

MasoneilanTM 28000 Series VariPakTM Adjustable-C_v Control Valves

Instruction Manual (Rev.C)



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Safety Information

Important - Please read before installation

These instructions contain **DANGER**, **WARNING**, and **CAUTION** labels, where necessary, to alert you to safety related or other important information. Read the instructions carefully before installing and maintaining your control valve. **DANGER** and **WARNING** hazards are related to personal injury. **CAUTION** hazards involve equipment or property damage. Operation of damaged **equipment can, under certain operational conditions, result in degraded process system performance that can lead to injury or death. Total compliance with all DANGER, WARNING, and CAUTION notices is required for safe operation.**



This is the safety alert symbol. It alerts you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.



When used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, could result in property damage.

Note: Indicates important facts and conditions.

About this Manual

- The information in this manual is subject to change without prior notice.
- The information contained in this manual, in whole or part, shall not be transcribed or copied without Baker Hughes's written permission.
- Please report any errors or questions about the information in this manual to your local supplier.
- These instructions are written specifically for the 28000 Series control valves, and do not apply for other valves outside of this product line.

Useful Life Period

The current estimated useful life period for the 28000 Series control valves is 25+ years. To maximize the useful life of the product, it is essential to conduct annual inspections, routine maintenance and ensure proper installation to avoid any unintended stresses on the product. The specific operating conditions will also impact the useful life of the product. Consult the factory for guidance on specific applications if required prior to installation.

Warranty

Items sold by Baker Hughes are warranted to be free from defects in materials and workmanship for a period of one year from the date of shipment provided said items are used according to Baker Hughes recommended usages. Baker Hughes reserves the right to discontinue manufacture of any product or change product materials, design or specifications without notice.

Note: Prior to installation:

- The valve must be installed, put into service and maintained by qualified and competent professionals who have undergone suitable training.
- All surrounding pipe lines must be thoroughly flushed to ensure all entrained debris has been removed from the system.
- Under certain operating conditions, the use of damaged equipment could cause a degradation of the performance of the system which may lead to personal injury or death.
- Changes to specifications, structure, and components used may not lead to the revision of this manual unless such changes affect the function and performance of the product.

1. General

These installation, operation, and maintenance instructions apply to Masoneilan VariPak 28000 series control valves. They also include a parts reference list with recommended spare parts.

IMPORTANT REMARKS

Before installing, operating, or performing maintenance on this equipment, you should read these instructions carefully and make sure you have understood them.

Work on this equipment should only be carried out by qualified personnel.

Failure to follow the instructions and precautions given in this document could lead to a malfunction and seriously damage the equipment.

1.1 Spare Parts

For maintenance purposes, always use original Masoneilan spare parts obtained through your local Baker Hughes representative or Spare Parts Department. When ordering, always give the references of the original order for the equipment concerned and, in particular, the number indicated on the serial plate. (135)

1.2 After Sales Department

Baker Hughes has a highly skilled After Sales Department to assist customers with start-up, maintenance, and repair of valves and instruments. Contact your nearest Baker Hughes Sales Office or Representative.

1.3 Training

Baker Hughes organizes regular training courses in the operation, maintenance and application of its Masoneilan control valves and instruments for customer service and instrumentation personnel. For further details, please contact your local Baker Hughes representative or Training Department.

2. Operation

The Masonellan VariPak microflow control valve features a very wide range of rated flow coefficients (C_V), from 0.004 to 3.8.

Two types of actuators are available:

- The VariPak 28001 with a single lever, designed for just one rated C_V . This version is used when enough is known about the operating conditions when sizing the valve.
- The VariPak 28002 with an adjustable rated C_V . This valve uses a patented lever system to adjust the rated C_V on site to suit the actual operating conditions, thereby avoiding any oversizing in flow capacity. Each plug and seat ring combination can be adjusted without changing the control signal.

2.1 Precise Adjustment of the Varipak 28002 Adjustable- C_V Valve

The valve is adjusted using a simple, but robust, crossed-lever system with an adjustable fulcrum. This can be done easily by hand, either before installation or during operation. For example, an application requiring a theoretical C_V of 0.006 could be handled using a VariPak 28002 with a maximum C_V of 0.010, that can subsequently be calibrated on site between 0.004 and 0.010.

2.2 Flow Coefficient of Varipak 28001 Single-Lever And 28002 Adjustable- C_V Valves

2.2.1 Plug/seat ring combinations (trim)

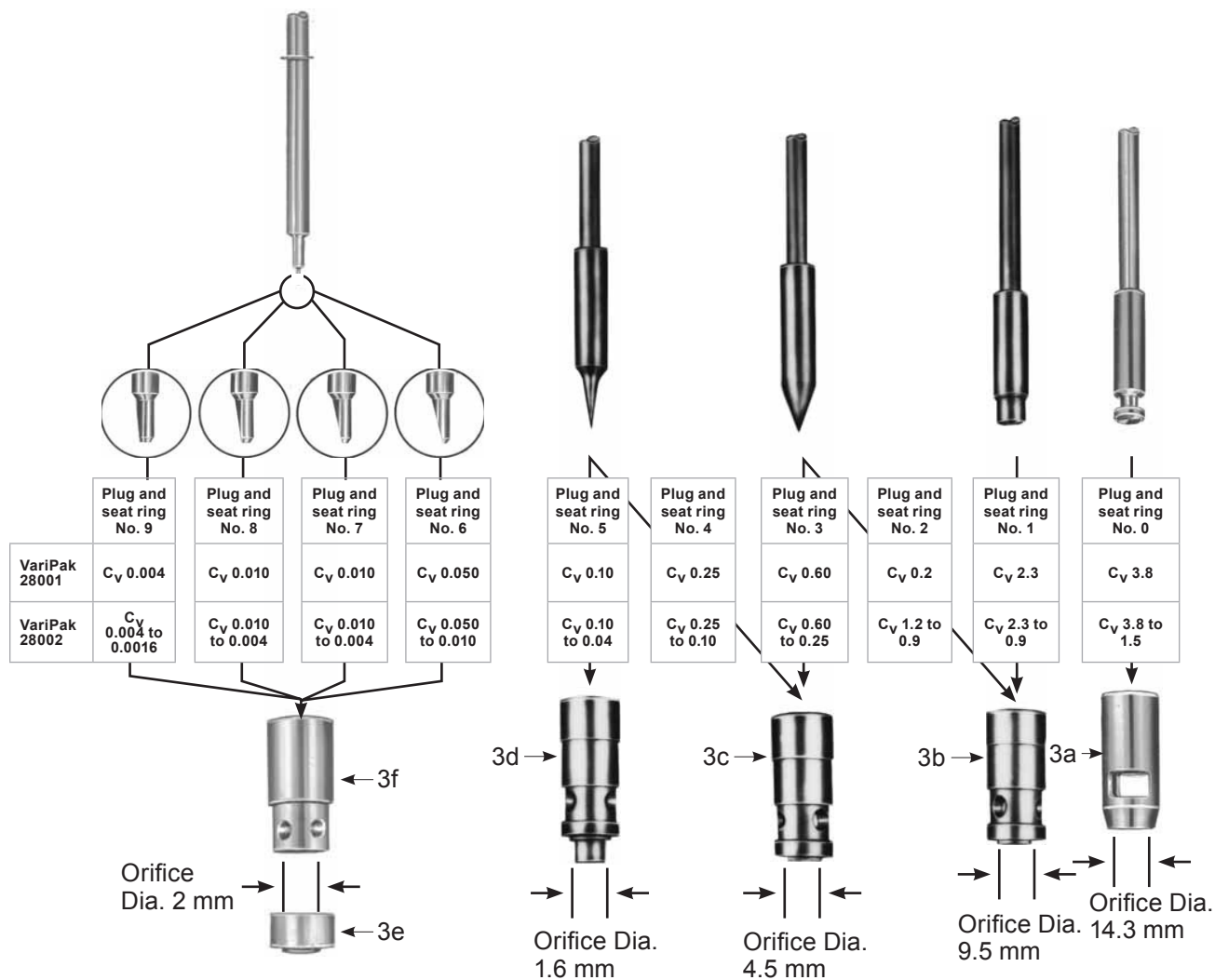
Eight plugs and five seat rings are used to make up the ten available plug and seat ring combinations, identified by codes from 0 to 9 (see figure 2). The shape of each plug and the port diameter of the seat ring can be used to match parts with the table in figure 2.

The difference between the four plugs in trim Nos. 6 to 9 lies in the angle of the flat machined on the tip. The same seat ring (3e) and the same spacer (3f) are used in all four cases (see figure 2).

Use the table in figure 1 to select the plug and seat ring combination to obtain the C_V value or range of C_V values you require.

Trim No.	FLOW COEFFICIENT C_V								
	VARIPAK 28001	VARIPAK 28002							
		MIN.	RISK FREE				MAX.		
9	0.0040	0.0016	0.0020	0.0024	0.0028	0.0032	0.0036	0.0040	
8	0.010	0.004	0.005	0.006	0.007	0.008	0.009	0.010	
7	0.025	0.010	0.013	0.016	0.019	0.021	0.023	0.025	
6	0.050	0.020	0.025	0.030	0.035	0.040	0.045	0.050	
5	0.10	0.04	0.05	0.06	0.07	0.08	0.09	0.10	
4	0.25	0.10	0.13	0.16	0.19	0.21	0.23	0.25	
3	0.6	0.25	0.30	0.35	0.4	0.45	0.5	0.55	0.6
2	1.2	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
1	2.3	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.3
0	3.8	1.5	1.9	2.3	2.6	2.9	3.2	3.5	3.8

Figure 1



2.2.2 Changing the plug and seat ring combination

The plug and seat ring combination can be changed very easily for trim Nos. 1 to 9 inclusive. Simply replace the following parts:

- The plug and seat ring (see figures 1 and 2 to select the combination required for the new C_V).

- The C_V adjustment plate (25) in the case of the VariPak 28002 adjustable- C_V valve.

- If necessary, the actuator spring (134) (see figure 3 to check the spring range corresponding to the new C_V).

Plug/ Seat No.	Flow Coeffi- cient C_V	Spring Range (134)			Max. Pressure Supply				
					Adjustable C_V		Single Lever		
		m.bar	Psi	Color Code	CI. IV	CI. V	CI. IV	CI. V	
					bar (Psi)	bar (Psi)	bar (Psi)	ATO	ATC
0	3.8 to 1.5	414	6-24	Red	2.1 (30)	2.1 (30)	2.1 (30)	2.8 (40)	
1	2.3 to 0.9								
2	1.2 to 0.5								
3	0.6 to 0.25	1660	3-15	Green	1.4 (20)	1.4 (20)	1.4 (20)	1.7 (25)	
4	0.25 to 1.10								
5	0.10 to 0.04								
6	0.050 to 0.020	207	3-15	Green	1.4 (20)	1.4 (20)	1.4 (20)	1.7 (25)	
7	0.025 to 0.010								
8	0.010 to 0.004								
9	0.004 to 0.0016	1035	3-15	Green	1.4 (20)	1.4 (20)	1.4 (20)	1.7 (25)	

Figure 3 - Actuator spring ranges and supply pressures

Follow the procedure described in the "Disassembly/Reassembly" section of the "Maintenance" chapter on pages 14 to 18.

- Also change the serial plate (135) or correct the information on the existing plate.

! CAUTION

If the valve in question includes a 1/2" or 3/4" NPT threaded end, the maximum capacity of the body is respectively limited to trim Nos. 9 to 3 inclusive or 9 to 2 inclusive. A trim No. 9 cannot be installed in a VariPak valve body designed for a trim No. 0. Likewise, a trim No. 0 cannot be installed in valve bodies designed for other trim numbers.

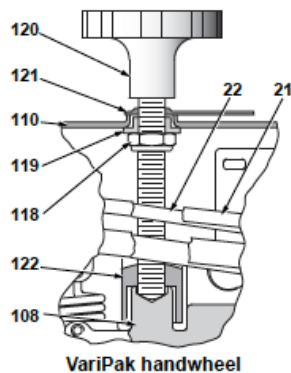
2.2.3 Adjusting the C_v of a VariPak 28002 valve for each plug and seat ring combination

This is done by moving adjustment knob (24) along adjustment plate (25) fastened to the top of lever No. 1 (21).

The adjustment plate (25) gives the range of C_v values offered by the selected plug and seat ring combination. Carry out this adjustment operation as follows:



Figure 4 - Adjusting the C_v of VariPak 28002 valve for each plug/seat ring combination



- Loosen adjustment knob (24) and slide it along the lever to the required value. Tighten the adjustment knob again firmly.

Note:

- *This operation entails moving lever No. 2, either pneumatically (by allowing air into the actuator), or manually (by pressing piston clevis (140b) with a screwdriver or similar tool) so that the slides of the two levers are perfectly parallel.*

- *It may be necessary to reset the zero to calibrate the closure point after changing the C_v.*

2.3 Actuator

A single actuator allows VariPak valves to act in direct Air-to-Close (ATC), or reverse Air-to-Open (ATO).

Valve action can be changed with no additional part by simply shifting:

- the pivot pin and the attachment hole of the positioner balance spring clamp for the singlelever VariPak 28001 valve,
- the two pivot pins for the adjustable-C_v VariPak 28002 valve, then calibrating as required.

Follow the instructions given under "Reversing the valve action" in paragraph 2.5.

2.4 Handwheel (Figure 5)

The handwheel is an optional feature located on top of the cover and fitted with a locking lever. Access can be gained to it directly without removing any other parts. It consists of a threaded rod, equipped with a handwheel (120) and a lever arm stop (122). The threaded rod rests freely on the actuator bracket (108) and is guided through the cover (110) by handwheel bushing (119). The stop consists of a block screwed onto the threaded rod. The block is guided by the actuator bracket (108).

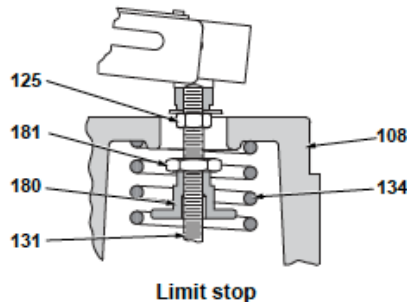


Figure 5

When the handwheel (120) is turned clockwise, the stop (122) moves up the threaded rod, compressing the spring (134) and raising lever No. 2 (22) (VariPak 28002) or (113) (VariPak 28001). This closes the valve if the valve is equipped with a direct-action actuator (Air-to-Close) and opens the valve if it is equipped with a reverse-action actuator (Air-to-Open).

The valve can be returned to automatic mode (neutral position), by turning the handwheel counterclockwise until the stop (122) comes into contact with the bracket (108).

Note: During this operation, the compression is released when the stop (122) moves away from the lever (22) (VariPak 28002) or (113) (VariPak 28001). Continue the operation until a slight tension reappears, then tighten the handwheel lock (121).

VariPak actuators are equipped with a limit stop. This consists of parts (180) and (181), and is designed to prevent damage to the plug and seat ring assembly and/or the plug stem in the event of handwheel or actuator overstroke.

Note: The limit stop is not used with air-to-open valves fitted with a handwheel, and must be screwed down at the bottom of the piston.

2.5 Reversing the Valve Action (Figures 5, 6, 26, 27 and 29)

CAUTION

The valve must be isolated and pressure vented before disassembly.

- A. Loosen and remove cover (110). On valves equipped with a handwheel, loosen cover screw (109), back off handwheel lock (121), and turn handwheel (120) counter-clockwise to release cover (110).
- B. Adjust the signal so that the valve closes. Change the signal slightly so that the plug just moves off the seat ring. On the VariPak 28002 adjustable-C_v valve, set the adjustment knob (24) to the minimum C_v setting.
- C. Loosen locknut (103) and, using a screwdriver, turn the plug stem one and three-quarter turns counter-clockwise. Shut off the signal and the supply pressure. Slightly tighten locknut (103) against the clevis.
- D. Unlock nut (117) and completely loosen screw (116). Unhook spring (114) from spring clamp (115).

2.5.1 VariPak 28001 single-lever valve

- E. Remove retainer clips (112b) from pin (18), and remove the pin from lever (113) and plug clevis (104a).

Note: This operation will be simplified by relieving the load exerted on the plug clevis by the conical compression spring (106). To do this push against the plug stem end with a screwdriver while driving out the pins.

- F. Remove the two retainer clips (112a) from the pin (105) and disengage it to uncouple the lever (113) from the bracket (108).
- G. Refit the levers (113) making sure that the pin (105) is fitted into the correct holes in the lever and bracket for the new action of the actuator (see figure 6). Fit the spring clamp (115) into the corresponding lever hole.

Note: Ensure that the clevis is correctly positioned before fitting the lever on the bracket.

- H. Couple the plug stem clevis (104a) to the lever (113) following the normal reassembly procedure (step I. in the "Reassembly" section). Then follow the same procedure as for the VariPak 28002 adjustable-C_v valve as from step L.

2.5.2 VariPak 28002 adjustable-C_v valve (2 levers)

- E. Remove retainer clips (112b) from each of the two pins (184) and remove pins from lever (113) and plug clevis (104a).

Note: This operation will be simplified by relieving the load exerted on the plug clevis by the conical compression spring (106). To do this push against the plug stem end with a screwdriver while driving out the pins.

- F. Remove the two retainer clips (112a) from pin No. 1 (105) and disengage it to uncouple lever No. 1 from bracket (108). Loosen adjustment knob (24) and slide it to the maximum C_v setting. Disengage the smooth end of the adjustment pin (23) from the groove in lever No. 2 while removing lever No. 1.
- G. Drive out pin No. 3 (18) and remove lever No. 2 (22) from the bracket.
- H. Remove the two screws (26) and refit C_v adjustment plate (25) after turning it round to comply with the new action.
- I. Refit levers No. 1 and 2 in sequence, making sure that pins (105) and (108) are fitted into the correct holes in the levers and bracket for the new action of the actuator (see figure 6).

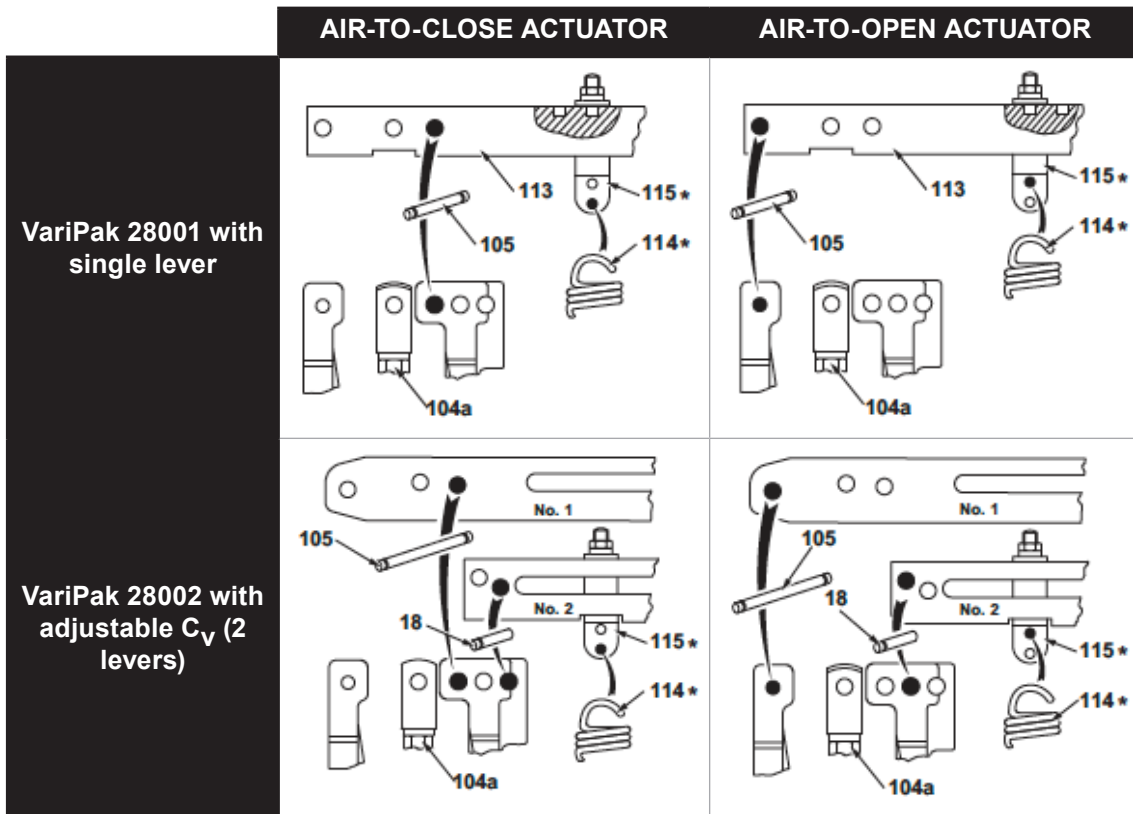
Note: Ensure that the clevis is correctly positioned before fitting the lever No. 1 on the bracket (108).

- J. Reset adjustment knob (24) to the minimum C_v position.
- K. Couple plug stem clevis (104a) to lever No. 1 following the normal reassembly procedure (step L. in the "Reassembly" section).
- L. Hook spring (114) in the appropriate hole in spring clamp (115) (see figure 6).
- M. Admit supply and signal pressures and complete calibration. Refit cover (110) using the two screws (109). If the valve is equipped with a handwheel, refit the cover and turn the handwheel clockwise so that it engages in lever arm stop (122). Tighten cover screws (109).

N. Put the valve back into service.

Note:

- **When replacing an Air-to-Close actuator with an Air-to-Open actuator, do not forget to neutralize the limit stop by screwing it down at the bottom of the piston.**
- **When replacing an Air-to-Open actuator with an Air-to-Close actuator, set the limit stop to the opening position.**



*Only with type 7700 positioner

Figure 6 - Identification of lever pivot pin holes

3. Installation

3.1 Preliminary Steps

- A. Before installing the valve in the line, remove all traces of foreign material from the piping such as welding chips, scale, oil, grease, etc.
- B. Note down all the data given on the serial plate.
- C. For valve inspection without interrupting process operation, a hand-operated stop valve will be required on either side of the VariPak, together with a hand-operated throttling valve mounted on a bypass line.

3.2 Valve Installation (Figures 7, 8 and 9)

Connections: The body of the ANSI Class 1500* rated VariPak valve can be:

- Bolted between 25 mm (1") pipe flanges machined to standards ISO-PN 10 to PN 250 (ANSI 150 - 300 - 600 - 900 and 1500 lb).

Use ASTM A 193 Gr B 7 (or equivalent) carbon steel bolting for temperatures between -29° and +350 °C. For corrosive or cryogenic service, use ASTM A 193 Gr B8 strain-hardened stainless steel. All the line bolting required for installation can be supplied by Baker Hughes on request.

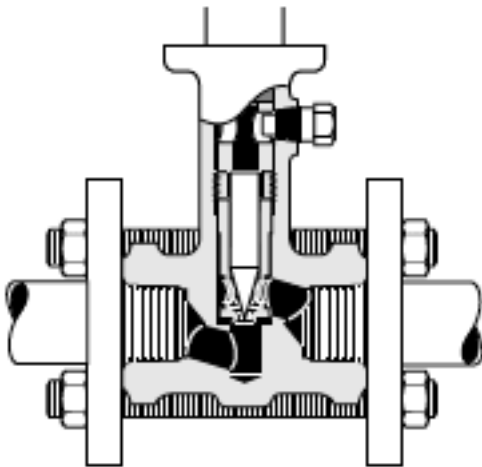


Figure 7 - VariPak flanged connection

- Connected by 25 mm flanges machined to standards ISO-PN 20, 50 and 100 (ANSI 150, 300 and 600 lb).

Fit gaskets compatible with service conditions between the valve body and the pipe flanges.

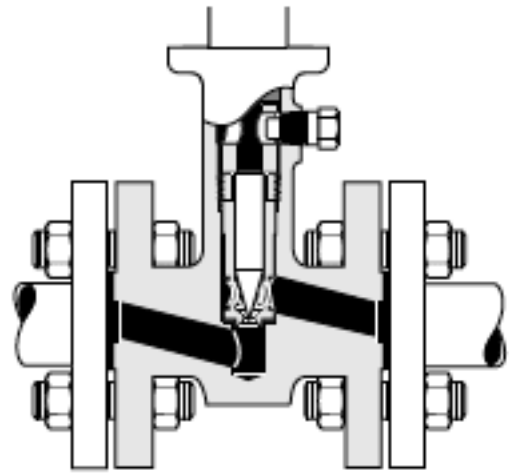


Figure 8 - VariPak flanged body

The VariPak valve body can be supplied on request with 1/2", 3/4", or 1" NPT threaded ends. Apply PTFE tape or a sealing compound compatible with the process to the threaded pipe ends.

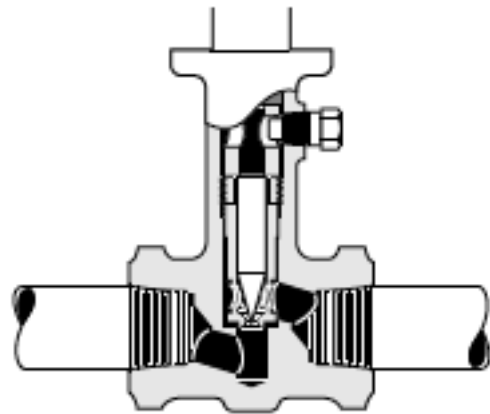


Figure 9 - VariPak screwed connection (option)

Alignment: This valve is small and light, making it easy to install on the piping. Support the valve body when fitting studs. Suitably shaped bosses are provided to center the valve in the line and prevent rotation before the studs are finally tightened.

The valve must always be installed with "flow tending to open". The flow arrow on the valve body must be pointing in the direction of flow. Fit the bolts and tighten in criss-cross fashion.

Insulation: If the valve is to be insulated, ensure that the insulation does not exceed the shaded area shown in figure 10 below.

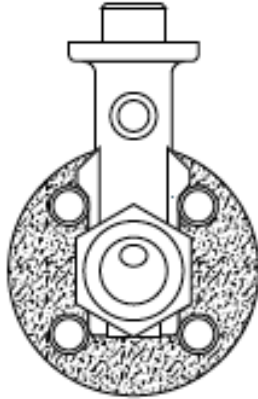


Figure 10 - Insulation limit for a VariPak valve

3.3 Pneumatic and Electrical Circuit (Figures 3, 11 and 12)

- On-off valve: connect the air supply line directly to the 1/8" NPT threaded connection in diaphragm cover (137).
- Control valve with 7700P positioner (air signal): connect the supply and instrument signal lines to the appropriate connections on the manifold block (144) (figure 11). Use 4 x 6 mm (1/4" O.D.) tubing.
- Control valve with 7700E positioner (electrical signal): connect the manifold block (144) air supply line and make the electrical connection for the I/P module (20) (figure 12). Use 4 x 6 mm (1/4" O.D.) tubing for the air line.

Note: Check that the supply pressure is that indicated on the serial plate.

7700P or 7700E positioners can be installed on both VariPak 28001 single-lever and VariPak 28002 adjustable-C_v valves.

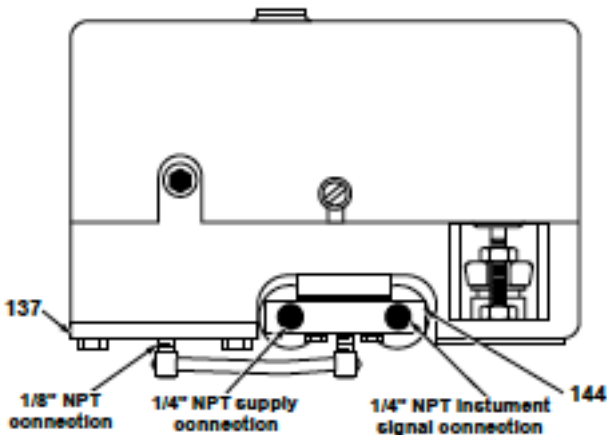


Figure 11 - Connections with 7700P positioner

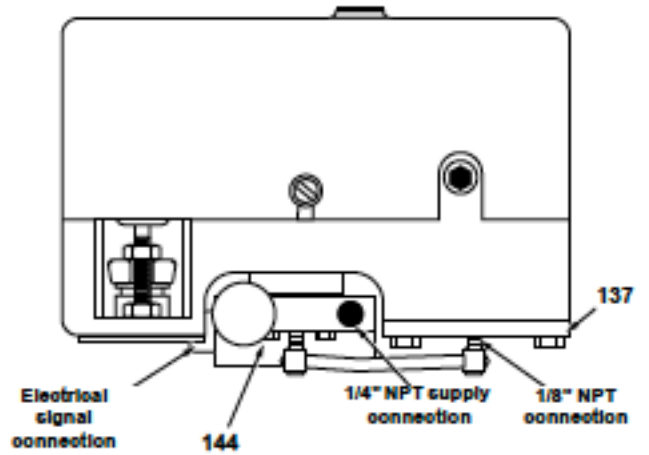


Figure 12 - Connections with 7700E positioner

3.4 Limit Switches (Figure 13)

In some cases, limit switches can be provided for the VariPak valve, on request. These are wired and adjusted in the factory to customer order. The black wire is connected to either the normally open or normally closed terminal of the upper limit switch. The black and white wire is connected to the common terminal of this switch. The red wire is connected to either the normally open or normally closed terminal of the lower limit switch.

The red and white wire is connected to the common terminal of this switch. To adjust limit switches, loosen their fasteners and move the valve to the required position. Adjust the position of the switch until it trips. Tighten fasteners (160 - 161 - 162).

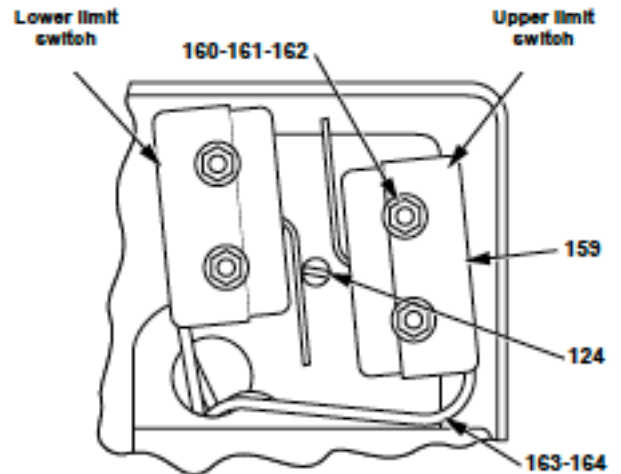


Figure 13 - Limit switch installation

4. Calibration

VariPak valves are factory-calibrated according to the components specified in the customer order. If for any reason this calibration has been disturbed (e.g. after changing from direct to reverse valve action, or replacing the plug and seat ring), all or some of the adjustments below must be carried out in the following order:

- Piston rod clevis (104b) adjustment.
- Plug stem adjustment.
- Limit stop adjustment.
- C_v adjustment.
- Positioner start-up pressure adjustment.

4.1 Piston Rod Clevis Adjustment

4.1.1 Adjusting the piston rod clevis on the VariPak 28001 single-lever valve (Figures 14 and 26)

Note: This adjustment is only required if the piston (131) has been removed. In this case, it should be carried out during reassembly, before coupling the lever (113) to the clevises (chap. MAINTENANCE - Reassembly. step H.).

With the piston resting against diaphragm cover (137), turn clevis (104b) so that the top of actuator bracket (108) is 0.5 mm to 1 mm from the bottom of indicator (126). A shim will simplify this operation. Admit enough air pressure to disengage locknut (125) and tighten it against indicator. Check that indicator (126) is correctly positioned. Release air pressure.

4.1.2 Adjusting the piston rod clevis on the VariPak 28002 adjustable-C_v valve (Figures 14 and 27)

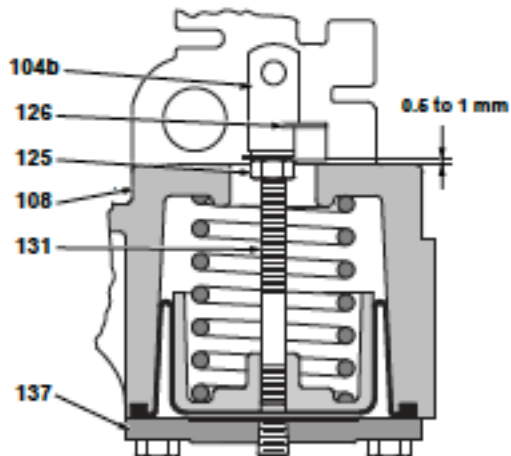


Figure 14 - Piston rod clevis (104b) adjustment

Note: This adjustment is only required if the piston (131) has been removed.

In this case, it should be carried out during reassembly, before coupling the levers (21) and (22) to the clevises (chap. MAINTENANCE - Reassembly. step K.).

With the piston resting against diaphragm cover (137), turn clevis (104b) so that the top of the actuator bracket (108) is 0.5 mm to 1 mm from the bottom of indicator (126). A shim will simplify this operation.

Couple lever No. 2 (22) in this clevis position. Admit enough air pressure to disengage locknut (125) and tighten it against the indicator. Check that indicator (126) is correctly positioned. Release air pressure.

4.2 Plug Stem Adjustment

4.2.1 Adjusting the plug stem on the VariPak 28001 single-lever valve (Figures 15, 16 and 26)

Note: This adjustment should be carried out during reassembly, before coupling the lever (113) to the clevises.

- Loosen nut (103) and turn the plug stem using a screwdriver while blocking clevis (104a) until the clevis is in the position shown in figure 15. Lock nut (103).

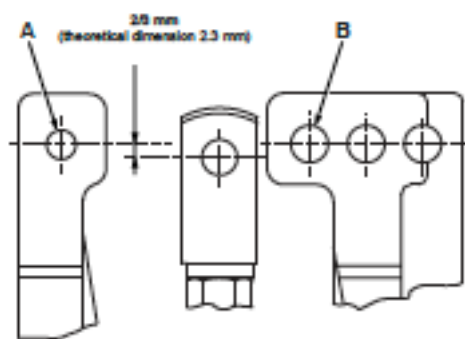


Figure 15 - Presetting the plug stem position

- B. Fit lever (113) with spring clamp (115) positioning hole facing upwards, fit pin (105) into hole A, then fit pin (18) into clevis (104a). Note: All pins should be greased slightly before fitting.
- C. Press the lever on the actuator side to check for plug/seat ring leaks at ΔP 3.5 barg (50 psig). If the valve is equipped with a handwheel, lever (113) should not touch lever arm stop (122). If the valve leaks, release the pressure at the inlet and remove pin (18) of clevis (104a), then loosen nut (103). Loosen the plug stem in order to move the clevis up (104a). A complete turn moves the position up by 1 mm. Then tighten the locknut (103) again.
- D. Check that the distance between clevis (104b) pin and the hole in lever (113) is approximately 2 mm. If necessary, adjust the position of clevis (104a) to obtain this distance, see figure 16. This value provides the initial compression of actuator spring (134).

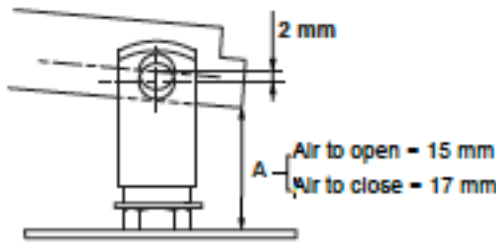


Figure 16 - Adjusting the lever (113)

- E. Admit enough air pressure to the actuator to drive piston clevis (104b) upwards. Couple the clevis to lever (113) using pin (124).
- F. Release the actuator pressure and repeat the plug/seat ring leak test at ΔP 3.5 barg (50 psig). Dimension A should be the same as in figure 16. Release the valve pressure once this step is completed.

4.2.2 Adjusting the plug stem on the VariPak 28002 adjustable- C_V valve (Figures 27, 28 and 29)

Once all the coupling operations are completed, proceed as follows:

- A. Admit enough pressure to the actuator to drive out the piston rod far enough to place a shim under the indicator (126). Use a 1.5 mm shim for an Air-to-Open actuator, and a 25 mm shim for an Air-to-Close actuator. Release the air pressure after inserting the shim.

Note: At this closing point where the plug is not tightened onto the seating, the slides of levers No. 1 and 2 should be perfectly parallel. This characteristic makes it possible to change the adjustment knob (24) position later to obtain the required real C_V value.

- B. Loosen adjustment knob (24) and slide it along lever No. 1 to the maximum C_V position on adjustment plate (25). Fully tighten adjustment knob (24).
- C. Loosen locknut (103) and, using a screwdriver, turn the plug stem until the plug is just touching the seat ring. If the valve has been removed from the pipe, a bubble test can be performed on the calibration bench to obtain a very accurate adjustment. Using the screwdriver to hold the plug stem in position, tighten locknut (103) against clevis (104a).
- D. Admit air pressure again to remove the shim, then release the pressure.

Note: On an Air-to-Open actuator, shim thickness may be increased or decreased by one or two-tenths of a millimeter to ensure that levers No. 1 and 2 are perfectly parallel and to obtain the required tightness on closing, especially for very low C_V values ($C_V < 0.10$).

4.3 Limit Stop Adjustment (Figure 5)

VariPak valves include a limit stop to prevent damage to the plug and seat ring and/or plug stem in the event of actuator or handwheel overstroke. This device consists of a nut (180) acting as a stop, screwed onto the piston rod inside the spring chamber, and a locknut (181).

If necessary, this device should be adjusted immediately after plug stem adjustment (see section 4.2).

- A. Remove the shim (for VariPak 28002 adjustable- C_V valve only) and admit sufficient supply pressure to close the valve. Turn locknut (181) on the piston rod until it touches locknut (125). Turn limit stop (180) until it just touches the inside of actuator bracket (108).
- B. Hold the limit stop with a 12 mm wrench and tighten locknut (181). Release the air pressure.

4.4 Varipak 28002 C_v Adjustment

This adjustment is carried out by moving adjustment knob (24) along adjustment plate (25) fastened to the top of lever No. 1 (21). See section "Adjusting the C_v of a Varipak 28002 valve for each plug and seat ring combination."

4.5 Positioner Start-Up Pressure Adjustment (Figures 7, 25, 26 and 27)

- A. Connect the air supply and signal lines to the 7700P or 7700E (with electrical signal) positioner.
- B. Set the supply pressure according to the valve C_v value (see the table in figure 3).
- C. Set the signal to the minimum value for an Air-to-Open actuator, and to the maximum value for an Air-to-Close actuator. Turn take-up screw (116) until the piston rod just begins to move. Tighten locknut (117).

5. Maintenance

CAUTION

Always ensure that there is no pressure in the valve, actuator, or positioner before maintenance or disassembly.

5.1 Actuator Diaphragm Removal (Figures 17, 24, 25, 26 and 27)

- A. Unscrew the two pressure connection nuts (138a) and pull tubing (140) out. Remove the four cap screws (139) and diaphragm cover (137). Remove the worn diaphragm. Form new diaphragm (136) and fit it on the piston as shown in figure 17. Fit the diaphragm roll into the bracket groove. Take care not to twist or bend the diaphragm during replacement. Refit diaphragm cover (137) with the four screws (139) and reconnect the tubing with the two pressure connection nuts (138a). Check that all connections are leaktight.



Figure 17 - Diaphragm replacement

5.2 Adding Packing Ring (Figures 18, 26 and 27)

- A. Before adding packing ring, the valve must be isolated and all pressure released. Remove packing flange nuts (8b), lift the packing flange and follower, and insert a new packing ring. Tighten nuts (8b) finger tight and then tighten one full turn with the wrench.



Figure 18 - Adding a packing ring

5.3 Disassembly (Figures 5, 24, 25, 26, 27, 28 and 29)

In some cases, it may be necessary to disassemble the VariPak valve, for example, to replace the plug/seat ring assembly (fitting new parts or changing the maximum C_v value) or to change the packing rings when the maximum C_v is less than 0.6.

Note: If the maximum $C_v \geq 0.6$, a quick change method can be used to avoid disassembling the valve (see section 5.5).

CAUTION

The valve must be isolated and pressure vented before disassembly.

- A. Loosen cover screws (109) and remove cover (110). If the valve is equipped with a handwheel, loosen cover screws (109) and handwheel lock (121), then turn handwheel (120) counterclockwise to release cover (110).

Disassembly procedure for the VariPak 28001 single-lever valve:

- B. Unlock nut (117) and completely loosen screw (116). Remove spring clamp (115) from lever (113) and remove spring (114) from the positioner.
- C. Remove the two retainer clips (112c) from pin (124) and disengage the pin to uncouple piston clevis (104b) from lever (113).

Note: To simplify this operation, admit air pressure to the actuator to drive the piston clevis (104b) upwards, then release the air pressure.

- D. Remove retainer clips (112b) from pin (18) and disengage the pin from lever (113) and plug clevis (104a).
- E. Remove two retainer clips (112a) from pin (105) and disengage the pin to uncouple lever (113) from actuator bracket (108). Now proceed in the same way as for the VariPak 28002 adjustable- C_v valve, as from step I.

Disassembly procedure for the VariPak 28002 adjustable- C_v valve:

- B. Adjust the signal to close the valve. Change the signal slightly so that the plug just moves off the seat ring. Set adjustment knob (24) to the minimum C_v position.
- C. Loosen locknut (103) and, using a screwdriver, turn the plug stem one and three-quarter turns counter-clockwise. Shut off signal and supply pressure. Slightly tighten locknut (103) against the clevis.

- D. Completely loosen locknut (117) and screw (116). Remove spring clamp (115) from lever No. 2 and remove balance spring (114) from the positioner.
- E. Remove the retainer clip (112b) from each of the two pins (184) and disengage the pins from lever No. 1 and clevis (104a).

Note: This operation will be simplified by relieving the load exerted on the plug clevis by the conical compression spring (106). To do this push against the plug stem end with a screwdriver while driving out the pins.

- F. Remove the two retainer clips (112c) from pivot pin No. 4 (124) and disengage the pin to uncouple piston clevis (104b) from lever No. 2 (22).
- G. Remove the two retainer clips (112a) from pivot pin No. 1 (105) and disengage the pin to uncouple lever No. 1 from the actuator bracket (108). Disengage the smooth end of adjustment pin (23) from the groove in lever No. 2 and remove adjustment knob (24) and adjustment pin (23) from lever No. 1.
- H. Drive out pivot pin No. 3 (18) and remove lever No. 2 (22).
- I. Hold the plug stem in place using a screwdriver and unlock nut (103). Loosen clevis (104a) and locknut (103). Remove spring button (102), spring (106), and grommet plate (101).
- J. Remove the two packing flange nuts (8b), packing flange (10) and packing follower (9). Remove the two bracket mounting nuts (8a) as well as the bracket (108).
- K. Using a packing hook, remove as many packing rings (6) as possible from the packing box. Remove safety pin (11) and pull the plug stem to remove the packing spacer (5), the plug and its stem and, if necessary, the rest of the packing.
- L. Using a 9/16" or 14 mm piece of hex stock and a wrench, unlock and pull out the seat-ring retainer (4).
- M. Remove seat ring (3) and gasket (2) using a hook made from steel wire, approx. diameter 3 mm. Carefully fettle the hook end.

Notes:

- **The seat-ring of VariPak valves with $C_v \text{ max.} < 0.10$ consists of two parts: the seat ring proper (3e), and a spacer (3f). These parts have a small orifice and so cannot be removed using a hook. It is therefore necessary to remove the body from the pipe and turn it over and, if necessary, hit the bottom with a wooden mallet. If the seat ring (3a) is jammed in its housing, it can be removed by inserting a screwdriver through the outlet orifice.**
- **VariPak valves with $C_v \text{ max.} 3.8$ do not have seatring gaskets (2).**

5.4 Reassembly (Figures 5, 15, 19, 20, 24, 25, 26, 27, 28 and 29)

Before reassembly, thoroughly clean the inside of the valve body and parts, paying particular attention to gasket seating surfaces and contact surfaces. Make sure to use a new seat-ring gasket (2) and new packing (6) during reassembly.

- A. Insert a new seat-ring gasket (2) into valve body (13), then fit seat ring (3), making sure that the gasket is correctly centered on the seat-ring shoulder. Turn it so that one of its ports is lined up with the valve body outlet orifice.

Note: If the maximum C_v is less than 0.10, first fit the seat ring (3e) on the new gasket (2), taking the same precautions as above. Then fit the spacer (3f), turning it so that one of its ports is turned towards the body outlet orifice.

VariPak valves with a maximum C_v of 3.8 do not include a seat-ring gasket (2).

- B. Carefully apply Never Seez grease or equivalent to the threads and bottom of the seat-ring retainer (4). Using a 9/16" or 14 mm piece of hex stock and a wrench, torque the retainer to 59 ftlb or 8 daN.m for stainless-steel reinforced graphite gaskets or 40 ft-lb or 5.5 daN.m for glass-filled PTFE gaskets (see figure 19).

Note: Torque the retainer to 30 ft-lb or 4 daN.m for valves with a maximum C_v of 3.8.

- C. Insert the plug and stem assembly into the seat ring. For valves with a maximum $C_v < 0.10$, check that there are no friction points in the plug stroke. If a friction point is detected, loosen retainer (4) and reposition seat ring (3e) until the stem slides smoothly. Fit spacer (5), turning it so that one of its holes is aligned with safety pin (11) hole in the valve body.

Note: For valves with a maximum C_v less than 0.10, check that the retaining ring (182) is fitted on the plug before fitting the plug in the spacer (3f). If the retaining ring is worn or damaged, replace it.



Figure 19 - Tightening the seat-ring retainer (4)

- D. Wind two layers of PTFE tape around the safety pin (11). Screw the pin into the bonnet five and a half to six turns as from the thread engagement point.

Note: To determine the thread engagement point:

- Screw the safety pin about one turn.

- Pull the safety pin out while unscrewing it.

- E. Fit the packing, making sure that the skive cut of each packing ring is located 120° away from the that of the adjacent ring. Push the rings down slightly using a 1/2" sch., size 160 tube. Fit the packing follower (9) onto the plug stem.
- F. Fit actuator bracket (108) and secure it with two nuts (8a). Slip packing flange (10) onto plug stem. Handtighten the two packing flange nuts and add one full turn with the wrench.
- G. Fit, in the following order, grommet plate (101), conical compression spring (106) and its spring button (102) (see position in figure 26 and 27). Screw nut (103) and clevis (104a) on the plug stem.

Adjust the nut and clevis without locking them together until the clevis holes are positioned approximately:

- 2.3 mm below the alignment of the pin holes in the actuator bracket (108) for the VariPak 28001 single-lever valve (see figure 15).

- 1.5 mm above the alignment of the pin holes in the actuator bracket (108) for the VariPak 28002 adjustable- C_v valve (see figure 20).

Note: Measuring this distance can be simplified by fitting pins (105), (184) and (18) into their holes.

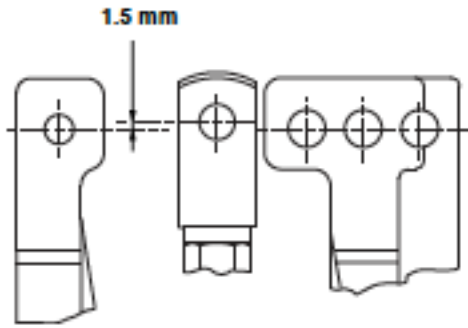


Figure 20 - Plug stem pre-adjustment for VariPak 28002 adjustable-C_v

Reassembly procedure for the VariPak 28001 single-lever valve (continued):

- H. Couple lever (113) to actuator bracket (108) using pin (105) and the 2 retainer clips (112a). Ensure that the holes in lever (113) where spring clamp (115) is fitted is located above.

Note: Check that the clevis (104a) is correctly positioned before fitting the lever (113) on the actuator support (108).

To identify the position of the lever connecting holes and the spring clamp (115) attachment hole, with respect to the required action, see figure 6.

- I. Couple clevis (104a) to lever (113). To do this, press the end of the plug stem with a screwdriver until the holes in the clevis and lever are aligned. Couple using the pin (18) and retainer clips (112b).

Note: Slightly grease all pins before fitting. Perform the adjustment operation described in "Calibration", section 4.2.1.

- J. If piston rod clevis (104b) has not been disturbed during disassembly, couple it to the end of lever (113) by admitting air pressure to the actuator to drive clevis (104b) upwards. Couple the clevis to lever (113) using pin (124) and two retainer clips (112c).

Note: If the clevis (104b) has been disturbed, proceed with adjustment and coupling as described in "Calibration", section 4.1.1.

- K. Release the pressure from the actuator and check tightness again (see "Calibration", section 4.2.1). Then continue from step M. of the VariPak 28002 procedure.

Reassembly procedure for the VariPak 28002 adjustable-C_v valve (continued):

- H. Couple lever No. 2 (22) to the actuator bracket (108) using pin (18). Ensure that the hole in lever No. 2 where spring clamp (115) is fitted is located above and in line with balance spring (114).

- I. Fit adjustment pin (23) in the slide of lever No. 1 and screw adjustment knob (24) on its threaded end. Insert the smooth end of pin (23) into the groove in lever No. 2 and place lever No. 1 on support bracket (108). Couple lever No. 1 to actuator bracket (108) using pin (105) and two retainer clips (112a).

Note: Check that the clevis (104a) is correctly positioned before fitting lever No. 1 on the actuator support (108).

To identify the position of the connecting holes of levers No. 1 and 2 with respect to the required action, see figure 6.

- J. Set adjustment knob (24) to the minimum C_v position.

- K. If piston rod clevis (104b) has not been disturbed during disassembly, couple it to the end of lever No. 2 using pin (124) and two retainer clips (112c).

Note: This operation will be simplified by applying air pressure to the diaphragm (136) to set the piston rod to an intermediate position, and by setting the adjustment knob to a position where lever No. 2 is most accessible. If the clevis (104b) has been disturbed, proceed with adjustment and coupling as described in "Calibration", section 4.1.1.

- L. Couple clevis (104a) to lever No. 1. To do this, press the end of the plug stem with a screwdriver until the holes in the clevis and lever No. 1 are aligned. Couple using the two pins (184) and retainer clips (112b).

Note: The clips are inserted on the pins between the sides of the clevis and lever No. 1.

- M. Fully unscrew take-up screw (116) from spring clamp (115), then fit clamp, after hooking balance spring (114) first to the positioner spring bracket of the diaphragm S/A (152), and then to spring clamp (115).

Note: The spring clamp (115) has two holes. If an Air-to-Open actuator is used, the spring must be hooked to the top hole. If an Air-to-Close actuator is used, the spring must be hooked to the bottom hole (see figure 6).

- N. Admit the signal and supply pressure and complete calibration. Refit cover (110) using the two screws (109). If the valve is equipped with a handwheel, refit the cover, then turn the handwheel clockwise until it is engaged in lever arm stop (122). Tighten cover screws (109).
- O. If the valve body has been removed, reinstall it taking the precautions given under "Valve Installation" in section 3.2. Put the valve back into service.

5.5 Packing Quick Change Method (Only For Valves With Max. C_V Of 0.6 To 3.8) (Figures 21, 26 And 27)

The quickest and easiest way to replace packing is to remove the entire actuator from the valve body, taking care not to modify the actuator setting. This method is not recommended, however, for valves with a maximum C_V less than 0.6 because of their extremely fine plugs. For these valves, disassemble the valve to replace the packing (see "DISASSEMBLY", section 5.3).

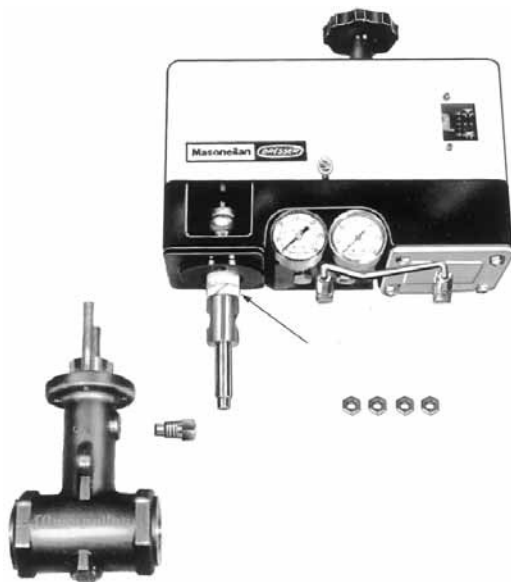


Figure 21 - Packing replacement (for C_V maxi \geq 0.6)

Vent the valve pressure and proceed as follows:

- A. Check that the plug is not resting on the seat ring. For valves equipped with an Air-to-Open actuator, admit air pressure under the diaphragm and turn the handwheel to move the plug off its seat ring.
- B. Remove safety pin (11) from the valve body. The safety pin stub engages with the hole in packing spacer (5). The function of the safety pin and spacer is to prevent the plug from being pushed out if the actuator is accidentally removed while the valve is still pressurized. The internal parts of the valve cannot be removed unless the safety pin is removed first. Remove the two packing flange nuts (8b) and back off the two actuator bracket mounting nuts (8a) as far as possible.
- C. Remove the actuator-plug assembly from the valve body, tapping it off with a block of wood and mallet if necessary. Clean the packing box in the valve body. Remove the worn packing, then clean the plug stem thoroughly. Carefully fit new packing rings around the stem, positioning the skive cut of each ring 120° from that of the adjacent ring.

- D. Refit the actuator-plug assembly on the valve body, taking care to:
 - align hole in packing spacer (5) with safety pin (11) hole,
 - and refit the two mounting nuts (8a).
 - Take extra care when guiding each packing ring into the packing box.
- E. Wind two layers of PTFE tape around the safety pin. Screw the pin into the bonnet five and a half to six turns as from the thread engagement point.

Note: To determine the thread engagement point:

- Screw the safety pin about one turn,
 - Pull the safety pin out while unscrewing it.
- F. Refit the packing follower, packing flange, and flange nuts (8b). Tighten the packing assembly correctly. If the valve is equipped with an Air-to- Open actuator, release the air pressure or turn the handwheel to bring the plug back into contact with the seat ring. Put back into service.

5.6 7700P or 7700E Positioner Maintenance (Figures 22, 23, 24, 25, 26 And 27)

CAUTION

Shut off the signal and supply pressure. Isolate and depressurize the valve body.

- A. Disconnect the two pressure connection nuts (138a) and pull tubing (140) out.
- B. Loosen the two cap screws (141a) and remove manifold block (144), spring (158), gasket (146) and its three O-rings, pilot valve assembly (155 to 157), shims (145), and O-ring (153).

CAUTION

Caution: Handle the shims carefully (145).

- C. Loosen locknut (117) and take-up screw (116), unhook the spring clamp from lever (22) or (113).
- D. Unscrew cap screws (141b) from positioner block (147) and remove the positioner block from the actuator bracket.

Remove screws (148) to separate positioner diaphragm assembly (152) and spring (154) from the positioner block. Examine all the parts and replace if worn or damaged.

- E. Refit positioner diaphragm assembly (152) and spring (154) to positioner block and tighten screws (148). Check that the small signal port O-ring is in its recess in the diaphragm assembly.
- F. Reinstall the block assembly on the actuator bracket.

Note: When installing the positioner block (147), turn it so that when the manifold block (144) is installed, the gauge(s) is(are) facing in the right direction (figure 22).



Figure 22 - Positioner assembly

Note how the positioner (147) and gasket (146) are oriented

- G. Check that gasket (146), three O-rings, and seats are not worn or damaged and replace if necessary.
- H. Fit O-ring (153), shims (145), pilot valve assembly, gasket (146) and its three O-rings, spring (158) and manifold block (144). Tighten the screws (141a), refit tubing (140) and tighten pressure connection nuts (138a).

Note: The ports in gasket (146) must be aligned with those in the positioner block (147). To ensure correct positioner performance, check that all gaskets are perfectly leaktight.

- I. Hook spring clamp (115) to lever (22) or (113). In the case of VariPack 28001 valve, see figure 6 to position the spring clamp (115) according to the actuator required action. Admit the supply pressure and the signal. Set the start-up pressure following the instructions given in the "Calibration" chapter. Put back into service.

Positioner	Signal (Psi)	Spring ref. No.	Spring color code
7700P	3-15 or 6-30 or 3-27	114 154	Yellow Red
	3-9	114 154	White Blue
	9-15	114 154	White Green
7700E	4-20 mA	114 154	Yellow Red

Figure 23 - Color code for positioner springs (114 and 154)

5.7 Maintenance Operations Specific to the 7700E Positioner

Note: Refer to ATEX Instruction Manual No. 33424 for all maintenance on the electrical parts of the 7700E positioner.

- A. Loosen screws (27) and remove I/P module (20).

Note: If damaged, the I/P module must be replaced.

- B. Check that O-rings (28, 29 and 30) and their seats are not worn or damaged.

Note: All worn or damaged parts must be replaced.

- C. Fit O-rings (28, 29 and 30) in their recesses on the I/P module (20). Refit I/P module (20) on manifold block (144). Tighten screws (27).

Note: To ensure correct positioner performance, check that all gaskets are perfectly leaktight.

5.8 Converting a 7700P Positioner (Pneumatic) into a 7700E Positioner (Electropneumatic)

A kit comprising the manifold block (144) and the I/P module (20) is available from your local Masoneilan representative or the Spare Parts Department.

Note: Refer to atex Instruction Manual No. 33424 for all maintenance on the electrical parts of the 7700E positioner.

Shut off the signal and supply pressure. Isolate and depressurize the valve body.

- A. Disconnect the two pressure connection nuts (138a) and pull the tubing (140) out.

- B. Loosen the two cap screws (141a) and remove manifold block (144). The spring (158), gasket (146) and the three O-rings, the pilot valve assembly (155 to 157), shims (145), and O-ring (153) do not need to be removed unless you have new parts. Otherwise, simply check that parts are in perfect condition before refitting.

⚠ CAUTION

Handle the shims carefully (145).

- C. If the parts mentioned above have been removed, proceed as follows:

Fit the O-ring (153), shims (145), pilot valve assembly (155 to 157), gasket (146) and the three O-rings, the spring (158) and manifold block (144) - I/P module (20). Tighten screws (141a), refit tubing (140) and tighten pressure connection nuts (138a).

Note: The ports in gasket (146) must be aligned with those in positioner block (147). To ensure correct positioner performance, check that all gaskets are perfectly leaktight.

- D. Hook spring clamp (115) to lever (22) (VariPak 28002) or (113) (VariPak 28001). In the case of VariPack 28001 valve, see figure 6 to position the spring clamp (115) according to the actuator required action. Admit the supply pressure and enable the electrical signal. Adjust the start-up pressure following the instructions under "Calibration". Put back into service.

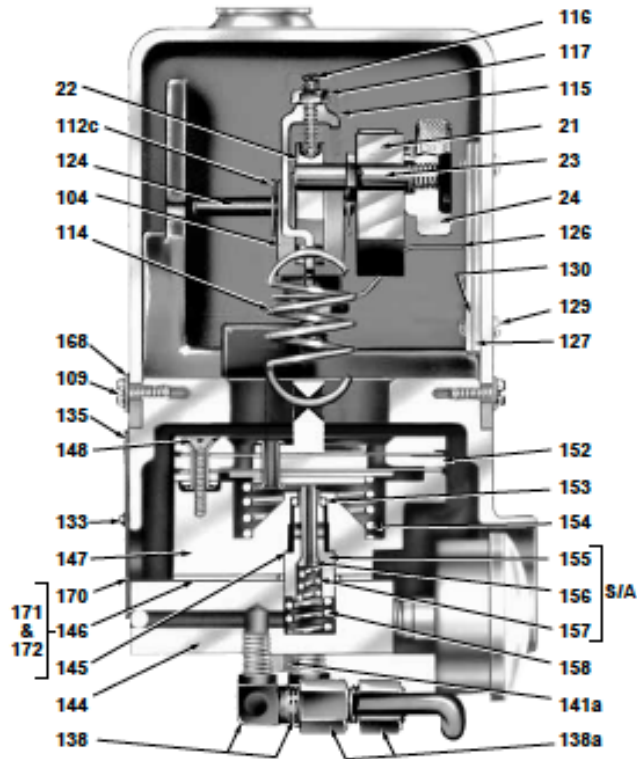


Figure 24 - Cross-section of the VariPak 28002 adjustable-C_v actuator and the 7700P positioner

PARTS LIST

Ref.	Qty	Part Name	Ref.	Qty	Part Name	Ref.	Qty	Part Name
Δ □	1	1/4" NPT pipe plug	101	1	Grommet support plate	◆	140	1 Tubing
○	2	Seat-ring gasket	102	1	Spring button	◆	141 (a, b)	4 Screw
	a	Seat ring C _v max. 3.8	103	1	Locknut	◆	142	1 Output gauge
	b	Seat ring C _v max. 2.3 and 1.2	104	2	Clevis	◆	143	1 Instrument gauge
◎	3	Seat ring C _v max. 0.25 and 0.60	105	1	Pivot pin No. 1	◆	144	1 Manifold block
	d	Seat ring C _v max. 0.10	106	1	Conical compression spring	◆	145	1 to 5 Shim
	e	Seat ring C _v max. < 0.10	○ 107	1	Grommet	○ ◆	146	1 Gasket (includes 171 & 172)
□	3	Spacer C _v max. < 0.10	108	1	Actuator bracket	◆	147	1 Positioner block
	4	Seat-ring retainer	109	2	Cover screw	◆	148	2 Slotted flat. c screw
	5	Packing spacer	110	1	Cover	○ ◆	152	1 Positioner diaphragm S/A
○	6	Packing ring	◆ 112 (a, b, c)	6	Retainer clip	○ ◆	153	1 O-ring
	7	Packing flange stud	◇ ◆ 114	1	Balance spring	▼ ◆	154	1 Spring
	8	a	◆ 115	1	Spring clamp	○ ◆	155	1 Sleeve
	8	b	◆ 116	1	Take-up screw	○ ◆	156	1 Spool
	9	Packing follower	◆ 117	1	Locknut	○ ◆	157	1 Spring
	10	Packing flange	★ 118	1	Handwheel locknut	◆	158	1 Spring
	11	Safety pin	★ 119	1	Handwheel bushing	Δ	159	2 Switch
	a	Plug/stem C _v max. 3.8	★ 120	1	Handwheel	Δ	160	4 Screw
	b	Plug/stem C _v max. 2.3	★ 121	1	Handwheel lock	Δ	161	4 Washer
	c	Plug/stem C _v max. 1.2 & 0.6	★ 122	1	Lever arm stop	Δ	162	4 Nut
	d	Plug/stem C _v max. 0.25 & 0.10	123	1	Cover plug	Δ	163	4 Wire
13	a	Body C _v max. < 3.8	124	1	Pivot pin No. 4	Δ	164	1 Terminal
13	b	Body C _v max. 3.8	125	1	Locknut	■	165	2 Logo
18		Pivot pin No. 3 (22/108)	126	1	Indicator	168	1	Cover washer
20		I/P module	127	1	Indicator plate	◆	170	2 Signal decal
21		Lever No. 1	129	2	Indicator plate screw	■ ◆	171	1 O-ring
22		Lever No. 2	130	2	Speed nut	■ ◆	172	1 O-ring
23		Adjustment pin	131	1	Piston S/A	173	1	Cover plug
24		C _v adjustment knob	133	2	Serial plate screw	▼	180	1 Limit stop
25		C _v adjustment plate	134	1	Actuator spring	▼	181	1 Locknut
26	2	Adjustment plate screw	135	1	Serial plate	182	1	Retaining ring (C _v max. <0.10)
27	4	Screw	○ 136	1	Diaphragm	183	1	Plug (C _v max. <0.10)
○ 28	1	O-ring	137	1	Diaphragm cover	184	2	Pivot pin No. 2
○ 29	1	O-ring	◆ 138	1	Union elbow t(incl. 138a)			
○ 30	1	O-ring	139	1	Cover cap screw			

○ Recommended spare parts

□ Complete subassembly includes: plug and stem (183), retaining ring (182), seat ring (3e) and spacer (3f) (see figure 2).

◆ Only for pneumatic positioner.

◎ See Figure 2.

◇ See table in figure 23.

★ Only for handwheel (optional) (fig. 5).

○ Complete subassembly includes Ref. Nos. (155, 156 and 157).

■ Not shown.

▲ Only for cast bodies.

▼ Only on actuator with handwheel and/or Model 8013 E.P. positioner (fig. 5).

Δ Only for optional limit-switch adaptation: quantity given for two limit switches (see fig. 13).

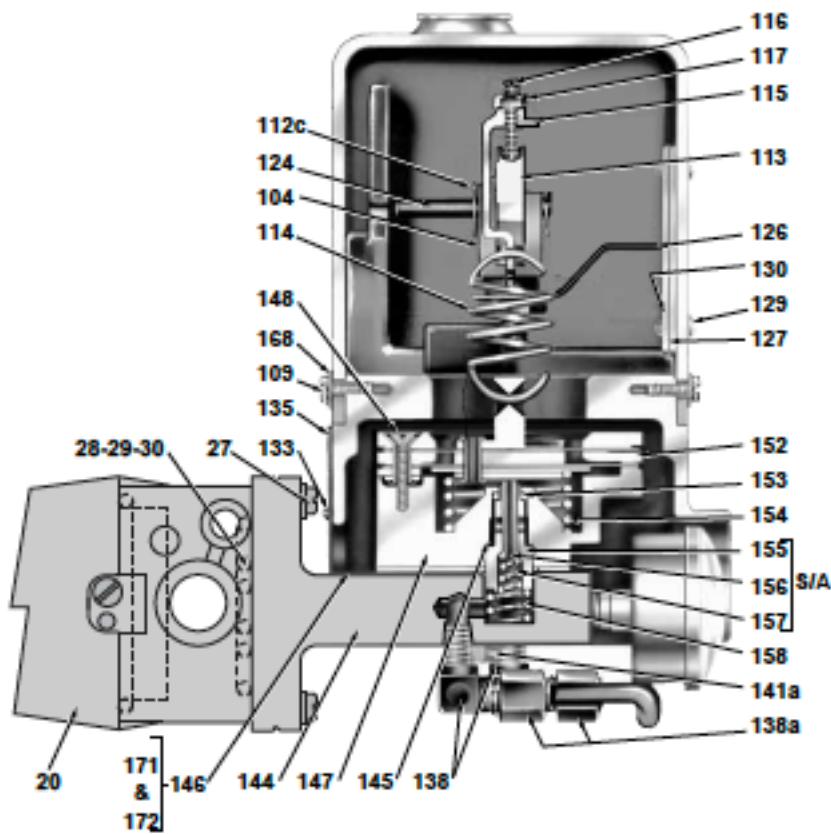


Figure 25 - Cross-section of the VariPak 28001 single-lever actuator and the 7700E positioner

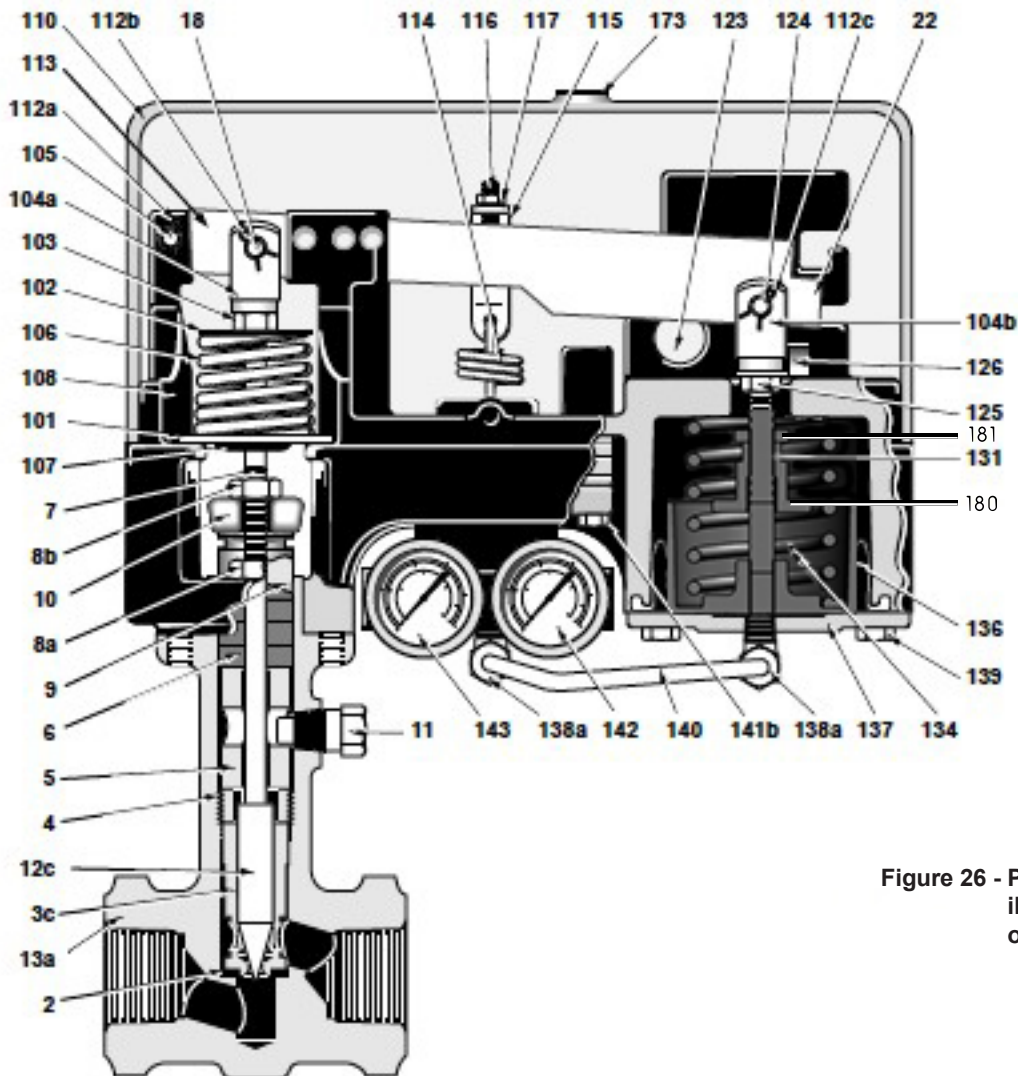


Figure 26 - Partial cross-section of VariPak 28001 single-lever, air-to-open valve

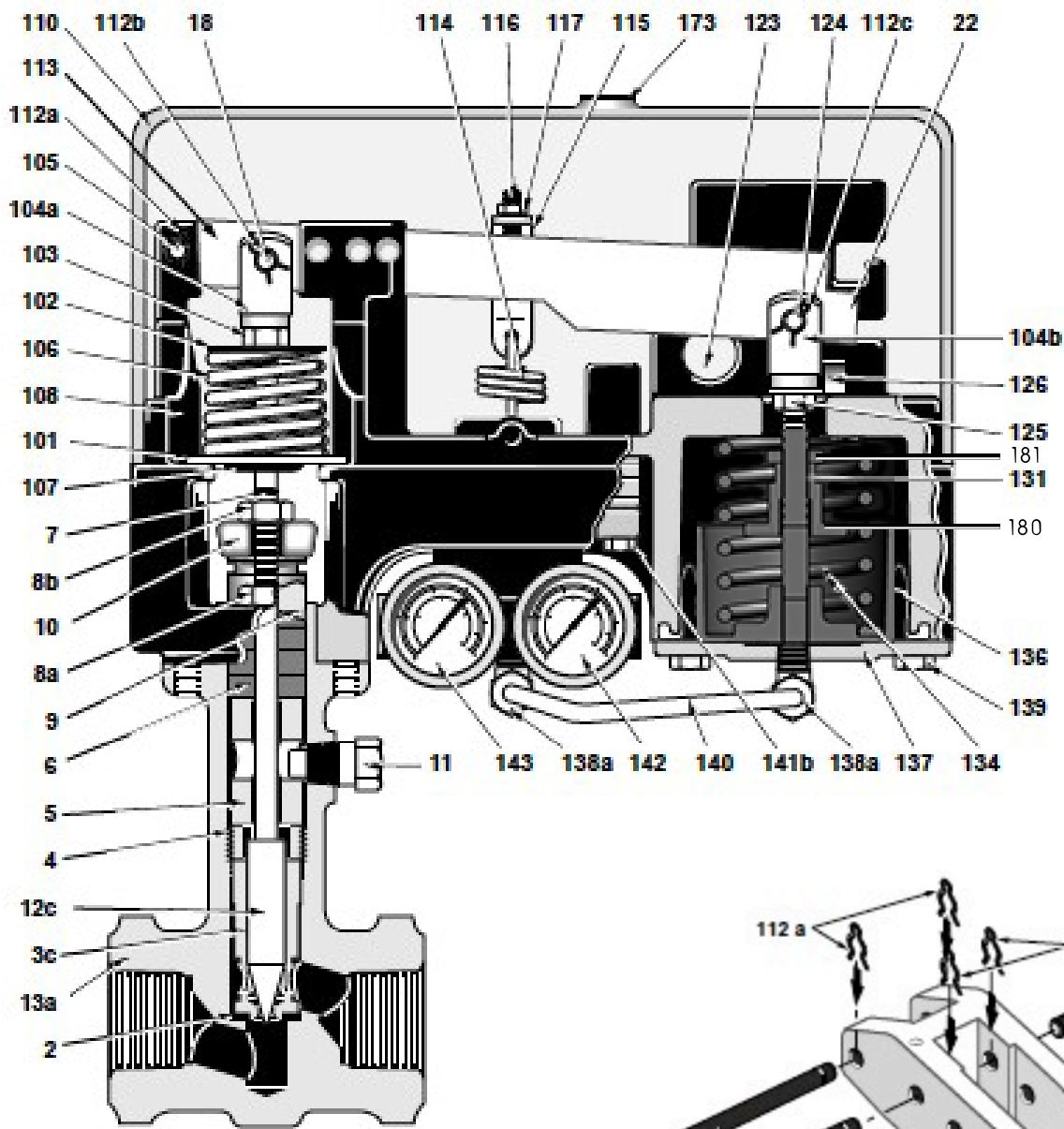


Figure 27 - Partial cross-section of VariPak 28002 adjustable-C_v air-to-open valve

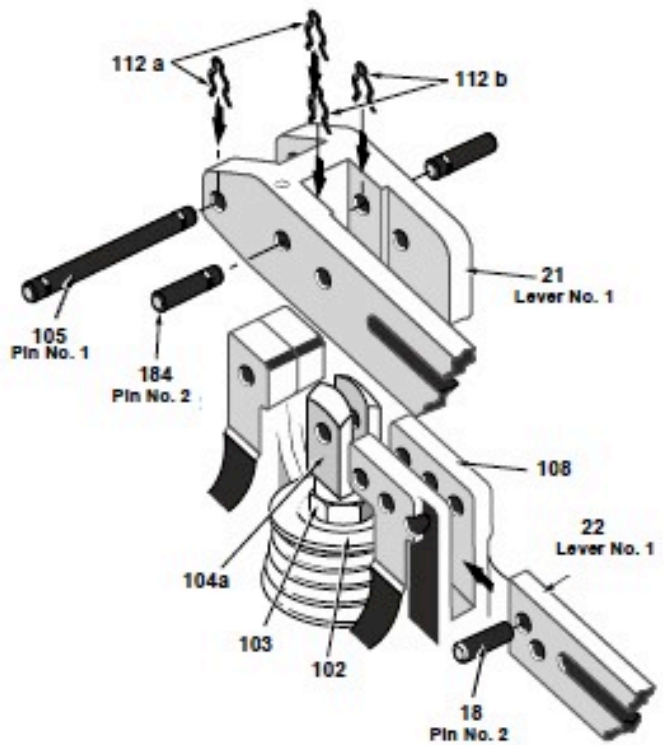


Figure 29 - Coupling detail of levers No. 1 and 2

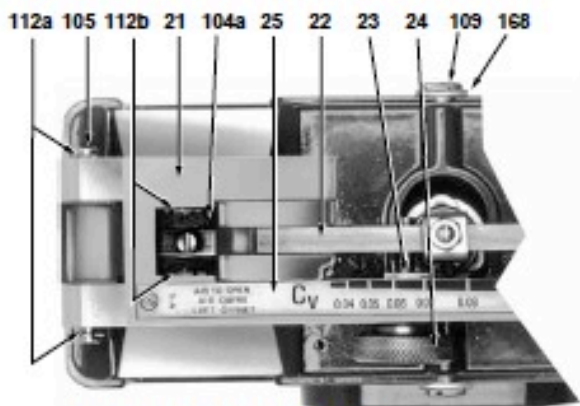


Figure 28 - Partial top view

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