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Type CT88 Backpressure Regulator

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 **WARNING**

Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion, fire and/or chemical contamination causing property damage and personal injury or death.

Fisher™ backpressure regulators must be installed, operated and maintained in accordance with federal, state and local codes, rules and regulations and Emerson Process Management Regulator Technologies, Inc. (Emerson) instructions.

If a leak develops or if the outlet continually vents liquid, service to the unit may be required. Failure to correct trouble could result in a hazardous condition. Only a qualified person must install or service the unit.

Installation, operation and maintenance procedures performed by unqualified personnel may result in improper adjustment and unsafe operation. Either condition may result in equipment damage or personal injury.



Figure 1. Type CT88

Use qualified personnel when installing, operating and maintaining the Type CT88 backpressure regulator.

Introduction

Scope of the Manual

This Instruction Manual provides instructions for the installation, adjustment, maintenance and parts ordering information of Type CT88 backpressure regulator.

Product Description

The Type CT88 backpressure regulator (Figure 1) is used to maintain backpressure on Lease Automatic Custody Transfer (LACT) skids. It is designed to allow accurate measurement by the positive displacement pump or coriolis meter and protect other upstream LACT skid equipment. The high flow capability, as compared with other backpressure regulators, maximizes transfer efficiency.

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Specifications

The Specifications section lists the specifications for the Type CT88 backpressure regulators. Factory specification is stamped on the nameplate fastened on the backpressure regulator at the factory.

<p>Body Sizes NPS 2, 3 and 4 / DN 50, 80 and 100</p> <p>End Connection CL150 RF</p> <p>Maximum Working Pressure⁽¹⁾⁽⁴⁾ Based on CL150 RF Flange Pressure Rating, See Table 1</p> <p>Backpressure Control Ranges⁽¹⁾⁽²⁾ NPS 2 / DN 50: 10 to 145 psi / 0.7 to 10 bar NPS 3 and 4 / DN 80 and 100: 15 to 145 psi / 1.0 to 10 bar</p> <p>Wide-Open Flow Coefficients C_v NPS 2 / DN 50–C_v: 59 NPS 3 / DN 80–C_v: 148 NPS 4 / DN 100–C_v: 240</p> <p>Flow Characteristic Quick Open</p>	<p>Shutoff Classification ANSI Class VI</p> <p>Temperature Capabilities⁽¹⁾⁽³⁾ Fluorocarbon (FKM)⁽⁵⁾: 20 to 248°F / -7 to 120°C⁽⁶⁾</p> <p>Construction Materials Body: Carbon steel (WCB) Diaphragm and Seals: Fluorocarbon (FKM) Trim Parts: 316 Stainless steel</p> <p>Control Line Connection Size 1/4 NPT</p> <p>Approximate Weights NPS 2 / DN 50: 89 lbs / 40 kg NPS 3 / DN 80: 131 lbs / 60 kg NPS 4 / DN 100: 184 lbs / 84 kg</p>
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1. The pressure/temperature limits in this Instruction Manual and any applicable standard limitation should not be exceeded.
2. For lower set pressures, contact the factory.
3. It may be assumed that the material temperature is the same as the working fluid temperature.
4. Maximum inlet pressure depends on working temperature (Refer to ASME B16.42 or Table 1).
5. Fluorocarbon (FKM) is limited to 200°F / 93°C for hot water.
6. Increased working temperature may reduce the maximum inlet pressure range (Refer to ASME B16.42 or Table 1).

Table 1. Pressure-Temperature Ratings for CL150 Carbon steel (WCB)

TEMPERATURE ⁽¹⁾	MAXIMUM WORKING PRESSURE
°F	psi
20 to 100	290
200	260
248	245
°C	bar
-7 to 38	20.0
50	17.0
100	17.9
120	16.9

1. For intermediate temperatures, linear interpolation is permitted.

Principle of Operation

See Figure 2. Type CT88 direct-operated backpressure regulator responds to changes in inlet pressure. Inlet pressure is registered on the underside of the diaphragm through an external sensing line that is connected to the lower diaphragm casing.

As long as the inlet pressure remains below setpoint, control spring keeps the disk against the seat ring providing tight shutoff with no flow through the backpressure regulator.

When inlet pressure rises above the set pressure, pressure on the diaphragm overcomes the control spring force. This causes the diaphragm to move upward, lifting valve stem together with the valve plug away from seat ring. The flow path through the valve opens and excess pressure is vented. When upstream pressure drops below setpoint, the valve closes.

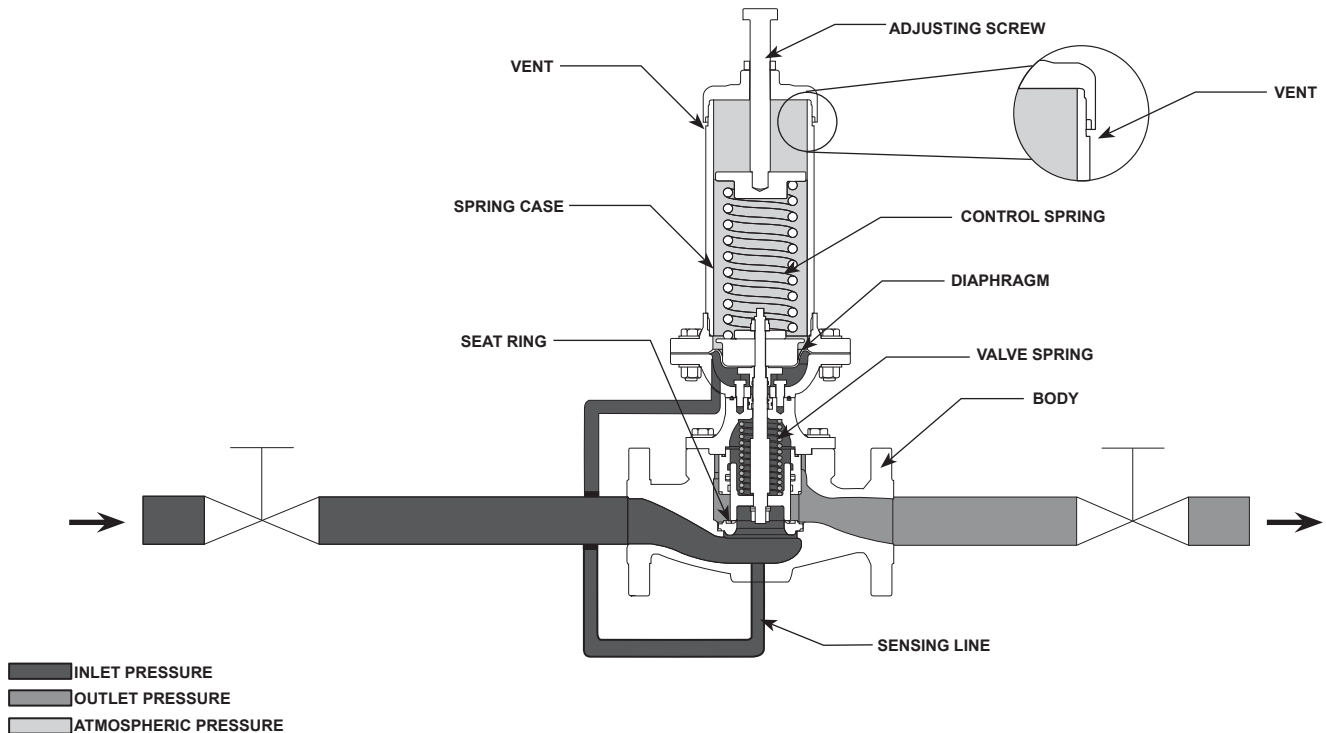


Figure 2. Type CT88 Backpressure Regulator Operational Schematic

Installation



WARNING

Personal injury or system damage may result if this backpressure regulator is installed, without appropriate overpressure protection, where service conditions could exceed the limits given in the Specifications section and/or backpressure regulator nameplate. Refer to Overpressure Protection section for recommendations on how to prevent service conditions from exceeding those limits.

Additionally, physical damage to the backpressure regulator may result in personal injury or property damage due to escaping of accumulated fluid. To avoid such injury and damage, install the backpressure regulator in a safe location.

All vents should be kept open to permit free flow of gas to the atmosphere. Protect openings against entrance of rain, snow, insects or any other foreign material that may plug the vent.

Do not install the Type CT88 backpressure regulator in hazardous or flammable service indoors or in an enclosure where accumulation of vented fluid may occur. In hazardous or flammable fluid applications, vented fluid may accumulate and cause personal injury, death, or property damage due to fire, explosion and/or chemical contamination.

Note

To avoid premature wear of internal parts, it is recommended that the actuator be oriented vertically as shown in Figures 1 and 2.

General Installation Instructions

- Vertical installation with the actuator installed directly above the main valve is recommended for optimal performance, as shown in Figures 1 and 2.
- The use of the bleed plug is recommended for installations of the actuator mounted above the main valve.

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- The unit will operate in horizontal installations with the actuator on the side, however, this could result in premature wear of the parts.
- Make sure that flow will be in the same direction as indicated by the flow arrow on the body.

Note

For proper backpressure regulator control and operation, make sure that the flow arrow matches the flow direction.



CAUTION

To protect against precipitation, make sure that the actuator is oriented upward.

Some installations, such as areas with heavy snowfall, may require a hood or enclosure to protect the backpressure regulator from snow load and vent freeze over.

1. Before installing the backpressure regulator:
 - Check for damage which might have occurred during shipment.
 - Check and remove any dirt or foreign material which may have accumulated in the backpressure regulator body.
 - Blow out any debris, dirt or copper sulfate in the tubing and pipeline.
2. Body installed horizontally with the actuator spring case pointing upward is recommended.
3. Use gaskets between pipeline and regulator flanges when installing a regulator with flanged end connections. Use approved piping procedures when installing the regulator.

Overpressure Protection



WARNING

Personal injury, equipment damage or leakage due to escaping accumulated liquid or bursting of pressure-containing parts may result if this backpressure regulator is:

- Overpressurized;
- Used with incompatible process fluid;

- Installed where service conditions could exceed the limits given in the Specifications section and on the appropriate nameplate; or
- Where conditions exceed any ratings of adjacent piping or piping connections.

To avoid such injury or damage, provide pressure-relieving or pressure-limiting devices to prevent service conditions from exceeding those limits.

Overpressuring any portion of this equipment may result in equipment damage, leaks in the backpressure regulator or personal injury due to bursting of pressure-containing parts. The system should be inspected after any overpressure condition.

The backpressure control range and maximum inlet pressure can be found in the Specifications section.

Startup



WARNING

To avoid possible personal injury, equipment damage or leakage due to escaping fluid, make certain the backpressure regulator is installed as instructed in the Installation section.

Escaping process fluid from an open bleed plug may result in backpressure regulator damage, personal injury and property damage. To avoid such injury and damage, make certain the bleed plug is properly closed after venting air.

Always open bleed plugs slowly. These plugs contain no packing, so some fluid weepage will occur when the plugs are opened. Operating personnel must protect themselves from exposure to system fluids.



CAUTION

Pressure gauges must always be used to monitor upstream pressure during startup.

1. Open the system shutoff valve.
2. Slowly open the outlet block valve.
3. Open the inlet block valve slightly and keep in this position until pressure is maintained at the desired setpoint and stabilized.
4. Slowly unscrew the bleed plug to exhaust air that might have been trapped in the actuator. Screw and tighten the plug. Exercise caution at all times.
5. If resetting setpoint, then set the regulator to the desired set pressure according to the Adjustment procedure.

Adjustment

WARNING

Personal injury, equipment damage or leakage due to escaping fluid may result if adjusting screw and jam nut are not installed properly.

Always use a pressure gauge to monitor pressure when making adjustments.

The backpressure regulator spring can be backed off to 0 psig / 0 bar. Recommended maximum inlet pressures and temperatures are shown in Table 1.

1. Loosen the jam nut.
2. To increase the setting, turn the adjusting screw clockwise. Turn the adjusting screw counterclockwise to decrease the setting.
3. Tighten the jam nut to maintain the desired setting.

Shutdown

WARNING

Escaping process fluid from an open bleed plug may result in backpressure regulator damage, personal injury and property damage. To avoid such injury and property damage, make certain the bleed plug is properly closed after bleeding process fluid.

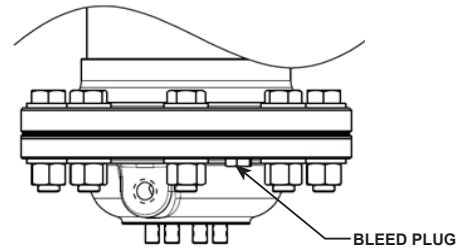


Figure 3. Diaphragm Case

1. Close the inlet block valve (see Figure 2).
2. Close the outlet block valve.
3. Turn the adjusting screw counterclockwise until all spring force from the backpressure regulator has been removed.
4. Slowly open the outlet block valve to release upstream pressure.
5. Slowly open bleed plug and make sure all pressure has been relieved from the control line.

Maintenance

WARNING

Personal injury, equipment damage or leakage due to escaping fluid may result if seals are not properly lubricated or maintained. Due to normal part wear or damage that may occur from external sources, this backpressure regulator should be inspected and maintained periodically. The frequency of inspection, maintenance and replacement of parts depends upon the severity of service conditions or the requirements of local, state and federal regulations.

Backpressure regulators that have been disassembled for repair must be tested for proper operation before being returned to service. Only parts manufactured by Emerson should be used for repairing Fisher™ backpressure regulators. Restart liquid utilization equipment according to normal startup procedures.

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Note

To protect against reduced performance, ensure vents are not plugged when conducting routine maintenance.

- Before maintenance, close the inlet and outlet block valves and exhaust the pressure in the valve body and piping as described in the Shutdown section.
- When removing or replacing parts such as the orifice or diaphragm, be careful not to damage it.
- Ensure movable parts can move freely after reassembly.
- Recommission according to the Installation and Startup procedures.
- Ensure all connections are tight and check for leaks.

Regular Maintenance

1. Make sure that there is no leakage on the backpressure regulator and tubing connections.
2. Observe the gauges to make sure that the pressure being controlled is stable and at the correct set point.
3. Ensure the pipeline system is clean and free of foreign materials.

Periodic Maintenance

1. Check Type CT88 backpressure regulator reset pressure. Slowly increase the inlet pressure until the outlet pressure starts to rise, then slowly decrease the inlet pressure until the outlet pressure stabilizes. Ensure that the downstream pressure does not increase.
2. Clean wear parts like the Disk, Diaphragm and Seat Ring. Make sure to check and replace deformed and worn out seals when necessary.
3. Check wear parts for damage and replace when necessary, replace O-rings after disassembly.

Maintenance Instructions for Actuator Replacement Parts (keys 15, 21, 22, 23, 56 and 68)

Refer to Figure 4 for the Type CT88 Actuator Assembly, Figure 5 for the NPS 2 / DN 50 body assembly drawing and Figure 6 for the NPS 3 and 4 / DN 80 and 100 body assembly drawing.

Actuator Disassembly

1. Isolate the Backpressure Regulator, relieve all pressure in body and actuator and relieve spring force by following the procedure described in the Shutdown section.
2. Loosen and remove sense line from diaphragm lower casing (key 54).
3. Loosen and remove 8 bolts (key 58), 8 nuts (key 57) and 8 washers (key 8) around the actuator flange.
4. Lift the upper casing (key 59) directly upward over the main spring (key 48). Set aside spring and upper spring seat (key 50).
5. Loosen and remove 2 hex nuts (keys 60 and 34) from stem (key 14)⁽¹⁾.
6. Remove lower spring seat (key 37), diaphragm plate (key 55) diaphragm (key 56), diaphragm head (key 36) and O-ring (key 68) upward and over stem (key 14)⁽¹⁾. Do not damage or remove pin (key 66) from diaphragm head (key 36).
7. Loosen and remove 4 screws (key 16) and 4 spring washers (key 17).
8. Carefully remove diaphragm lower casing (key 54) upward and over stem (key 14).
9. Remove bushing (key 20), 2 stem guides (key 21), O-rings (keys 22 and 23) upward over the stem (key 14).
10. Remove O-ring (key 15).

Actuator Assembly

1. Lightly lubricate O-ring (key 15) and place it into the body.
2. Carefully place the diaphragm lower casing on the body, make sure the thread holes on both of casing and body are aligned. The position of sense line pipe hole should be aligned with the sense line pipe hole of the body.
3. Place spring washers (key 17) on screw (key 16), apply lubricant to the thread of bolts.
4. Bolt body and casing together and tighten screws (key 16) securely using a multi-pass, criss-cross pattern. Torque values listed in Table 4.
5. Lightly lubricate O-ring (key 68) and mount it into the groove of diaphragm head (key 36); Insert the stem (key 14) through center of the diaphragm head, and press until it makes contact with

1. Refer to Figures 5 and 6.

diaphragm lower casing (key 54), make sure the ribs of the diaphragm head are aligned in between the screws (key 16) and washers (key 17).

- Lay the diaphragm (key 56) on the surface of diaphragm head (key 36); make sure all diaphragm holes are aligned with the pin (key 66) and the bolt holes of diaphragm lower casing (key 54) for the remainder of the assembly steps.

Note

Exercise care to ensure that the diaphragm (key 56) is not pinched, twisted or wrinkled while compressing between the upper and lower diaphragm casings (keys 59 and 54), diaphragm head and diaphragm plate (keys 5 and 36).

- Place the diaphragm plate (key 55) and lower spring seat (key 37) on the diaphragm in turn and tighten using two nuts (keys 34 and 60). Thin nut (key 34) is below the nut (key 60). Make sure the pin (key 66) is inserted into the hole of diaphragm plate (key 55). Tighten securely, torque values listed in Table 4.

Note

Hold the wrench flat on top of stem (key 14) while tightening the nuts (keys 34 and 60). Make sure the diaphragm does not move or become pinched, twisted or wrinkled.

- Insert upper spring seat (key 50) into the spring (key 48) and apply lubricant into the hole of the spring seat that contacts the adjusting screw (key 53) and to both ends of the spring.
- Place the spring (key 48) and upper spring seat (key 50) onto the lower spring seat (key 37).

Note

Make sure the position of stem and lower spring seat are at the center of the spring.

- Place the upper diaphragm casing (key 59) (along with other attached components) over the spring (key 48) and upper spring seat (key 50). Align the bolt holes of the upper diaphragm casing and lower diaphragm casing.
- Apply lubricant to the thread of 8 bolts (key 58) and insert the bolts down through the upper diaphragm casing (key 59) then through the lower diaphragm casing (key 54).

- Place 8 washers (key 8) and 8 nuts (key 57) onto the 8 bolts (key 58) from below the lower diaphragm casing (key 54). Tighten the nuts and bolts using a multi-pass, criss-cross pattern. Torque values listed in Table 4.

Maintenance Instructions for Body Replacement Parts (keys 2, 3, 7, 9, 10 and 11)

Refer to Figure 5 for maintenance instructions for NPS 2 / DN 50 body. Refer to Figure 6 for maintenance instructions for a NPS 3 and 4 / DN 80 and 100 body.

Body Disassembly

- Isolate the Backpressure Regulator, relieve all pressure in body and actuator and relieve spring force by following the procedure described in the Shutdown section.
- Loosen and remove 8 bolts (key 13) and 8 washers (key 8 for NPS 2 / DN 50 and key 26 for the NPS 3 and 4 / DN 80 and 100 body).
- Carefully, remove the bonnet (key 12) (along with all other attached components) upward and out of the body (key 1).

Note

Some components may stick together and seem to be connected. Be careful not to allow these components to drop or separate unexpectedly e.g. sleeve (key 6), O-rings (keys 7, 10 and 11) and sliding ring (key 9).

- Slide apart sliding ring (key 6) from piston (key 4) to access 2 sliding rings (key 9) and O-rings (keys 7 and 10).
- Remove cage (key 18), seat ring (key 3) and O-ring (key 2).
- Replace worn or damaged parts during assembly by following the procedure described in the Body Assembly section.

Body Assembly

- Clean the surface and interior of the body (key 1) by using penetrating oil, water removal spray, and/or air gun. Lightly lubricate O-ring (key 2) and place it on the corner of body/seat ring (key 3) intersection.

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Table 2. Troubleshooting

PROBLEM	POSSIBLE CAUSE	POSSIBLE SOLUTION
Backpressure regulator is not working	Backpressure regulator is undersized or oversized	Review sizing
	Damaged diaphragm	Replace diaphragm
	Restrictor or control line is blocked	Check restrictor and control line, clean debris
Backpressure regulator inlet pressure increases	Application flow rate exceeds product's advertised capacity	Review sizing
	O-ring in disk assembly damaged	Replace O-ring
	Debris caught in between disk and seat ring	Remove debris
Backpressure regulator lock-up pressure decreases	Damaged, deformed or worn out diaphragm	Replace diaphragm
	Deformed or worn out disk or seat ring	Replace disk or seat ring
	Damaged disk assembly O-ring	Replace O-ring
	Debris caught in between disk and seat ring	Clean or replace disk
Backpressure regulator inlet pressure fluctuates	Actual flow rate much lower than normal	Review sizing or check upstream equipment when upstream pressure fluctuates

Table 3. Spare Parts Kits⁽¹⁾

BODY SIZE		SPARE PART NUMBER
NPS	DN	
2	50	RCT88X00F22
3	80	RCT88X00F32
4	100	RCT88X00F42

1. Includes diaphragm, O-rings, stem guide, ring sliding, seat, etc.

2. Place the seat ring (key 3) onto the step inside the body carefully, make sure the O-ring (key 2) does not move.
3. Place the cage (key 18) into the groove of the seat ring (key 3).
4. Lightly lubricate O-ring (key 7) and 2 sliding rings (key 9), and install the O-ring and sliding rings into the grooves of the sleeve (key 6) in turn.
5. Lightly lubricate O-ring (key 10) and place it into the groove at the top of the sleeve (key 6).
6. Insert the trim assembly (key 4 and other attached components) through the sleeve/sliding ring/O-ring assembly (keys 6, 7 and 9) from top of the sleeve, make sure the O-ring (key 7) is not moved or damaged.
7. Lightly lubricate O-ring (key 11) and place into the corner of the body/bonnet interface (keys 1 and 12).
8. Insert trim assembly (key 4 and other attached components) and sleeve/sliding/O-ring assembly (keys 6, 7 and 9) into body (key 1), press until piston (key 4) contacts seat ring (key 3) and sleeve (key 6) contacts cage (key 18).

9. Carefully align the bonnet (key 12) on to body (key 1) into the correct orientation.

Note

The sense line hole in the lower diaphragm casing (key 54) should align with the sense line hole in the body (key 1).

10. Press bonnet (key 12) down until it contacts the body (key 1).
11. Apply the lubricant to thread of bolts (key 13), then bolt together the bonnet and body using washers (key 8 for NPS 2 / DN 50 and key 26 for the NPS 3 and 4 / DN 80 and 100 body). Tighten bolts using a multi-pass, criss-cross pattern by using a torque wrench. Torque values are listed in Table 4.

Parts Ordering

When corresponding with your local Sales Office about this regulator, include the type number and all other pertinent information stamped on the nameplate. Specify the part name when ordering new parts from the following parts list. Separate repair part kits containing all recommended elastomer spare parts are available.

Table 4. Torque Specifications

PART NAME	TORQUE FOR ALL BODY SIZES	
	Ft-Lb	N•m
Screw (key 16), 4 required	18.5 to 22.1	25 to 30
Bolts (key 42); Nuts (key 40)	20.7 to 23.6	28 to 32
Bolts (key 13), 8 required	NPS 2 / DN 50	44.3 to 55.3
	NPS 3 / DN 80	39.9 to 54.5
	NPS 4 / DN 100	69.4 to 94.4
Hex Nut (key 34)	11.8 to 14	16 to 19
Hex Nut (key 60)	15.5 to 17.7	21 to 24
Bolts (key 45)	18.5 to 22.1	25 to 30
Bolts (key 58), 8 required; Nuts (key 57)	45 to 54.5	61 to 74
Locknut (key 29)	15.5 to 17.7	21 to 24

Parts List

Key Description

	Type CT88 Spare Part Kits (Repair Parts kit includes Diaphragm, O-rings, Stem Guide, Ring Sliding, Seat, etc.) See Table 3
1	Body, Ductile Iron
2	O-ring, Fluorocarbon (FKM)
3	Seat Ring, Stainless steel/Fluorocarbon (FKM)
4	Piston, Stainless steel
5	Valve Spring, Stainless steel
6	Sleeve, Stainless steel
7	O-ring, Fluorocarbon (FKM)
8	Plate Washer, Steel NPS 2 / DN 50 (16 required) and NPS 3 and 4 / DN 80 and 100 (8 required)
9	Ring Sliding, 2 required, PTFE/ Molybdenum disulfide
10	O-ring, Fluorocarbon (FKM)
11	O-ring, Fluorocarbon (FKM)
12	Bonnet, Carbon steel
13	Bolt, 8 required, Steel
14	Stem, Stainless steel
15	O-ring, Fluorocarbon (FKM)
16	Screw, 4 required, Stainless steel
17	Spring Washer, 4 required, Stainless steel
18	Cage, Stainless steel
19	Plate, Stainless steel NPS 3 / DN 80 NPS 4 / DN 100
20	Bushing, Stainless steel
21	Stem Guide, 2 required, PTFE
22	O-ring, Fluorocarbon (FKM)
23	O-ring, Fluorocarbon (FKM)

Key Description

24	Plate Washer, 2 required, Steel
26	Plate Washer, 8 required, Steel NPS 3 / DN 80 NPS 4 / DN 100
29	Locknut, Stainless steel
30	Nameplate
31	Rivet, 6 required
34	Hex Nut, Steel
36	Diaphragm Head, Stainless steel
37	Lower Spring Seat, Lower, Stainless steel
44	Spring Case, Stainless steel
48	Spring, Yellow, Chromium Silicon, 30 to 145 psi / 2 to 10 bar
50	Upper Spring Seat, Carbon steel
51	Spring Cap, Carbon steel
52	Nut, Steel
53	Screw Adjusting, Steel
54	Lower Diaphragm Casing, Lower, Carbon steel
55	Diaphragm Plate, Stainless steel
56	Diaphragm, Fluorocarbon (FKM)
57	Nut, 8 required, Steel
58	Bolt, 8 required, Steel
59	Upper Diaphragm Casing, WCB or Carbon steel
60	Hex Nut, Steel
61	Flow Arrow
65	Drain Valve Manual, Brass
66	Pin, Steel
68	O-ring, Fluorocarbon (FKM)
69	Connector, Steel
67	Restrictor, Stainless steel

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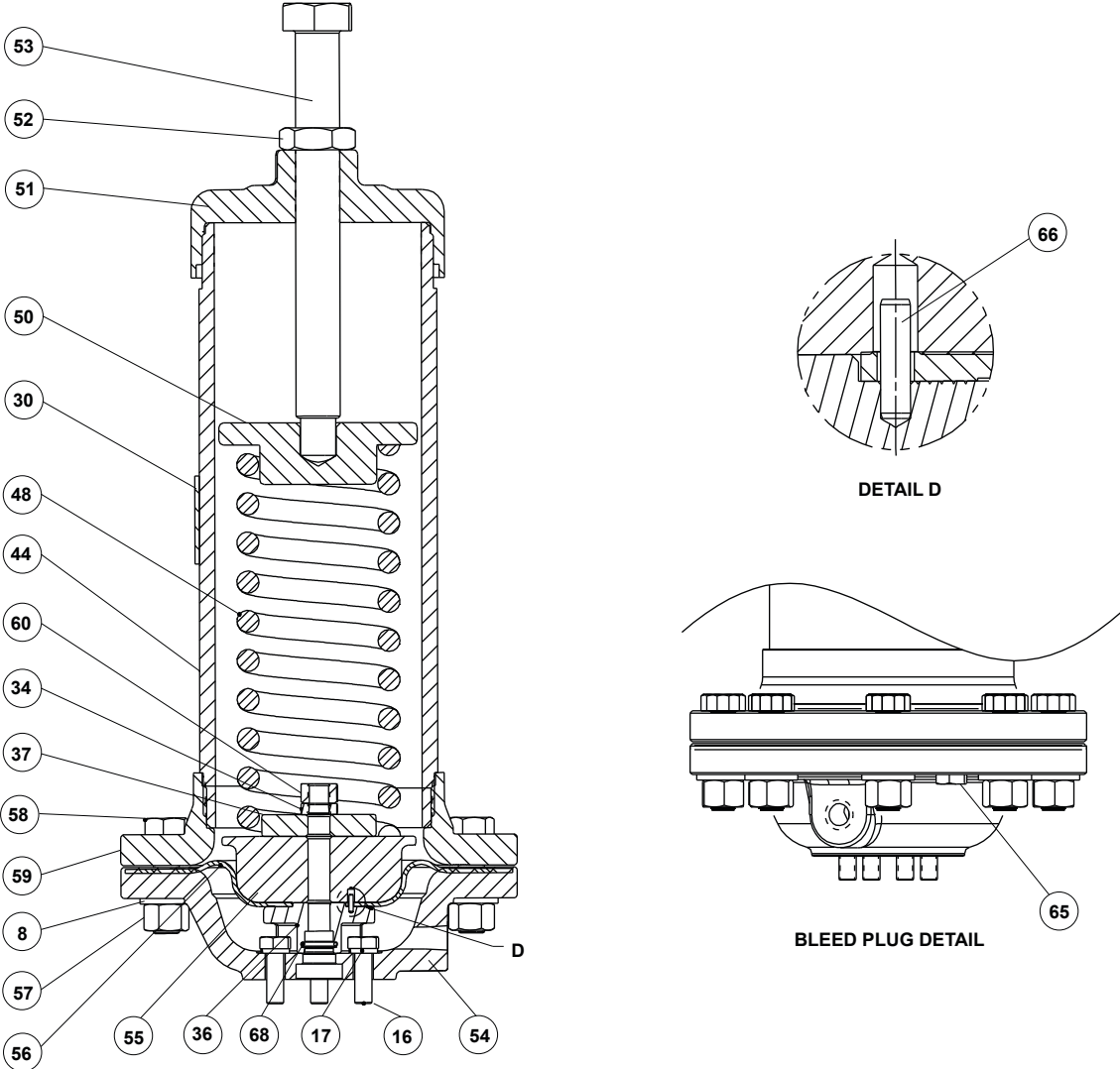


Figure 4. Type CT88 Actuator Assembly

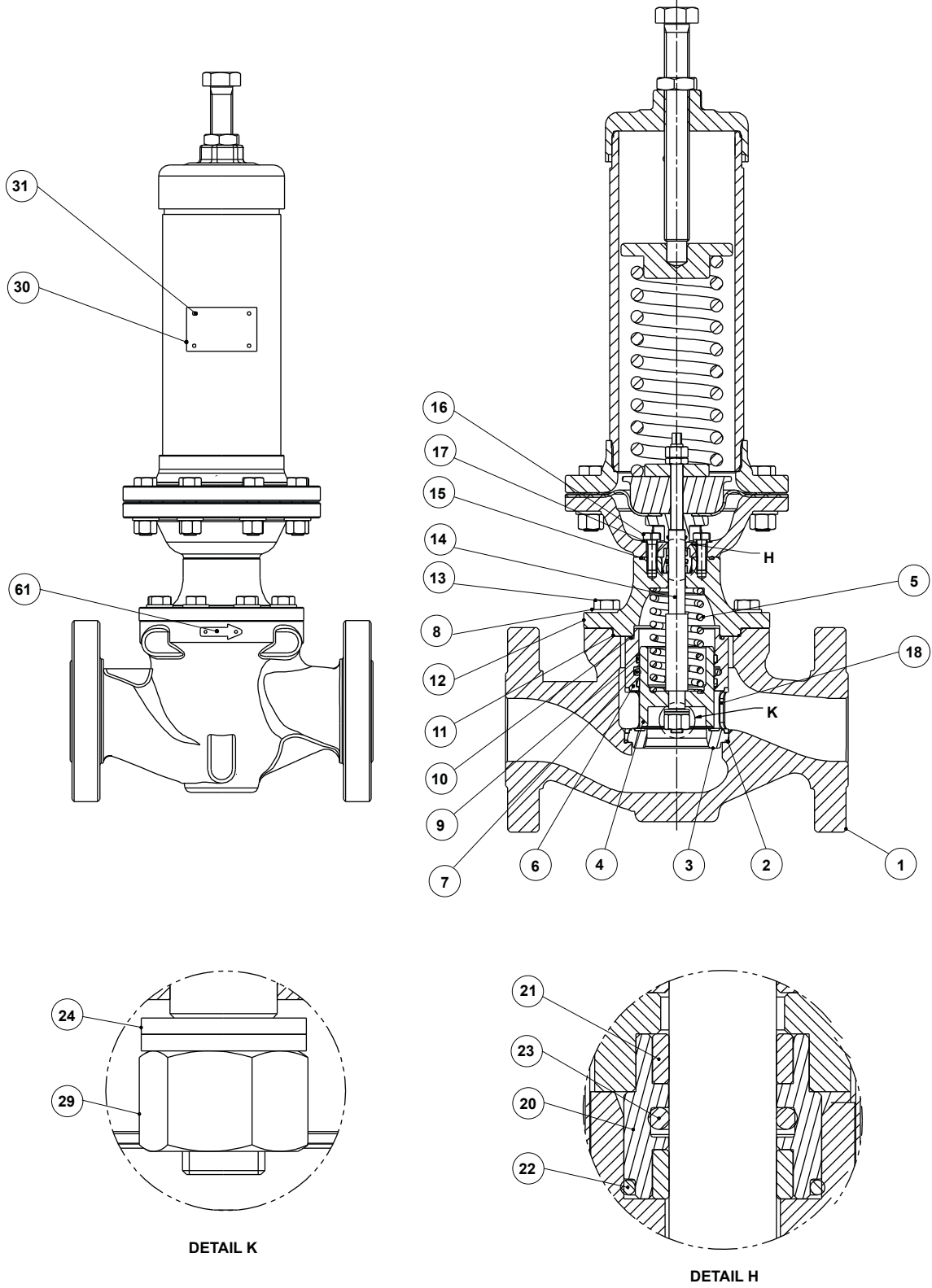


Figure 5. Type CT88 Body Assembly for NPS 2 / DN 50

Type CT88

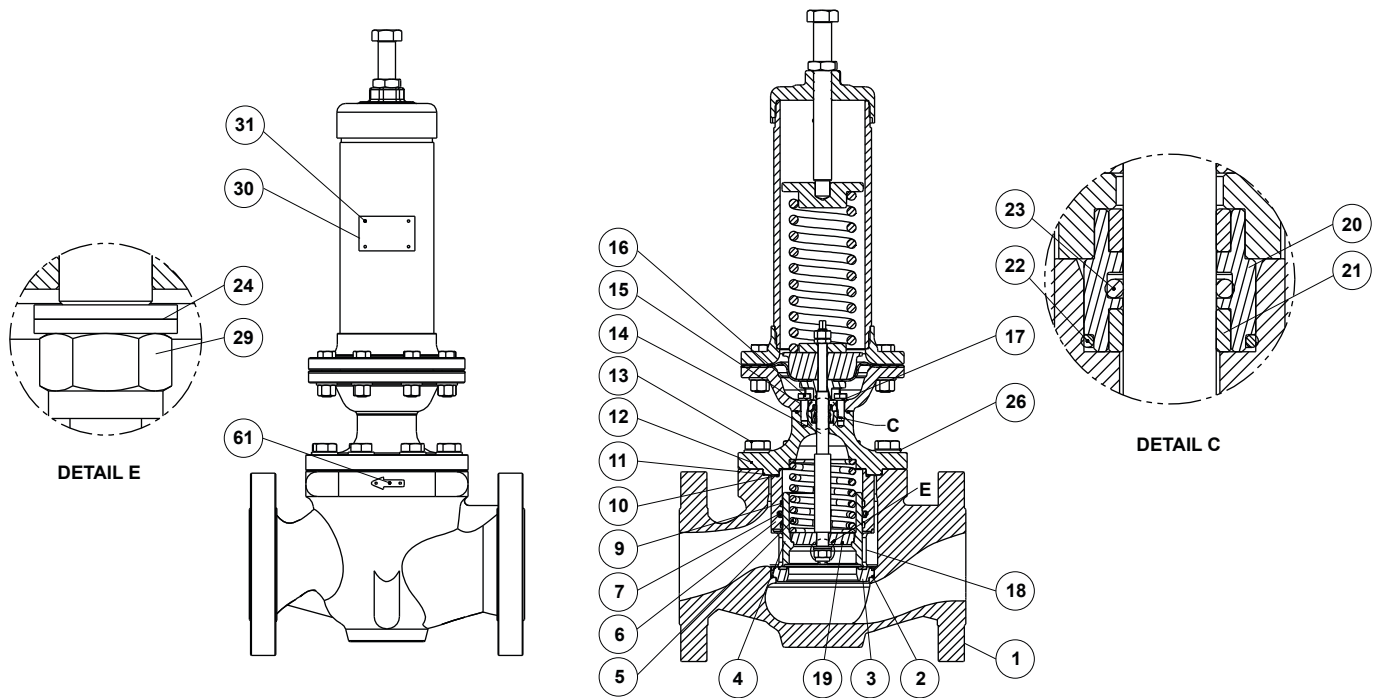


Figure 6. Type CT88 Body Assembly for NPS 3 and 4 / DN 80 and 100

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