

Type ACE97 Pad-Depad Valve

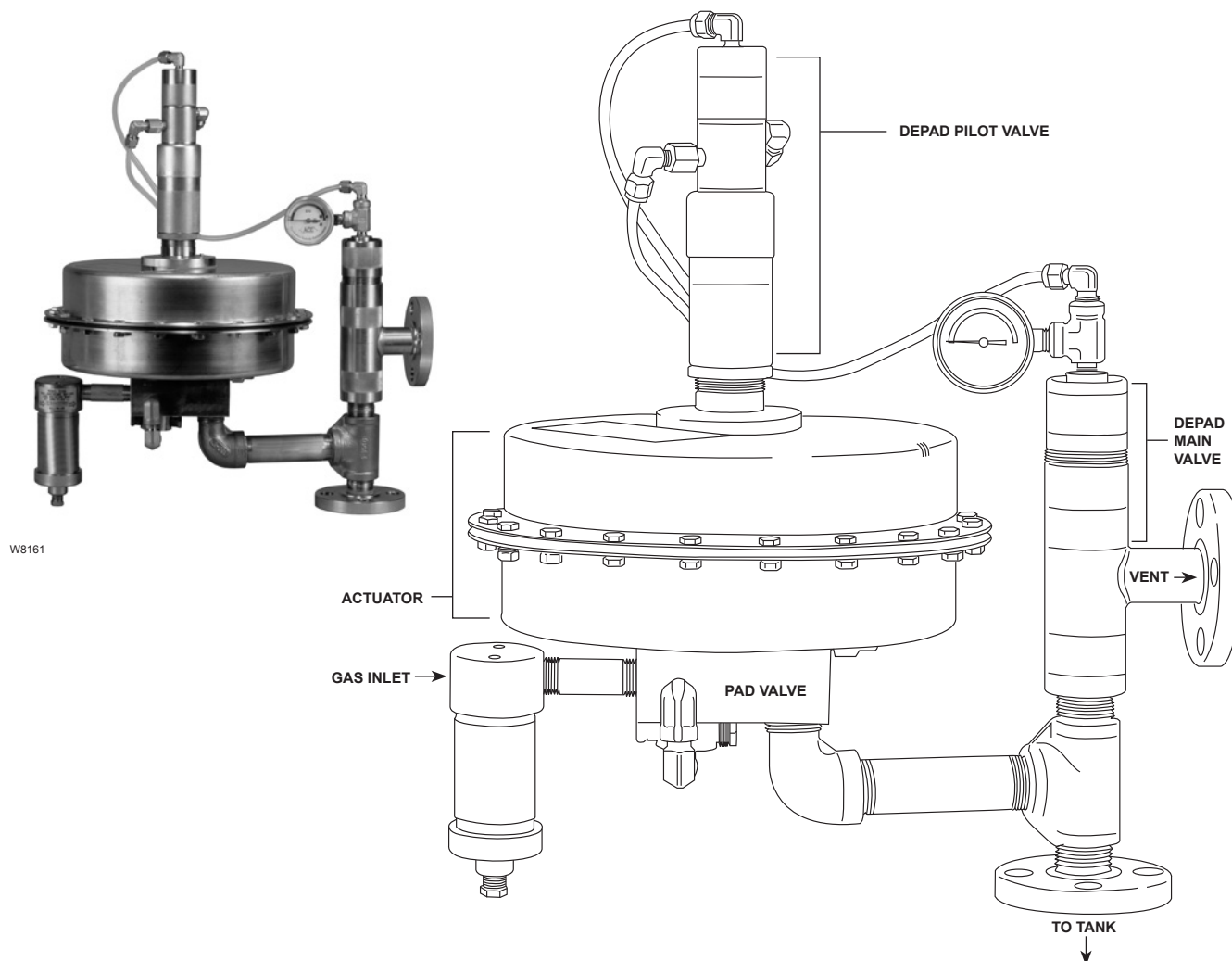


Figure 1. Type ACE97 Pad-Depad Valve (NPS 1/2 / DN 15 Pad Valve / 1 NPT Depad Valve Shown)



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® pad-depad valves must be installed, operated, and maintained in accordance with federal, state, and local codes, rules and regulations, and Emerson Process Management Regulator Technologies, Inc. (Regulator Technologies) instructions.

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Specifications

Ratings and specifications for the Type ACE97 Pad-Depad valve are listed in the Specifications section below. Factory specifications are stamped on the nameplate fastened to the actuator of the valve.

Pad (Tank Blanketing) Specifications

Pad Body Sizes and End Connection Styles

1/2, 1, and 2 NPT
NPS 1/2, 1, and 2 / DN 15, 25, and 50
CL150 RF

Maximum Operating Inlet Pressure⁽¹⁾

200 psig / 13,8 bar

Maximum Main Valve Inlet Pressure⁽¹⁾

200 psig / 13,8 bar

Inlet Operating Ranges⁽¹⁾

NPS 1/2 / DN 15 pad valve:

25 to 200 psig / 1,7 to 13,8 bar

NPS 1 and 2 / DN 25 and 50 pad valves:

25 to 50 psig / 1,7 to 3,4 bar

51 to 120 psig / 3,5 to 8,2 bar

121 to 200 psig / 8,3 to 13,8 bar

Control Pressure Ranges⁽¹⁾

See Table 1

Maximum and Minimum Differential Pressures⁽¹⁾

25 psig / 1,7 bar minimum

200 psig / 13,8 bar maximum

Maximum Backpressure⁽¹⁾

20 psig (1,4 bar)

Flow Coefficients for Relief Valve Sizing (110% of rated C_v)

NPS 1/2 / DN 15:

C_v 0.2 use C_v 0.22

C_v 0.4 use C_v 0.44

NPS 1 / DN 25:

C_v 1 use C_v 1.1

C_v 2 use C_v 2.2

C_v 4 use C_v 4.4

C_v 7.5 use C_v 8.25

C_v 10 use C_v 11

NPS 2 / DN 50:

C_v 20 use C_v 22

C_v 45 use C_v 50

C_v 60 use C_v 66

Depad (Vapor Recovery) Specifications

Depad Body Sizes

1 and 2 NPT

NPS 3 and 4 / DN 80 and 100

Depad Pressure Ranges⁽¹⁾

See Table 1

Valve Coefficients (110% of rated C_v)

1 NPT:

C_v 3 use C_v 3.3

C_v 6 use C_v 7

C_v 12 use C_v 13

C_v 17 use C_v 19

2 NPT:

C_v 20 use C_v 22

C_v 35 use C_v 39

C_v 70 use C_v 77

NPS 3 / DN 80:

C_v 90 use C_v 99

C_v 115 use C_v 127

C_v 140 use C_v 154

NPS 4 / DN 100:

C_v 150 use C_v 165

C_v 200 use C_v 220

C_v 280 use C_v 308

General Type ACE97 Specifications

Pressure Registration

External

Temperature Capabilities

Nitrile (NBR):

-20° to 180°F / -29° to 82°C

Fluorocarbon (FKM):

0° to 212°F / -18° to 100°C

Ethylene propylene (EPDM - FDA):

-20° to 212°F / -29° to 100°C

Perfluoroelastomer (FFKM):

-20° to 212°F / -29° to 100°C

Approximate Weights

NPS 1/2 x 1 x 1 / DN 15 x 25 x 25:

70 pounds / 32 kg

NPS 1 x 2 x 2 / DN 25 x 50 x 50:

105 pounds / 48 kg

NPS 2 x 3 x 3 / DN 50 x 80 x 80:

175 pounds / 79 kg

1. The pressure/temperature limits in this Instruction Manual or any applicable standard limitation should not be exceeded.

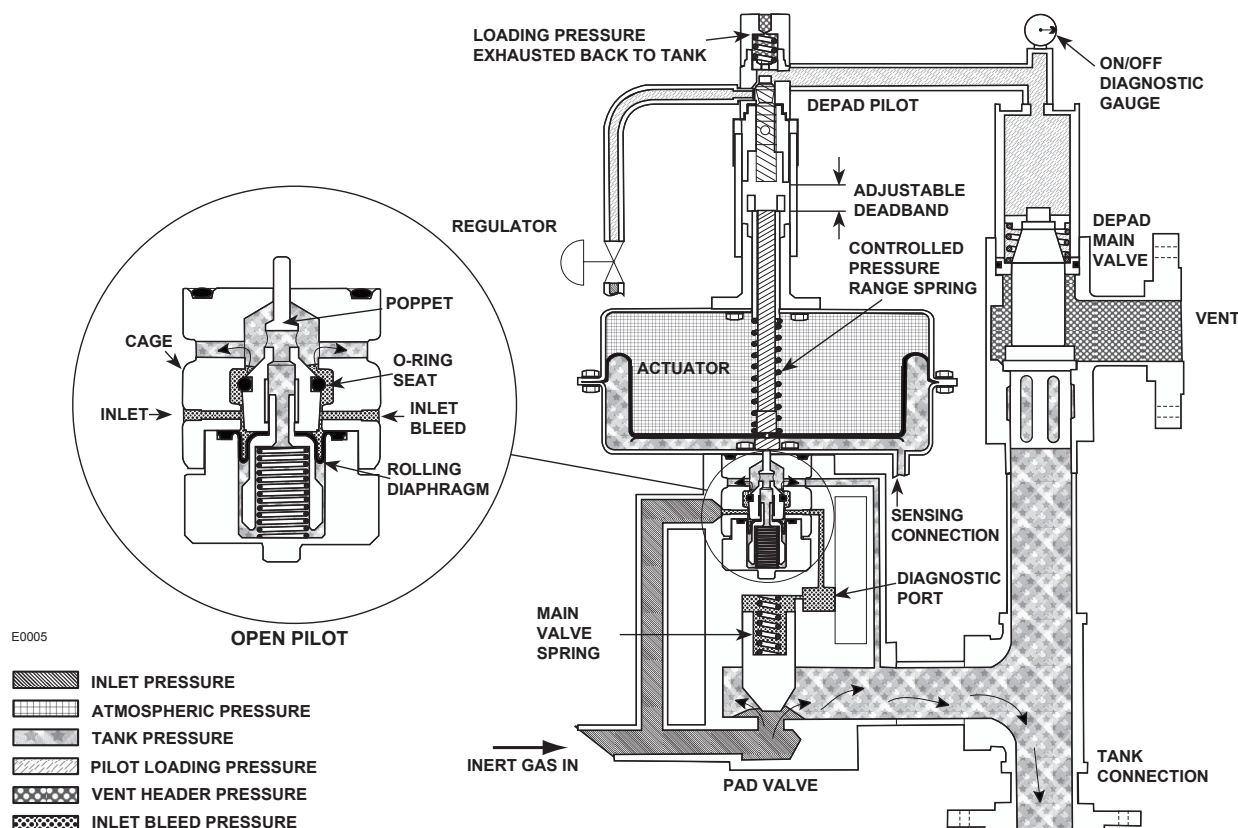


Figure 2. Type ACE97 Pad On / Depad Off

Table 1. Actuator Spring Pressure Ranges

CONTROL PRESSURE RANGES				SPRING FREE LENGTH		SPRING WIRE DIAMETER	
Pad Setpoint		Depad Setpoint (Above Pad)		INCHES	mm	INCHES	mm
inches w.c.	mbar	inches w.c.	mbar				
0.5 to 3-	1 to 7	4 to 10	10 to 25	3.08	78,2	0.105	2,67
0.5 to 7	1 to 17	4 to 6	10 to 15	4.0	102	0.092	2,34
3 to 13	7 to 32	4 to 16	10 to 40	3.73	94,7	0.156	3,96
4 to 10	10 to 25 ⁽¹⁾	16 to 78	40 to 194 ⁽¹⁾	3.73 2.90	94,7 73,7	0.156 0.250	3,96 6,35
0.5 to 1.4 psig	34 to 97 mbar	0.25 to 1 psig	17 to 69	3.8	96,5	0.250	6,35
1.0 to 2.2 psig	69 to 152 mbar	0.25 to 2 psig	17 to 138	3.8	96,5	0.313	7,95

1. Two nested springs are used (See Figure 12).

If a leak develops or if the unit or outlet continually vents gas, 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. Use qualified

personnel when installing, operating, and maintaining the Type ACE97 pad-depad valve.

Introduction

Scope of the Manual

This instruction manual provides installation, startup, maintenance, and parts ordering information for the Type ACE97 Pad-Depad valve (Figure 1). The product photo may vary depending on the size of the valve ordered.

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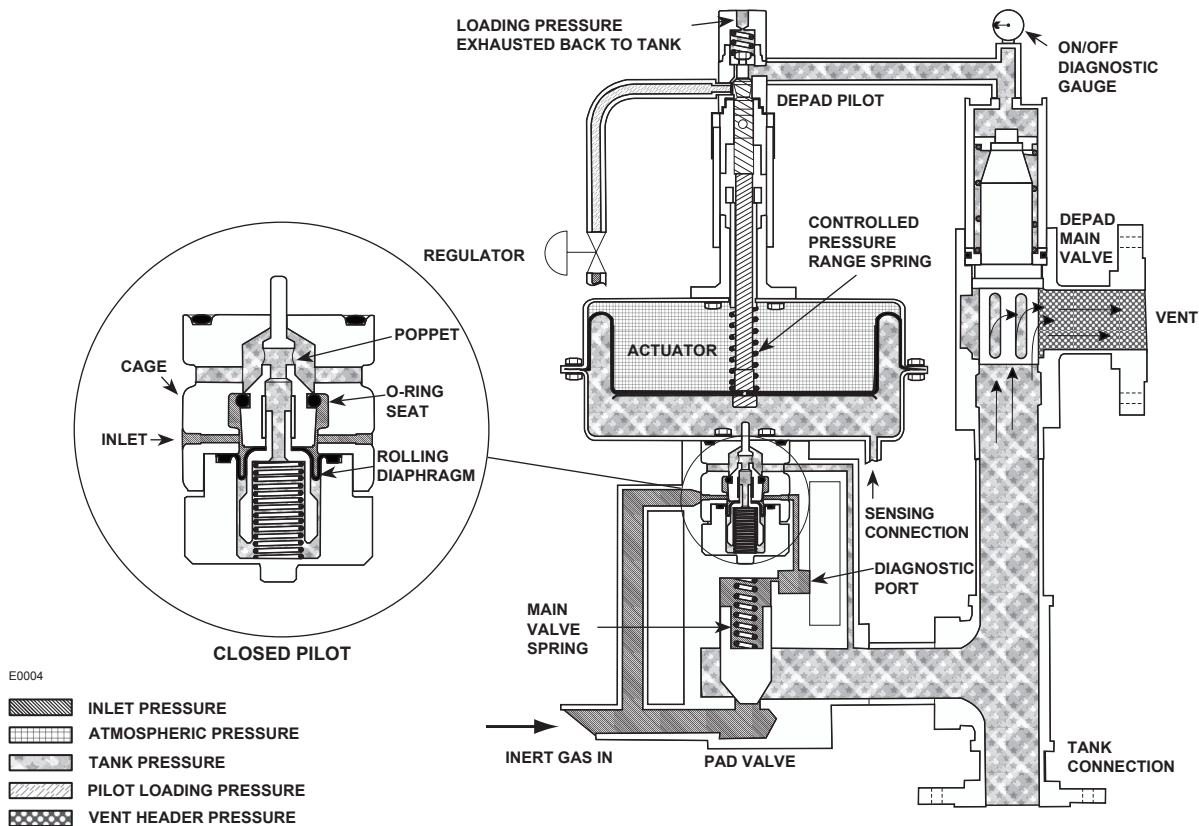


Figure 3. Type ACE97 Pad Off / Depad On

Product Description

The Type ACE97 Pad-Depad valve is a self-contained, pilot-operated valve that maintains a blanket of inert gas on top of a stored product to protect it from atmospheric contamination. It reduces combustibility, decreases vaporization, controls vapor space pressure during pump-in and pump-out operations, and prevents the tank from entering a vacuum condition and collapsing upon itself. The Type ACE97 valve provides excellent and accurate pressure control of the vapor space in the tank. Blanketing pressure is kept to a minimum in order to conserve the use of blanketing gas.

Pad (tank blanketing) is used to describe the process of replacing the vapor space of a storage tank with an inert gas.

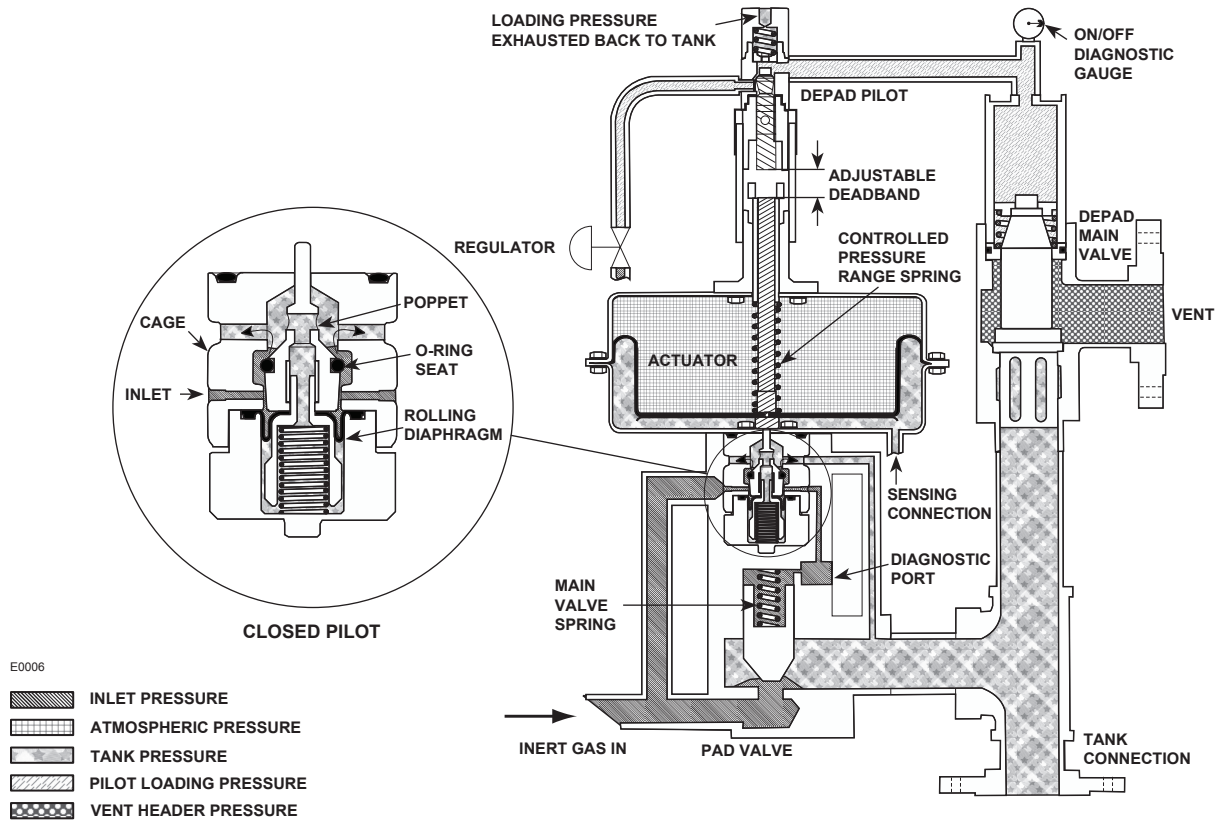
Depad (vapor recovery) is used to describe the process of relieving or venting the vapor space as a result of pressure rise.

Tank and vapor recovery connections are available to meet most customer requirements. A Single Array Manifold (S.A.M) provides a single tank and sensing connection and is required for tanks having a single nozzle. Accessories include gauges, purge meters, pressure switches, and check valves.

Principle of Operation

Type ACE97 pilot-operated valves (except for the NPS 1/2 / DN 15 pad valve) control the vapor space pressure over a stored liquid. The unit is stainless steel and is controlled by a very large actuator diaphragm. The oversized actuator diaphragm offers high sensitivity to changes in tank pressure. When a storage tank cools and tank vapors condense, Type ACE97 pad (tank blanketing) valves replace the condensing vapors with an inert gas to prevent internal tank pressure from decreasing. Positive tank pressure prevents outside air from contaminating the product and reduces the possibility of atmospheric pressure collapsing the tank.

Additionally, Type ACE97 valves provide depad (vapor recovery) capabilities through the depad main valve and depad pilot valve. When the temperature outside the tank rises causing the vapor inside the tank to expand, Type ACE97 depad valve vents the excess tank pressure to a safe place.



NPS 1 and 2 / DN 25 and 50 Pad Valves (Figure 2)

When tank pressure decreases below the pad setpoint (due to pump-out operations or thermal cooling), the actuator diaphragm moves downward pushing open the pad pilot. This creates flow from the pad loading chamber to downstream. When pad loading pressure decreases, the force created by inlet pressure on the pad main valve plug overcomes the main spring force and opens the main valve plug allowing flow through the pad valve to the tank. Once tank pressure reaches pad setpoint, the pad pilot closes, pad loading pressure equalizes with inlet pressure and the pad valve closes.

NPS 1/2 / DN 15 Pad Valve (Not Shown)

The NPS 1/2 / DN 15 pad valve has a main valve only. When tank pressure decreases below the pad setpoint the actuator diaphragm moves downward pushing the valve plug open and allowing flow through the pad valve to the tank.

Depad (Figure 3)

When tank pressure increases above the depad setpoint (due to pump-in operations or thermal heating), the actuator diaphragm moves upward and pushes open the depad pilot. This releases depad loading pressure (nitrogen or other supply gas). When depad pilot loading pressure decreases, the depad main valve opens by a spring and allows flow from the tank to the vent or recovery system.

The blanketing (padding) gas is used as the pilot fluid. The link between the actuator and the depad main valve is provided by the depad pilot valve, which is located on top of the actuator. The depad pilot valve is connected to the actuator by an adjustable coupling, which can be rotated to adjust the depad setpoint. A locknut is provided on the depad pilot valve to secure the setpoint adjustment.

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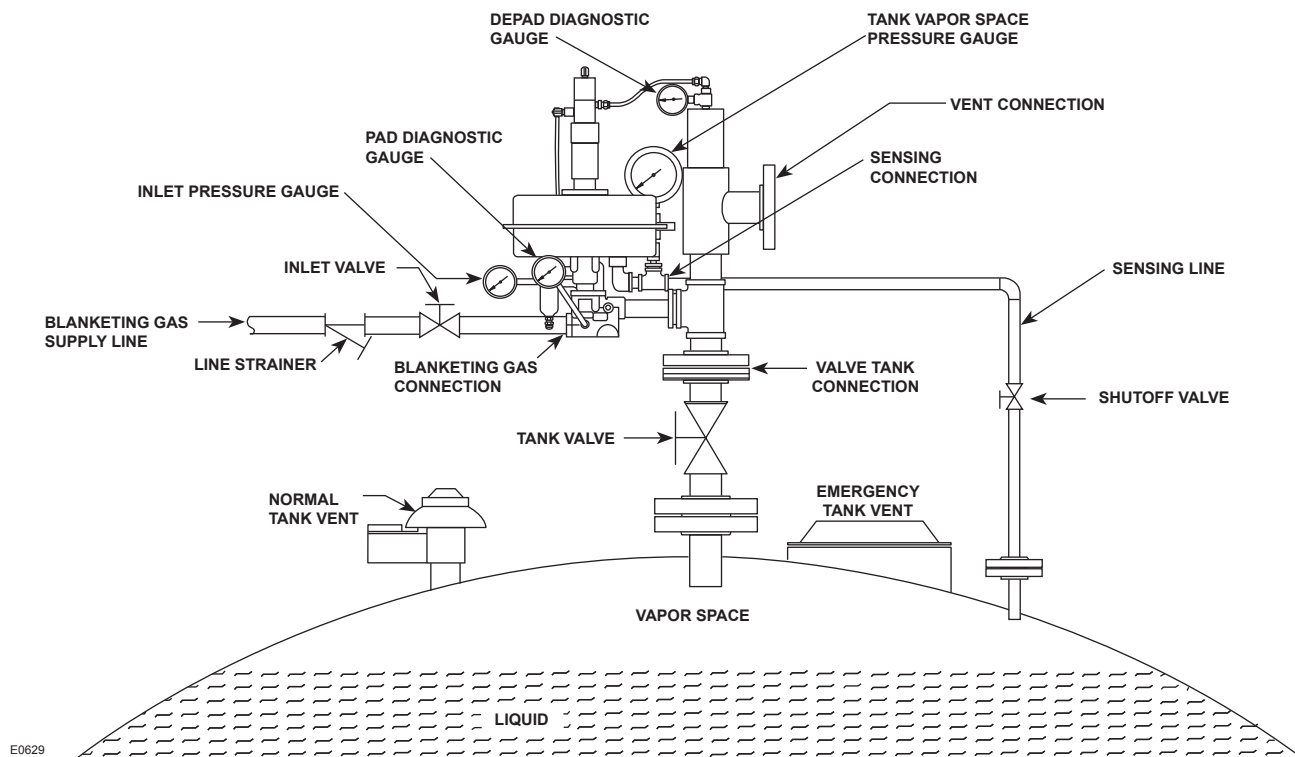


Figure 5. Type ACE97 Pad-Depad Valve Installation

Installation and Startup



WARNING

Personal injury, equipment damage, or leakage due to escaping accumulated gas or bursting of pressure-containing parts may result if this gas blanketing system is overpressured or installed where service conditions could exceed the limits given in the Specifications section or on the valve nameplate, or where conditions exceed any ratings of the adjacent piping, piping connections, or compatibility of valve materials with process fluids.

To avoid such injury or damage, provide pressure-relieving or pressure-limiting devices (as required by Title 49, Part 192, of the U.S. Code of Federal Regulations, by the National Fuel Gas Code Title 54 of the National Fire Codes of the National Fire Protection Agency, or by other applicable codes) to prevent service conditions from exceeding those limits.

Additionally, physical damage to the tank blanketing system could result in personal injury and property damage due to escaping gas or tank contents. To avoid such injury and damage, install the tank blanketing valve in a safe location.

The Type ACE97 Pad-Depad valve is assembled and preset to the customer specified pressure and setpoint. The pressure ranges of the valve are stamped on the nameplate attached to the upper actuator case.

1. Use qualified personnel when installing, operating, and maintaining valves. Before installing, inspect the main valve, pilot, and tubing for any shipment damage or foreign material that may have collected. Ensure that the body interior is clean and the pipelines are free of foreign material. Apply pipe compound only to the external pipe threads with a threaded body, or use suitable line gaskets and good bolting practices with a flanged body.
2. Inspect the nameplate on the upper actuator case. It displays the model number, serial number, blanketing gas supply pressure range, maximum inlet pressure, C_v value, and set pressures. These

must agree with the system that you are Padding (blanketing) or Depadding (recovering). The serial number will be needed in any communication with your local Sales Office.

3. Clean the gas padding (blanketing) supply lines of all dirt and foreign material before connecting them to the Type ACE97 Pad-Depad valve.
4. The valve should be mounted above the tank with the actuator case in a horizontal position. Four connections are required (see Figure 5):
 - a. Blanketing gas supply to the valve
 - b. Vapor recovery/process connection (vent)
 - c. System tank connection
 - d. Sensing line to the tank

Piping Considerations

Piping must be capable of supporting the weight of the system. Use pipe supports when necessary. Refer to Figure 5.

Inlet Piping

The padding (blanketing) gas supply line should be equipped with a Number 100 mesh strainer to remove dirt and pipe scale. Inlet piping must be sized to adequately deliver padding (blanketing) gas at the specified inlet pressure under full flow conditions.



CAUTION

Undersized piping may inadequately deliver Padding (blanketing) gas at the specified inlet pressure under full flow conditions. This may result in unacceptable performance under high demand conditions.

Outlet Piping

Valve outlet is piped into the tank vapor space. Outlet piping should be self-draining to the tank and of equal or greater size than the Type ACE97 valve tank connection. The valve should be situated above and as close as possible to the tank vapor space for best performance.



CAUTION

Unnecessarily long or restricted outlet piping may result in poor setpoint control.

Sensing Line

The sensing line should be 1/2-inch / 13 mm tubing or pipe, must slope toward the tank, and should not contain low points (or traps) that could catch liquid. The sensing line must enter the tank above the liquid level at a point that senses the vapor space pressure and is free from turbulence associated with tank nozzles or vents.

Note

Best control is obtained when both connections to the tank are separate. If the tank has only one available nozzle, contact Regulator Technologies for alternate methods of installation. A Single Array Manifold (S.A.M.) is available for such situations.

Vent Connection

The vent connection must be self-draining, facing away from the valve, and of equal or greater size than the valve tank connection.

Tank Venting

The tank may require normal and emergency vents. The Type ACE97 Pad-Depad valve does not perform these functions, it only controls the vapor space pressure under process conditions.

Diagnostic Gauges

An on/off diagnostic gauge is mounted on the depad main valve at the inlet to the cylinder. The face on the gauge is marked to indicate whether the main pad valve is opened, closed, or throttled.

Shutoff Valves

Note

Safety considerations may dictate shutoff valves between the tank and Type ACE97 valve.

Inlet (isolation) valves are desirable for servicing the Type ACE97 valve. If this valve was not ordered with an inlet pressure gauge, it is advisable to install a gauge between the inlet isolation (full-port) valve and the padding (blanketing) valve.

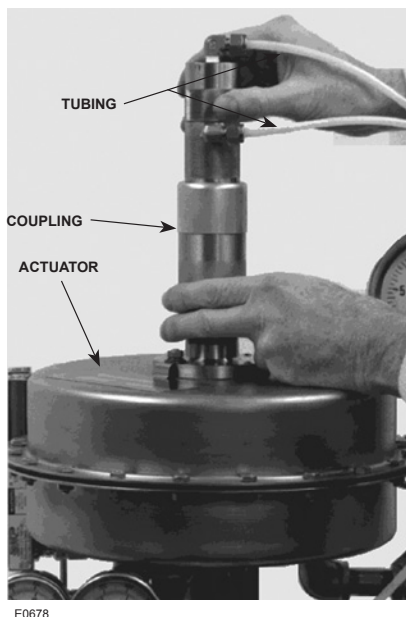


Figure 6. Unthreading the Adjusting Coupling

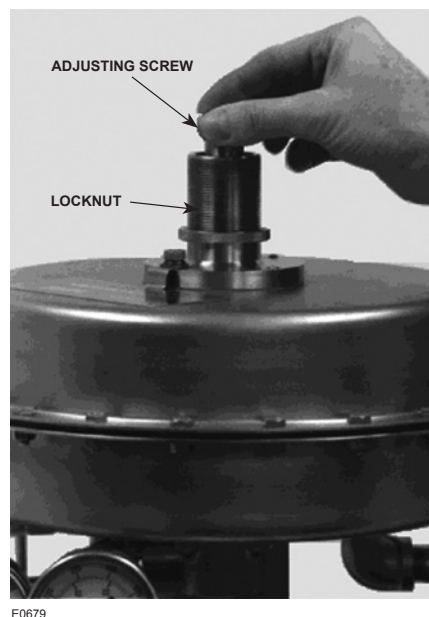


Figure 7. Changing the Pad Setpoint

Startup, Adjustment, and Shutdown



CAUTION

If required, tank vents (normal and emergency) must be in place and operating.

Startup



CAUTION

Always open the tank shutoff valve prior to the inlet shutoff valve. Failure to do so could result in inlet pressure being applied to the actuator casing, potentially damaging it. Refer to Figure 5.

1. Open the tank and sensing line shutoff valves (between the Type ACE97 valve and tank).
2. A tank vapor space pressure gauge should be installed and visible.
3. Slowly open the inlet shutoff valve (to the pad valve) and leave it fully open.
4. Monitor the tank vapor space pressure.

Adjustment

The setpoint of this unit is factory set. If an adjustment is to be made, it should be made in small increments while the unit is controlling tank pressure. It is difficult to make field adjustments due to the slow changes in tank pressure.

To change the pad (blanketing) setpoint:

1. Disconnect the tubing from the depad pilot valve (See Figure 6).
2. Loosen the locknut (See Figure 7), but maintain its position in relation to the adjusting coupling. Doing so leaves the depad setpoint unchanged.
3. Separate the depad pilot valve from the actuator by unthreading and removing.
4. Unthread and remove the adjusting coupling.
5. Increase the pad setpoint by turning the adjusting screw clockwise. (Turning the screw counterclockwise decreases the setpoint). See Figure 7.
6. Replace the depad adjusting collar against the locknut to re-establish the depad setpoint.

To change the depad setpoint:

1. Loosen the locknut below the adjusting coupling.
2. Rotate the collar to change the setpoint. (The bottom of the coupling—nearest the locknut—is left-hand threaded).
3. Tighten the locknut.

Table 2. Diagnostic Analysis Pressure Ranges

DIAGNOSTIC	STATUS
Equal to inlet supply pressure	Pilot and main valves are closed. Tank pressure is at or above set pressure.
Slightly below inlet supply pressure	Pilot valve supplies gas to tank. Tank pressure is just below set pressure.
Well below inlet supply pressure	Pilot and main valves are both supplying gas to the tank. Tank pressure is below setpoint.

Shutdown

In any installation it is important to open and close valves slowly and to close the inlet shutoff valve first when shutting down the system.

Maintenance

Valve parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and replacement of parts depend on the severity of service conditions and the requirements of local, state, and federal regulations. Due to the care Regulator Technologies takes in meeting all manufacturing requirements, use only replacement parts manufactured or furnished by Regulator Technologies.

All O-rings, gaskets, and seals should be lubricated with a good grade of general purpose lubricant and installed gently rather than forced into position. Approved lubricants, sealants, thread protectors, and adhesives are as follows:

Lubricants: Dow Corning® #111, Dow Corning® #3452 Chemical Resistant Lubricant

Thread Protector: Anti-Seize

Sealant: Loctite® PST #592, Polytetrafluoroethylene (PTFE) Tape

Adhesive: Loctite® #222

Be certain that nameplates are updated to accurately indicate any field changes in equipment, materials, service conditions, or pressure settings.

Monthly Maintenance

1. Visually inspect the unit to ensure tight connections, tight seals, and safe operation.
2. Observe the pad and depad (tank blanketing and vapor recovery) pressures.
3. Inspect the inlet pressure for the proper range (stamped on the valve nameplate).

Table 3. Diagnostics Table: C_v 1 through 4, Inlet Pressure Range Spring 25 to 50 psig / 1,7 to 3,4 bar

ACTUAL INLET SUPPLY PRESSURE TO VALVE		DIAGNOSTIC PORT PRESSURE					
		Pressure when Pilot Starts to Open		Pressure when Main Valve Starts to Open		Pressure when Main Valve is Fully Open	
psig	bar	psig	bar	psig	bar	psig	bar
25	1,7	24	1,7	9	0,62	2	0,14
30	2,1	29	2,0	13	0,90	6	0,41
35	2,4	34	2,3	16	1,1	9	0,62
40	2,8	39	2,7	20	1,4	13	0,90
45	3,1	44	3,0	24	1,7	17	1,2
50	3,4	49	3,4	28	1,9	21	1,4

Table 4. Diagnostics Table: C_v 1 through 4, Inlet Pressure Range Spring 51 to 120 psig / 3,5 to 8,3 bar

ACTUAL INLET SUPPLY PRESSURE TO VALVE		DIAGNOSTIC PORT PRESSURE					
		Pressure when Pilot Starts to Open		Pressure when Main Valve Starts to Open		Pressure when Main Valve is Fully Open	
psig	bar	psig	bar	psig	bar	psig	bar
51	3,5	50	3,4	29	2,0	5	0,35
60	4,1	59	4,1	36	2,5	12	0,83
70	4,8	69	4,8	43	3,0	19	1,3
80	5,5	79	5,4	51	3,5	27	1,9
90	6,2	89	6,1	59	4,1	34	2,3
100	6,9	99	6,8	66	4,5	42	2,9
110	7,6	109	7,5	74	5,1	50	3,4
120	8,3	119	8,2	81	5,6	57	3,9

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Table 5. Diagnostics Table: C_v 1 through 4, Inlet Pressure Range Spring 121 to 200 psig / 8,3 to 13,8 bar

ACTUAL INLET SUPPLY PRESSURE TO VALVE		DIAGNOSTIC PORT PRESSURE					
		Pressure when Pilot Starts to Open		Pressure when Main Valve Starts to Open		Pressure when Main Valve is Fully Open	
psig	bar	psig	bar	psig	bar	psig	bar
121	8,3	120	8,3	74	5,1	30	2,1
130	9,0	129	8,9	81	5,6	37	2,5
140	9,6	139	9,6	88	6,1	45	3,1
150	10,3	149	10,3	96	6,6	53	3,6
160	11,0	159	10,9	104	7,2	60	4,1
170	11,7	169	11,7	111	7,6	68	4,7
180	12,4	179	12,3	119	8,2	75	5,2
190	13,1	189	13,0	127	8,8	83	5,7
200	13,8	199	13,7	134	9,2	91	6,3

Table 6. Diagnostics Table: C_v 7.5 through 10, Inlet Pressure Range Spring 25 to 50 psig / 1,7 to 3,4 bar

ACTUAL INLET SUPPLY PRESSURE TO VALVE		DIAGNOSTIC PORT PRESSURE					
		Pressure when Pilot Starts to Open		Pressure when Main Valve Starts to Open		Pressure when Main Valve is Fully Open	
psig	bar	psig	bar	psig	bar	psig	bar
25	1,7	24	1,7	11	0,76	0	0,00
30	2,1	29	2,0	14	0,96	3	0,21
35	2,4	34	2,3	17	1,2	6	0,41
40	2,8	39	2,7	21	1,4	9	0,62
45	3,1	44	3,0	24	1,7	13	0,89
50	3,4	49	3,4	27	1,9	16	1,1

Table 7. Diagnostics Table: C_v 7.5 through 10, Inlet Pressure Range Spring 51 to 120 psig / 3,5 to 8,3 bar

ACTUAL INLET SUPPLY PRESSURE TO VALVE		DIAGNOSTIC PORT PRESSURE					
		Pressure when Pilot Starts to Open		Pressure when Main Valve Starts to Open		Pressure when Main Valve is Fully Open	
psig	bar	psig	bar	psig	bar	psig	bar
51	3,5	50	3,4	24	1,7	3	0,21
60	4,1	59	4,1	30	2,1	9	0,62
70	4,8	69	4,8	36	2,5	15	1,0
80	5,5	79	5,4	42	2,9	22	1,5
90	6,2	89	6,1	49	3,4	28	1,9
100	6,9	99	6,8	55	3,8	34	2,3
110	7,6	109	7,5	61	4,2	41	2,8
120	8,3	119	8,2	68	4,7	47	3,2

Table 8. Diagnostics Table: C_v 7.5 through 10, Inlet Pressure Range Spring 121 to 200 psig / 8,3 to 13,8 bar

ACTUAL INLET SUPPLY PRESSURE TO VALVE		DIAGNOSTIC PORT PRESSURE					
		Pressure when Pilot Starts to Open		Pressure when Main Valve Starts to Open		Pressure when Main Valve is Fully Open	
psig	bar	psig	bar	psig	bar	psig	bar
121	8,3	120	8,3	63	4,3	31	2,1
130	9,0	129	9,0	69	4,8	37	2,5
140	9,6	139	9,6	75	5,2	43	3,0
150	10,3	149	10,3	82	5,6	49	3,4
160	11,0	159	10,9	88	6,1	56	3,9
170	11,7	169	11,7	94	6,9	62	4,3
180	12,4	179	12,3	101	7,0	68	4,7
190	13,1	189	13,0	107	7,4	75	5,2
200	13,8	199	13,7	113	7,8	81	5,6

Table 9. Diagnostics Table: C_v 20 through 60, Inlet Pressure Range Spring 25 to 50 psig / 1,7 to 3,4 bar

ACTUAL INLET SUPPLY PRESSURE TO VALVE		DIAGNOSTIC PORT PRESSURE					
		Pressure when Pilot Starts to Open		Pressure when Main Valve Starts to Open		Pressure when Main Valve is Fully Open	
psig	bar	psig	bar	psig	bar	psig	bar
25	1,7	24	1,7	16	1,1	5	0,21
30	2,1	29	2,0	20	1,4	9	0,62
35	2,4	34	2,3	24	1,6	14	0,96
40	2,8	39	2,7	29	2,0	18	1,2
45	3,1	44	3,0	33	2,2	23	1,6
50	3,4	49	3,4	38	2,6	27	1,9

Table 10. Diagnostics Table: C_v 20 through 60, Inlet Pressure Range Spring 51 to 120 psig / 3,5 to 8,3 bar

ACTUAL INLET SUPPLY PRESSURE TO VALVE		DIAGNOSTIC PORT PRESSURE					
		Pressure when Pilot Starts to Open		Pressure when Main Valve Starts to Open		Pressure when Main Valve is Fully Open	
psig	bar	psig	bar	psig	bar	psig	bar
51	3,5	50	3,4	39	2,7	11	0,76
60	4,1	59	4,1	48	3,3	19	1,3
70	4,8	69	4,8	57	3,9	28	1,9
80	5,5	79	5,4	66	4,5	37	2,5
90	6,2	89	6,1	75	5,2	46	3,2
100	6,9	99	6,8	84	5,8	55	3,8
110	7,6	109	7,5	93	6,4	64	4,4
120	8,3	119	8,2	102	7,0	73	5,0

Table 11. Diagnostics Table: C_v 20 through 60, Inlet Pressure Range Spring 121 to 200 psig / 8,3 to 13,8 bar

ACTUAL INLET SUPPLY PRESSURE TO VALVE		DIAGNOSTIC PORT PRESSURE					
		Pressure when Pilot Starts to Open		Pressure when Main Valve Starts to Open		Pressure when Main Valve is Fully Open	
psig	bar	psig	bar	psig	bar	psig	bar
121	8,3	120	8,3	103	7,1	60	4,1
130	9,0	129	8,9	111	7,6	68	4,7
140	9,6	139	9,6	120	8,3	77	5,3
150	10,3	149	10,3	129	8,9	86	5,9
160	11,0	159	10,9	138	9,5	95	6,5
170	11,7	169	11,7	147	10,1	104	7,2
180	12,4	179	12,3	156	10,8	113	7,8
190	13,1	189	13,0	165	11,4	122	8,4
200	13,8	199	13,7	174	12,0	134	9,2

Annual Maintenance

1. Visually inspect the unit to ensure tight connections, tight seals, and safe operation.
2. Observe the pad and depad (tank blanketing and vapor recovery) pressures.
3. Inspect the inlet pressure for the proper range (stamped on the valve nameplate).
4. Visually inspect valve for any external wear.
5. If there is evidence of leakage or unstable internal motion, a rebuild with seal replacement and relubrication may be in order.

Pad Valve Diagnostics

Note

A pressure gauge must be installed in the pad valve diagnostic port to perform diagnostic analysis. See Figures 2 through 4.

Diagnostics are an optional feature of the NPS 1 and 2 / DN 25 and 50 Type ACE97 valves and aid in evaluating valve operation. The diagnostic analysis relies on the relationship of pad valve pilot pressure and the inlet pressure of the pad valve. The basic relationships

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are shown in Table 2. In order to evaluate a valve, examine the valve nameplate to determine the C_v and inlet pressure range (main valve spring).

There are four pressures involved in evaluating a valve: actual inlet pressure, pressure to start opening pilot valve, pressure to start opening main valve, and pressure to fully open main valve.

Actual Inlet Pressure: The gas pressure supplied to the inlet of the valve. This is the maximum diagnostic pressure.

Pressure to Start Opening Pilot Valve: The diagnostic pressure drops to this value as the valve senses decreasing tank pressure. The main pad valve remains closed at this pressure.

Pressure to Start Opening Main Valve: The diagnostic pressure drops to this level as the tank pressure decreases the valve setpoint. The pilot is fully open at this pressure.

Pressure to Fully Open Main Valve: At this point, both the main valve and pilot valve are fully open and supplying gas to the tank.

Follow these steps and refer to the diagnostics tables (Tables 3 through 11) to evaluate a valve under actual operating conditions:

1. Select the table (Tables 3 through 11) that corresponds to the C_v and inlet pressure range of your pad valve.
2. Determine the actual valve operating inlet pressure in the first column of the diagnostics table.
3. In the second column of the table, determine the pressure of the pilot as it opens.
4. Determine the diagnostic pressure for the start to open pressure of the main valve in the third column.
5. The fourth column displays the diagnostic pressure for the full open pressure of the main valve.

Disassembly and Assembly



CAUTION

Before removing the valve from the line, ensure that it is isolated from the gas supply pressure and that all pressure has been released from the valve. All tank connections must be closed or sealed in accordance with your plant's

operating and safety procedures. If installed, electrical connections to the explosion proof switch must be deactivated before opening the enclosure or disconnecting the wiring (in accordance with codes and safety practices).

Refer to the following instructions and to Figures 11 through 20 in the Parts Ordering section when performing assembly and disassembly operations.

It is recommended that all seals and diaphragms be replaced whenever a valve is disassembled and re-assembled. Parts kits are available through your local Sales Office.

Note

Have your model number, serial number, inlet pressure, and set pressure range available when ordering parts. Valve information is on the nameplate (on the upper actuator case).

The Type ACE97 Pad-Depad valve should be viewed as four connected elements. These include the pad valve, the actuator, the depad pilot valve, and the depad main valve. See Figure 1.

Disassembly

When performing disassembly operations, please take care not to adjust or alter the pressure setpoints. Read the following instructions carefully before proceeding.

Depad Pilot Valve Removal

Refer to Figures 11 and 19.

1. Disconnect the tubing lines (key 143, three connections) from the depad pilot valve.
2. Loosen the locknut (key 99) but maintain its position in relation to the adjusting coupling (key 107). By maintaining the position of the locknut and the lower cage (key 110), the depad setpoint remains unchanged.
3. Separate the pilot valve from the spring case (key 120) by unthreading and removing.

Depad Pilot Valve Disassembly

Refer to Figure 19.

1. Unthread and remove the coupling (key 107).

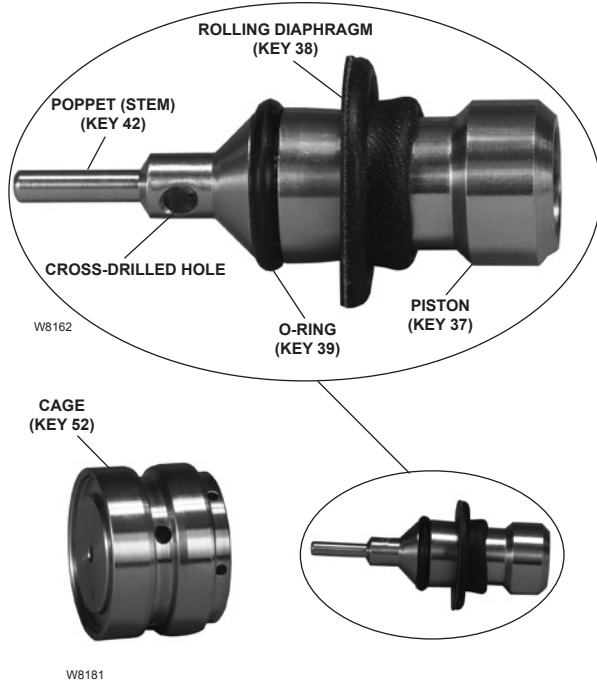


Figure 8. NPS 1/2 / DN 15 Pad Valve Cage Assembly

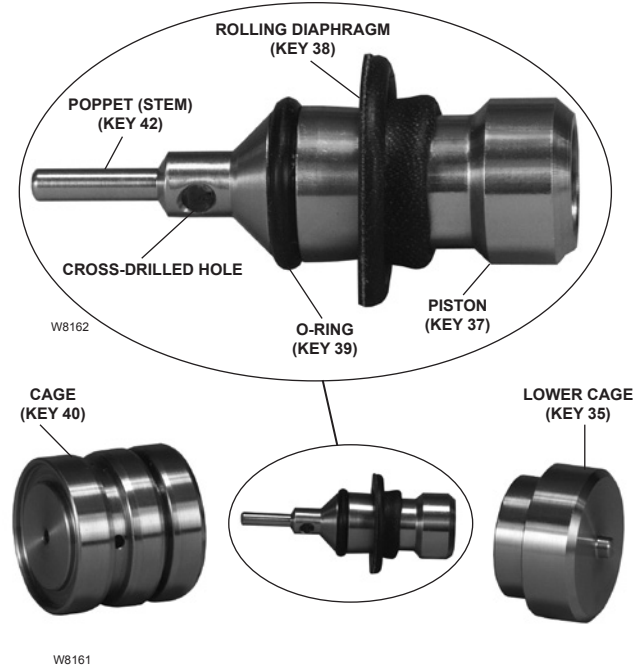


Figure 9. NPS 1 and 2 / DN 25 and 50 Pad Valve Cage Assembly

2. Unthread the lower cage (key 110).
3. Remove the rain cap (key 109).
4. Unthread the upper cage (key 106).
5. Remove the return spring (key 101).
6. Place a pin through the follower (key 103) and unthread the nut (key 31). This will release the internal components.
7. Remove all internal components, seals, and the rolling diaphragm (key 38).

Actuator Disassembly

Refer to Figure 20.

1. Remove actuator case cap screws, lock washers, and nuts (keys 93, 28, and 31).
2. Remove the upper actuator case (key 114).
3. Remove the spring (key 95). This may be one or more springs and associated hardware, depending on the actual spring range. See Figure 12.
4. Remove the actuator stem (key 94), diaphragm bolt (key 117), upper diaphragm plate (key 119), diaphragm (key 163), and lower diaphragm plate (key 116).
5. Hold the actuator stem (key 94) with soft-jawed pliers and unthread the diaphragm bolt (key 117).

6. Separate the upper diaphragm plate (key 119), lower diaphragm plate (key 116), and diaphragm (key 163).
7. Remove the hex-head cap screws and lock washers (keys 29 and 28) that attach the lower actuator case (key 113) to the body (key 18) or bonnet (key 17).
8. Remove the lower actuator case (key 113) and gasket (key 27) from the valve body (key 18) or bonnet (key 17).

Pad Valve Disassembly

For NPS 1/2 / DN 15 pad valve, no further disassembly steps are required. Proceed to Pad Valve Cage Disassembly for NPS 1/2 / DN 15 valve section.

For NPS 1 and 2 / DN 25 and 50 pad valves, perform the following procedures for pad valve disassembly. Refer to Figures 14 and 15.

1. For NPS 2 / DN 50 valve: Remove the cap screws and lock washers (keys 50 and 51) that attach the bonnet (key 17) to the body (key 18).
2. Lift the bonnet (key 17) from the body (key 18).
3. Remove the piston (key 25), main valve spring (key 26), spring shim (key 34, if required), and spring guide (key 49, if required) from the bonnet (key 17).
4. Unthread the screw (key 20) and remove from the main valve, along with the lock washer (key 21).

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5. Remove the plug (key 22) from the main valve.
6. Insert wooden dowel rod (or similar blunt tool) through the bottom of the bonnet bore to remove the cage sub-assembly (keys 35 and 40).

Pad Valve Cage Disassembly (NPS 1/2 / DN 15 valve)

Refer to Figures 8 and 13.

1. Remove the cage (key 52) from the body (key 18) by slowly applying shop air (approximately 20 psig / 1,4 bar) at the inlet of the body. Use your hand to safely catch the cage as it is removed from the body. See Figure 8.
2. Remove the pilot valve from the cage (key 52) by pressing on the poppet (key 42) stem.

Use soft-jaws to restrain the piston (key 37) without damaging it. Do not hold the poppet (key 42) by the stem.

3. To unscrew the piston (key 37) from the poppet (key 42), insert a small drill bit into the cross-drilled holes on the poppet to turn and loosen. Unthread the poppet from the piston and remove the rolling diaphragm (key 38).

Pad Pilot Valve/Cage Disassembly (NPS 1 and 2 / DN 25 and 50 valves)

Refer to Figures 9, 14, and 15.

1. The upper cage (key 40) will readily separate from the lower cage (key 35). See Figure 9.
2. Gently press the poppet stem (key 42) to remove the pilot from the upper cage (key 40).



CAUTION

Use soft-jaws to restrain the piston (key 37) without damaging it. Do not hold the poppet (key 42) by the stem.

3. To unscrew the piston (key 37) from the poppet (key 42), insert a small drill bit into the cross-drilled holes on the poppet to turn and loosen. Unthread the poppet from the piston and remove the rolling diaphragm (key 38).

Depad Main Valve Disassembly

Refer to Figures 16, 17, and 18.

1. Remove the tubing (key 143) from the end of the bonnet (key 87).
2. For 1 NPT Main Valve: Unthread the bonnet (key 87) from the depad valve body (key 91). Remove the retaining ring (key 89), cap (key 90), and O-ring (key 88).

For 2 NPT and NPS 3 and 4 / DN 80 and 100 Main Valves: Unthread the flange bolts (key 160) and washer (key 161). Remove the bonnet (key 87) from the depad valve body (key 91).

3. Gently remove the internal components by lifting the depad main valve stem (key 75).



CAUTION

When working with the main valve stem sub-assembly, take care not to scratch the coated surface (the surface that operates in contact with the seal (key 81)). Refer to Figure 16, 17, or 18.

4. Hold the main valve stem (key 75) on its flat sides in a soft-jawed vise. Apply enough pressure to keep the main valve stem from turning.
5. Remove the cap screw (key 78), lock washer (key 79), and cage (key 77).
6. Separate the cage (key 77) and seat O-ring (key 76) from the main valve stem (key 75).



CAUTION

The main valve return spring (key 84) is compressed and could cause damage or injury. Remove this spring with care.

7. For 1 and 2 NPT Main Valves: Remove spring guide (key 85) by removing the retaining ring (key 86).

For NPS 3 and 4 / DN 80 and 100 Main Valves: Remove the spring guide (key 82), tap bolt (key 126), and lock washer (key 79).

8. Remove the spring (key 84) and seal retaining plate (key 83).
9. Remove the O-rings (key 82) and the seal retainer (key 80).
10. Remove the stem seal (key 81).

Assembly

Before proceeding, read the following instructions. Refer to the figures that pertain to your valve (Figures 11 through 20) and review the list of approved lubricants, sealants, and adhesives (in the Maintenance section) when performing assembly operations.

1. Clean and inspect all parts.
2. Replace all O-rings, seals, gaskets, and any parts that are worn or damaged.
3. Lightly lubricate all O-rings and metal parts in moving contact.
4. Seal all pipe fittings.

Depad Pilot Valve Assembly

Refer to Figure 19.

1. Invert the rolling diaphragm (key 38) and place it over the threaded portion of the follower (key 103).
2. Install the poppet (key 105) onto the threaded portion of the follower (key 103) with the tapered end against the rolling diaphragm (key 38).
3. Install the O-ring (key 104) onto the poppet (key 105).
4. Place this sub-assembly into the center cage (key 108) from the end with internal threads.
5. Install the seal retainer and O-ring (keys 127 and 104) onto the follower (key 103).
6. Apply Loctite® #222 to the threads on the follower (key 103). Thread the nut (key 31) onto the follower.
7. Insert a small drill bit into the cross-drilled hole on the follower (key 103), turn, and tighten the nut (key 31) and internal parts.
8. Install the return spring (key 101) onto the seal retainer (key 127).
9. Place the gasket (key 102) into the cavity of the upper cage (key 106) and thread the upper cage onto the center cage (key 108).
10. Place the rain cap (key 109) onto the threaded portion of the lower cage (key 110). The bead on the rolling diaphragm (key 38) must be positioned to engage the groove in the lower cage.
11. Thread the lower cage (key 110) onto the center cage (key 108). Tighten all parts uniformly.
12. Lubricate the threads of the coupling (key 107) with anti-seize. Thread the lower cage (key 110) onto the coupling (key 107) one full turn.

Note

The locknut (key 99) must be in place when attaching the lower cage (key 110) and coupling (key 107) to the spring case (key 120).

13. Thread the coupling (key 107) onto the spring case (key 120) one full turn (while restraining the coupling from turning against the lower cage (key 110)). Turn the coupling (while restraining the center cage (key 108)) and spring case.

Note

The coupling (key 107) is left-hand threaded on the end with the knurled (rough) finish. The opposite end is right-hand threaded.

Pad Valve Cage Assembly (NPS 1/2 / DN 15 valve)

Refer to Figures 8 and 13.

1. Place the rolling diaphragm (key 38) over the threaded portion of the piston (key 37). Use caution not to place the rolling diaphragm upside down (refer to Figure 8). Apply Loctite® #222 to the piston threads. Thread the poppet (key 42) onto the piston. Use soft-jaws to hold the piston. Insert a small drill bit into the cross-drilled holes on the poppet to turn and tighten.
2. Install the O-ring (key 39) onto the poppet (key 42).
3. Lightly lubricate the piston (key 37).
4. Place the sub-assembly into the cage (key 52).

Pad Pilot Valve/Cage Assembly (NPS 1 and 2 / DN 25 and 50 valves)

Refer to Figures 9, 14, and 15.

1. Install O-rings (key 16) into the bonnet (key 17).
2. Apply Loctite® #222 to the piston threads. Place the rolling diaphragm (key 38) over the threaded portion of the piston (key 37). Position the rolling diaphragm bead as shown in Figure 9.



CAUTION

Do not place the rolling diaphragm upside down.

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3. Thread the poppet (key 42) onto the piston (key 37). Use soft-jawed pliers to restrain the piston so it is not damaged. Do not hold the poppet by the stem. Insert a small drill bit into the cross-drilled hole on the poppet stem (key 42) to turn and tighten.
4. Slide the O-ring (key 39) onto the poppet (key 42).
5. Place the pilot sub-assembly into the upper cage (key 40).
6. Press the lower cage (key 35) and upper cage (key 40) together to ensure the groove in the lower cage engages the rolling diaphragm (key 38) bead.

Note

Ensure that the rolling diaphragm bead is positioned so that it sits in the groove of the lower cage (See Figure 9). If it does not, the rolling diaphragm was installed upside down in step 2.

7. Remove the lower cage (key 35).
8. Lubricate the piston (key 37) and lower cage (key 35) groove with Dow Corning® #111.
9. Install the pilot spring (key 36) into the piston (key 37) and re-install the lower cage (key 35).
10. Hold the pilot/cage sub-assembly together and insert it into the bonnet (key 17). Press firmly (the bonnet O-rings will offer resistance).
11. Press the poppet (key 42) stem. It should freely move up and down. If it does not, repeat the procedure to this point to determine the cause.

Pad Valve Assembly (NPS 1/2 / DN 15 valve)

Refer to Figure 13.

1. Install O-rings (key 16) into the body (key 18).
2. Place the spring (key 36) into the body (key 18) cavity.
3. Insert the cage (key 52) and valve sub-assembly into the body (key 18) cavity.
4. Press the body (key 18) and cage (key 52) together to engage the rolling diaphragm bead into the groove.

Note

Ensure that the rolling diaphragm bead is positioned so that it sits in the groove of the body (see Figure 14). If it does not, the rolling diaphragm was installed upside down in step 1 of the Pad Valve Cage Assembly (NPS 1/2 / DN 15 valve).



Figure 10. NPS 2 / DN 50 Pad Valve Piston and Spring

5. Press and release the poppet (key 42) stem. It should freely move up and down. If it does not, repeat the procedure to this point to determine the cause.
6. Place the O-ring (key 41) onto the cage (key 52).

Pad Valve Assembly (NPS 1 and 2 / DN 25 and 50 valve)

Refer to Figures 14 and 15.

1. Prepare the main piston (key 25) by installing the plug (key 22) and O-ring (key 23) with the screw and lock washer (keys 20 and 21). Apply Loctite® #222 to the screw threads.
2. Install the main valve spring (key 26), spring shim (key 34, if required), and spring guide (key 49, if required) into the piston (key 25).
3. Place the valve sub-assembly (piston (key 25), spring (key 26), and plug (key 22)) into the body (key 18).
4. Place an O-ring (key 19) into the body (key 18).
5. Place the bonnet (key 17) onto the body (key 18) and main valve (key 25).
6. Press firmly to seat the bonnet O-ring joint. If you are performing assembly operations on a NPS 2 / DN 50 valve, attach the bonnet (key 17) to the body (key 18) with four cap screws and lock washers (keys 51 and 52).

Actuator Assembly

Refer to Figure 20.

1. Place the actuator gasket (key 27) and lower actuator case (key 113) onto the body (key 18). Secure with lock washers and hex-head screws (keys 28 and 29). Tighten all hex-head screws uniformly.
2. Place the actuator gasket (key 27) onto the pad valve.
3. Attach the lower actuator case (key 113) to the pad valve with cap screws, lock washers (keys 29 and 28), and seal bushings (key 46, NPS 1 / DN 25 valve only).
4. Place an O-ring (key 118) into the groove of the diaphragm bolt (key 117).
5. Apply Loctite® #222 to the threads of the diaphragm bolt (key 117).
6. Build the diaphragm sub-assembly with the lower diaphragm plate (key 116), diaphragm (key 163), and upper diaphragm plate (key 119). Fasten with the diaphragm bolt (key 117) and actuator stem (key 94).
7. Place the diaphragm sub-assembly into the lower actuator case (key 113) and align the diaphragm flange bolt holes with the actuator case flange holes.
8. Install the range spring(s) (key 95 and/or 96) and associated hardware per your spring range, as shown in Figure 12.
9. Set the upper actuator case (key 114) into position, aligning the flange holes.
10. Place cap screws (key 29) in the aligned flange holes and fasten with lock washers and nuts (key 28 and 31). Tighten uniformly.

Depad Main Valve Assembly

Refer to Figures 16, 17, and 18.

Note

For the depad main valve assembly, use Dow Corning® #3452 chemical resistant lubricant.

1. Build the stem (key 75) assembly by installing the seat O-ring (key 76) and cage (key 77) with the cap screw (key 78) and lock washer (key 79). The stem may be held on the flat sides using soft-jaws for this purpose.
2. Lubricate the main valve stem (key 75).
3. Carefully install the stem seal (key 81)—closed-end first—into the seal retainer (key 80).

4. Slide the seal retainer (key 80) over the stem assembly with the open end of the stem seal (key 81) facing up. Take care not to scratch the stem. Slide the seal retaining plate (key 83) over the stem assembly with the counter-bore facing up.
5. For 1 and 2 NPT Main Valves: Install the spring (key 84) into the groove of the seal retaining plate (key 83) and spring guide (key 85). Secure with the retaining ring (key 86). Use a small flat screw driver to engage the notch in the retaining ring. Twist to install the retaining ring into the groove.

For NPS 3 and 4 / DN 80 and 100 Main Valves: Install the spring (key 84) into the groove of the seal retaining plate (key 83) and spring guide (key 85). Secure with a cap screw and lock washer (keys 126 and 79).
6. For 1 NPT and NPS 3 and 4 / DN 80 and 100 main valves, place the O-ring (key 82) into the main valve body (key 91). For 2 NPT main valve, place the O-ring (key 82) into the groove of the seal retainer (key 80). Carefully install the stem and spring sub-assembly. Press down on the stem (key 75) to ensure it is able to move. Install the second O-ring (key 82).
7. For 1 NPT Main Valve: Lubricate the threads of the bonnet (key 87) with anti-seize. Thread into place and tighten.

For 2 NPT and NPS 3 and 4 / DN 80 and 100 Main Valves: Install the bonnet (key 87) and secure with cap screws and lock washers (keys 160 and 161). Tighten uniformly.
8. Connect all tubing lines (key 143).
9. Reinstall the valve according to the instructions in the Installation section of this manual.

Parts Ordering

Each Type ACE97 Pad-Depad valve is assigned a serial number printed on the nameplate on the main valve actuator. Refer to this number when contacting your local Sales Office for assistance or when ordering replacement parts. When ordering a replacement part, be sure to reference the key number for each needed part and include the complete 11-character part number from the following parts list.

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Parts List

Key	Description	Part Number	Key	Description	Part Number
	Parts Kits				
	NPS 1/2 / DN 15 pad valve (includes keys 16, 27, 38, 39, and 41)		21	Lock Washer (NPS 1 and 2 / DN 25 and 50 pad valves only)	
	Nitrile (NBR)	19B6041X012		NPS 1 / DN 25 pad valve	GC060903X02
	Fluorocarbon (FKM)	19B6041X022		NPS 2 / DN 50 pad valve	GC060906X02
	Perfluoroelastomer (FFKM)	19B6041X032	22	Plug (NPS 1 and 2 / DN 25 and 50 pad valves)	
	Ethylene propylene (EPDM - FDA)	19B6041X042		C _v 1	GC053206X02
	NPS 1 / DN 25 pad valve, C _v 1 through 4 (includes keys 16, 19, 23, 24, 27, 38, 39, 41, and 46)			C _v 2	GC053205X02
	Nitrile (NBR)	19B6043X012		C _v 4	GC053204X02
	Fluorocarbon (FKM)	19B6043X022		C _v 7.5	GC053213X02
	Perfluoroelastomer (FFKM)	19B6043X032		C _v 10	GC053212X02
	Ethylene propylene (EPDM - FDA)	19B6043X042		C _v 20	GC053220X02
	NPS 1 / DN 25 pad valve, C _v 5 through 10 (includes keys 16, 19, 23, 24, 27, 38, 39, 41, and 46)			C _v 45	GC053221X02
	Nitrile (NBR)	19B6044X012		C _v 60	GC053218X02
	Fluorocarbon (FKM)	19B6044X022	23*	O-ring (2 required, NPS 1 and 2 / DN 25 and 50 pad valves)	
	Perfluoroelastomer (FFKM)	19B6044X032		C _v 1 through 4	
	Ethylene propylene (EPDM - FDA)	19B6044X042		Nitrile (NBR)	1D2888X0032
	NPS 2 / DN 50 pad valve, C _v 20 through 60 (includes keys 16, 19, 23, 24, 27, 38, 39, and 41)			Ethylene propylene (EPDM - FDA)	1D2888X0042
	Nitrile (NBR)	19B6042X012		Fluorocarbon (FKM)	1D2888X0052
	Fluorocarbon (FKM)	19B6042X022		Perfluoroelastomer (FFKM)	1D2888X0022
	Perfluoroelastomer (FFKM)	19B6042X032		C _v 7.5 through 10	
	Ethylene propylene (EPDM - FDA)	19B6042X042		Nitrile (NBR)	18A1088X022
	Actuator (diaphragm/O-ring)			Ethylene propylene (EPDM - FDA)	18A1088X042
	(includes keys 27, 38, 102, 104, 118, 121, and 163)			Fluorocarbon (FKM)	18A1088X052
	NBR/FFKM	19B6050X042		Perfluoroelastomer (FFKM)	18A1088X032
	FKM/FFKM	19B6050X052		C _v 20 through 60	
	EPDM - FDA/FFKM	19B6050X062		Nitrile (NBR)	1C628006992
				Ethylene propylene (EPDM - FDA)	1C6280X0102
				Fluorocarbon (FKM)	1C6280X0012
				Perfluoroelastomer (FFKM)	1C6280X0092
16*	O-ring (pad valve, 2 required)		24*	O-ring (NPS 1 and 2 / DN 25 and 50 pad valves)	
	Nitrile (NBR)	1F115306992		C _v 1 through 4	
	Ethylene propylene (EPDM - FDA)	1F1153X0062		Nitrile (NBR)	1C782206992
	Fluorocarbon (FKM)	1F1153X0022		Ethylene propylene (EPDM - FDA)	1C7822X0122
	Perfluoroelastomer (FFKM)	1F1153X0032		Fluorocarbon (FKM)	1C7822X0132
				Perfluoroelastomer (FFKM)	1C7822X0112
17	Bonnet (pad valve)			C _v 7.5 through 10	
	C _v 1 through 4	GC050929X12		Nitrile (NBR)	1D2375X0062
	C _v 7.5 through 10	GC050929X02		Ethylene propylene (EPDM - FDA)	1D2375X0082
	C _v 20 through 60	GC050919X62		Fluorocarbon (FKM)	1D237506382
				Perfluoroelastomer (FFKM)	1D2375X0072
18	Body (pad valve)			C _v 20 through 60	
	C _v 0.2	GC052930X32		Nitrile (NBR)	1D785306992
	C _v 0.4	GC052907X32		Ethylene propylene (EPDM - FDA)	1D7853X0032
	C _v 1 through 4	GE02623X012		Fluorocarbon (FKM)	1D7853X0042
	C _v 7.5 through 10	GE02627X012		Perfluoroelastomer (FFKM)	1D7853X0012
	C _v 20 through 60	GC050927X62	25	Piston (main valve, NPS 1 and 2 / DN 25 and 50 pad valves)	
19*	O-ring (NPS 1 and 2 / DN 25 and 50 pad valves only)			C _v 1 through 4	GC053203X02
	C _v 1 through 10			C _v 7.5 through 10	GC053211X02
	Nitrile (NBR)	1C415706992		C _v 20 through 60	GC053219X02
	Ethylene propylene (EPDM - FDA)	1C4157X0092	26	Spring (pad main valve)	
	Fluorocarbon (FKM)	1C4157X0032		NPS 1 / DN 25 pad valve	
	Perfluoroelastomer (FFKM)	1C4157X0082		C _v 1 through 4	
	C _v 20 through 60			25 to 50 psig / 1,7 to 3,4 bar	GC220704X22
	Nitrile (NBR)	1F3581X0082		51 to 120 psig / 3,5 to 8,27 bar	GC220705X22
	Ethylene propylene (EPDM - FDA)	1F3581X0102		121 to 200 psig / 8,3 to 13,8 bar	GC220706X22
	Fluorocarbon (FKM)	1F3581X0022		C _v 7.5 through 10	
	Perfluoroelastomer (FFKM)	1F3581X0092		25 to 50 psig / 1,7 to 3,4 bar	GC220705X22
				51 to 120 psig / 3,5 to 8,3 bar	GC220706X22
20	Round-Head Machine Screw (NPS 1 and 2 / DN 25 and 50 pad valves only)			121 to 200 psig / 8,3 to 13,8 bar	GC220709X22
	NPS 1 / DN 25 pad valve	1A3776X0012		NPS 2 / DN 50 pad valve	
	NPS 2 / DN 50 pad valve	GC060225X02		C _v 20 through 60	
				25 to 50 psig / 1,7 to 3,4 bar	GC220714X22
				51 to 120 psig / 3,5 to 8,3 bar	GC220712X22
				121 to 200 psig / 8,3 to 13,8 bar	GC220713X22

*Recommended Spare Part

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Key	Description	Part Number	Key	Description	Part Number
27	Gasket (bonnet, pad valve)	GC070429X32	76*	O-ring (continued)	
28	Lock Washer (28 required)	GC060906X02		NPS 3 / DN 80 depad main valve	
29	Hex-Head Machine Screw (4 required)			Fluorocarbon (FKM)	17B1364X052
	NPS 1/2 / DN 15 body pad valve	GC060220X02		Ethylene propylene (EPDM - FDA)	17B1364X062
	NPS 1 / DN 25 body pad valve	GC060219X02		Perfluoroelastomer (FFKM)	17B1364X072
	NPS 2 / DN 50 body pad valve	GC060220X02		NPS 4 / DN 100 depad main valve	
31	Hex Nut (21 required)	1A3457K0012		Nitrile (NBR)	GC072010X02
34	Spring Shim (NPS 1 / DN 25 pad valve)			Fluorocarbon (FKM)	GC072010X12
	25 to 50 psig / 1,7 to 3,4 mbar	GC053209X02		Ethylene propylene (EPDM - FDA)	GC072010X52
35	Lower Cage (NPS 1 and 2 / DN 25 and 50 pad valves)	GC053002X02		Perfluoroelastomer (FFKM)	GC072010X62
36	Spring (pad pilot valve)	GC220707X22	77	Cage (depad main valve)	
37	Piston (pad pilot valve)	GC053202X02		C _v 3	GC053253X12
38*	Diaphragm (pad and depad pilot valves)			C _v 6	GC053253X32
	Nitrile (NBR)	GC071101X02		C _v 12	GC053253X52
	Ethylene propylene (EPDM - FDA)	GC071101X22		C _v 17	GC053253X72
	Fluorocarbon (FKM)	GC071101X12		C _v 20	GC053257X52
	Perfluoroelastomer (FFKM)	GC071101X32		C _v 35	GC053257XB2
39*	O-ring			C _v 70	GC053257XF2
	Nitrile (NBR)	1D2888X0032		C _v 90	GC053265X12
	Ethylene propylene (EPDM - FDA)	1D2888X0042		C _v 115	GC053265X32
	Fluorocarbon (FKM)	1D2888X0052		C _v 140	GC053265X72
	Perfluoroelastomer (FFKM)	1D2888X0022		C _v 150	GC053248X32
40	Upper Cage (NPS 1 and 2 / DN 25 and 50 pad valves)	GC053001X02		C _v 200	GC053248X52
41*	O-ring			C _v 280	GC053248X92
	Nitrile (NBR)	10A0042X052	78	Hex-Head Machine Screw	
	Ethylene propylene (EPDM - FDA)	10A0042X072		1 NPT depad main valve	GC060229X02
	Fluorocarbon (FKM)	10A0042X012		2 NPT, NPS 3 and 4 / DN 80 and 100 depad main valve	GC060226X02
	Perfluoroelastomer (FFKM)	10A0042X062	79	Lock Washer	
42	Poppet (pad pilot valve)	GC053201X02		1 NPT depad main valve (1 required)	GC060905X02
46	Seal Bushing (4 required)			2 NPT depad main valve (1 required)	GC060907X02
	NPS 1 / DN 25 pad valve	GC071202X32		NPS 3 and 4 / DN 80 and 100 depad main valve (2 required)	GC060907X02
49	Spring Guide (pad valve)		80	Seal Retainer (4 required)	
	25 to 50 psig / 51 to 120 psig / 1,7 to 3,4 bar / 3,5 to 8,3 bar	GC050505X22		1 NPT depad main valve	GC053315X02
50	Hex-Head Cap Screw (4 required)	GC060224X12		2 NPT depad main valve	GC053310X02
51	Lock Washer (4 required)	GC060905X02		NPS 3 / DN 80 depad main valve	GC053318X02
52	Cage (NPS 1/2 / DN 15 pad valve)	GC053003X02		NPS 4 / DN 100 depad main valve	GC053337X02
75	Stem		81*	Stem Seal (4 required)	
	1 NPT depad main valve	GC050616X02		1 NPT depad main valve	GC071203X12
	2 NPT depad main valve	GC050616X12		2 NPT depad main valve	GC071203X02
	NPS 3 / DN 80 depad main valve	GC050616X22		NPS 3 / DN 80 depad main valve	GC071203X22
	NPS 4 / DN 100 depad main valve	GC050616X32		NPS 4 / DN 100 depad main valve	GC071203X32
76*	O-ring		82*	O-ring (2 required)	
	1 NPT depad main valve			1 NPT depad main valve	
	Nitrile (NBR)	GC072006X02		Nitrile (NBR)	12B3522X042
	Fluorocarbon (FKM)	GC072006X12		Fluorocarbon (FKM)	12B3522X022
	Ethylene propylene (EPDM - FDA)	GC072006X52		Ethylene propylene (EPDM - FDA)	12B3522X102
	Perfluoroelastomer (FFKM)	GC072006X62		Perfluoroelastomer (FFKM)	12B3522X092
	2 NPT depad main valve			2 NPT depad main valve	
	Nitrile (NBR)	16A1178X042		Nitrile (NBR)	1H8762X0012
	Fluorocarbon (FKM)	16A1178X022		Fluorocarbon (FKM)	1H8762X0052
	Ethylene propylene (EPDM - FDA)	16A1178X062		Ethylene propylene (EPDM - FDA)	1H8762X0072
	Perfluoroelastomer (FFKM)	16A1178X052		Perfluoroelastomer (FFKM)	1H8762X0062
	NPS 3 / DN 80 depad main valve			NPS 3 / DN 80 depad main valve	
	Nitrile (NBR)	17B1364X042		Nitrile (NBR)	1H7422X0022
				Fluorocarbon (FKM)	1H7422X0052
				Ethylene propylene (EPDM - FDA)	1H7422X0042
				Perfluoroelastomer (FFKM)	1H7422X0032
				NPS 4 / DN 100 depad main valve	
				Nitrile (NBR)	1D267306992
				Fluorocarbon (FKM)	1D2673X0012
				Ethylene propylene (EPDM - FDA)	1D2673X0072
				Perfluoroelastomer (FFKM)	1D2673X0062

*Recommended Spare Part

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Key	Description	Part Number	Key	Description	Part Number
83	Seal Retaining Plate 1 NPT depad main valve 2 NPT depad main valve NPS 3 / DN 80 depad main valve NPS 4 / DN 100 depad main valve	GC053314X02 GC053311X02 GC053317X02 GC053327X02	97	Upper Spring Guide (actuator) (continued) Pad 1.0 to 2.2 psig / 69 to 152 mbar Depad 0.25 to 2.0 psig / 17 to 138 mbar	GC050513X02
84	Spring (depad main valve) C _v 3 through 17 C _v 20 through 70 C _v 90 through 140 C _v 150 through 280	GC220723X22 GC220722X72 GC220724X22 GC220729X22	98	Spacer Pad 4 to 10-inches w.c. / 10 to 25 mbar Depad 16 to 78-inches w.c. / 40 to 194 mbar Pad 0.5 to 1.4 psig / 34 to 97 mbar Depad 0.25 to 1 psig / 17 to 69 mbar Pad 1.0 to 2.2 psig / 69 to 152 mbar Depad 0.25 to 2 psig / 17 to 138 mbar	GC053309X02 GC053308X02 GC053308X02
85	Spring Guide (depad main valve) C _v 3 through 17 C _v 20 through 70 C _v 90 through 140 C _v 150 through 280	GC050511X02 GC050510X02 GC050512X02 GC053329X02	99	Locknut (depad pilot valve)	GC053305X02
86	Retaining Ring 1 and 2 NPT depad main valves	GC061104X12	100	Spring Adjuster (depad pilot valve)	GC053302X02
87	Bonnet 1 NPT depad main valve 2 NPT depad main valve NPS 3 / DN 80 depad main valve NPS 4 / DN 100 depad main valve	GC052919X02 GC052923X52 GC052921X52 GC052929X52	101	Return Spring (depad pilot valve)	GC220715X22
88*	O-ring (1 NPT depad main valve) Nitrile (NBR) Fluorocarbon (FKM) Ethylene propylene (EPDM - FDA) Perfluoroelastomer (FFKM)	1F115306992 1F1153X0022 1F1153X0062 1F1153X0032	102	Gasket (upper cage, depad pilot valve)	GC070435X02
89	Retaining Ring 1 NPT depad main valve	GC061104X32	103	Follower	GC053224X02
90	Cap (1 NPT depad main valve)	GC053313X02	104	O-ring (2 required, depad pilot valve) Nitrile (NBR) Fluorocarbon (FKM) Perfluoroelastomer (FFKM) Ethylene propylene (EPDM - FDA)	1F1139G0012 1N463906382 1F1139X0042 1F1139X0052
91	Body (depad main valve) 1 NPT depad main valve 2 NPT depad main valve	GC052709X02 GC052718X52	105	Poppet (depad pilot valve)	GC053223X02
93	Hex-Head Machine Screw (24 required)	GC060220X02	106	Upper Cage (depad pilot valve)	GC053004X02
94	Stem (actuator)	GC053303X02	107	Coupling	GC053304X92
95	Actuator Spring Pad 0.5 to 3-inches w.c. / 1 to 7 mbar Depad 4 to 10-inches w.c. / 10 to 25 mbar Pad 0.5 to 7-inches w.c. / 1 to 17 mbar Depad 4 to 6-inches w.c. / 10 to 15 mbar Pad 3 to 13-inches w.c. / 7 to 32 mbar Depad 4 to 16-inches w.c. / 10 to 40 mbar Pad 4 to 10-inches w.c. / 10 to 25 mbar Depad 16 to 78-inches w.c. / 40 to 194 mbar Pad 0.5 to 1.4 psig / 34 to 97 mbar Depad 0.25 to 1 psig / 17 to 69 mbar Pad 1.0 to 2.2 psig / 69 to 152 mbar Depad 0.25 to 2 psig / 17 to 138 mbar	GC220730X72 GC220718X72 GC220719X72 GC220720X72 GC220721X72 GC220725X72	108	Center Cage (depad pilot valve)	GC053005X02
96	Spring (one of two springs used for this range, See Figure 12) Pad 4 to 10-inches w.c. / 10 to 25 mbar Depad 16 to 78-inches w.c. / 40 to 194 mbar	GC220719X72	109	Rain Cap	GC053801X42
97	Upper Spring Guide (actuator) Pad 3 to 13-inches w.c. / 7 to 32 mbar Depad 4 to 16-inches w.c. / 10 to 40 mbar Pad 4 to 10-inches w.c. / 10 to 25 mbar Depad 16 to 78-inches w.c. / 40 to 194 mbar Pad 0.5 to 1.4 psig / 34 to 97 mbar Depad 0.25 to 1 psig / 17 to 69 mbar	GC050509X02 GC050509X02 GC050509X02 GC050509X02	110	Lower Cage (depad pilot valve)	GC053006X02
			111	Fixed Orifice C _v 3 through 12 C _v 17 through 70 C _v 90 through 140 C _v 150 through 280	19B6407X012 19B6406X012 19B6406X012 19B6407X012
			112	Spring Seat Pad 4 to 10-inches w.c. / 10 to 25 mbar Depad 16 to 78-inches w.c. / 40 to 194 mbar	GC050507X02
			113	Lower Actuator Case, Stainless Steel	GC260111X02
			114	Upper Actuator Case, Stainless Steel	GC260112X02
			116	Lower Diaphragm Plate	GC260104X02
			117	Diaphragm Bolt	GC053229X02
			118*	O-ring Nitrile (NBR) Ethylene propylene (EPDM - FDA) Fluorocarbon (FKM) Perfluoroelastomer (FFKM)	GC070173X02 GC070173X52 GC070173X12 GC070173X62
			119	Upper Diaphragm Plate	GC260108X02
			120	Spring Case	GC053103X02
			121	Gasket (spring case)	GC070434X02
			126	Hex-Head Tap Bolt C _v 90 through 140 C _v 150 through 280	GC060216X22 GC060232X02
			127	Seal Retainer (depad pilot valve)	GC053222X02
			129	Connector (external, 3/8-inch / 9.5 mm tube x 1/4 NPT, NPS 1 and 2 / DN 25 and 50 pad valves only)	-----

*Recommended Spare Part

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Key	Description	Part Number	Key	Description	Part Number
131	Tube Elbow (2 required) (external, 1/4-inch / 6,4 mm tube x 1/8 NPT)	-----	153	Pipe Nipple (1-inch, / 25 mm SCH80 x 2.75-inches / 70 mm, 1 NPT depad valve and NPS 1/2 / DN 15 pad/2 NPT depad valve only)	GC023226X02
132	Tube Elbow (3 required) (external, 1/4-inch / 6,4 mm tube x 1/4 NPT)	-----	157	Body/Piping Weld (Pad Body x Depad Body x Tank Connection x Vent Connection) NPS 1 / DN 25 x NPS 3 / DN 80 x 3-inch / 76 mm x 3-inch / 76 mm NPS 1 / DN 25 x NPS 4 / DN 100 x 4-inch / 102 mm x 4-inch / 102 mm NPS 2 / DN 50 x NPS 3 / DN 80 x 3-inch / 76 mm x 3-inch / 76 mm NPS 2 / DN 50 x NPS 4 / DN 100 x 4-inch / 102 mm x 4-inch / 102 mm	GC973300X52 GC973301X52 GC973303X12 GC973302X52
133	Type 252 Pilot Filter (NPS 1 and 2 / DN 25 and 50 pad pilot valve)	17B6809X042	160	Hex-Head Machine Screw 2 NPT and NPS 3 / DN 80 depad main valve (4 required) NPS 4 / DN 100 depad main valve (6 required)	GC060214X02 GC060214X02
134	Pressure Gauge (depad main valve)	GC160122X02	161	Lock Washer 2 NPT and NPS 3 / DN 80 depad main valve (4 required) NPS 4 / DN 100 depad main valve (6 required)	GC060908X02 GC060908X02
135	Tubing Insert (6 required)	-----	163	Actuator Diaphragm Nitrile (NBR) Fluorocarbon (FKM) Ethylene propylene (EPDM-FDA)	GC071102X02 GC071102X12 GC071102X22
138	Plug (pipe, hex, 1 NPT)	1A7947X0022	164	Caution Tag (depad adjustment)	GC090807X02
139	Hex-Head Pipe Plug (2 required), 1/4 NPT	1A767535072	165	Nipple (NPS 1/2 x 3 / DN 15 x 80, NPS 1/2 / DN 15 pad valve)	GC023154X02
140	Regulator (pilot supply)	GC017001X02	166	Housing Inlet Filter (NPS 1/2 / DN 15 pad valve)	GC040711X02
141	Tee Street (for NPS 1/2 / DN 15 Pad Valve)	-----	167	Filter Element (NPS 1/2 / DN 15 pad valve)	GC200211X02
142	Tee Street (2 required) (for NPS 1 and 2 / DN 25 and 50 Pad Valves)	-----			
143	Tubing (6-foot length / 1,8 m, 1-inch / 25 mm diameter, PTFE)	-----			
145	Pipe Street Elbow (1-inch / 25 mm)	-----			
146	Flange (Depad Body x Tank Connection) 1 NPT x NPS 1 / DN 25 CL150 RF 1 NPT x NPS 2 / DN 50 CL150 RF 2 NPT x NPS 2 / DN 50 CL150 RF 2 NPT x NPS 3 / DN 80 threaded flange 1 NPT x NPS 1 / DN 25 sanitary flange	1H9368X0032 GC031202X02 11A4038X022 GC031204X02 GC052514X52			
148	Pipe Nipple (1-inch / 25 mm), SCH80 x 5-inches / 127 mm	GC023217X02			
149	Close Nipple 1 NPT Depad valve (1 required) 2 NPT Depad valve (2 required)	GC020285X02 GC023053X02			
150	Pipe Tee 1 NPT Depad valve 2 NPT Depad valve	GC020299X02 GC023062X02			
151	Bushing (2 x 1 NPT)	13A8621X022			
152	S.A.M. (Single Array Manifold) (Depad Body x Tank Connection) 1 NPT x NPS 1-1/2 / DN 40 CL150 1 NPT x NPS 2 / DN 50 CL150 1 NPT x NPS 2 / DN 50 sanitary flange 1 NPT x NPS 3 / DN 80 CL150 2 NPT x NPS 3 / DN 80 CL150	GC230201X42 GC230201X12 GC230509X52 GC230206X52 GC230213X52			

Type ACE97

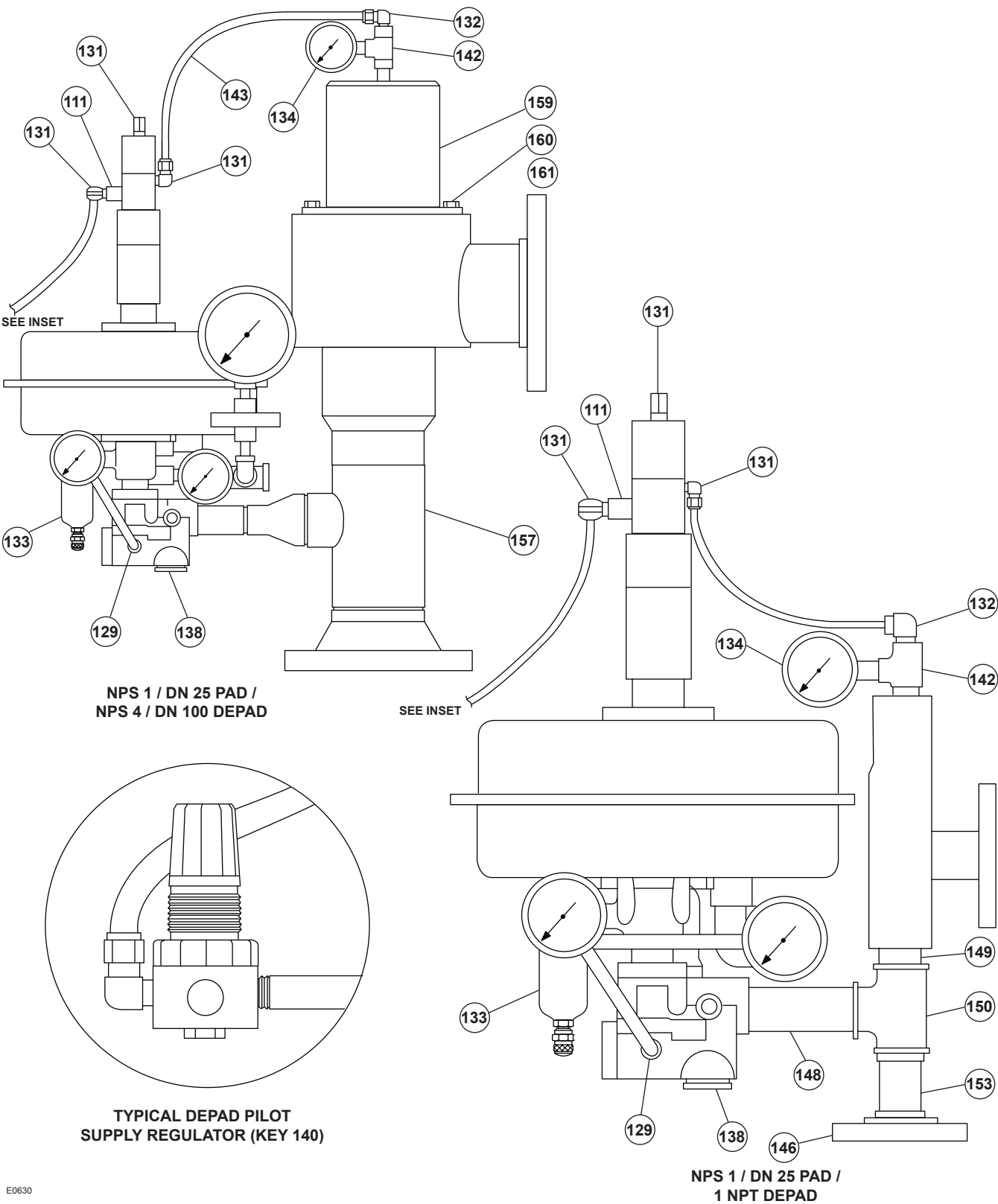
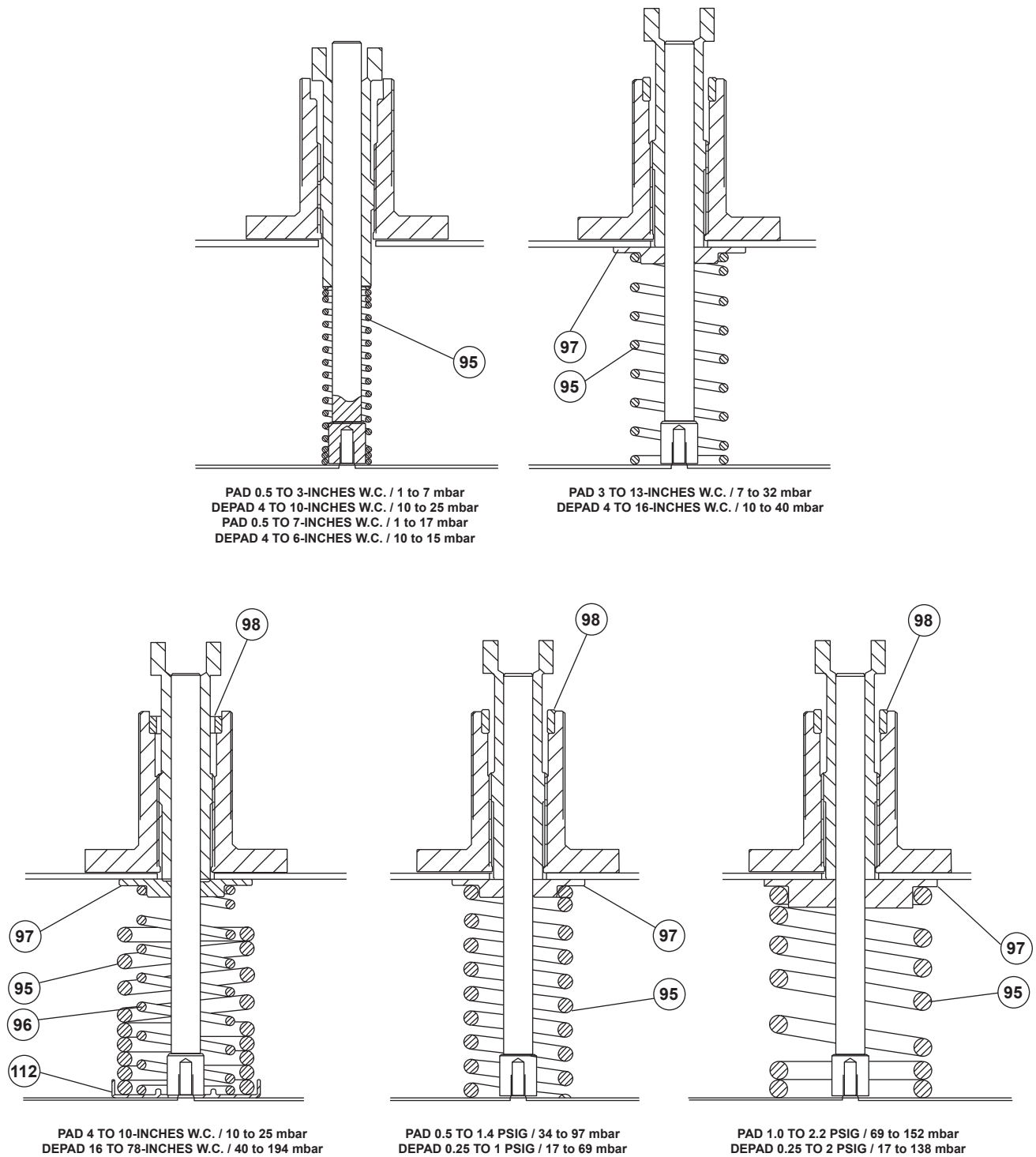
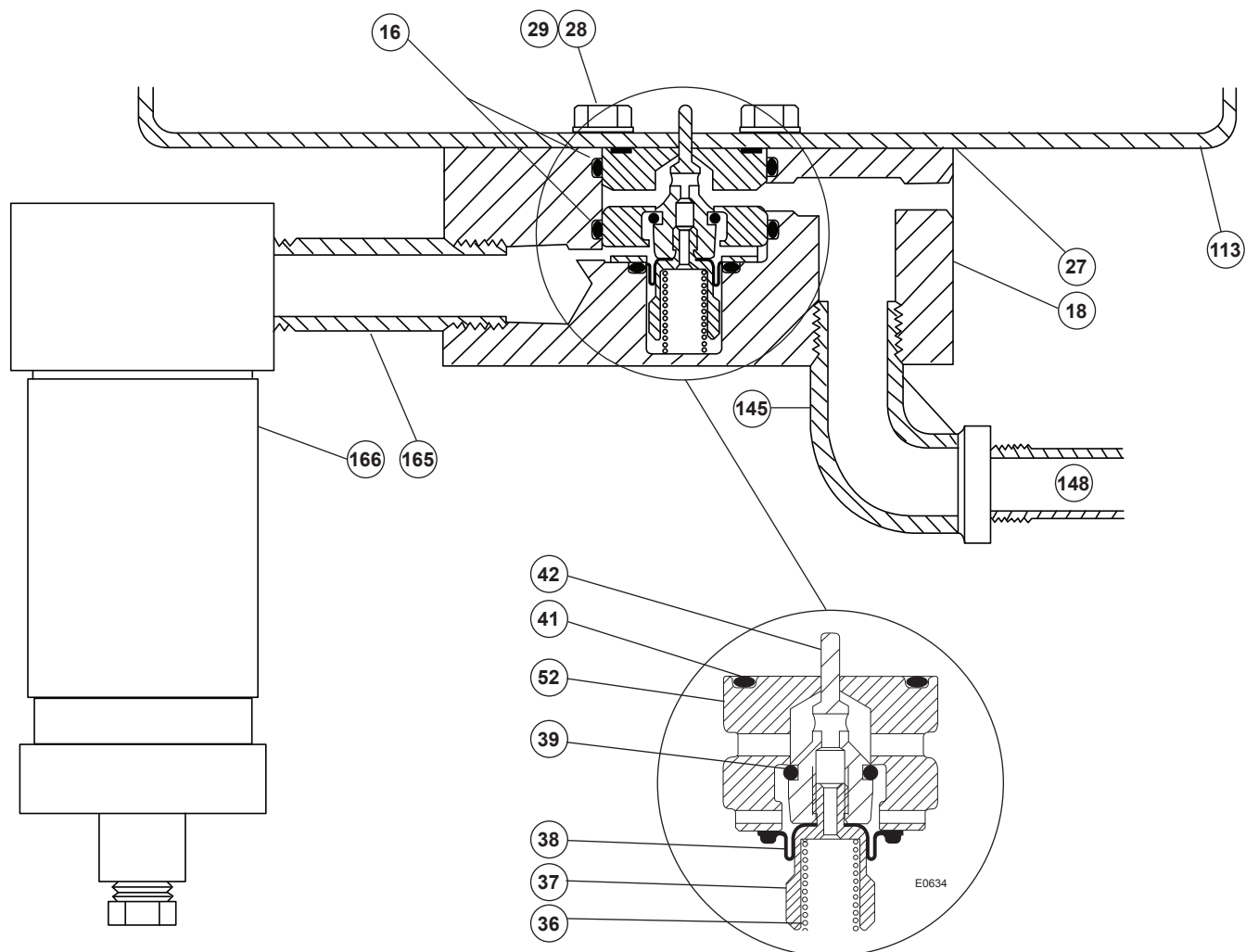


Figure 11. Type ACE97 Pad-Depad Valve Exterior



E0677

Figure 12. Actuator Spring Ranges



E0631

Figure 13. Type ACE97 NPS 1/2 / DN 15 Pad Valve

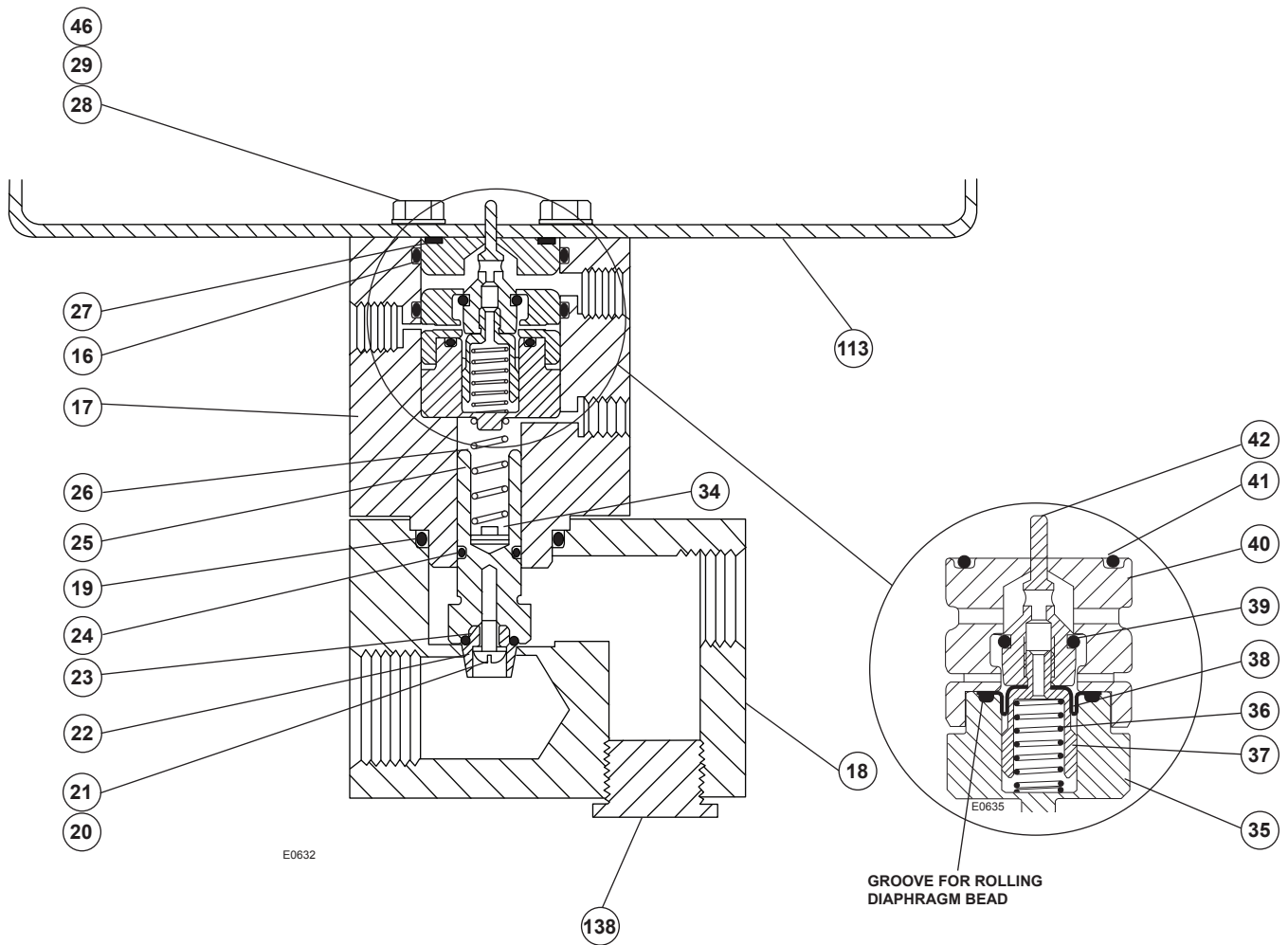


Figure 14. Type ACE97 NPS 1 / DN 25 Pad Valve

Type ACE97

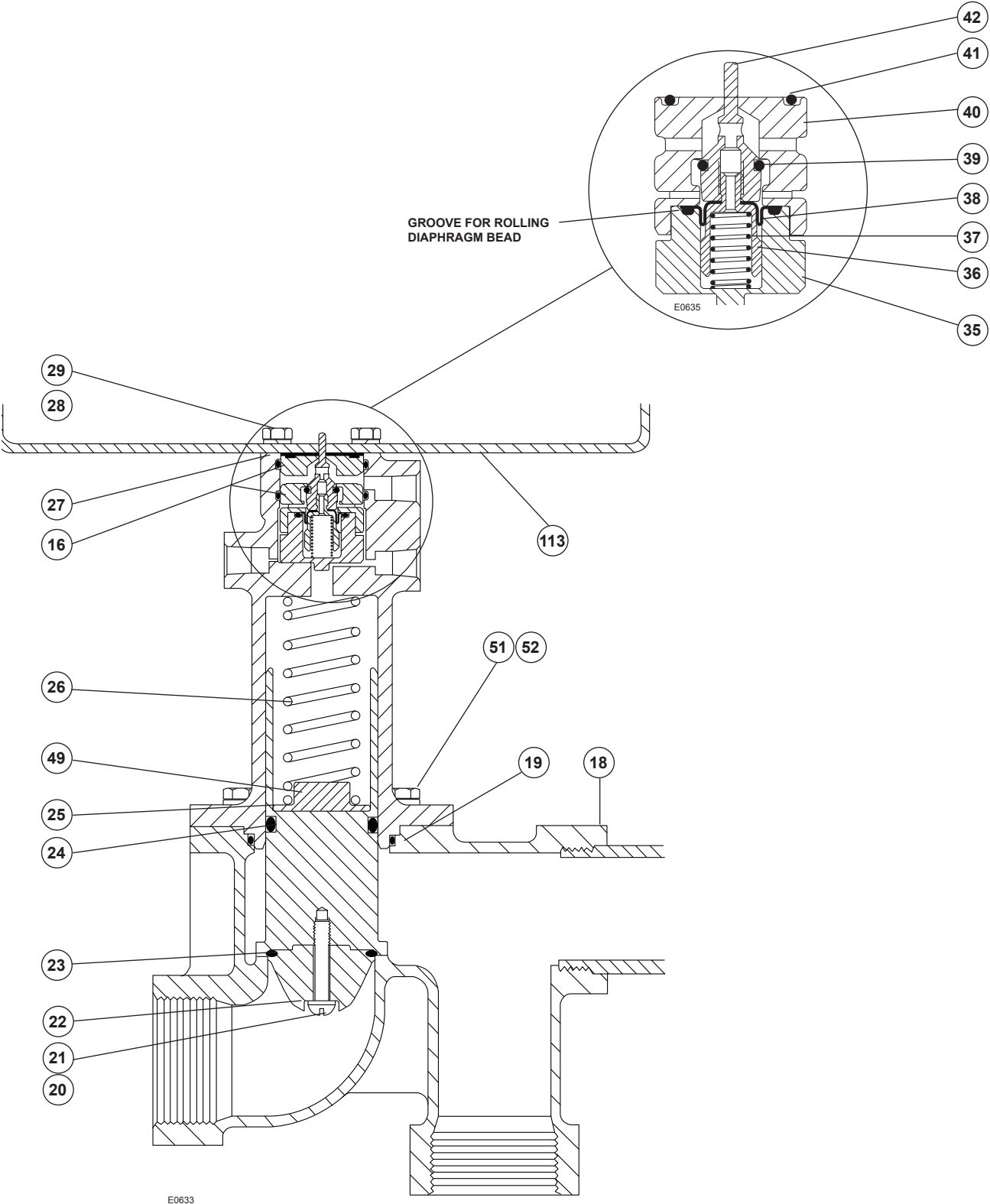
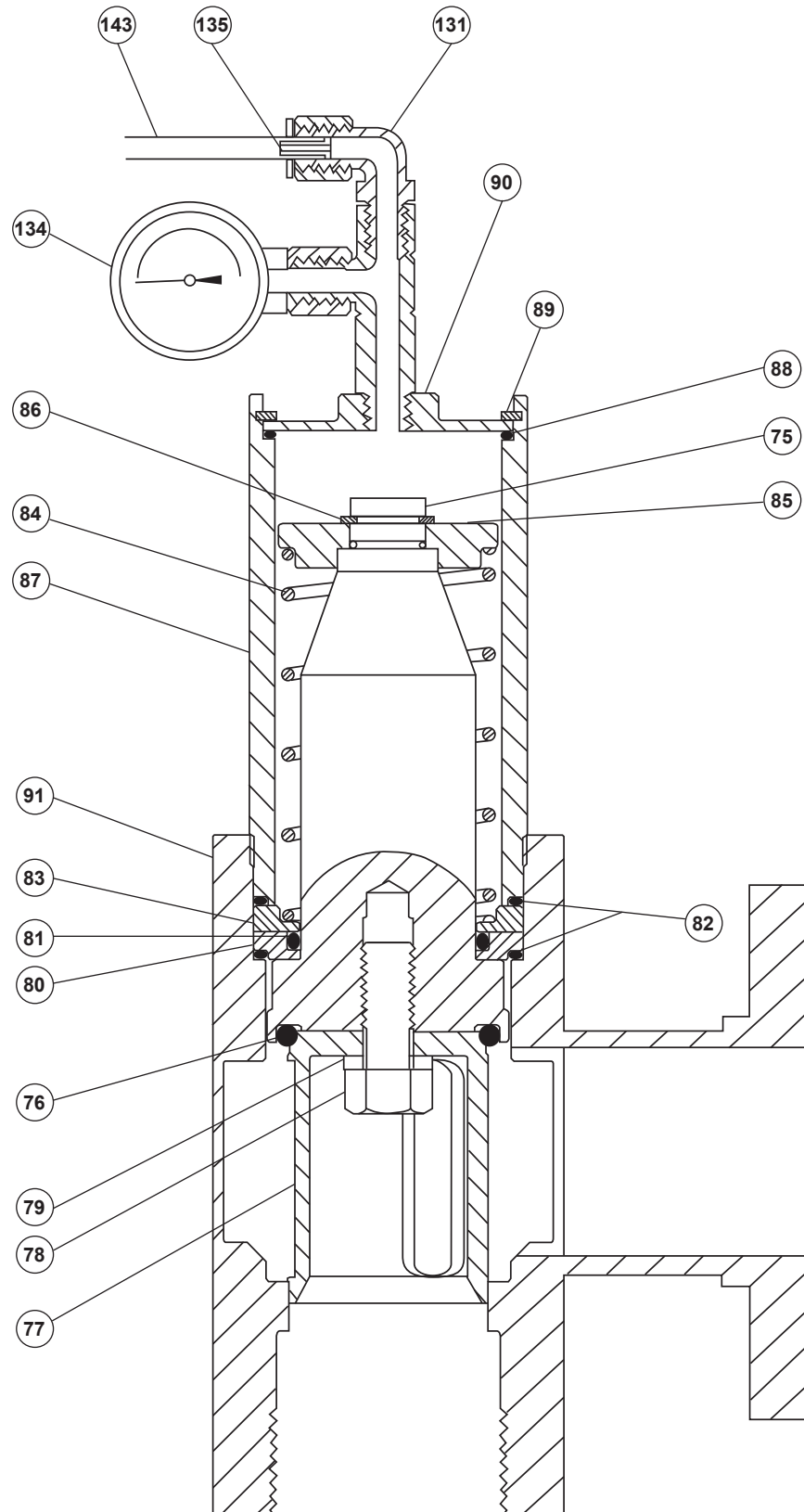
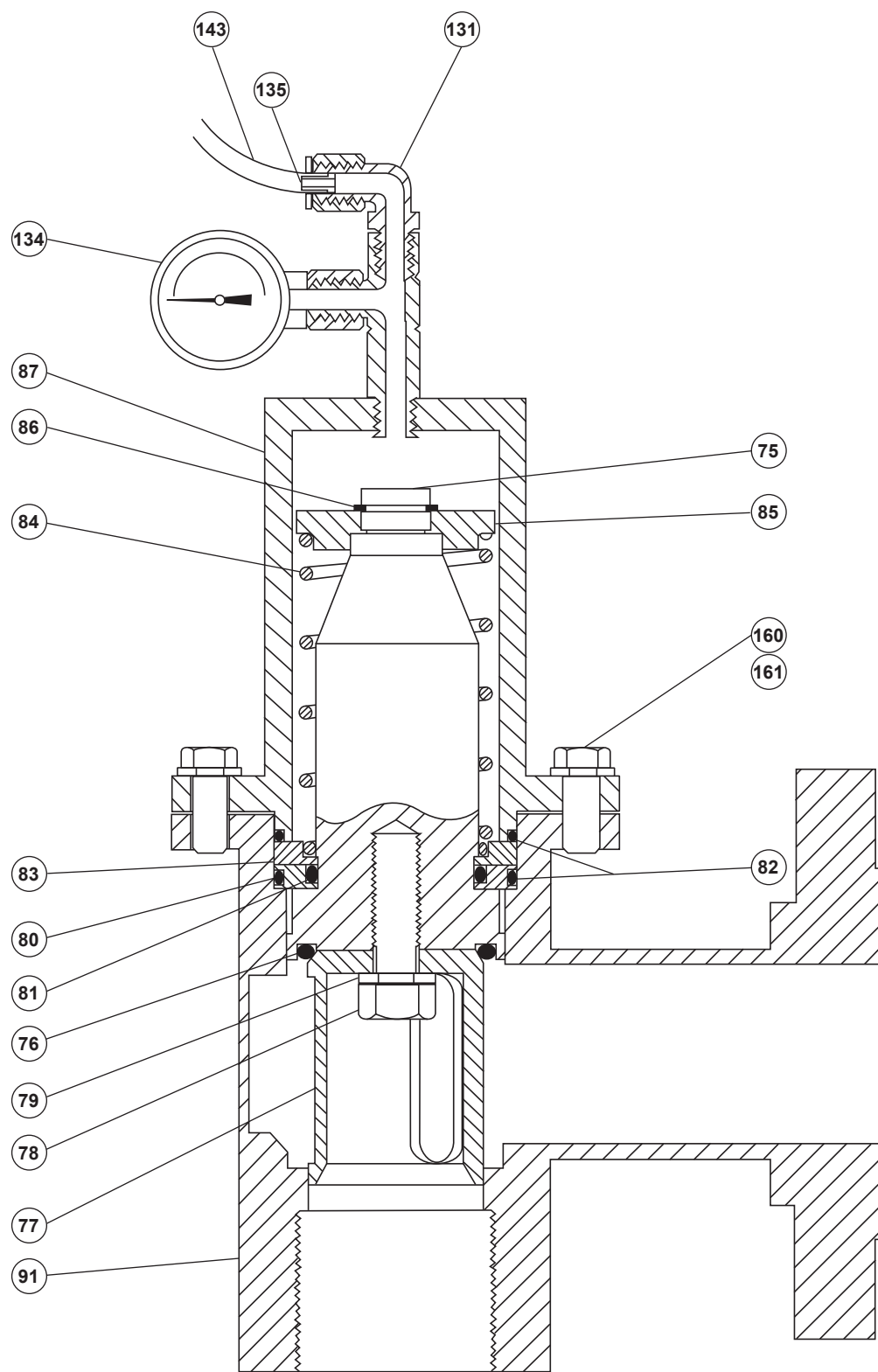


Figure 15. Type ACE97 NPS 2 / DN 50 Pad Valve



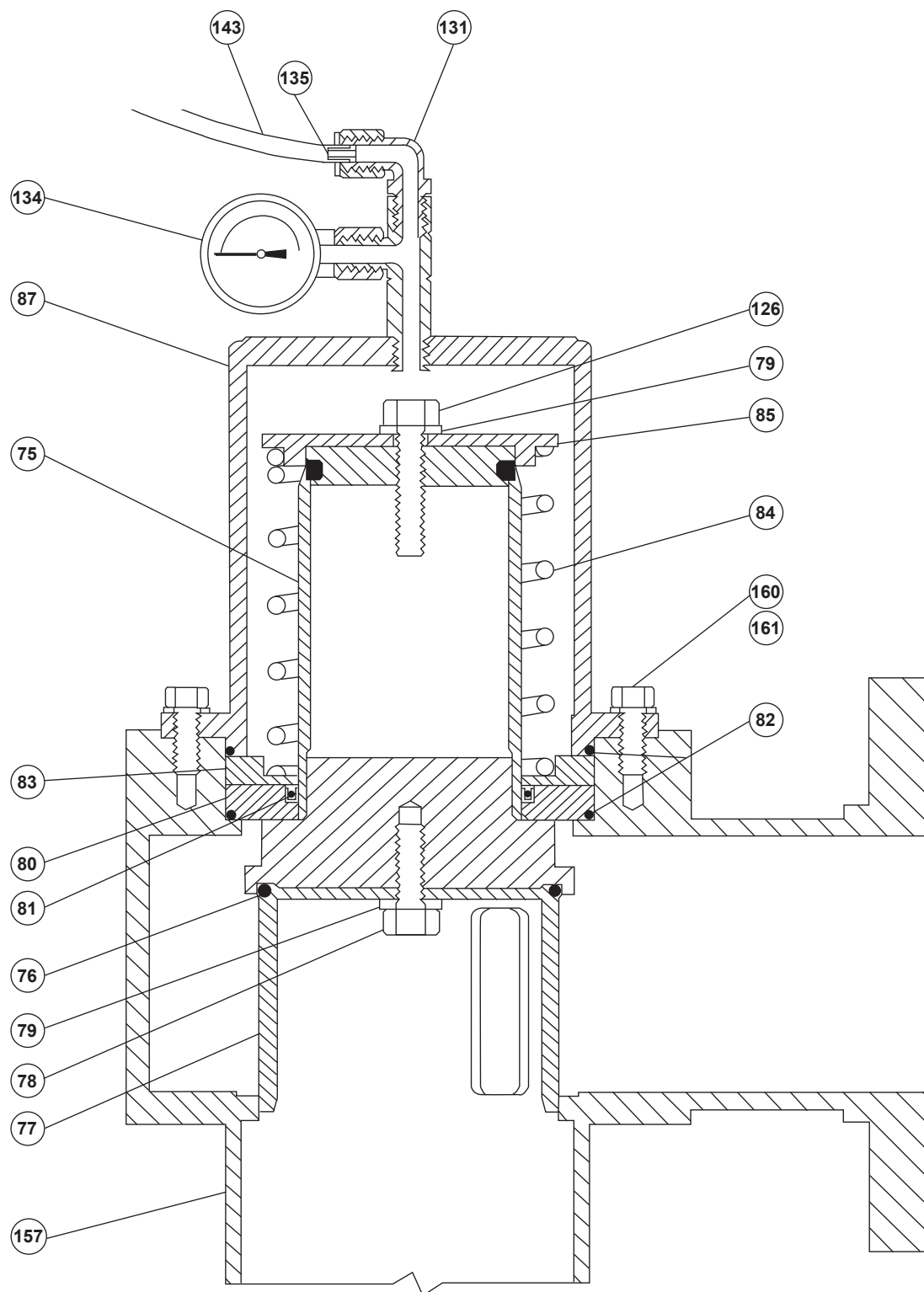
E0636

Figure 16. 1 NPT Depad Main Valve



E0705

Figure 17. 2 NPT Depad Main Valve



E0674

Figure 18. NPS 3 and 4 / DN 80 and 100 Depad Main Valve

Type ACE97

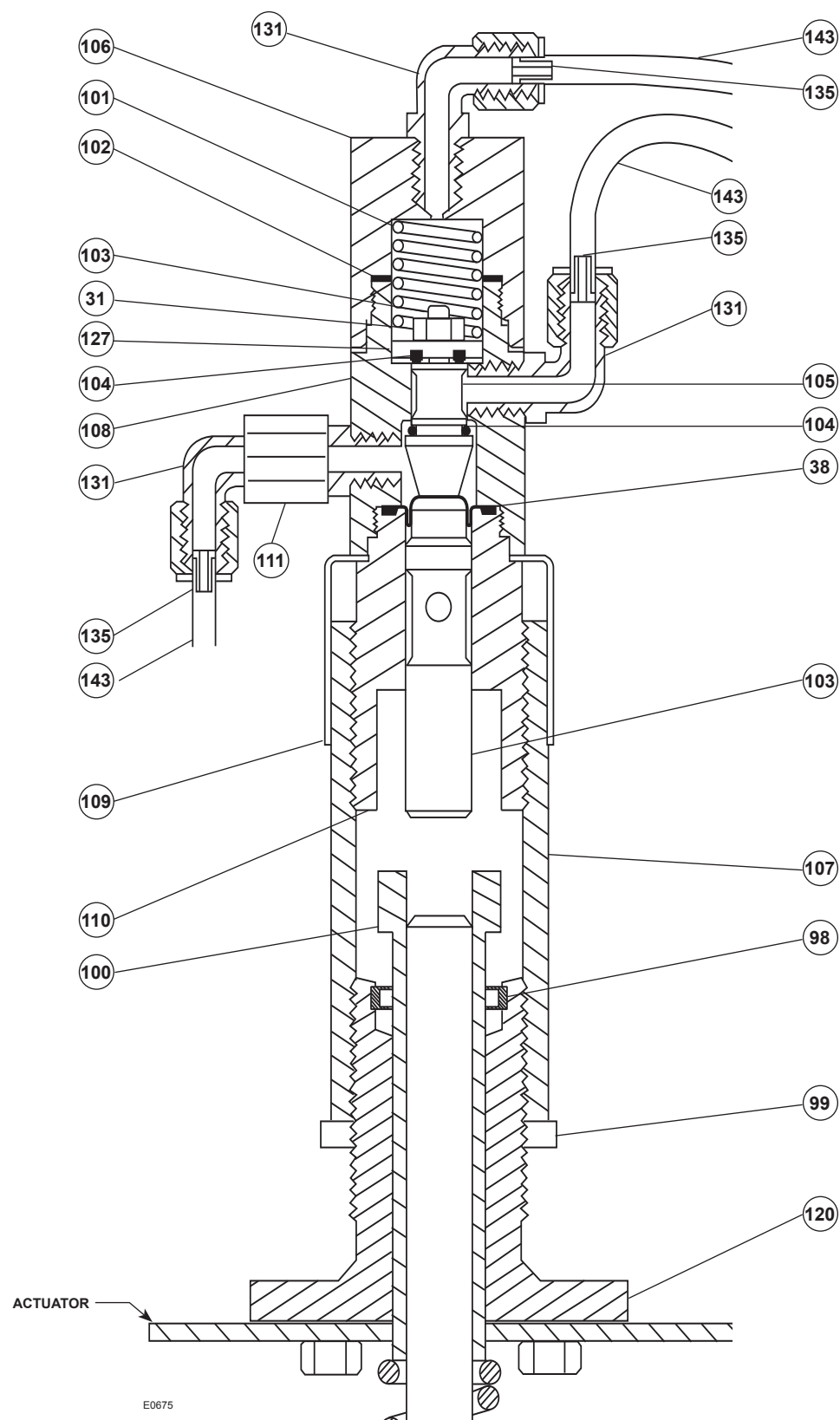


Figure 19. Depad Pilot Valve Parts



Type ACE97

Industrial Regulators

Emerson Process Management Regulator Technologies, Inc.

USA - Headquarters
McKinney, Texas 75069-1872, USA
Tel: +1 800 558 5853
Outside U.S. +1 972 548 3574

Asia-Pacific
Shanghai 201206, China
Tel: +86 21 2892 9000

Europe
Bologna 40013, Italy
Tel: +39 051 419 0611

Middle East and Africa
Dubai, United Arab Emirates
Tel: +971 4811 8100

For further information visit www.fisherregulators.com

Natural Gas Technologies

Emerson Process Management Regulator Technologies, Inc.

USA - Headquarters
McKinney, Texas 75069-1872, USA
Tel: +1 800 558 5853
Outside U.S. +1 972 548 3574

Asia-Pacific
Singapore 128461, Singapore
Tel: +65 6770 8337

Europe
Bologna 40013, Italy
Tel: +39 051 419 0611
Gallardon 28320, France
Tel: +33 2 37 33 47 00

TESCOM

Emerson Process Management Tescom Corporation

USA - Headquarters
Elk River, Minnesota 55330-2445, USA
Tels: +1 763 241 3238
+1 800 447 1250

Europe
Selmsdorf 23923, Germany
Tel: +49 38823 31 287

Asia-Pacific
Shanghai 201206, China
Tel: +86 21 2892 9499

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