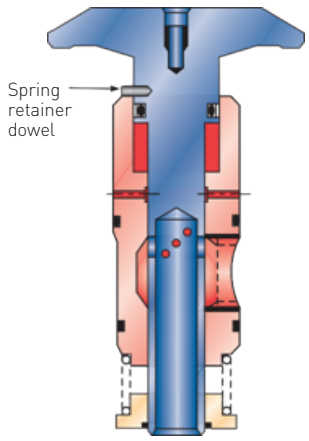
NOTES

1. Recommended spare parts for service inspection.
2. Recommended spare parts for service overhaul.

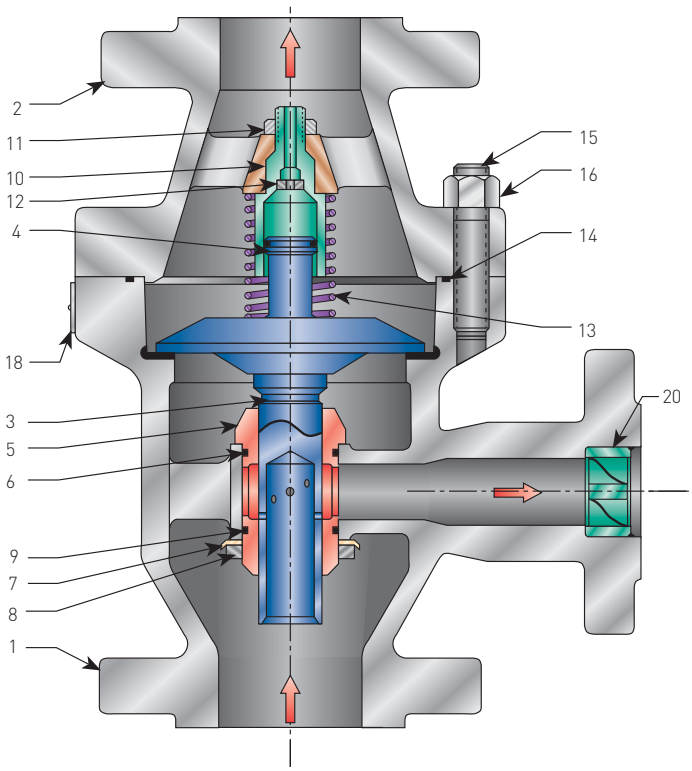
Old restraining method



New restraining method



Bypass with back pressure regulator installed **
2" to 8" [50 to 200 mm] valves



PARTS AND MATERIALS

Item	Part	Material
1	Body	ASTM A-216 Grade WCB
2	Bonnet	ASTM A-216 Grade WCB
3[2]	Disc assembly (bypass element)	2" to 6": ASTM A351 type CF10SMnN (Nitronic 60 Cast) 8" to 12": ASTM A351 type CF8M disc with ASTM A479 type A21800A stem
4[1][2]	Snubber-seal assembly	Turcite 51 (Glyd ring) and TFE/Propylene (O-ring)
5[2]	Bypass bushing	ASTM A747 Grade CB7Cu-1 (17-4PH Cast) Condition H900 (J92180)
6[1][2]	O-ring	TFE/Propylene
7[2]	Lock washer	ASTM A194 Grade 8 (18-8)
8[2]	Lock nut	Stainless steel 18-8
9[1][2]	O-ring	TFE/Propylene
10[2]	Upper guide bushing	ASTM A747 Grade CB7Cu-1 (17-4 PH Cast) Condition A
11[2]	Lock nut	300 series stainless steel
12[2]	Snubber orifice	Stainless steel 18-8
13[2]	Spring	17-7 PH Condition CH-900
14[1][2]	O-ring	TFE/Propylene
15	Stud	ASTM A193 Grade B7 (G41400)
16	Nut	ASTM A194 Grade 2H (K04002)
18	Nameplate	300 series stainless steel
20	Flow conditioner (600 class only)	ASTM A351 type CF8M

NOTES

1. Recommended spare parts for service inspection.
2. Recommended spare parts for service overhaul.

** Back Pressure Regulator spare parts available only as a replacement capsule (parts 21 to 30).