

# Fisher™ Vee-Ball™ V150, V200, and V300 Rotary Control Valves NPS 1 through 12

## Contents

Introduction .....	1
Scope of Manual .....	1
Description .....	2
Specifications .....	2
Educational Services .....	2
Installation .....	3
Maintenance .....	8
Packing Maintenance .....	8
Replacing the Ball Seal .....	11
Disassembly .....	11
Assembly .....	14
HD Ball Seal Lubrication .....	20
Bearing and Ball Maintenance .....	20
DN80 - 300 (NPS 3 - 12) valves .....	20
Welded Taper Key Replacement .....	24
DN25 - 50 (NPS 1 - 2) valves .....	25
Cavitrol™ Hex Installation .....	32
Actuator Mounting .....	32
NPS 3 - 12 without Attenuator .....	33
Determining Mounting Position .....	33
Determining Closed Position .....	33
Parts Ordering .....	40
Parts Kits .....	42
Parts List .....	44
Appendix A Instructions for Non-Series B .....	45

Figure 1. Fisher Vee-Ball with 2052 Actuator and FIELDVUE™ DVC6200 Digital Valve Controller



X0187

## Introduction

### Scope of Manual

This instruction manual provides installation, operation, maintenance, and parts information for the Fisher Vee-Ball V150 (NPS 1 through 12), V200 (NPS 1 through 10), and V300 (NPS 1 through 12) rotary control valves (see figure 1). NPS 3 through 12 valves without an attenuator currently in production are referred to as Series B (for more information on this distinction see Appendix A).

For larger valves (NPS 14, 16, and 20), refer to a separate instruction manual. For information on ENVIRO-SEAL™ packing, see the ENVIRO-SEAL Packing System for Rotary Valves instruction manual ([D101643X012](#)). Refer to separate manuals for information concerning the actuator, positioner and accessories.

Do not install, operate, or maintain Vee-Ball valves without being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance. To avoid personal injury or property damage, it is important to carefully read, understand, and follow all the contents of this manual, including all safety cautions and warnings. If you have any questions about these instructions, contact your [Emerson sales office](#) or Local Business Partner before proceeding.

Table 1. Specifications

<p><b>Valve Sizes</b> See table 2</p> <p><b>Valve End Connection Styles</b>  <b>V150:</b> Flanged valves that mate with CL150 raised-face flanges and EN 1092-1 Type B raised-face and Type F Recess  <b>V200:</b> Flangeless (all sizes) and flanged valves that mate with CL600 raised-face flanges (NPS 2-8)  <b>V300:</b> Flanged valves that mate with CL300 raised-face flanges and EN 1092-1 Type B raised-face and Type F Recess</p> <p><b>Maximum Inlet Pressure<sup>(1)</sup></b> Consistent with applicable ASME B16.34 or EN 12516-1 ratings</p> <p><b>Standard Flow Direction</b> Forward (into the convex face of the Vee-ball)</p>	<p><b>Actuator Mounting</b>  <b>■</b> Right-hand, standard or <b>■</b> left-hand, optional, as viewed from upstream end of valve (see figure 23 and the Actuator Mounting section)</p> <p><b>Maximum Ball Rotation</b>  <b>Standard:</b> Ball rotates counterclockwise to close when viewed from actuator side of valve  <b>Optional:</b> Ball rotates clockwise to close  Ball rotation is 90 degrees</p> <p><b>Valve/Actuator Action</b>  With diaphragm or piston rotary actuator, field-reversible between: <b>■</b> push-down-to-close (extending actuator rod closes valve) and <b>■</b> push-down-to-open (extending actuator rod opens valve.) See actuator manual for details</p>
---	--

1. The pressure/temperature limits in this manual, and any applicable code or standard limitation, should not be exceeded.

## Description

The V150, V200, and V300 Vee-Ball valves (figure 1) with a V-notch ball are used in throttling or on-off service. The V200 is a flangeless construction. The V150 and V300 valves are raised-face flanged constructions. The splined valve shaft of all these valves connect to a variety of rotary-shaft actuators.

## Specifications

Specifications for these valves are shown in table 1 and in the Fisher Vee-Ball V150, V200, and V300 Rotary Control Valves Bulletin 51.3:Vee-Ball ([D101363X012](#)).

## Educational Services

For information on available courses for Fisher Vee-Ball valves, as well as a variety of other products, contact:

Emerson Automation Solutions  
Educational Services - Registration  
Phone: 1-641-754-3771 or 1-800-338-8158  
E-mail: [education@emerson.com](mailto:education@emerson.com)  
[emerson.com/fishervalvetraining](http://emerson.com/fishervalvetraining)

Table 2. Valve Body Materials, End Connections, and Ratings

VALVE DESIGN	VALVE BODY MATERIAL	SIZE	RATINGS
		NPS / DN	ASME / PN
V150	WCC	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12, 14, 16, 20, 24x20 <sup>(5)</sup>	CL150
	WCC / 1.0619 <sup>(1)</sup>	DN 80, 100, 150	PN 10-16
		DN 200, 250, 300	PN 10 or PN 16
	LCC	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12	CL150
		DN 80, 100, 150	PN 10-16
	CF3M <sup>(2)</sup>	DN 200, 250, 300	PN 10 or PN 16
		NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12	CL150
	CF3M/1.4409 <sup>(1)</sup>	DN 80, 100, 150	PN 10-16
		DN 200, 250, 300	PN 10 or PN 16
	CG8M	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12, 14, 16, 20, 24x20 <sup>(5)</sup>	CL150
	CW2M	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12	
	M35-2	NPS 1, 1-1/2, 2, 3, 4, 6, 8	
CD3MN <sup>(3)</sup>	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12		
CD3MWCuN <sup>(3)</sup>	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12		
CK3MCuN	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12		
	NPS 1, 1-1/2, 2	CL150/300/600 flangeless	
V200 <sup>(4)</sup>	WCC, LCC, CG8M, or CF3M <sup>(2)</sup>	NPS 3, 4	CL150 and CL300/600 flangeless
		NPS 6, 8	CL150/300 and CL600 flangeless
		NPS 10	CL150 flangeless
		NPS 2, 3, 4, 6, or 8	CL600
	WCC, LCC, or CG8M	NPS 1, 1-1/2, 2, 3, 4, 6, 8	CL150/300/600 flangeless
	CW2M, M35-2, or CK3MCuN	NPS 10	CL150 flangeless
V300	WCC	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12, 14, 16, 20	CL300
	WCC / 1.0619 <sup>(1)</sup>	DN 25, 40, 50	PN 10-40
		DN 80, 100, 150	PN 25-40
		DN 200, 250, 300	PN 25 or PN 40
	LCC	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12	CL300
		DN 25, 40, 50	PN 10-40
		DN 80, 100, 150	PN 25-40
	CF3M <sup>(2)</sup>	DN 200, 250, 300	PN 25 or PN 40
		NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12	CL300
		DN 25, 40, 50	PN 10-40
	CF3M/1.4409 <sup>(1)</sup>	DN 80, 100, 150	PN 25-40
		DN 200, 250, 300	PN 25 or PN 40
		NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12, 14, 16, 20	CL300
	CW2M	NPS 1, 1-1/2, 2, 3, 4, 6, 8	
	M35-2	NPS 1, 1-1/2, 2, 3, 4, 6, 8	
CD3MN <sup>(3)</sup>	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12		
CD3MWCuN <sup>(3)</sup>	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12		
CK3MCuN	NPS 1, 1-1/2, 2, 3, 4, 6, 8, 10, 12		

1. WCC and EN Std 1.0619 are dual certified. CF3M and EN SST 1.4409 are dual certified.  
 2. CF3M is a standard offering in Europe and Asia Pacific.  
 3. NORSOK compliant materials available upon request.  
 4. Flangeless V200 assemblies mate with raised-face flanges.  
 5. Valve body mates with NPS 24 ASME CL150 flanges. Internal based on NPS 20 valve design.

## Installation

Separate installation steps are provided in this section for V150 and V300 flanged valves, V200 flangeless valves. Key numbers in installation procedures are shown in figures 24, 25, and 26 unless otherwise indicated.

Some types of ceramic trim, including VTC, can create a spark under certain conditions. If an edge of a ceramic part is struck against a second ceramic part with enough force, it can produce a spark.

**⚠ WARNING**

Avoid personal injury and property damage from ignition of process fluid caused by sparks from ceramic trim. Do not use ceramic trim where the process fluid is unstable or if it is an explosive mixture (such as ether and air).

**⚠ WARNING**

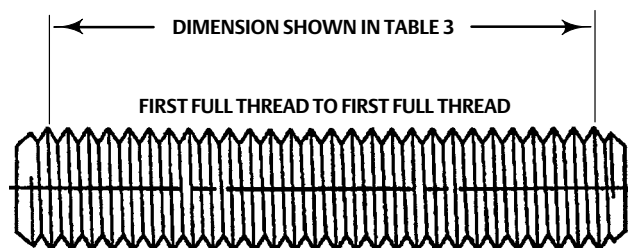
Always wear protective gloves, clothing, and eyewear when performing any installation operations to avoid personal injury.

Personal injury or equipment damage caused by sudden release of pressure may result if the valve assembly is installed where service conditions could exceed either the valve body rating or the mating pipe flange joint rating. To avoid such injury or damage, provide a relief valve for overpressure protection as required by government or accepted industry codes and good engineering practices.

Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

If installing into an existing application, also refer to the WARNING at the beginning of the Maintenance section in this instruction manual.

Figure 2. Flange Stud Length for Seal Protector End



1A4520

Table 3. Flange Stud Lengths Required for Seal Protector Ring End of Fisher V150, V200, and V300 Valves

VALVE SIZE		V150 <sup>(2)</sup>				V200 <sup>(1)</sup>		V300 <sup>(2)</sup>	
		ANSI/ISA 575.08.02 Face-to-Face		ASME B16.10 Short Face-to-Face		ANSI/ISA 575.08.02 Face-to-Face		ANSI/ISA 575.08.02 Face-to-Face	
DN	NPS	mm	Inches	mm	Inches	mm	Inches	mm	Inches
25	1	70	2.75	95	3.75	---	---	89	3.50
40	1-1/2	83	3.25	127	5.00	---	---	102	4.00
50	2	95	3.75	146	5.75	121	4.75	95	3.75
80	3	95	3.75	133	5.25	140	5.50	121	4.75
100	4	108	4.25	146	5.75	165	6.50	127	5.00
150	6	114	4.50	152	6.00	197	7.75	140	5.50
200	8	121	4.75	171	6.75	216	8.50	152	6.00
250	10	133	5.25	165	6.50	---	---	171	6.75
300	12	140	5.50	159	6.25	---	---	184	7.25

1. For the flanged V200, the same bolt lengths are used for both the inlet and outlet flange ends because the studs for threaded flange holes are double nutted. If the Cavitrol Hex anti-cavitation trim is installed, the required outlet flange bolt length will be 1/2" longer than the Dimension specified in the table above. See Vee-Ball bulletin (D101363X012).

2. For V150 and V300 valve assemblies with the Cavitrol Hex anti-cavitation trim installed, the same bolt lengths are used for both the inlet and outlet flange ends.

**⚠ WARNING**

When ordered, the valve configuration and construction materials were selected to meet particular pressure, temperature, pressure drop, and controlled fluid conditions. Responsibility for the safety of process media and compatibility of valve

materials with process media rests solely with the purchaser and end-user. To avoid possible personal injury and because some valve/trim material combinations are limited in their pressure drop and temperature ranges, do not apply any other conditions to the valve without first contacting your [Emerson sales office](#) or Local Business Partner.

## **⚠ WARNING**

The valve drive shaft is not necessarily grounded to the pipeline when installed. Personal injury or property damage could result from an explosion caused by a discharge of static electricity from valve components if the process fluid or the atmosphere around the valve is flammable. If the atmosphere around the valve or the process fluid is flammable, electrically bond the drive shaft to the valve.

### **Note**

Standard PTFE packing is composed of a partially conductive carbon-filled PTFE female adaptor with PTFE V-ring packing. Standard graphite packing is composed of all conductive graphite ribbon packing. Alternate shaft-to-valve body bonding is available for hazardous service areas where the standard packing is not sufficient to bond the shaft to the valve (see the following step).

Attach the optional bonding strap assembly (key 131, figure 3) to the valve drive shaft (key 6) with the clamp (key 130, figure 3) and connect the other end of the bonding strap assembly to the valve body with the cap screw (key 23).

1. If the valve is to be stored before installation, protect the flange mating surfaces and keep the valve body cavity dry and free of foreign material.
2. Install a three-valve bypass around the control valve assembly if continuous operation will be necessary during inspection and maintenance of the valve.
3. The valve is normally shipped as part of a control valve assembly, with an actuator mounted on the valve. If the valve and actuator have been purchased separately or if the actuator has been removed, mount the actuator according to the Actuator Mounting section and the appropriate actuator instruction manual.
4. Standard flow direction is with the seal protector ring (key 3) facing upstream.
5. Install the valve in a horizontal or vertical pipeline with the drive shaft in a horizontal position.

## **CAUTION**

**Do not allow the valve to be installed in the pipeline with the drive shaft in the vertical position because of excessive wear to valve component parts.**

6. The actuator can be right- or left-hand mounted with the shaft in a horizontal orientation as shown in figure 1. If necessary, refer to the appropriate actuator instruction manual for actuator installation and adjustment procedures.

## **CAUTION**

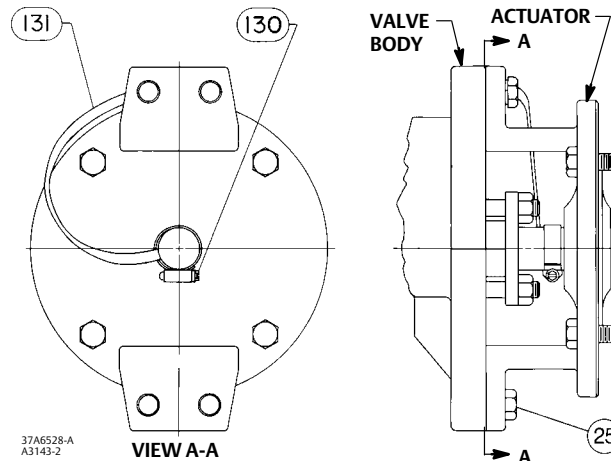
**Ensure the valve and adjacent pipelines are free of foreign material that could damage the valve seating surfaces.**

7. Be certain the valve and adjacent pipelines are free of any foreign material that could damage the valve sealing surfaces.
8. Be sure the pipeline flanges are in line with each other.

## Installing V150, V300, and Flanged V200 Valves

1. Install the V150 and V300 valve using studs (keys 32 and 33, not shown) and nuts to connect the valve flanges to the pipeline flanges. The seal protector ring (key 3) end of the valve requires longer line flange studs (key 32) than standard. Do not use standard-length line flange studs for the seal protector ring end of the valve. The seal protector ring end of the valve for the DN25/NPS 1 constructions will have threaded flange holes due to insufficient nut clearance.

Figure 3. Optional Shaft-to-Body Bonding Strap Assembly



2. See table 3 and figure 2 for length of studs for the seal protector ring end of V150 and V300 valves. Lubricate the studs with anti-seize lubricant.
3. Insert flat-sheet line flange gaskets (or spiral-wound gaskets with compression-controlling center rings) that are compatible with the flowing media.
4. Connect pressure lines to the actuator as indicated in the actuator instruction manual. When an auxiliary manual actuator is used with a power actuator, install a bypass valve on the power actuator (if one is not supplied) for use during manual operation.

### **⚠ WARNING**

**Personal injury could result from packing leakage. Valve packing was tightened before shipment; however the packing might require some readjustment to meet specific service conditions. Check with your process or safety engineer for any additional measures that must be taken to protect against process media.**

If the valve has ENVIRO-SEAL live-loaded packing installed, this initial re-adjustment will probably not be required. See ENVIRO-SEAL Packing System for Rotary Valves instruction manual ([D101643X012](#)) for packing instructions.

## Installing V200 Valves

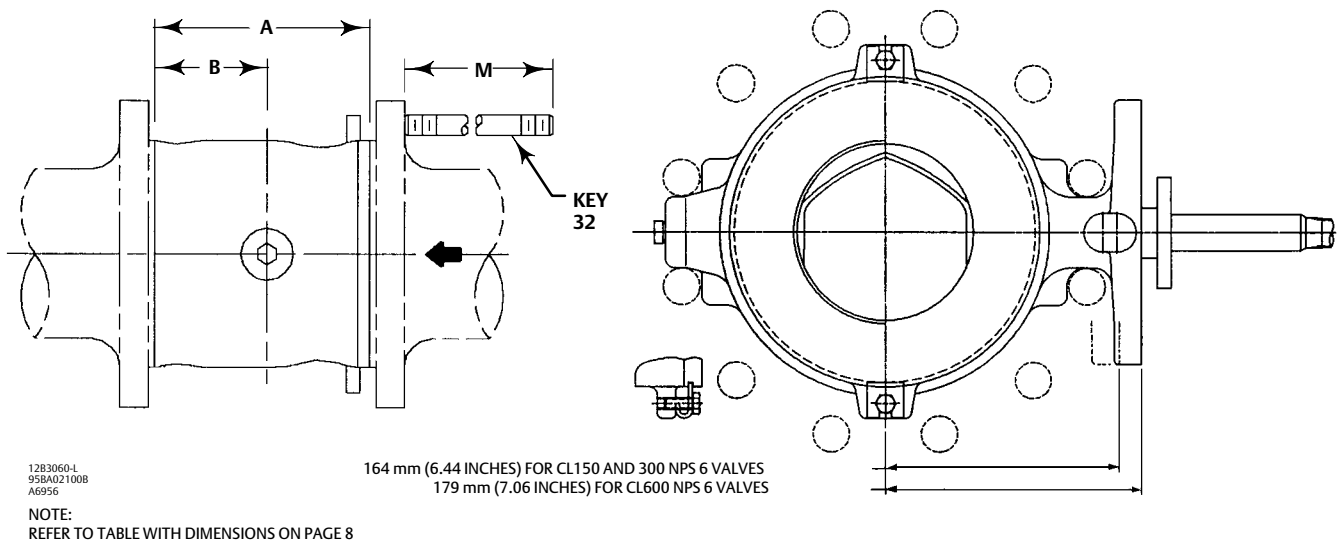
Stud length dimensions are shown in figure 4 for the seal protector ring end of the valve. For V200, CL600, the dimension from the center line of the valve bore to the mounting flange face is larger than a CL150 or 300 valve.

1. Install the V200 valve using long studs (key 32, figure 4) to connect the two pipeline flanges. Refer to figure 4 for the size of studs required. Lubricate the studs with anti-seize lubricant.
2. Install two studs in the flanges before you place the valve in the line. Place the two studs so they will contact the line-centering notches at the bottom of the valve body.
3. Insert flat-sheet line flange gaskets (or spiral-wound gaskets with compression-controlling center rings) that are compatible with the process fluid.
4. Place the valve on the two studs. Install all remaining studs. Measure carefully to be sure the valve is centered on the pipeline flanges, and tighten the flange stud nuts. Tighten the nuts in a criss-cross sequence to be sure the flange gaskets are properly torqued.
5. Connect pressure lines to the actuator as indicated in the actuator instruction manual. When an auxiliary manual actuator is used with a power actuator, install a bypass valve on the power actuator (if one is not supplied) for use during manual operation.

### **⚠ WARNING**

**Personal injury could result from packing leakage. Valve packing was tightened before shipment; however the packing might require some readjustment to meet specific service conditions. Check with your process or safety engineer for any additional measures that must be taken to protect against process media.**

Figure 4. Fisher V200 Dimensions and Required Clearances for Installation



V200 VALVE SIZE, NPS	DIMENSION						
	A		B	M			
	Standard ANSI/ISA S75.08.02 <sup>(1)</sup>	CL150 ASME B16.10 <sup>(2)</sup> Short (Optional)		Standard CL150 ANSI/ISA S75.08.02 <sup>(1)</sup>	CL150 ASME B16.10 <sup>(2)</sup> Short (Optional)	CL300	CL600
mm							
1	102	127	58	176	202	202	202
1-1/2	114	165	64	189	240	224	224
2	124	178	57	211	268	237	237
3	165	203	87	254	286	279	286
4	194	229	92	286	321	305	343
6	229	267	119	343	381	362	423
8	243	292	119	343	394	387	426
10	297	330	151	419	451	---	---
Inches							
1	4.00	5.00	2.29	6.94	7.94	7.94	7.94
1-1/2	4.50	6.50	2.50	7.44	9.44	8.81	8.81
2	4.88	7.00	2.25	8.31	10.56	9.31	9.31
3	6.50	8.00	3.44	10.00	11.25	11.00	11.25
4	7.62	9.00	3.62	11.25	12.62	12.00	13.50
6	9.00	10.50	4.69	13.50	15.00	14.25	16.25
8	9.56	11.50	4.69	13.50	15.50	15.25	16.75
10	11.69	13.00	5.94	16.50	17.75	---	---

1. IEC 534-3-2 face-to-face dimensions are equivalent to ANSI/ISA S75.08.02 face-to-face dimensions.  
2. 150 pound class only.

## Maintenance

Valve parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and replacement depends upon the severity of service conditions.

Key numbers in this procedure are shown in figures 24, 25, and 26, unless otherwise noted.

### **⚠ WARNING**

The Vee-ball closes with a shearing, cutting motion, which could result in personal injury. To avoid injury, keep hands, tools, and other objects away from the Vee-ball while stroking the valve.

Avoid personal injury from sudden release of process pressure. Before performing any maintenance operations:

- Do not remove the actuator from the valve while the valve is still pressurized.
- Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.
- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.
- Vent the power actuator loading pressure and relieve any actuator spring precompression.
- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.
- Always wear protective gloves, clothing, and eyewear when performing any maintenance operations.
- The valve packing area may contain process fluids that are pressurized, *even when the valve has been removed from the pipeline*. Process fluids may spray out under pressure when removing the packing hardware or packing rings.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

## Packing Maintenance

Key numbers in this procedure are shown in figures 24, 25, and 26, unless otherwise noted. A detailed view of the packing is also shown in figure 5.



If the valve is equipped with the ENVIRO-SEAL Packing System, refer to:

- the separate ENVIRO-SEAL Packing System for Rotary Valves instruction manual ([D101643X012](#)) for maintenance instructions, and
- the Parts List section of this manual for retrofit kits, parts kits, and individual parts.

If the packing is relatively new and tight on the drive shaft (key 6), and if tightening the packing follower nuts does not stop leakage, it is possible that the drive shaft is worn or nicked so that a seal cannot be made. If the leakage comes from the outside diameter of the packing, it is possible that the leakage is caused by nicks or scratches on the packing box wall. Inspect the drive shaft and packing box wall for nicks or scratches while performing the following procedure.

## Replacing Packing

When using this procedure, it is recommended that the actuator not be removed from the valve while the valve is still in the pipeline or between flanges. Valve/actuator adjustments must be made with the valve out of the pipeline. Refer to the Determining Closed Position portion of the Actuator Mounting section.

### Disassembly

#### **⚠ WARNING**

**Observe the steps in the WARNING at the beginning of the Maintenance section.**

1. Isolate the control valve from the line pressure, release pressure from both sides of the valve body, and drain the process media from both sides of the valve. If using a power actuator, shut off all pressure lines to the power actuator, release pressure from the actuator, and disconnect the pressure lines from the actuator. Use lock-out procedures to be sure that the above measures stay in effect while you are working on the equipment.
2. Remove line bolting, remove the control valve from the pipeline, and place the valve/actuator assembly on a flat surface with the seal protector ring facing up.
3. Remove the actuator cover. Take note of the orientation of the actuator with respect to the valve body and the lever orientation with respect to the valve drive shaft (see figure 6).

#### **⚠ WARNING**

**When the actuator is removed from the valve, the ball/shaft assembly may suddenly rotate, with a shearing, cutting motion, which could result in personal injury. To avoid injury, carefully rotate the ball to a stable position after the actuator is removed.**

#### **CAUTION**

**When removing the actuator from the valve, do not use a hammer or similar tool to drive the lever or actuator off the valve shaft. Driving the lever or actuator off the valve shaft could damage the ball, seal, and valve. If necessary, use a puller to remove the lever or actuator from the valve shaft. It is okay to tap the puller screw lightly to loosen lever or actuator, but hitting the screw with excessive force could damage the ball, seal, and valve.**

4. Remove the clamped lever (do not loosen the actuator turnbuckle adjustment), remove the actuator mounting screws and nuts (keys 23 and 24), and remove the actuator. (If necessary, refer to the actuator instruction manual for assistance.)

5. If applicable, remove the bonding strap assembly before attempting to remove the packing (see figure 3).
6. Remove the packing follower nuts and packing follower (keys 17 and 20). For alloy packing constructions, the packing follower (key 17) and a separate packing flange (key 40) must be removed if present.

If the valve is equipped with the ENVIRO-SEAL packing system, refer to the ENVIRO-SEAL Packing System for Rotary Valves instruction manual ([D101643X012](#)) for disassembly.

## **⚠ WARNING**

**Personal injury could result from packing leakage. Do not scratch the drive shaft or packing box wall while removing packing parts in the following procedure.**

7. Remove the packing parts (see figure 5, keys 16, 17, 35, and 39 depending on construction) using a formed wire hook with a sharp end. Pierce the rings with the sharp end of the hook in order to remove them. Do not scratch the drive shaft or packing box wall; scratching these surfaces could cause leakage. Clean all accessible metal parts and surfaces to remove particles that would prevent the packing from sealing.

## Assembly

If the valve is equipped with the ENVIRO-SEAL packing system, refer to the ENVIRO-SEAL Packing System for Rotary Valves instruction manual ([D101643X012](#)) for assembly.

### Series B only

1. For NPS 8, 10, and 12 valves, install the packing spacer (key 34) if it has been removed.
2. To help ensure correct centering of the Vee-ball (key 2) on the seal (key 11), make sure the ball is closed while you install or tighten new packing. Insert a screwdriver, pry bar, or similar tool between the lower ear of the ball and the valve body. Use the pry to move the ball tightly against the bearing on the actuator side of the valve (see figure 6). Keep the ball in that position until you have completed packing installation and adjustment.
3. Install the new packing parts using the parts sequence shown in figure 5. Install the packing follower (key 17). Alloy constructions have a packing follower (key 17) and a separate packing flange (key 40) that must be replaced.
4. Secure the packing follower with the packing follower nuts (key 20). Tighten the nuts far enough to stop leakage under operating conditions.

Handle the seal protector ring, seal, and other parts carefully to prevent damage. A new gasket (key 15) is required whenever the seal protector ring (key 3) (figure 11) is removed.

Flow ring construction does not use a seal, shims, or spring seal. Use this procedure to remove the seal protector ring from flow ring constructions, but disregard any instructions calling for the seal, shims, or spring seal.

---

## Note

If the valve is equipped with a bonding strap assembly (figure 3), re-install the assembly.

---

5. Reconnect the actuator and lever in accordance with the orientations that were noted in step 3 of the disassembly procedures. If necessary, use figure 23 to identify the correct index marks.
6. Refer to the appropriate actuator instruction manual to complete actuator assembly and adjustment.
7. When the control valve is in operation, check the packing follower for leakage and retighten the packing follower nuts (key 20) as necessary.

## Replacing the Ball Seal

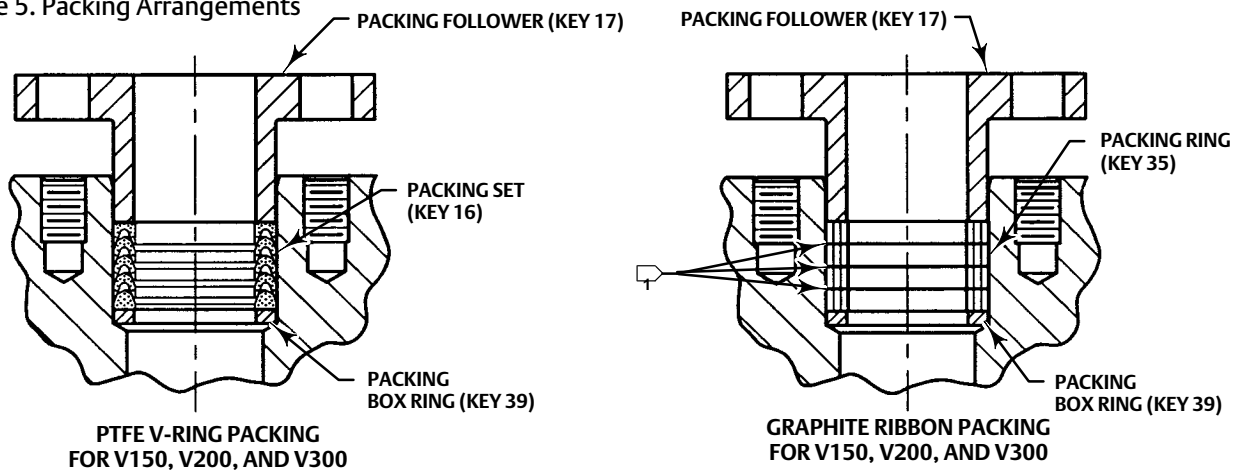
### Disassembly

Perform this procedure if the control valve is not shutting off properly or if seal inspection is necessary. If you find upon inspection that the ball, shaft, or bearings need to be replaced, use this procedure to remove the ball seal. Then, proceed to the Bearing and Ball Maintenance procedures. Then, return to this procedure and begin with the assembly of the ball seal steps.

While the actuator/valve assembly must be removed from the pipeline, the actuator may remain mounted on the valve as you replace the ball seal.

Key numbers are shown in figures 24, 25, and 26, unless otherwise indicated. Ball Seal assembly details (with key numbers) are also shown in figures 8, 9, and 10.

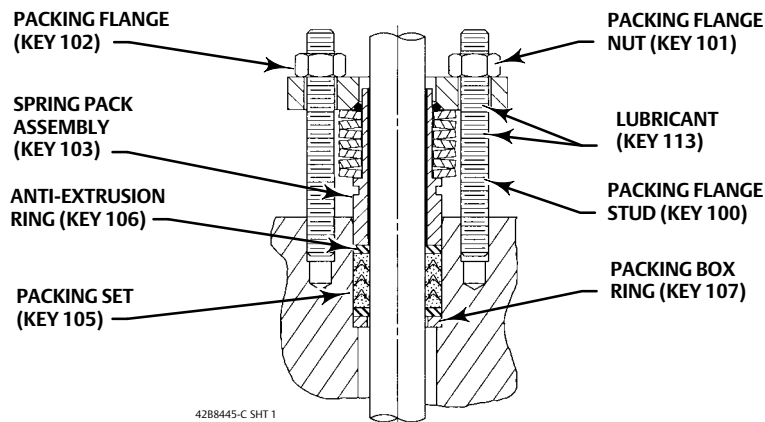
Figure 5. Packing Arrangements



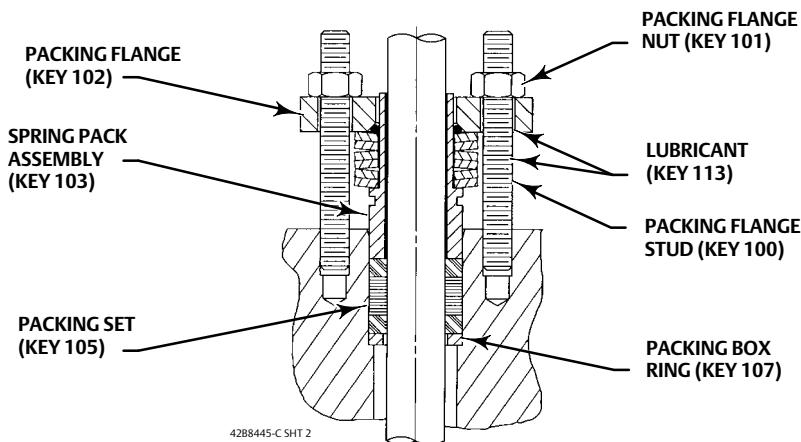
NOTE:  
 ① INCLUDES ZINC WASHERS (KEY 36) FOR GRAPHITE RIBBON PACKING ONLY.

2885170

**STANDARD PACKING**



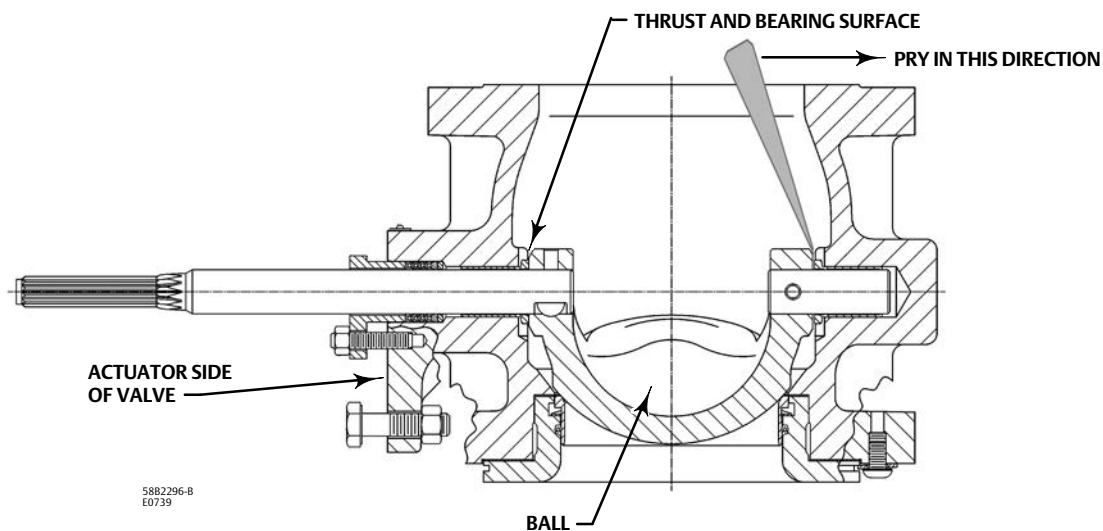
**ENVIRO-SEAL PTFE PACKING SYSTEM**



**ENVIRO-SEAL GRAPHITE PACKING SYSTEM**

B2412-1

Figure 6. Typical Vee-Ball Valve Showing Pry Bar



**⚠ WARNING**

Perform the steps in the **WARNING** at the beginning of the Maintenance section of this manual.

1. Remove line bolting, remove the control valve from the pipeline, and place the valve on a flat surface with the seal protector ring facing up. Carefully rotate the ball to the open position.
2. Remove protector ring screws and washers (keys 21 and 22). Carefully remove the seal protector ring and gasket (keys 3 and 15). (For flow ring constructions, go to step 4.)
  - a. For a Fisher TCM seal, remove the seal (key 11) from the valve body. For NPS 1, 1-1/2, and 2 valves, also remove the backup ring (key 14, figure 8) from the valve body.
  - b. For a flat metal seal, remove the spring seal, seal, and shims (keys 13, 11, and 12). (Note: It may be necessary to re-use some of the original shims when reassembling the flat metal seal.)
  - c. For an HD ball seal or a high temperature HD ball seal, once the protector ring has been removed from the valve, push the metal seal (key 11) out of the seal protector ring (key 3). Remove the wave spring (key 13), and on the HD metal seal, the radial seal (key 37).

**Note**

The high temperature HD ball seal also has a piston ring (key 133) that will need to be removed. It will be in two pieces for the NPS 1, 1-1/2 and 2 valves, and one piece with a break in it for the NPS 3 through 12 valves.

**CAUTION**

Exercise care to avoid damaging components in the following procedure.

- It might be necessary to remove the HD seal by carefully tapping it with a soft punch and hammer. Take care not to damage the seal protector ring.
  - NPS 3 through 12 valves, if the seal is difficult to push out, it is recommended that a seal removal plate be used to press the HD seal out of the seal protector ring. Refer to figure 12 for dimensions of the seal removal plate.
  - NPS 10 and 12 valves with an attenuator only: Remove the retaining ring (key 41) in the seal protector ring. This retaining ring is an octagonal-shaped support wire. To remove the retaining ring, find one of the free ends of the ring. Use a screwdriver or similar tool to pry inward and upward until the ring is removed.
3. Inspect the gasket and sealing surfaces on the valve body (key 1 or 1A), the seal protector ring (key 3), Vee-Ball (key 2), and the retaining ring (key 41 for NPS 10 and 12 valves with an attenuator only). Be sure the sealing surfaces are not damaged.
  4. If replacement of the ball, shafts (keys 6 or 9), or bearings (key 10) is needed, proceed to the Bearing and Ball Maintenance procedure. If only the seal is to be replaced, proceed to the Assembly steps below.

## Assembly

Refer to figures 8, 9, and 10 for key number locations during seal installation. Valve key number locations are shown in figures 24, 25, and 26.

1. Thoroughly clean all parts that are to be re-used and obtain replacement parts. Be sure that all sealing surfaces are in good condition without scratches or wear. If the valve has been installed between line flanges and the flange studs and nuts have been tightened, always replace the gasket (key 15) with a new gasket.
2. To help ensure correct side-to-side centering of the ball (key 2) on the seal (key 11), make sure the ball is closed while you install the seal or flow ring and seal protector ring. Insert a screwdriver, pry bar, or similar tool between the lower ear of the ball and the valve body (see figure 6).
3. Use the pry to move the ball tightly against the bearing on the actuator side of the valve. Be careful, excessive force may damage the ball. Keep the ball in that position until you have completed seal or flow ring installation. Check the ball's position periodically, and re-center if necessary, during lever assembly and packing adjustments.

### **⚠ WARNING**

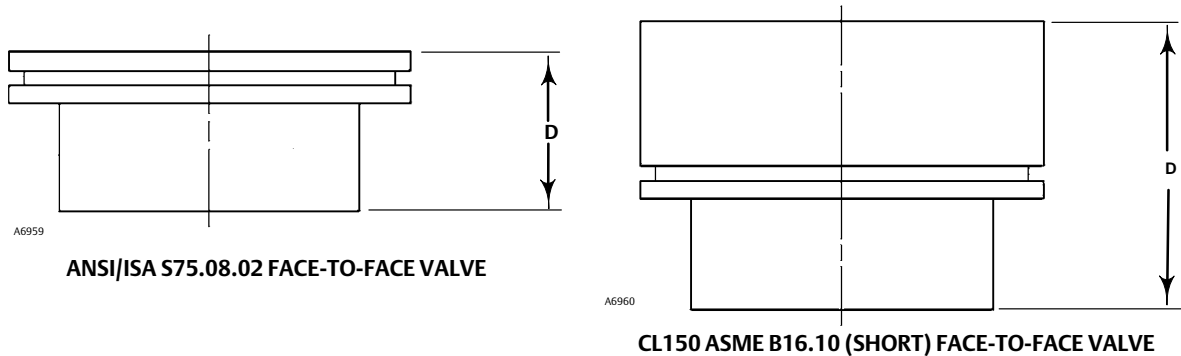
**The Vee-Ball closes with a shearing, cutting motion, which could result in personal injury. To avoid injury or property damage, keep hands, tools, and other objects away from the Vee-Ball while stroking the valve.**

4. Install the seal.

### **CAUTION**

**Due to the Vee-ball shape, take care to never completely rotate either the front skirted edge or the circular back edge of the ball out of the ball seal as the seal could be damaged.**

Figure 7. NPS 1 and 1-1/2 Seal Protector Ring Measurements



Valve Size, DN	Valve Size, NPS	Construction <sup>(1)</sup>	TCM Seal "D"	HD Seal "D"	Flow Ring "D"
mm					
25	1	New	37.6	44.7	39.6
		Old	25.1	33.0	26.9
40	1-1/2	New	39.1	44.5	40.9
		Old	27.4	32.8	29.2
Inches					
25	1	New	1.48	1.76	1.56
		Old	0.99	1.30	1.06
40	1-1/2	New	1.54	1.75	1.61
		Old	1.08	1.29	1.15

1. See the Note on page 14 of this Instruction Manual.

Valve Size, NPS	Construction <sup>(1)</sup>	TCM Seal "D"	HD Seal "D"	Flow Ring "D"
mm				
1	New	63.0	70.1	65.0
	Old	50.5	58.4	52.3
1-1/2	New	89.9	95.3	91.7
	Old	78.2	83.6	80.0
Inches				
1	New	2.48	2.76	2.56
	Old	1.99	2.30	2.06
1-1/2	New	3.54	3.75	3.61
	Old	3.08	3.29	3.15

1. See the Note on page 14 of this Instruction Manual.

Figure 8. Ball Seal Assembly for NPS 1, 1-1/2, and 2 Valves

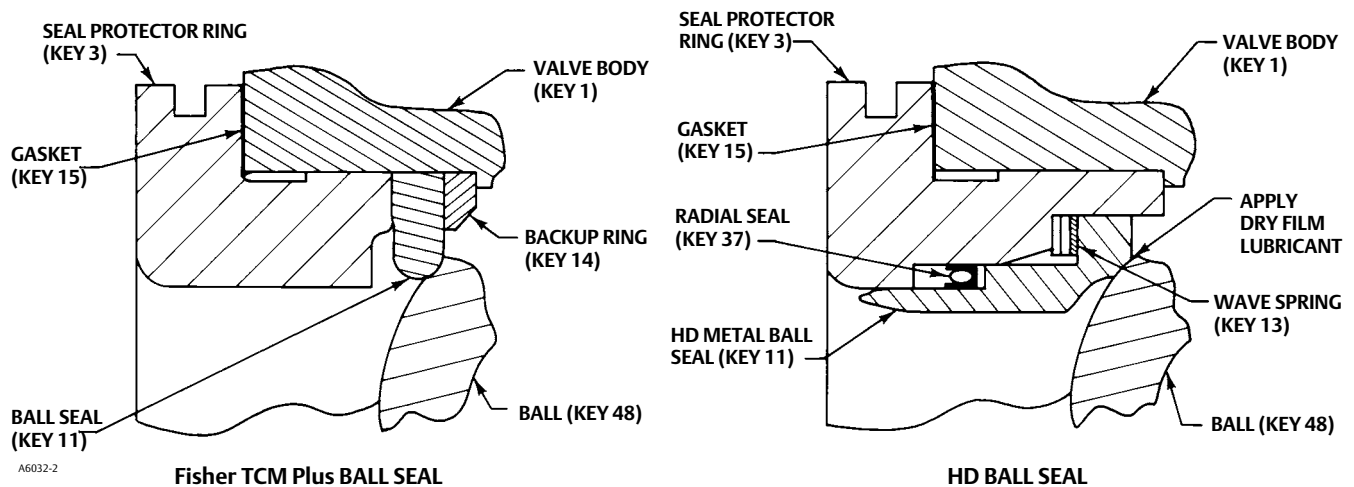


Figure 9. Ball Seal Assembly for NPS 3 through 12 Valves

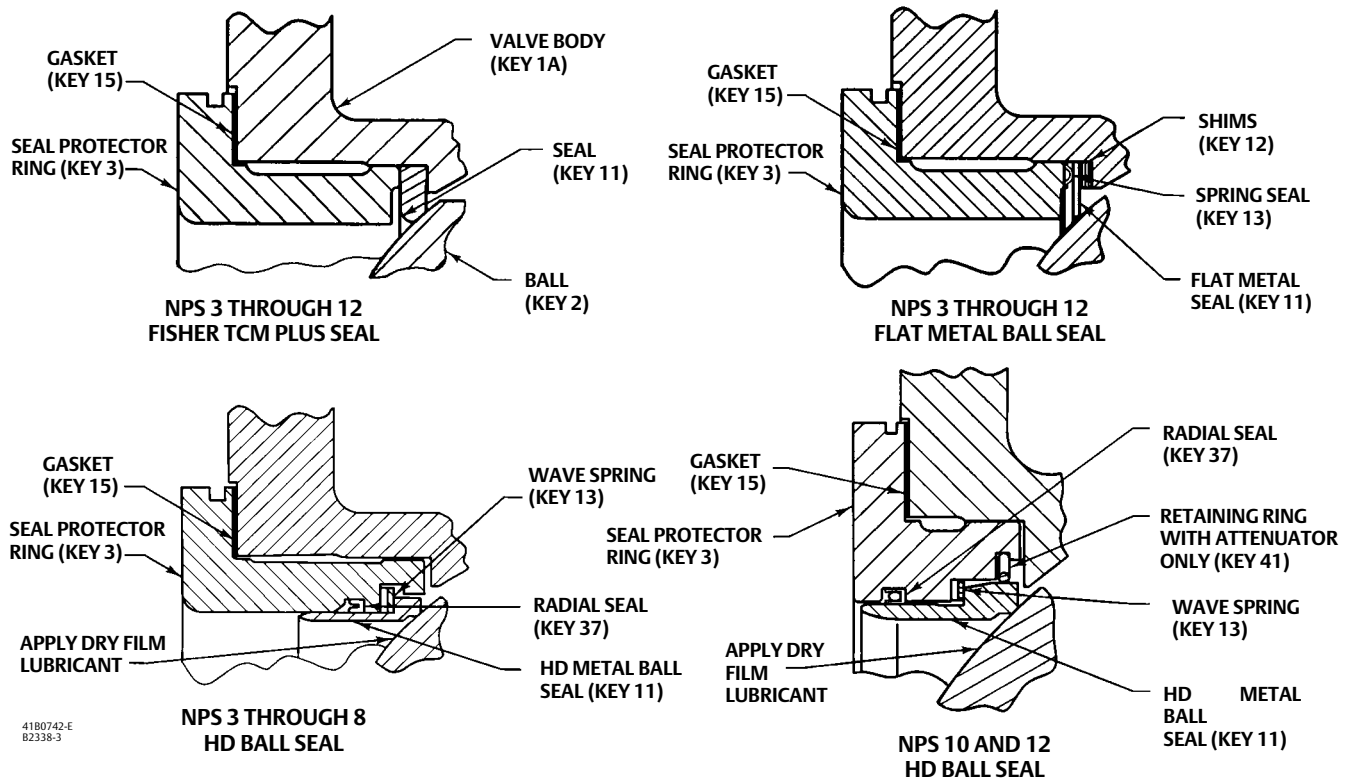


Figure 10. High Temperature HD Ball Seal Details

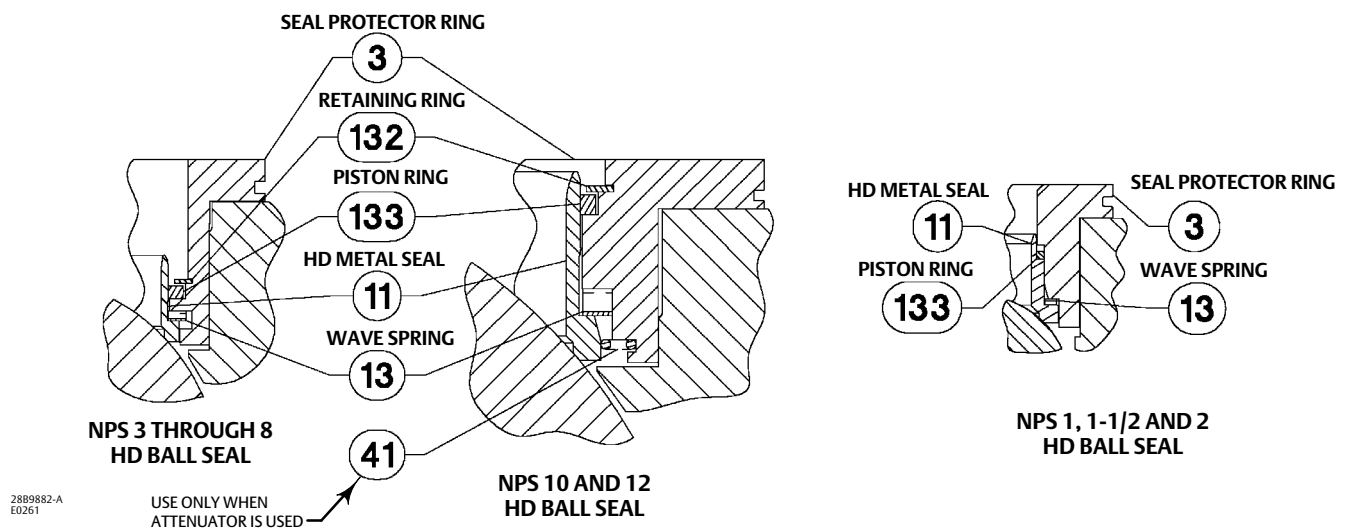




Figure 11. Seal Protector Ring

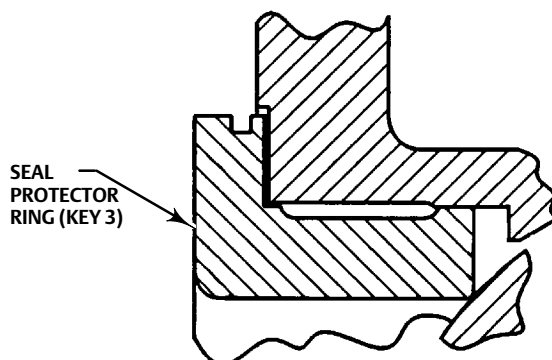
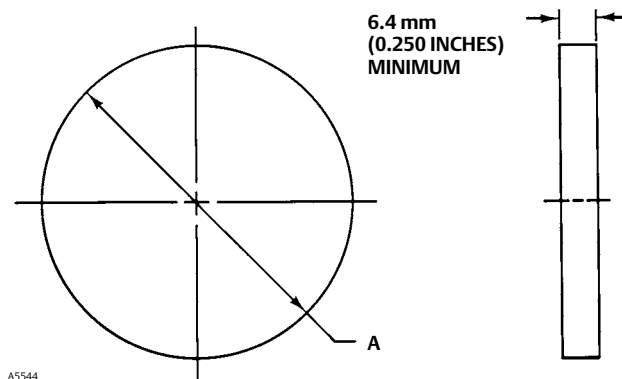


Figure 12. HD Seal Removal Plate Dimensions



VALVE SIZE		DIMENSION A	
DN	NPS	Minimum-Maximum, mm	Minimum-Maximum, Inches
80	3	75.9-76.2	2.990-3.000
100	4	95.0-95.3	3.740-3.750
150	6	126.7-127.0	4.990-5.000
200	8	158.5-158.8	6.240-6.250
250	10	212.5-212.7	8.365-8.375
300	12	263.3-263.5	10.365-10.375

**Installing Fisher TCM Plus or Extra ball seals:**

- a. NPS 1, 1-1/2, and 2 valves: Install the backup ring (key 14). Install the Fisher TCM seal (key 11) into the valve body. Refer to figure 7.
  - Install the gasket (key 15) on the valve body.
  - Install the seal protector ring (key 3) into the valve body. Now go to step 5 in this procedure.
- b. NPS 3 through 12 valves: Install the Fisher TCM seal (key 11) into the valve body.
  - Install the gasket (key 15) on the valve body.
  - Install the seal protector ring (key 3) into the valve body. Now go to step 5 in this procedure.

**Installing flat metal seals:**

- a. Install 12 shims in the valve and install the flat metal seal on top of the shims.
- b. Install the spring seal (key 13) on the flat metal seal (key 11) with the convex side of the spring seal facing the ball.
- c. Install the seal protector ring, and install the protector ring screws and washers (keys 21 and 22). Tighten the screws.
- d. Add or remove shims under the ball seal as necessary to obtain zero ball seal deflection as accurately as possible.

---

**Note**

Zero ball seal deflection for a flat metal seal is the point at which the addition of one 0.13 mm (0.005 inch) thick shim causes contact between the ball and ball seal to be broken. Hold the parts tightly together when determining zero deflection, or improper zero deflection might result.

---

- e. After zero deflection is reached, remove the seal protector ring, spring seal, seal and 4 shims. Final assembly of the control valve should not exceed a maximum of 9 shims for zero deflection. If more than 9 shims are required, contact your [Emerson sales office](#) or Local Business Partner.
- f. Install the gasket (key 15) on the valve body.
- g. Install the seal protector ring (key 3) into the valve body. Now go to step 5 in this procedure.

**Installing HD ball seals:**

---

**Note**

The older and newer designs of the NPS 1 and 1-1/2 seal protector ring are functionally the same, but are different lengths and not interchangeable. All NPS 1 and 1-1/2 sizes of V150 and V300 valves are the newer design. The change in seal protector ring length occurred in the 1992/1993 timeframe and affects NPS 1 and 1-1/2 V200 valves only. To determine whether you have the older or newer design, measure the length of the seal protector ring (key 3, figure 26) from its pipeline flange mating surface to its opposite end. Compare your measurement to those listed in figure 7.

---

- a. **For NPS 1 and 1-1/2 valves:** The older and newer designs of the NPS 1 and 1-1/2 seal protector rings are functionally the same, but are different lengths and not interchangeable. Refer to figure 7 for protector ring dimensions.
  - Install the wave spring (key 13) onto the ball seal.
  - Lubricate and install the radial seal (key 37) onto the ball seal (key 11). Make sure the open side of the radial seal faces away from the ball.
  - Push the ball seal assembly into the seal protector ring (key 3).
  - Go to step 5 in this procedure.

b. For all NPS 3 through 8 valves and NPS 10 and 12 valves without attenuator:

- Lubricate and install the radial seal (key 37) into the appropriate groove in the seal protector ring making sure the open side of the radial seal faces away from the ball.
- Install the wave spring (key 13) into the seal protector ring (key 3).
- Install the HD seal (key 11) into the seal protector ring (key 3), past the radial seal. While pushing it past the radial seal, make sure the HD seal is level. Go to step 5 in this procedure.

c. For NPS 10 and 12 valves with attenuator:

- Lubricate the radial seal with lithium grease and install the radial seal (key 37) into the appropriate groove in the seal protector ring making sure the open side of the radial seal faces away from the ball.
- Install the wave spring (key 13) into the seal protector ring (key 3).
- To install the retaining ring (key 41), find one of the free ends of the ring. Insert the free end into the groove in the seal protector ring. Work around the ring, pressing it into the groove until the ring is completely in its groove.
- Install the HD seal (key 11) into the seal protector ring (key 3), past the radial seal. While pushing it past the radial seal, make sure the HD seal is level.
- The HD seal uses a retaining ring (key 41) for NPS 10 and 12 valves only. This retaining ring is an octagonal-shaped support wire. Go to step 5 in this procedure.

Installing high temperature HD ball seals:

a. For NPS 1, 1-1/2 and 2 valves: The older and newer designs of the NPS 1 and 1-1/2 seal protector rings are functionally the same, but are different lengths and not interchangeable. All part numbers in this manual are for the newer design. Refer to figure 7 for ring dimensions.

- Place the wave spring (key 13) on top of the HD seal (key 11).
- Break the piston ring (key 133) into two approximately equal pieces either by placing the ring over a pencil or similar object and applying pressure down-wards on the ring until the ring snaps. Be sure to match the broken ends together as you install it on the HD seal (key 11).
- Lay the HD seal (key 11) down on a flat surface and push the seal protector ring (key 3) into place. Make sure the seal is level. Go to step 5 in this procedure.

b. For NPS 3 through 8 valves:

- Place the piston ring (key 133) and retaining ring (key 132) into the appropriate groove in the seal protector ring (key 3). The piston ring has one break in it; do **not** break it further.
- Install the wave spring (key 13) into the seal protector ring (key 3).
- Lay the HD seal (key 11) down on a flat surface and push the seal protector ring (key 3) past the piston ring (key 133) and into place. Make sure the seal is level. Go to step 5 in this procedure.

## c. For NPS 10 and 12 valves:

- Place the piston ring (key 133) and retaining ring (key 132) into the appropriate groove in the seal protector ring (key 3). The piston ring has one break in it; do not break it further.
  - Install the wave spring (key 13) into the seal protector ring (key 3).
  - If the valve has an attenuator, install the retaining ring (key 41). The octagonal shaped support wire ring has two free ends. Place one of the free ends into the groove in the seal protector ring. Then starting at the inserted end, press the rest of the ring into the groove completely.
  - Lay the HD seal (key 11) down on a flat surface and push the seal protector ring (key 3) past the piston ring (key 133) and into place. Make sure the seal is level. Go to step 5 in this procedure.
5. Install a replacement gasket (key 15) on the valve body (key 1 or 1A). Install the HD ball seal/seal protector ring assembly into the valve body (key 1 or 1A).
  6. Install washers (or clips), and screws that clamp the seal protector ring to the valve body [keys 3, 21, and 22; the V200 valve uses clips (key 22) in place of washers].
  7. If necessary, refer to the Packing Maintenance procedures to install the packing. Install the actuator using the Actuator Mounting procedures or to the appropriate actuator instruction manual.

## HD Ball Seal Lubrication

To assist with break-in of the HD seals, it is recommended that the ball and seal be lubricated with dry film lubricant or equivalent moly disulfide.

## Bearing and Ball Maintenance

### **⚠ WARNING**

**Before performing the steps in this section, observe the WARNING at the beginning of the Maintenance section on page 8.**

### DN 80 - 300 (NPS 3 through 12) Valves

Procedures for disassembly and assembly of the bearings and ball cannot be accomplished until the ball seal and valve packing are removed from the valve.

Refer to the Replacing Packing procedures to remove the actuator, and to remove the packing flange and packing follower from the valve. When the packing disassembly steps are complete, return to this section.

Refer to the Replacing the Ball Seal procedures to remove the ball seal from the valve.

Table 4. Continuous Threaded Rod

Valve Size, DN	Valve Size, NPS	Threaded Rod Thread Size	Thread Depth in Follower Shaft
80	3	0.25-20	0.5
100	4	0.25-20	0.5
150	6	0.25-20	0.5
200	8	0.3125-18	0.62
250	10	0.3125-18	0.62
300	12	0.3125-18	0.94

## Disassembly

### **⚠ WARNING**

**When the actuator is removed from the valve, the ball/shaft assembly may suddenly rotate, with a shearing, cutting motion, which could result in personal injury. To avoid injury, carefully rotate the ball to a stable position at the bottom of the valve body cavity. Make sure the ball will not rotate.**

Key numbers in this procedure are shown in figures 24, 25, and 26, unless otherwise indicated.

1. A taper key (key 4, figures 14, 24, 25 and 32) is used to connect the ball and drive shaft in NPS 3 through 12 valves.
2. Carefully rotate the ball to the open position after the actuator is disconnected. Make sure the ball will not rotate (see warning above). Provide support for the ball during the following disassembly.
3. Working from the small end of the groove pin (key 7), use a pin punch to drive the groove pin out of the ball ear and follower shaft.

For tack welded taper keys, driving the taper key out of the ball ear will shear the tack welding.

4. Locate the small end of the taper key (key 4, see figures 14, 24, 25 and 32). Using a pin punch on the smaller end of the taper key, drive it out of the ball (key 2) and drive shaft (key 6). Note: driving the taper key in the wrong direction will tighten it.
5. Pull the drive shaft (key 6) out of the actuator side of the valve body.

### **CAUTION**

**Exercise care to avoid damaging components in the following procedure.**

6. The ball will be free to move when both shafts are removed. Make sure the sealing surface of the ball is not damaged while removing the follower shaft.
  - a. Unscrew the pipe plug (key 25) if one is installed. Use a punch to drive the follower shaft (key 9) into the center of the ball.
  - b. If a pipe plug is not installed, use a piece of continuous threaded rod as a removal rod when moving the follower shaft (key 9) into the center of the ball. Refer to the table 4 for a description of the size threaded rod needed. The length of the rod should allow easy working room from the valve body.
7. Carefully remove the follower shaft and ball (key 2) from the valve body.

For NPS 4 valves with attenuator, remove the ball/attenuator through the inlet of the valve. Taking hold of the follower shaft ear on the ball/attenuator, you must position the scalloped edge of the attenuator against the valve bore opening and then pivot, or roll, the ball/attenuator out of the valve body (see figure 18).

For NPS 6, 8, 10, and 12 valves with attenuator, remove the ball/attenuator through the outlet of the valve by carefully turning and manipulating the ball. The NPS 6, 8, 10, or 12 ball/attenuator will not come straight out of the valve body.

8. Remove the bearings (key 10) by hand. If the bearings are tight in the valve body, then pull or drive them out with a slight pressure.
  - To remove the follower shaft bearings, use a blind-hole bearing puller. If you do not have such a tool, you can machine the bearing out.

9. Thoroughly clean surfaces of all parts that are to be re-used or obtain replacement parts.

## Assembly

1. Inspect all sealing surfaces to ensure they are in good condition and without scratches or wear.
2. Install the replacement bearings (key 10) by hand. The bearing flanged end should touch the valve body.
3. **Installing the Vee-Ball:** Ensure the ball part number matches up with the appropriate seal type as shown in the key 2 ball table in the parts list section of this instruction manual.

## **⚠ WARNING**

**The ball might be damaged if it is allowed to fall into the valve body. To avoid personal injury or damage to the sealing surfaces, support the ball to prevent it from falling into or out of the valve body cavity.**

### Note

For ease of assembly, the follower shaft (key 9) should be inserted into the ball before installing the ball in the following applications:

- NPS 3 valve without ball/attenuator
- NPS 4 through 12 valves with ball/attenuator.

Carefully install the ball into the valve body cavity.

- **For Vee-Ball with attenuator (NPS 4 through 12 valves),** carefully install the ball into the valve body cavity. For NPS 4 valves, install the ball/attenuator through the inlet of the valve. For NPS 6, 8, 10, and 12 valves, install the ball/attenuator through the outlet of the valve. Taking hold of the follower shaft ear on the ball/attenuator, you must position the scalloped edge of the attenuator against the valve bore opening and then carefully pivot, or roll, the ball/attenuator into the valve body (see figure 18).

After you have installed the ball (key 2) into the valve body assembly, firmly support the ball while installing the shafts.

4. Installing the follower shaft (key 9):

- **For NPS 3 valves:** The follower shaft (key 9) should already have been inserted into the ball before the ball was put into the valve body. Insert the follower shaft (key 9) into the valve body bearing (key 10).
- **For NPS 4 and larger valves:** Insert the follower shaft (key 9) through the ball, and into the valve body bearing (key 10).
- **For NPS 4 through 12 valves with ball/attenuator:** The follower shaft (key 9) should already have been inserted into the ball/attenuator before the ball was put into the valve body. Insert the follower shaft (key 9) into the valve body bearing (key 10).

**Then for all sizes,** align the hole in the follower shaft with the holes in the ball. Insert the small end of the groove pin (key 7) into the hole in the ball and into the follower shaft. The pin will hold the parts in place while the drive shaft (key 6) is being installed.

Table 5. Taper Key Minimum Depth

Valve Size, DN	Valve Size, NPS	Minimum Depth To Drive Taper Key After Initial Solid Contact, mm (Inches)
80, 100, 150	3, 4, 6	4.8 (0.188)
200, 250, 300	8, 10, 12	5.6 (0.219)

Table 6. Taper Key Maximum Depth

Valve Size, DN	Valve Size, NPS	Maximum Depth To Drive Taper Key After Initial Solid Contact, mm (Inches)
80, 100	3, 4	7.1 (0.281)
150	6	7.9 (0.312)
200, 250	8, 10	9.5 (0.375)
300	12	10.3 (0.406)

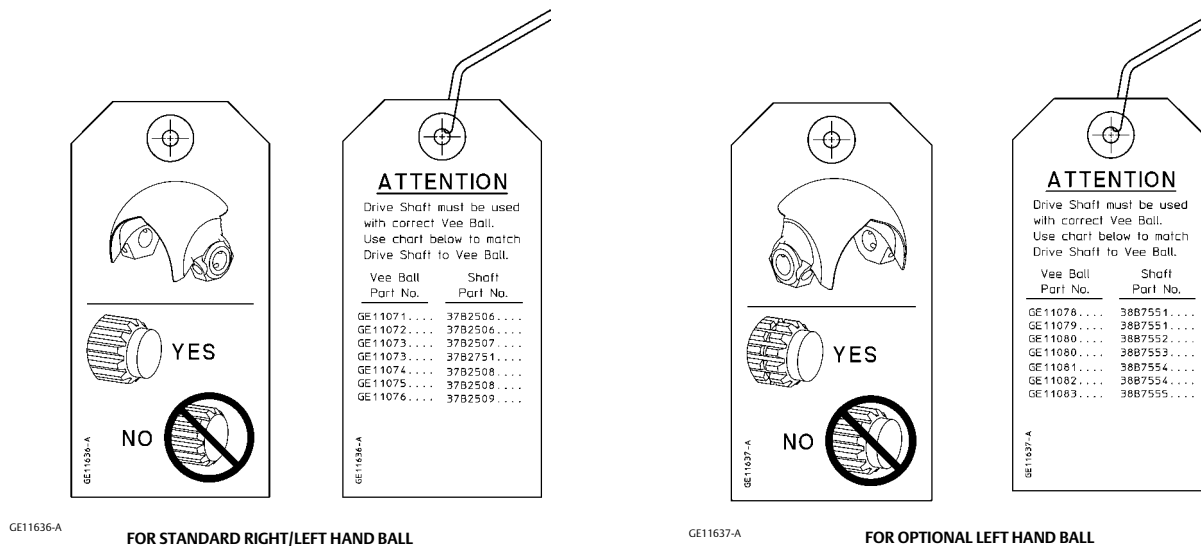
5. Installing the Drive Shaft:

**CAUTION**

The drive shaft must be used with the correct Vee-Ball. Refer to the tag (see figure 13) attached to the Vee-Ball and to the drive shaft.

Failure to use the correct Vee-Ball/shaft combination may result in the ball not being in the position indicated by the slash mark on the end of the shaft. If the ball is not properly aligned with the slash mark, the valve will not function correctly and seal damage may result.

Figure 13. Informational Tag



**CAUTION**

Make sure the drive shaft is free of oil or grease, otherwise the taper pin or taper key will not seat properly. Failure to properly set the taper pin or taper key could result in it coming loose while in service. Loosening of the taper key in service could result in improper valve function and equipment damage.

- a. Insert the drive shaft into the valve body bearing (key 10), and into the ball ear. Align the hole in the drive shaft with the holes in the ball.
- b. Insert the taper key into the ball and drive shaft as shown in figure 14.

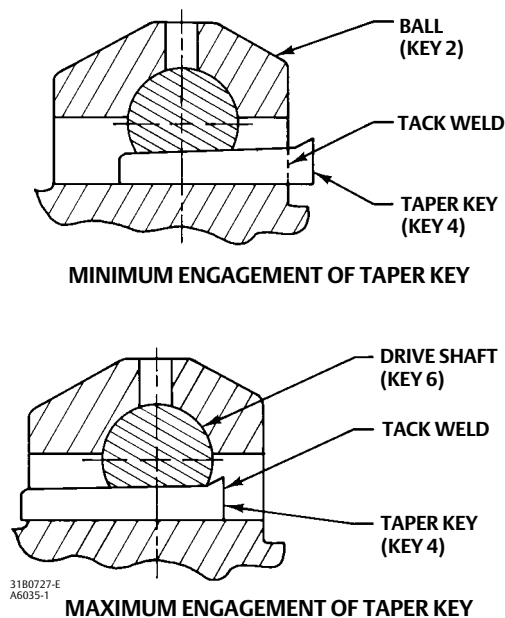
- Installing the Taper Key

Current standard construction materials for all NPS 3 through 12 valves require the taper key (key 4, figure 14) to be tack welded in place after properly seating, using the following procedure. Use standard welding preparations when preparing parts for reassembly.

## CAUTION

**Make sure the drive shaft (key 6) is free of oil or grease, otherwise the taper key will not seat properly. Failure to properly set the taper pin or taper key could result in it coming loose while in service. Loosening of the taper key in service could result in improper valve function and equipment damage.**

Figure 14. Taper Key Installation



6. Install the drive shaft (key 6) into the valve body through the ball and into the lower bearing.
7. Insert the taper key (key 4) into ball and drive shaft (keys 2 and 6) as shown in figure 14. The taper key inserts, with the flat side of the key, facing the drive shaft (key 6).
8. Using a flat end punch, drive the groove pin (key 7) into the ball ear and follower shaft until it is flat with the ball ear surface. Stake both ends of the pin hole with a center punch to ensure the groove pin does not come out.
9. Using a flat end punch, drive the taper key (key 4) into the ball ear and drive shaft (key 6) until solid, heavy contact is obtained between the key and shaft.
10. Measure the position of the taper key head.
11. Drive the taper key in further using the minimum distance shown in table 5.



12. Inspect the ball/shaft taper key connection to verify that the taper key spans the entire shaft flat width. If not, the taper key must be driven in further until this condition is satisfied. However, do not exceed the maximum depths shown in table 6.

**Note**

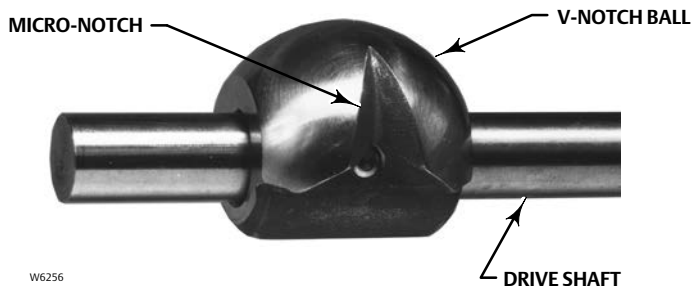
All valve taper keys are tack welded, except titanium.

13. When the above conditions are met, tack weld the taper key (key 4) to the ball ear on the head end of the key (see figures 24 and 25).

Use a:

- 1/8 inch diameter weld on NPS 3 through 6 valves,
- 3/16 inch diameter weld on NPS 8 through 10 valves, and
- 1/4 inch diameter weld on NPS 12 valves.

Figure 15. Typical Metal Micro-Notch Ball and Drive Shaft



For all constructions: Refer to Replacing the Ball Seal, Packing Maintenance, and other procedures as necessary to complete the assembly of the valve.

### DN 25 through 50 (NPS 1 through 2) Valves

Procedures for disassembly and assembly of the bearings and ball cannot be accomplished until the ball seal and valve packing are removed from the valve.

Refer to the Replacing Packing procedures to remove the actuator, and to remove the packing flange and packing follower from the valve. When the packing disassembly steps are complete, return to this section.

Refer to the Replacing the Ball Seal procedures to remove the ball seal from the valve.

### Disassembly

**⚠ WARNING**

When the actuator is removed from the valve, the ball/shaft assembly may suddenly rotate, with a shearing, cutting motion, which could result in personal injury. To avoid injury, carefully rotate the ball to a stable position at the bottom of the valve body cavity. Make sure the ball will not rotate.

Key numbers in this procedure are shown in figures 24, 25, and 26, unless otherwise indicated.

1. A taper pin (key 4, figure 20) is used in the NPS 1, 1-1/2, and 2 valves, and in the NPS 1 Metal Micro-Notch valve (figure 21).
2. Ceramic Micro Notch ball constructions: A screw (key 4, figure 22) is used to attach the ball to the drive shaft.

**CAUTION**

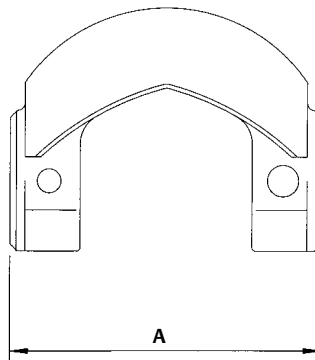
**Exercise care to avoid damaging components in the following procedure.**

- a. The parts are held together with a screw and an adhesive. Remove the screw (key 4) and separate the drive shaft from the ball. In some cases, a small amount of heat can be applied to help loosen the adhesive. However, excessive heat may damage other valve component parts.
- b. Once the shafts have been removed from the valve body, the ball may fall. To avoid personal injury or damage to the sealing surfaces, provide support for the ball to prevent it from falling as the shaft(s) are being removed.

Table 7. Continuous Threaded Rod

Valve Size, DN	Valve Size, NPS	Threaded Rod Thread Size	Thread Depth in Follower Shaft
25	1	1/4-20	0.5
40	1.5	1/4-20	0.5
50	2	1/4-20	0.5

Figure 16. Dimensions of Ball in Ball / Shaft Assembly



VALVE SIZE		A			
		NEW - WITHOUT THRUST WASHER		OLD - WITH THRUST WASHER	
DN	NPS	mm	Inches	mm	Inches
25	1	32.9	1.29	31.8	1.25
40	1.5	48.6	1.91	47.7	1.88
50	2	64.5	2.54	63.4	2.50

3. Carefully rotate the ball to the open position after the actuator is disconnected. Make sure the ball will not rotate (see warning above). Provide support for the ball during the following disassembly.
4. Unscrew the pipe plug (key 25). (The pipe plug is optional and may not be available.)

- Working from the small end of the groove pin (key 7), use a pin punch to drive the groove pin out of the ball ear and follower shaft.

**Note**

All NPS 1 Micro-Notch constructions use a one piece shaft. They do not have a follower shaft.

- Locate the small end of the taper key (key 4, figure 14). Using a pin punch on the smaller end of the taper key, drive it out of the ball (key 2) and drive shaft (key 6). Note: driving the taper key in the wrong direction will tighten it.
- Pull the drive shaft (key 6) out of the actuator side of the valve body.

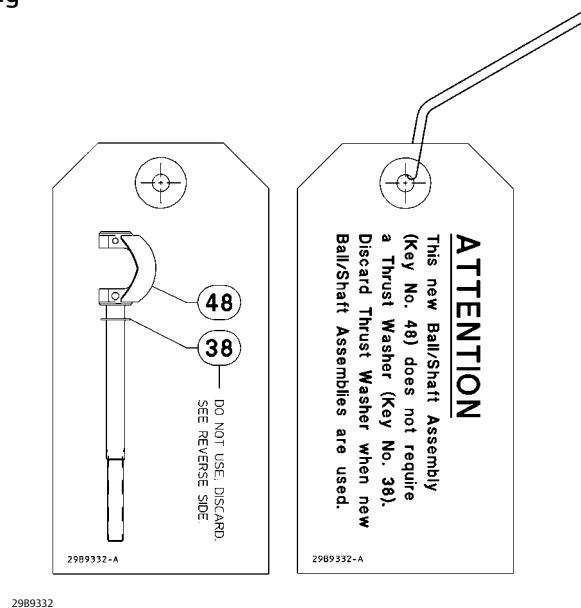
**Note**

The new ball/shaft assembly (key 48) does not require a thrust washer (key 38) in valves ordered after November 01, 2001.

Discard the thrust washer in valves ordered prior to this date when new ball/shaft assemblies are used as spare parts.

Figure 17 shows the informational tag that is attached with the new ball/shaft assembly when shipped as a spare part. Refer to figure 16 for dimensions of the ball in the ball/shaft assembly.

Figure 17. Informational Tag



**CAUTION**

Exercise care to avoid damaging components in the following procedure.

8. Make sure the sealing surface of the ball is not damaged while removing the follower shaft.
  - a. If a pipe plug (key 25) is installed, use a punch to drive the follower shaft (key 9) into the center of the ball.
  - b. If a pipe plug is not installed, use a piece of continuous threaded rod as a removal rod when moving the follower shaft (key 9) into the center of the ball. Refer to the table 7 shown below for a description of the size threaded rod needed. The length of the rod should allow easy working room from the valve body.
9. Remove the ball (key 2) by carefully removing the follower shaft and ball from the valve body.
10. Remove the bearings (key 10) by hand. If the bearings are tight in the valve body, then pull or drive them out with a slight pressure.
11. Thoroughly clean surfaces of all parts that are to be re-used or obtain replacement parts.

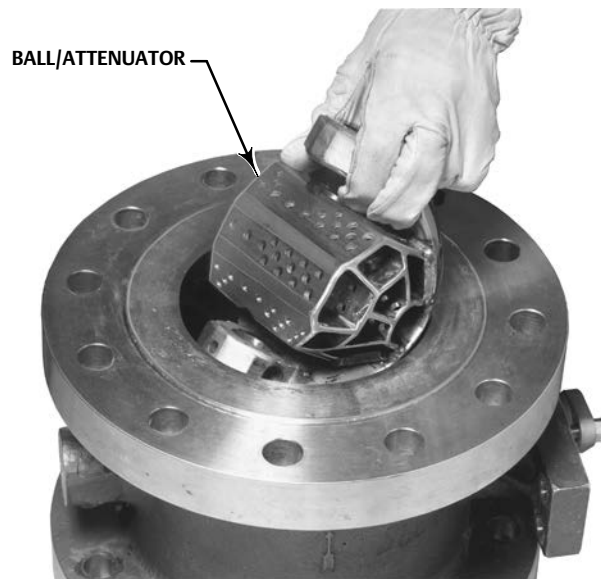
### Assembly

1. Inspect all sealing surfaces to ensure they are in good condition and without scratches or wear.
2. Install bearings (key 10) by hand. The bearing flanged end should touch the body.
3. Installing the ball (key 2):

### **⚠ WARNING**

The Vee-Ball might be damaged if it is allowed to fall into the valve body. To avoid personal injury or damage to the sealing surfaces, support the ball to prevent it from falling into or out of the valve body cavity.

Figure 18. Ball/Attenuator Installation and Removal Method



W6134

### Note

For ease of assembly, the follower shaft (key 9) should be inserted into the ball before installing the ball in an NPS 3 valve without ball/attenuator

Carefully install the ball into the valve body cavity.

After you have installed the ball (key 2) into the valve body assembly, firmly support the ball while installing the shafts.

4. Installing the follower shaft (key 9):

- For NPS 1 through 2 valves: The follower shaft (key 9) should already have been inserted into the ball before the ball was put into the valve body. Insert the follower shaft (key 9) into the valve body bearing (key 10).

**Note**

All NPS 1 Micro-Notch constructions use a one piece shaft. They do not have a follower shaft.

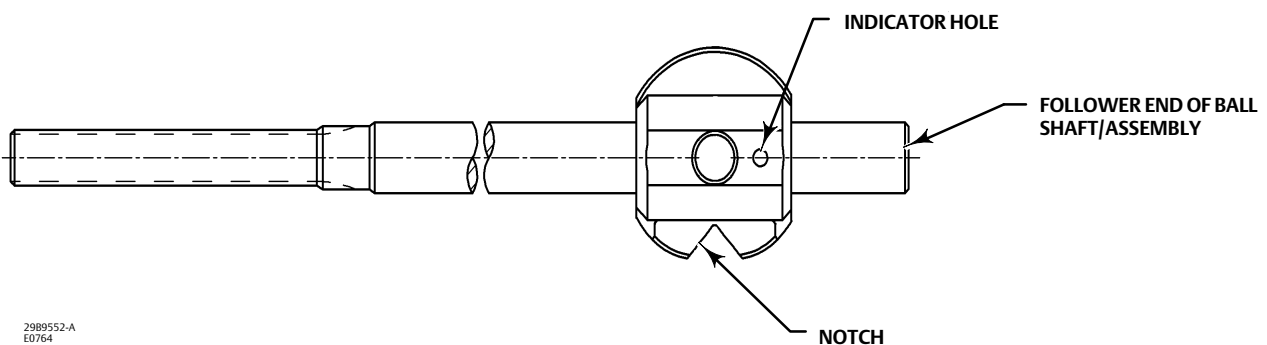
5. Installing the Drive Shaft for Valves with Taper Pins

**CAUTION**

The drive shaft must be used with the correct Vee-Ball. Refer to the tag (see figure 13) attached to the Vee-Ball and to the drive shaft.

Failure to use the correct Vee-Ball/ shaft combination may result in the ball not being in the position indicated by the slash mark on the end of the shaft. If the ball is not properly aligned with the slash mark, the valve will not function correctly and seal damage may result.

Figure 19. Location of Indicator Hole in Micro-Notch Vee-Balls



2989552-A  
E0764

**CAUTION**

Make sure the drive shaft is free of oil or grease, otherwise the taper pin will not seat properly. Failure to properly set the taper pin or taper key could result in it coming loose while in service. Loosening of the taper key in service could result in improper valve function and equipment damage.

6. Insert the drive shaft into the valve body bearing (key 10), and into the ball ear (or ball, for Micro-Notch constructions). Align the hole in the drive shaft with the holes in the ball.

---

**Note**

There is an indicator hole drilled in all Micro-Notch balls. This indicator hole must be oriented closest to the follower end of the ball/shaft assembly. See figure 19.

---

7. Insert the taper pin into the ball and drive shaft as shown in figures 20 and 21. The small end of the taper pin must be inserted into the larger hole side of the ball ear (or ball, for Micro-Notch constructions), and into the large hole side of the drive shaft.

---

**Note**

The taper pin will not fit correctly if inserted in the wrong direction through the ball ear (or ball, for Micro-Notch constructions) or through the drive shaft. Make sure the drive shaft and ball ear (or ball, for Micro-Notch constructions) are in the correct orientation for installing the pin.

---

- Installing Taper Pins in NPS 1, 1-1/2, and 2 Valves

---

**Note**

For NPS 1, 1-1/2, and 2 valves, the taper pins (figure 20) do not require welding.

---

Using a flat-end punch, drive the taper pin into the ball ear (or ball, for Micro-Notch constructions) and drive shaft until solid heavy contact is felt. Make sure the taper pin spans the width of the ball.

Using a flat end punch, drive the groove pin (key 7) into the ball and follower shaft until it is flat with the ball surface.

### Installing the Drive Shaft in VTC Ceramic Vee-Ball Valves

## CAUTION

**The drive shaft must be used with the correct Vee-Ball. Refer to the tag (see figure 13) attached to the Vee-Ball and to the drive shaft.**

**Failure to use the correct Vee-Ball/ shaft combination may result in the ball not being in the position indicated by the slash mark on the end of the shaft. If the ball is not properly aligned with the slash mark, the valve will not function correctly and seal damage may result.**

---

Figure 20. Taper Pin Installation for Fisher V150, V200, and V300 NPS 1, 1-1/2, and 2 Valves

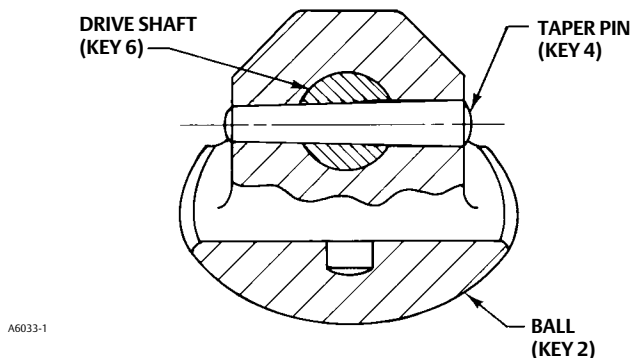
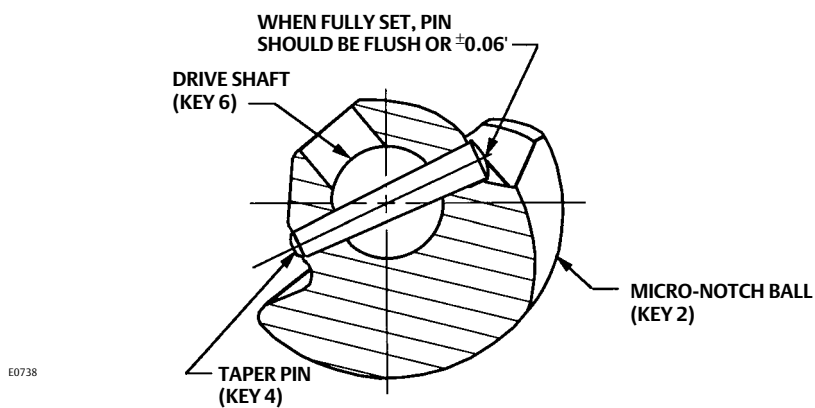
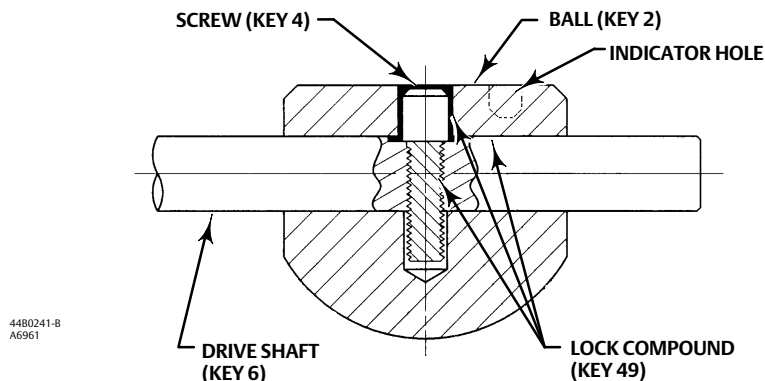


Figure 21. Taper Pin Installation for Fisher V150, V200, and V300 NPS 1 Valves with Micro-Notch Ball Construction



Valves with NPS 1 ceramic micro-notch balls use a screw with a threaded valve shaft to connect the ball to the shaft. An adhesive is used to lock the screw in the valve shaft (keys 4 and 6, figure 22).

Figure 22. Screw Installation for Fisher V150, V200, and V300 NPS 1 Valves with VTC Ceramic Micro-Notch Ball Construction



---

**Note**

There is an indicator hole drilled in all Micro-Notch balls. The orientation of this hole in the ceramic Vee-Ball is to the right of the screw in the ball, and must be located closest to the follower end of the ball/shaft assembly. See figures 19 and 22.

---

**⚠ WARNING**

**Avoid personal injury and property damage from ignition of process fluid caused by sparks from ceramic trim.  
Do not use ceramic trim where the process fluid is unstable or if it is an explosive mixture (such as ether and air).**

---

Within the valve body:

8. The threaded hole in the shaft, the screw and screw clearance hole in the ball must be free of oil and grease before applying an activator.
9. Apply Loctite® Depend® Activator 7387 to threaded hole, screw and ball clearance hole. Assemble the ball onto the shaft while aligning threaded shaft hole within the ball clearance hole.
10. The flat on the shaft must be oriented so that the head of the cap screw seats on the flat.
11. Apply 5 drops of Loctite Depend 330 into the hole in the ball.
12. Thread the screw into the shaft tightening it to 9.2 N•m (81 in•lbs) torque. Remove excess adhesive, Allow four hours to cure fully before continuing with assembly.

For all constructions: Refer to Replacing the Ball Seal, Packing Maintenance, and other procedures as necessary to complete the assembly of the valve.

## Cavitrol Hex Installation

The Cavitrol Hex anti-cavitation trim (key 64) is available for the NPS 4 through 12, V150, V300, and V200 flanged, raised-face body constructions. To retrofit the Cavitrol Hex to an existing valve assembly, special body machining is required. Two threaded holes must be added to the valve body outlet flange. Contact your [Emerson sales office](#) or Local Business Partner for retrofit information.

---

**Note**

The Cavitrol Hex anti-cavitation trim will add 0.5 inch to the face to face dimension of the valve. Refer to table 3 of this manual for information on required flange stud length.

---

The standard Cavitrol Hex is compatible with the counter clockwise (CCW) to close ball design. Contact your Local Business Partner or Emerson sales office for information on Cavitrol Hex compatibility with the special clockwise (CW) to close ball design.

## Assembly

1. The Cavitrol Hex anti-cavitation trim (key 64) is to be installed last, after the Vee-Ball valve body assembly is complete. The recommended valve orientation for assembly is with the body outlet flange facing up.
2. Ensure the ball is in the open position.
3. Place the gasket (key 65) over the body outlet flange serrated surface as illustrated in figure 28.



4. Insert the Cavitrol Hex anti-cavitation trim into the valve, ensuring the holes in the body outlet flange align with the holes in the trim flange.
5. Install two fasteners (key 21) and adequately tighten to secure the trim to the valve assembly.

## Actuator Mounting

Use the appropriate actuator instruction manual, this section of this manual, and figure 23 of this manual when mounting the actuator or changing actuator styles and positions.

1. To help ensure correct centering of the Vee-Ball (key 2) on the seal (key 11), be sure the ball is closed when mounting the actuator (for applications other than Spring Return Fail-Open).
2. Clean the valve shaft and actuator lever splines to be sure the actuator lever will slide on easily. Only drive the lever in if absolutely necessary.
3. Carefully wedge the ball solidly against the actuator-side bearing, using a screwdriver or similar tool inserted between the lower ear of the ball and the valve body. This will center the ball. See figure 6.
4. Keep the wedge in place while installing the lever, if necessary. Remove the wedge after you have clamped the actuator lever on the valve shaft and have connected the lever to the actuator piston rod or diaphragm rod.

## Determining Mounting Position

The actuator can be either right or left-hand mounted, with the actuator on the right or left side when viewed from upstream (see figure 23).

The Series B Vee-Ball, NPS 4 through 12 with attenuator, and the NPS 1 micro-notch Vee-Ball have one V-notch. For **right-hand mounting (standard)**, the ball will be in the top of the valve body when the valve is open and the shaft is horizontal. In this position the ball rotates CCW to Close. For **left-hand mounting (standard)**, the ball will be in the bottom of the valve body when the valve is open and the shaft is horizontal. In this position the ball rotates CCW to Close. An optional ball for **left-hand mounting**, which rotates into the top of the valve body when the shaft is horizontal, is also available. In this position the ball rotates CW to Close.

The NPS 1 through 2 has two notches, and can be rotated in either direction.

## Determining Closed Position

1. The valve must be removed from the line to check the position of the ball.

### **⚠ WARNING**

**The Vee-Ball closes with a shearing, cutting motion. To avoid personal injury, keep hands, tools, and other objects away from the ball while stroking the valve.**

2. Rotate the ball to the closed position.
3. Position the ball in the proper location

For Series B:

- When viewed from the valve body inlet, the ball is in the proper position when the flat spot on the top of the ball is exactly in the center of the seal package.

Make a copy of the centering template in figure 27 out of a suitable stiff material. Place the centering template in the opening at the seal (See figure 27). Find the center of the template and make sure the spot on the ball is centered directly below it.

For NPS 1, 1-1/2, and 2 valves: Follow one of the procedures below:

- When viewed from the valve body inlet, the ball is in the proper position when both V-notches of the ball are centered between the machined diameter of the ledge that supports the seal.
  - If the ball has a spot machined on the top, align that spot to the exact center of the seal cavity.
4. Adjust the actuator linkage as described in the appropriate actuator instruction manual until the ball is centered in the closed position. A line is stamped on the actuator end of the drive shaft (see figure 23) to indicate the ball position.

Use the appropriate actuator instruction manual and figure 23 of this manual when mounting the actuator or changing actuator styles and positions.

The Micro-Notch ball closed position is approximately 5 degrees closed from the first point of flow. This establishes the zero degree position for the ball.

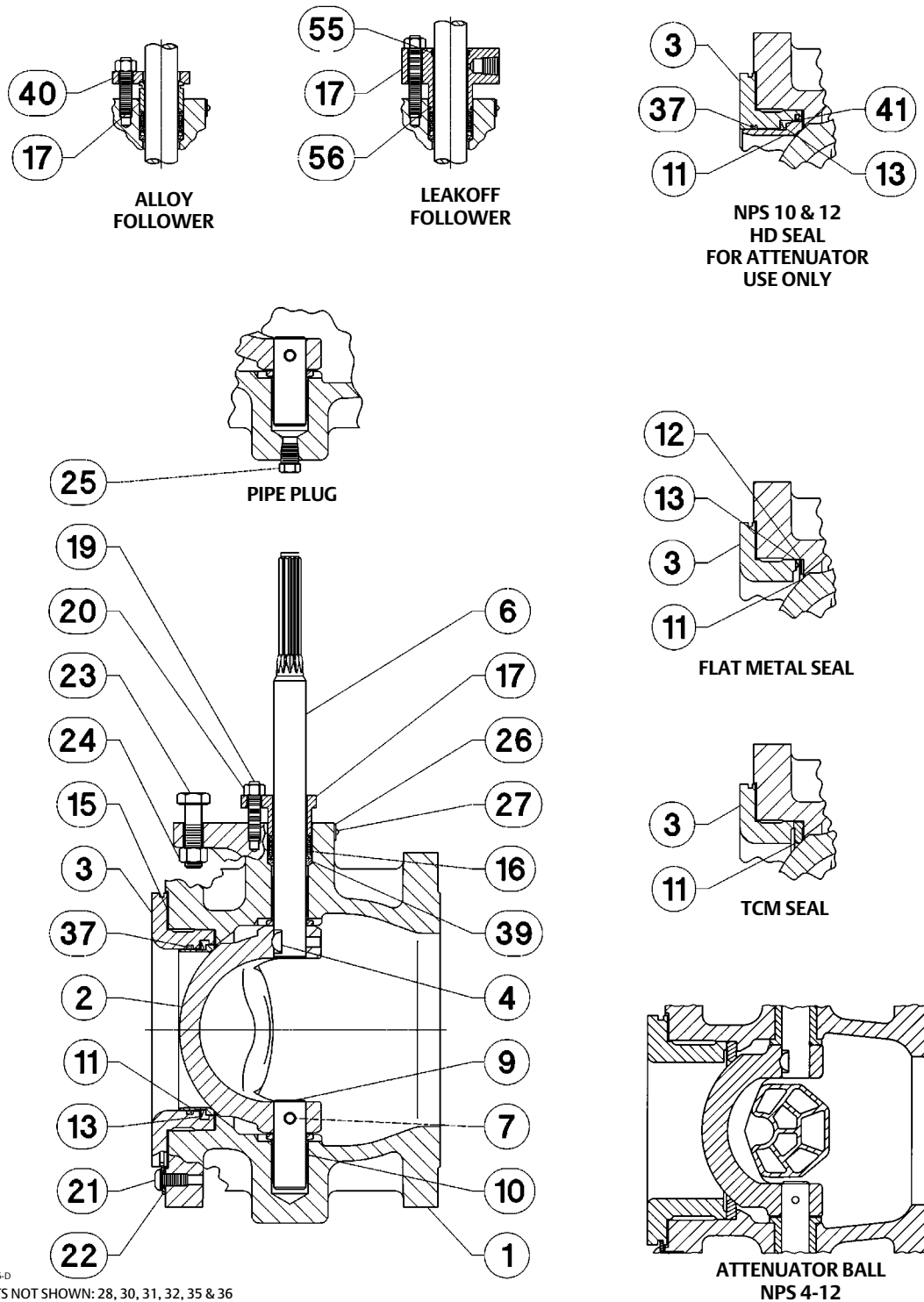
**Figure 23. Index Marks for Actuator Lever Orientation for NPS 1 through 12 Valves with or without Attenuator**

ACTUATOR		VALVE OPEN	ACTUATOR POSITION			
MOUNTING	STYLE		1	2	3	4
(STANDARD) RIGHT-HAND	STYLE A PUSH DOWN TO CLOSE					
	STYLE B PUSH DOWN TO OPEN					
(STANDARD) LEFT-HAND	STYLE C PUSH DOWN TO OPEN					
	STYLE D PUSH DOWN TO CLOSE					
(OPTIONAL) <sup>(2)</sup> LEFT-HAND	STYLE C PUSH DOWN TO CLOSE					
	STYLE D PUSH DOWN TO OPEN					

NOTE:  
1. ARROW ON LEVER INDICATES DIRECTION OF ACTUATOR THRUST TO CLOSE VALVE.  
2. THE OPTIONAL LEFT-HAND ORIENTATION IS NOT AVAILABLE FOR MICRO-NOTCH VEE-BALLS.

48B4773-C

Figure 24. Fisher V150 or V300 (NPS 3 - 12) or Flanged V200 (NPS 3 - 8) Valve Assembly  
(Details are typical for V200 Flangeless valve body)



58B2296-D  
PARTS NOT SHOWN: 28, 30, 31, 32, 35 & 36

Figure 25. Exploded View, Fisher V150 and V300 (NPS 3 - 12) and Flanged V200 (NPS 3-8) without Attenuator Assembly.

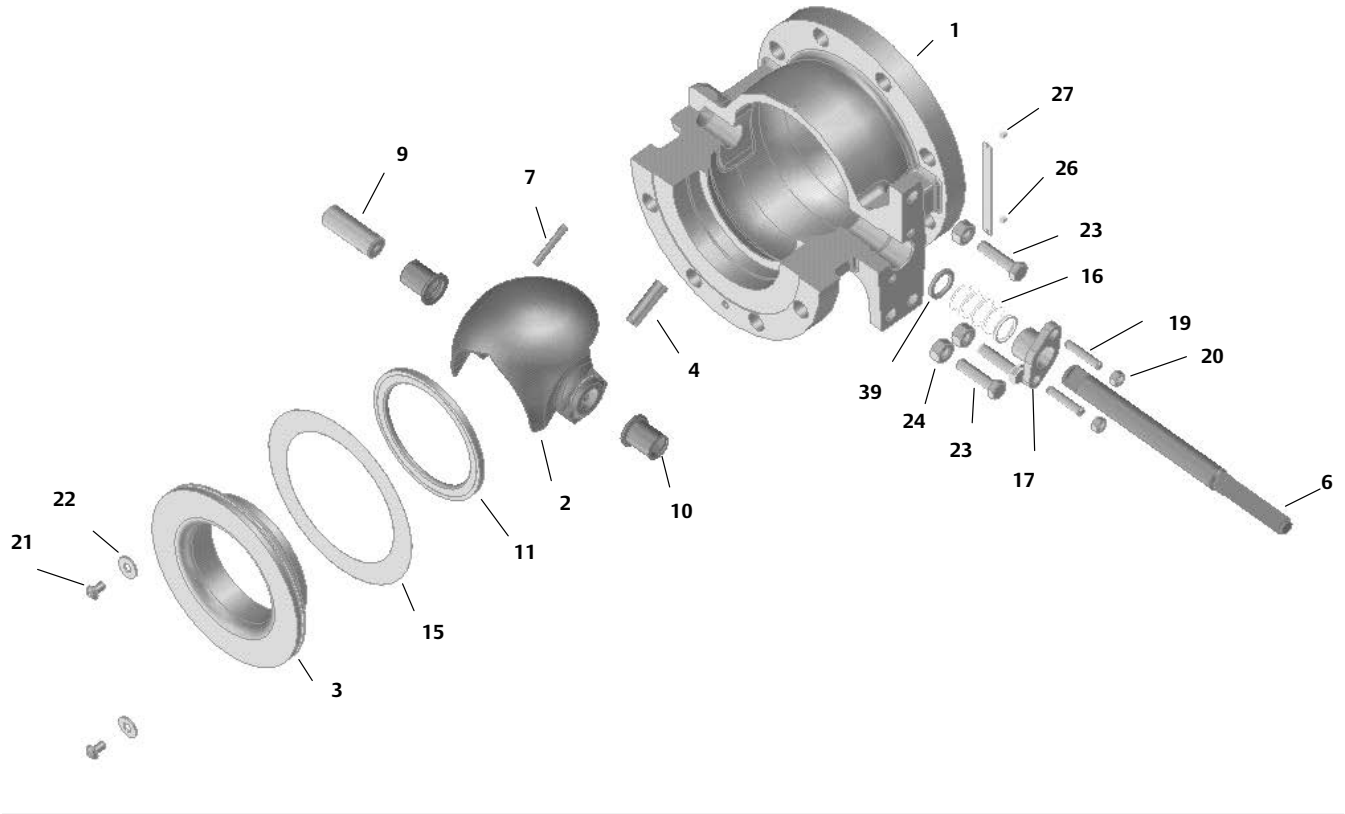
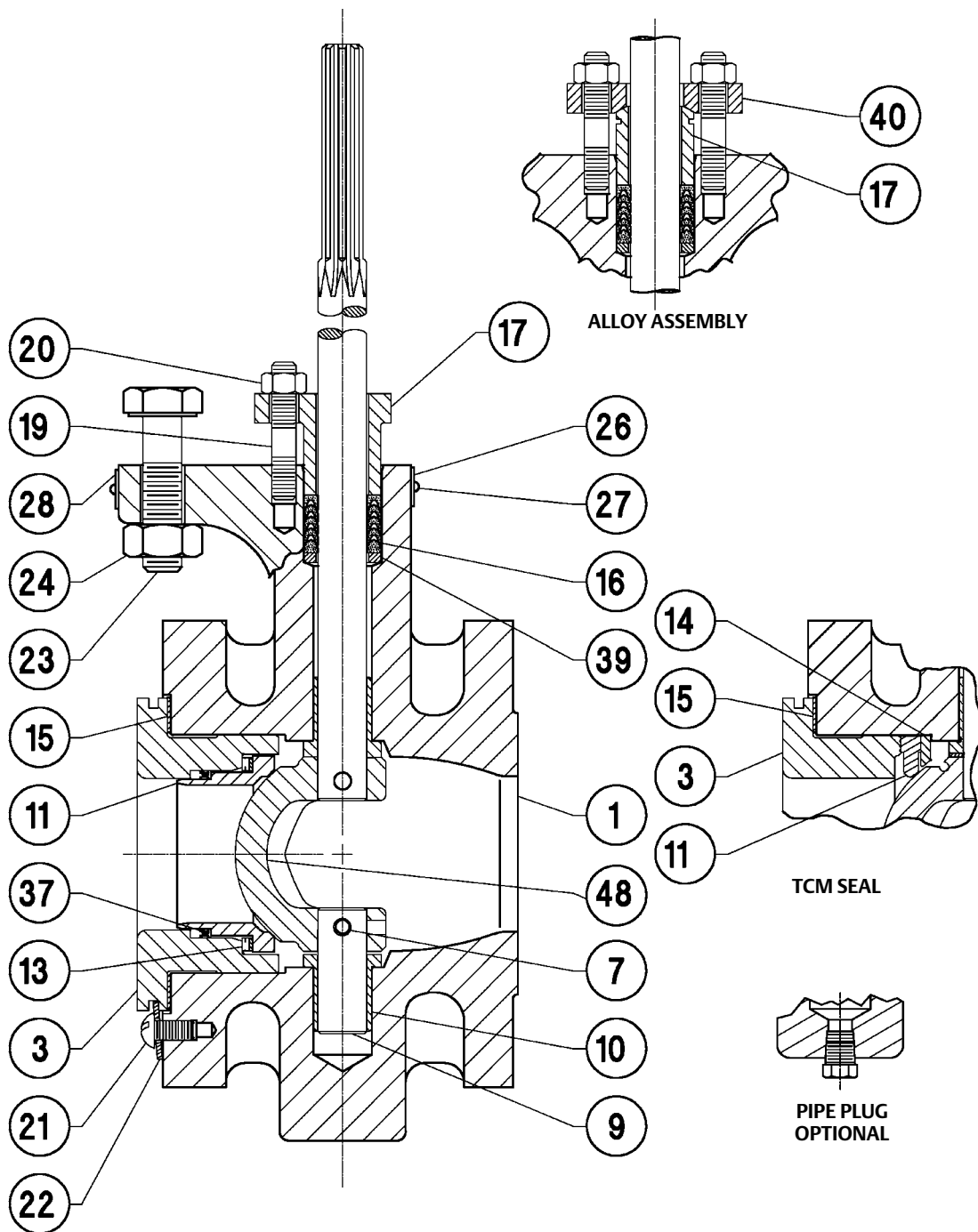
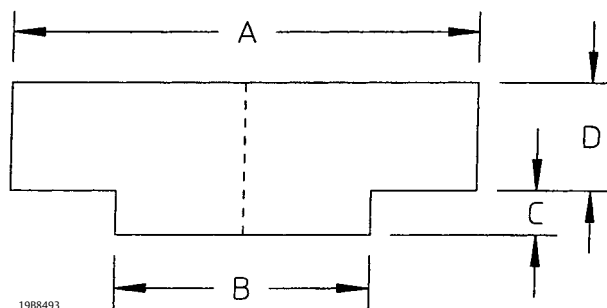
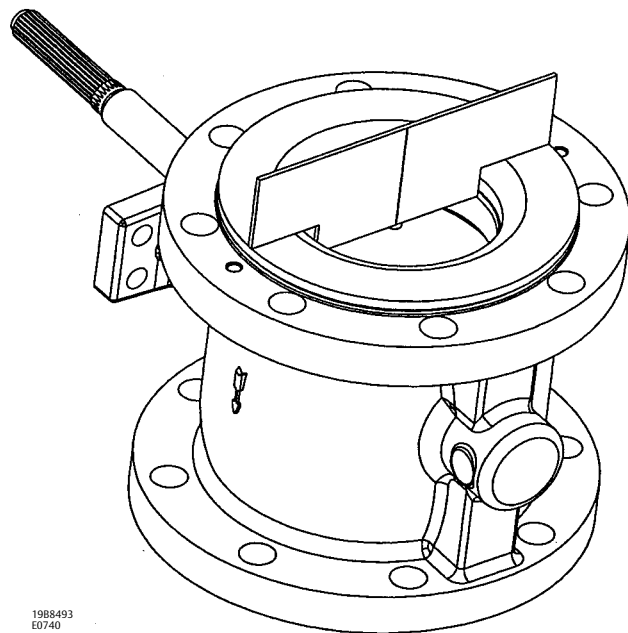


Figure 26. Fisher V150 or V300 (NPS 1, 1-1/2, and 2) and Flanged V200 (NPS 2) Valve Assembly  
(Details are typical for Flangeless V200)



NOTE:  
PARTS NOT SHOWN: 30, 31, 32, 33, 35 & 36  
4482228-B

Figure 27. Centering Template in Use and Template Dimensions



VALVE SIZE, DN	VALVE SIZE, NPS	A (FOR ASME VALVES)	A (FOR DIN VALVES)	B <sup>(1)</sup>	C <sup>(1)</sup> (ANSI/ISA S75.08.02)	C (ASME B16.10 Short <sup>(2)</sup> )	D <sup>(1)</sup>
<b>mm</b>							
25	1	63	68	19	35	61	25
40	1-1/2	82	88	28	34	85	25
50	2	102	102	38	31	85	25
80	3	127	138	63	24	62	38
100	4	157	157	82	36	71	44
150	6	216	212	117	21	59	51
200	8	270	268	139	12	61	57
250	10	324	320	203	2	35	60
300	12	381	378	254	2	20	63
<b>Inches</b>							
25	1	2.50	2.68	0.75	1.40	2.40	1.00
40	1-1/2	3.25	3.46	1.12	1.34	3.34	1.00
50	2	4.02	4.02	1.50	1.22	3.34	1.00
80	3	5.00	4.55	2.50	0.94	2.44	1.50
100	4	6.19	6.19	3.25	1.42	2.80	1.75
150	6	8.50	8.35	4.62	0.82	2.32	2.00
200	8	10.62	10.55	5.50	0.48	2.42	2.25
250	10	12.75	12.60	8.00	0.09	1.40	2.38
300	12	15.00	14.88	10.00	0.09	0.78	2.50
1. These dimensions are the same for ASME and DIN valves. 2. Note that ASME B16.10 Short dimensions are actually longer than ANSI/ISA S75.08.02 dimensions.							

## Parts Ordering

A serial number is assigned to each valve and stamped on the nameplate. Always refer to the valve serial number when corresponding with your [Emerson sales office](#) or Local Business Partner regarding spare parts or technical information. When ordering replacement parts, also specify the key number, part name, and desired material using the parts list.

### **⚠ WARNING**

**Use only genuine Fisher replacement parts. Components that are not supplied by Emerson Automation Solutions should not, under any circumstances, be used in any Fisher valve, because they will void your warranty, might adversely affect the performance of the valve, and could give rise to personal injury and property damage.**

### Note

For the NPS 2 V150 valve, this manual covers valves with serial numbers 12551183 and higher. Always reference the serial number of your valve when corresponding with your Emerson sales office or Local Business Partner.

## Retrofit Kits for ENVIRO-SEAL Packing

Retrofit kits include parts to convert existing V150, V200 and V300 valves with shallow (single packing depth) packing box to the ENVIRO-SEAL packing box construction. Retrofit kits include single PTFE packing. See following table.

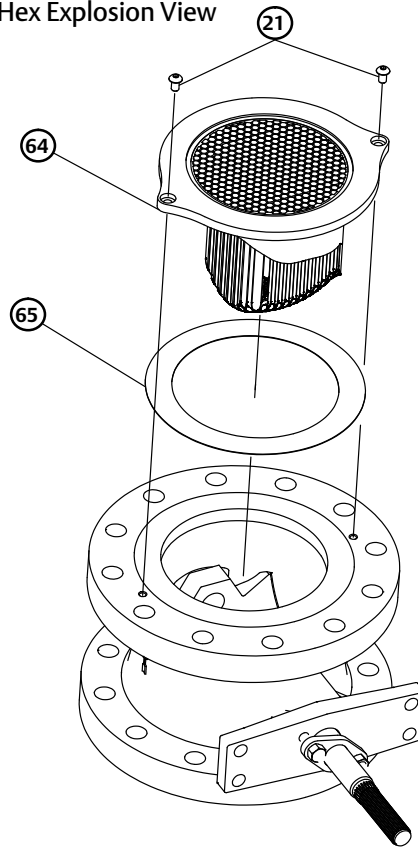
### ENVIRO-SEAL Packing Retrofit Kits

SHAFT DIAMETER <sup>(1)</sup>		PART NUMBER	
mm	Inches	Single PTFE	Graphite
12.7	1/2	RRTYXRT0012	RRTYXRT0312
15.9	5/8	RRTYXRT0022	RRTYXRT0322
19.1	3/4	RRTYXRT0032	RRTYXRT0332
25.4	1	RRTYXRT0052	RRTYXRT0352
31.8	1-1/4	RRTYXRT0062	RRTYXRT0362
38.1	1-1/2	RRTYXRT0072	RRTYXRT0372
Parts Included in Kit			
Key	Description	Quantity	
100	Packing stud	2	2
101	Packing nut	2	2
102	Packing flange	1	1
103	Spring pack assembly	1	1
105	Packing set	1	1
106	Anti-extrusion washer	2	---
107	Packing box ring <sup>(2)</sup>	1	1
---	Tag	1	1
---	Tie Cable	1	1

1. Diameter through the packing box.  
2. Not required for all sizes of V150 and V200 or for V300 with 1-1/4 or 1-1/2 inch diameter shafts.

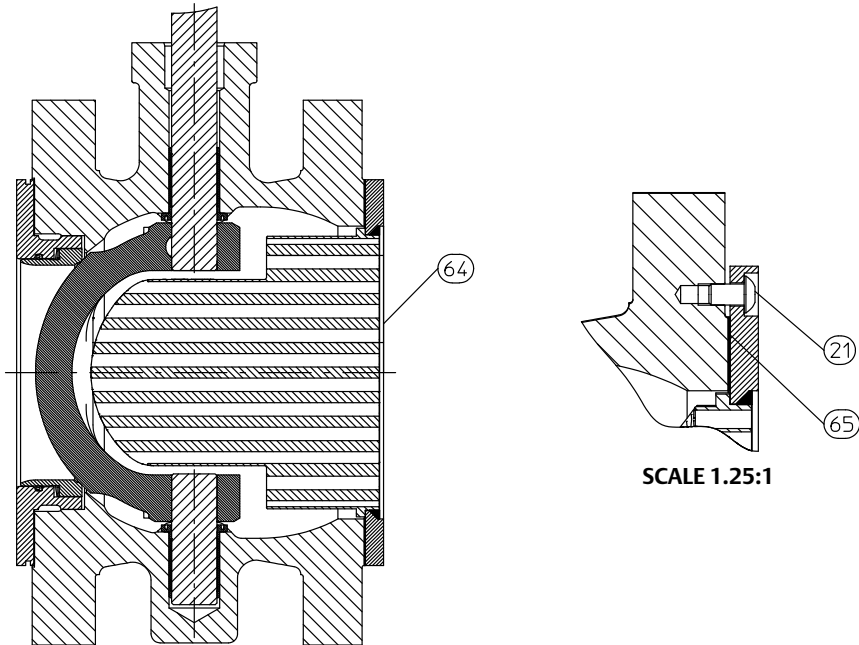


Figure 28. Fisher V300 with Cavitrol Hex Explosion View



GE96725

Figure 29. Fisher V300 with Cavitrol Hex Assembly View



GE96724

## Repair Kits for ENVIRO-SEAL Packing

Repair kits include valves parts for shallow (single packing depth) for ENVIRO-SEAL packing box construction. Repair kits include single PTFE or graphite packing. See following table.

### ENVIRO-SEAL Packing Repair Kits

SHAFT DIAMETER <sup>(1)</sup>		PART NUMBER	
mm	Inches	PTFE	Graphite
12.7	1/2	RRTYX000012	13B8816X012
15.9	5/8	RRTYX000022	13B8816X032
19.1	3/4	RRTYX000032	13B8816X052
25.4	1	RRTYX000052	13B8816X092
31.8	1-1/4	RRTYX000062	13B8816X112
38.1	1-1/2	RRTYX000072	13B8816X142
Parts Included in Kit			
Key	Description	Quantity	
105	Packing set	1	1
106	Anti-extrusion washer	2	--- <sup>(2)</sup>

1. Diameter through the packing box.  
2. Included in key 105.

## Repair Kits for Ball Seals

Seal repair kits include recommended spare parts for Fisher TCM Plus, S31600 stainless steel, CF10SMnN, or CD7MCuN ball seal constructions. The following table indicates the repair kit part number and the quantity of parts included in the kit.

### Fisher V150, V200, and V300 Repair Kits

VALVE SIZE		KIT PART NUMBER			
		Ball Seal Material			
DN	NPS	TCM Plus	---	Alloy 6	CD7MCuN (Alloy 255 Duplex SST)
25	1	RV150X00CA2	---	RV150XHDA2	RV150XHDC2
40	1-1/2	RV150X00CB2	---	RV150XHDB2	RV150XHDCB2
VALVE SIZE		Ball Seal Material			
DN	NPS	TCM Plus	S31600 (316 SST)	CF10SMnN	CD7MCuN (Alloy 255 Duplex SST)
50	2 <sup>(1)</sup>	RV150X00C12	RV150X00M12	RV150X0HD12	RV150XHDC12
50	2 <sup>(2)</sup>	RV150X00C82	---	RV150X0HD82	RV150XHDC82
80	3	RV150X00C22	RV150X00M22	RV150X0HD22	RV150XHDC22
100	4	RV150X00C32	RV150X00M32	RV150X0HD32	RV150XHDC32
150	6	RV150X00C42	RV150X00M42	RV150X0HD42	RV150XHDC42
200	8	RV150X00C52	RV150X00M52	RV150X0HD52	RV150XHDC52
250	10	RV150X00C62	RV150X00M62	RV150X0HD62	RV150XHDC62
300	12	RV150X00C72	RV150X00M72	RV150X0HD72	RV150XHDC72
Parts Included in Kit		Quantity in Kit			
Key No.	Description				
11	Ball seal	1	1	1	1
12	Shim seal <sup>(3)</sup>	---	4	---	---
13	Spring seal	---	1	---	---
13	Wave spring	---	---	1	1
15	Gasket	1	1	1	1
37	Radial seal	---	---	1	1
21	Retainer screw	2 or 4 <sup>(4)</sup>	2 or 4 <sup>(4)</sup>	2 or 4 <sup>(4)</sup>	2 or 4 <sup>(4)</sup>
22	Retainer washer	2 or 4 <sup>(4)</sup>	2 or 4 <sup>(4)</sup>	2 or 4 <sup>(4)</sup>	2 or 4 <sup>(4)</sup>

1. V150's only for serial numbers below 12551183.  
2. V150's for serial numbers 12551183 and above. All V200's and V300's.  
3. Fewer shim seals are furnished in the parts kits than are used in the original construction of the valve. Most original shim seals can be reused.  
4. A quantity of 2 is supplied for NPS 2 through 8 valves, and a quantity of 4 is supplied for NPS 10 and 12 valves.

## Cavitrol Hex Retrofit Kit

Kit includes the Cavitrol Hex (key 64), gasket (key 65), and fasteners (key 21). Kits are available for the NPS 4 through 12 V150, V300, and V200 flanged, raised-face body constructions. To retrofit the Cavitrol Hex anti-cavitation trim to an existing valve assembly, special body machining is required. Two threaded holes must be added to the valve body outlet flange. Contact your Local Business Partner or [Emerson sales office](#) for retrofit information.

### Fisher V150, V200<sup>(1)</sup>, and V300 Cavitrol Hex Kits

VALVE SIZE, NPS	KIT PART NUMBER	
	Material	
	S31603 (316L)	R31233 (Ultimet)
4	RCAVHEX0002	RCAVHEX0012
6	RCAVHEX0022	RCAVHEX0032
8	RCAVHEX0042	RCAVHEX0052
10	RCAVHEX0062	RCAVHEX0072
12	RCAVHEX0082	RCAVHEX0092

1. V200 raised face flanged body.

## Parts List

**Note**

Contact your [Emerson sales office](#) or Local Business Partner for Part Ordering information.

### Common Parts (figures 24, 25 & 26)

Key	Description
1	If you need a valve body as a replacement part, order by valve size, serial number, and desired valve body material. Contact your Emerson sales office or Local Business Partner for assistance.
2*	Ball
2*	Ball w/ attenuator
3	Seal Protector Ring
4*	Taper Key
6*	Drive Shaft
6*	Drive Shaft w/ attenuator
7*	Groove Pin
9*	Follower Shaft
9*	Follower Shaft w/ attenuator
10*	Bearing (2 req'd)
11*	Ball Seal
12*	Shim Seal (12 req'd) Use w/flat metal seal only
13*	Spring Seal Use w/ flat metal seal only
13*	Wave Spring use w/ HD Metal Seal only
14	Backup Ring (Composition seal only)

Key	Description
15*	Gasket
16*	Packing Set
17	Packing Follower w/integral flange
17	Packing Follower w/o integral flange
19	Packing Follower Stud
20	Packing Follower Nut
21	Seal Protector Screw
22	Seal Protector Clip
23	Actuator Mounting Screw
24	Actuator Mounting Nut
25	Pipe Plug (Optional) (not shown)
26	Identification Nameplate
27	Drive Screw
28	Flow Arrow
30	Nameplate
31	Nameplate Wire (not shown)
32	Line Flange Stud
33	Line Flange Stud
34	Spacer
35*	Packing Ring (4 req'd)
36*	Packing Washer
37*	Radial Seal Use w/HD Metal Seal
39*	Packing Box Ring
40	Packing Flange
41	Retaining Ring
48*	Ball-Shaft Assembly
64	Cavitrol Hex
65	Gasket
130	Clamp
131	Bonding Strap Assembly

### ENVIRO-SEAL Packing System (Parts in all Type Vee-Ball Valves) (figure 5)

Key	Description
100	Packing Flange Stud
101	Packing Flange Nut
102	Packing Flange
103	Spring Pack Assembly
105*	Packing Set
106*	Anti-Extrusion Ring (2 req'd)
107*	Packing Box Ring
108*	Packing Ring (2 req'd)
109*	Anti-Extrusion Ring (2 req'd)
110	Lantern Ring
111	Tag
112	Tie Cable
113	Lubricant, anti-seize (not furnished with packing system)

## Appendix A Instructions for Non-Series B

The Series B changes affected only the NPS 3 through 12 valves without attenuators. To determine if a Vee-Ball valve is Series B, you will need to examine several of the internal parts. Compare the distinctive skirted V-notch outline of the forward side and the circular edge on the reverse side of the Series B design ball to the V-notch on both sides of the non-series B design ball. Then look for bushings. The lack of bushings indicates the valve body is Series B.

All Vee-Ball valves NPS 3 through 12 produced before the Series B design changes use the Specifications table, the Installation, Maintenance, Packing Maintenance, Replacing Packing, and Replacing the Ball Seal instructions found elsewhere in this manual. Bearing and Vee-Ball Maintenance and Actuator Mounting instructions for these valves may be found below.

## Maintenance

### **⚠ WARNING**

The Vee-ball closes with a shearing, cutting motion, which could result in personal injury. To avoid injury, keep hands, tools, and other objects away from the Vee-ball while stroking the valve.

Avoid personal injury from sudden release of process pressure. Before performing any maintenance operations:

- Do not remove the actuator from the valve while the valve is still pressurized.
- Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.
- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.
- Vent the power actuator loading pressure and relieve any actuator spring precompression.
- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.
- Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury.
- The valve packing area may contain process fluids that are pressurized, *even when the valve has been removed from the pipeline*. Process fluids may spray out under pressure when removing the packing hardware or packing rings.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

Procedures for disassembly and assembly of the bearings and ball cannot be accomplished until the ball seal and valve packing are removed from the valve.

1. Refer to the Replacing Packing procedures to remove the actuator, and to remove the packing flange and packing follower from the valve. When the packing disassembly steps are complete, return to this section.
2. Refer to the Replacing the Ball Seal procedures to remove the ball seal from the valve.

## Disassembly

### **⚠ WARNING**

When the actuator is removed from the valve, the ball/shaft assembly may suddenly rotate, with a shearing, cutting motion, which could result in personal injury. To avoid injury, carefully rotate the ball to a stable position. Make sure the ball will not rotate.

Key numbers in this procedure are shown in figures 24, 26, and 32, unless otherwise indicated. A taper key (key 4, figure 14) is used in NPS 3 through 12 Non-Series B valves.

3. Carefully rotate the ball to the open position after the actuator is disconnected. Make sure the ball will not rotate (see warning above). Provide support for the ball during the following disassembly.
4. Unscrew the pipe plug (key 25). (With newer valve constructions, the pipe plug is optional and may not be available.)
5. Working from the small end of the groove pin (key 7), use a pin punch to drive the groove pin out of the ball ear and follower shaft.

For tack welded taper keys, driving the taper key out of the ball ear will shear the tack welding.

6. Locate the small end of the taper key (key 4, see figure 14). Using a pin punch on the smaller end of the taper key, drive it out of the ball (key 2) and drive shaft (key 6). Note: driving the taper key in the wrong direction will tighten it.
7. Pull the drive shaft (key 6) out of the actuator side of the valve body.
8. Make sure the sealing surface of the ball is not damaged while removing the follower shaft.
  - a. If a pipe plug (key 25) is installed, use a punch to drive the follower shaft (key 9) into the center of the ball.
  - b. If a pipe plug is not installed, use a piece of continuous threaded rod as a removal rod when moving the follower shaft (key 9) into the center of the V-notch ball. Refer to the table 8 for a description of the size threaded rod needed. The length of the rod should allow easy working room from the valve body.
9. Remove the ball (key 2) by carefully removing the follower shaft and ball from the valve body.
10. Remove the packing box spacer (key 34) for NPS 8, 10, and 12 valves.
11. Removing the bearings (key 10):
  - a. For composition bearings, remove the bearings by hand. If the bearings are tight in the valve body, then pull or drive them out with a slight pressure. Allow the bushings (key 5 or 8) to remain in the valve body.

Table 8. Continuous Threaded Rod

Valve Size, NPS	Threaded Rod Thread Size	Thread Depth in Follower Shaft
3	1/4-20	0.5
4	1/4-20	0.5
6	1/4-20	0.5
8	5/16-18	0.62
10	5/16-18	0.62
12	5/16-18	0.94

- b. For metal bearings, use a press and ram to remove the drive shaft bearings out of the valve body. Refer to figures 30 and 31 ram dimensions. The bushings (key 5 or 8) will normally remain in the valve body.

To remove the follower shaft bearings, use a blind-hole bearing puller. If you do not have such a tool, you can machine the bearing out.

---

#### Note

For proper shutoff performance, the ball and seal require the bearing (key 10) to be positioned correctly. If you removed the bearings (key 10), be sure to locate the new bearings as shown in figures 30 and 31.

---

12. Thoroughly clean surfaces of all parts that are to be re-used or obtain replacement parts.

## Assembly

1. Inspect all sealing surfaces to ensure they are in good condition and without scratches or wear.
2. Installing bearings (key 10):
  - a. For composition bearings, install the bearings by hand. The bearing flanged end should touch the bushing (key 5 or 8).
  - b. For metal bearings:
    - Use a press and ram to install the bearings (key 10). Refer to figures 30 and 31.
    - Press the bearings in until each bearing is flush with the bushing (key 5 or 8). The acceptable tolerance for bearing location is: flush with the bushing to 1.52 mm (0.060 inches) inside the bushing. That is, the bearings should not protrude into the flow cavity of the valve, and they should not be more than 1.52 mm (0.060 inches) inside the bushing.
    - Take care not to change the position of the bushings (key 5 or 8) when pressing in new bearings (key 10), otherwise the ball will not center in the valve body and seal.
3. Installing the Vee-Ball (key 2):

### **⚠ WARNING**

**The Vee-Ball might be damaged if it is allowed to fall into the valve body. To avoid personal injury or damage to the sealing surfaces, support the ball to prevent it from falling into or out of the valve body cavity.**

#### **Note**

For ease of assembly, the follower shaft (key 9) should be inserted into the ball before installing the ball in an NPS 3 valve without ball/attenuator.

Carefully install the ball into the valve body cavity.

After you have installed the ball (key 2) into the valve body assembly, firmly support the ball while installing the shafts.

#### 4. Installing the follower shaft (key 9):

- For NPS 3 valves: The follower shaft (key 9) should already have been inserted into the ball before the ball was put into the valve body. Insert the follower shaft (key 9) into the valve body bearing (key 10).
- For NPS 4 and larger valves without attenuator: Insert the follower shaft (key 9) through the ball, and into the valve body bearing (key 10).

Then for all sizes, align the hole in the follower shaft with the holes in the ball. Insert the small end of the groove pin (key 7) into the hole in the ball and into the follower shaft. The pin will hold the parts in place while the drive shaft (key 6) is being installed.

5. Insert the drive shaft (key 6) into the valve body bearing (key 10), and into the ball ear. Align the hole in the drive shaft with the holes in the ball.

### **CAUTION**

**The drive shaft must be used with the correct Vee-Ball. Refer to the tag (see figure 13) attached to the Vee-Ball and to the drive shaft.**

**Failure to use the correct Vee-Ball/ shaft combination may result in the ball not being in the position indicated by the slash mark on the end of the shaft. If the ball is not properly aligned with the slash mark, the valve will not function correctly and seal damage may result.**

#### 6. Installing the Taper Key (key 4):

Current standard construction materials for all NPS 3 through 12 valves require the taper key (key 4, figure 14) to be tack welded in place using the following procedure. Use standard welding preparations when preparing parts for reassembly.

### CAUTION

**Make sure the drive shaft (key 6) is free of oil or grease, otherwise the taper key will not seat properly. Failure to properly set the taper pin or taper key could result in it coming loose while in service. Loosening of the taper key in service could result in improper valve function and equipment damage.**

1. Install the drive shaft (key 6) into the valve body through the ball and into the lower bearing.
2. Insert the taper key (key 4) into ball and drive shaft (keys 2 and 6) as shown in figure 14. The taper key inserts, with the flat side of the key, facing the drive shaft (key 6).
3. Using a flat end punch, drive the groove pin (key 7) into the ball ear and follower shaft until it is flat with the ball ear surface.
4. Using a flat end punch, drive the taper key (key 4) into the ball ear and drive shaft (key 6) until solid, heavy contact is obtained between the key and shaft.
5. Measure the position of the taper key head.
6. Drive the taper key in further using the minimum distance shown in table 8.

Table 9. Taper Key Minimum Depth

VALVE SIZE, NPS	MINIMUM DEPTH TO DRIVE TAPER KEY AFTER INITIAL SOLID CONTACT, mm (INCHES)
3, 4, 6	4.8 (0.188)
8, 10, 12	5.6 (0.219)

Table 10. Taper Key Maximum Depth

VALVE SIZE, NPS	MAXIMUM DEPTH TO DRIVE TAPER KEY AFTER INITIAL SOLID CONTACT, mm (INCHES)
3, 4	7.1 (0.281)
6	7.9 (0.312)
8, 10	9.5 (0.375)
12	10.3 (0.406)

7. Inspect the ball/shaft taper key connection to verify that the taper key spans the entire shaft flat width. If not, the taper key must be driven in further until this condition is satisfied. However, do not exceed the maximum depths shown in table 9.

#### Note

When welding standard valves that have a CG8M (317 SST) or CF3M (316L SST) ball, use 309 or 309L filler rod material.

Alloy valve taper keys are normally not welded.

8. When the above conditions are met, tack weld the taper key (key 4) to the ball ear on the head end of the key (see figure 26). Use a:
  - 1/8 inch diameter weld on NPS 3 through 6 valves,



- 3/16 inch diameter weld on NPS 8 through 10 valves, and
- 1/4 inch diameter weld on NPS 12 valves.

For all constructions: Refer to Replacing the Ball Seal, Packing Maintenance, and other procedures as necessary to complete the assembly of the valve.

## Actuator Mounting

Use the appropriate actuator instruction manual and figure 23 of this manual when mounting the actuator or changing actuator styles and positions.

To help ensure correct centering of the ball (key 2) on the seal (key 11), be sure the ball is closed when mounting the actuator. Do not use a hammer or other tool to drive the actuator lever onto the valve shaft.

Clean the valve shaft and actuator lever splines to be sure the actuator lever will slide on easily. If the lever does not slide on easily, carefully wedge the ball solidly against the actuator-side bearing using a screwdriver or similar tool inserted between the lower ear of the ball and the valve body.

Keep the wedge in place while installing the lever, but again, do not drive on the lever. Remove the wedge after you have clamped the actuator lever on the valve shaft and connected the lever to the actuator piston rod or diaphragm rod.

## Determining Mounting Position

The actuator can be either right or left-hand mounted.

---

### Note

Right-hand mounting—Actuator is on the right side of the valve when viewed from valve inlet.

Left-hand mounting—Actuator is on the left side of the valve when viewed from valve inlet.

---

The preferred location of the ball is in the top of the valve body when the valve is open. To convert from right to left hand-mounting, turn the valve to position the actuator mounting pad on the left and rotate the ball to the top of the valve.

The number one V-notch controls flow on right-hand mounting. Turn the valve 180 degrees, and rotate the ball to the top of the valve to obtain left-hand mounting. The number two V-notch controls flow for this construction. See figure 33.

## Determining Closed Position

1. The valve must be removed from the line to check the position of the ball.

### **⚠ WARNING**

**The ball closes with a shearing, cutting motion. To avoid personal injury, keep hands, tools, and other objects away from the ball while stroking the valve.**

---

2. Rotate the ball to the closed position.
3. Follow one of the procedures below:
  - When viewed from the valve body inlet, the ball is in the proper position when both V-notches of the ball are centered between the machined diameter of the ledge that supports the seal.
  - If the ball has a spot machined on the top, align that spot to the exact center of the seal cavity.
4. Adjust the actuator linkage as described in the appropriate actuator instruction manual until the condition described in step 3 exists. A line is stamped on the actuator end of the drive shaft (see figure 23) to indicate the ball position.

### **⚠ WARNING**

**Use only genuine Fisher replacement parts. Components that are not supplied by Emerson Automation Solutions should not, under any circumstances, be used in any Fisher valve, because they will void your warranty, might adversely affect the performance of the valve, and could give rise to personal injury and property damage.**

## Non-Series B Design Parts (figure 32)

### **Note**

Contact your [Emerson sales office](#) or Local Business Partner for Part Ordering information.

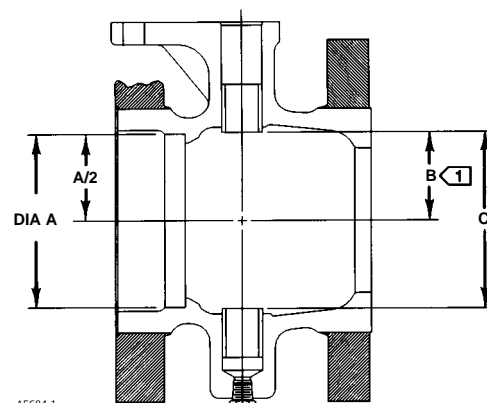
Key	Description
2	Ball
2	Ball with attenuator (RH mtg in Common parts section)
6	Drive Shaft
9	Follower Shaft
10*	Bearing (2 req'd)

VALVE SIZE, NPS	BEARING RAM DIMENSIONS								BUSHING RAM DIMENSIONS					
	Ram Lengths				Ram Diameters				Ram Diameters					
	L		M		D		d		D		Long Ram d		Short Ram d	
	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches
3 & 4	201.42 MIN	7.930 MIN <sup>(1)</sup>	95.25 MIN	3.750 MIN	22.86 22.61	0.900 0.890	19.05 18.80	0.750 0.740	28.19 27.94	1.110 1.100	19.05 18.80	0.750 0.740	22.86 22.61	0.900 0.890
6	247.65 MIN	9.750 MIN	95.25 MIN	3.750 MIN	29.21 28.96	1.150 1.140	25.40 25.15	1.000 0.990	34.54 34.29	1.360 1.350	25.40 25.15	1.000 0.990	29.21 28.96	1.150 1.140
8	338.75 MIN	13.310 MIN	139.70 MIN	5.500 MIN	35.56 35.31	1.400 1.390	31.75 31.50	1.250 1.240	40.89 40.64	1.610 1.600	31.75 31.50	1.250 1.240	35.56 35.31	1.400 1.390
10	396.75 MIN	15.620 MIN	139.70 MIN	5.500 MIN	35.56 35.31	1.400 1.390	31.75 31.50	1.250 1.240	40.89 40.64	1.610 1.600	31.75 31.50	1.250 1.240	35.56 35.31	1.400 1.390
12	476.25 MIN	18.750 MIN	152.40 MIN	6.000 MIN	41.91 41.66	1.650 1.640	38.10 37.85	1.500 1.490	50.42 50.17	1.985 1.975	38.10 37.85	1.500 1.490	41.91 41.66	1.650 1.640

1. MIN = Minimum.

VALVE SIZE, NPS	DIMENSION			
	B	C	B	C
	Millimeters		Inches	
3	48.26	100.38	1.960	3.952
	50.04	100.63	1.970	3.962
4	60.10	121.01	2.366	4.764
	60.35	121.26	2.376	4.774
6	83.59	168.00	3.291	6.614
	83.85	168.25	3.301	6.624
8	106.20	213.21	4.181	8.394
	106.45	213.46	4.191	8.404
10	135.33	271.48	5.328	10.688
	135.59	271.73	5.338	10.698
12	169.67	340.16	6.680	13.392
	169.93	340.41	6.690	13.402

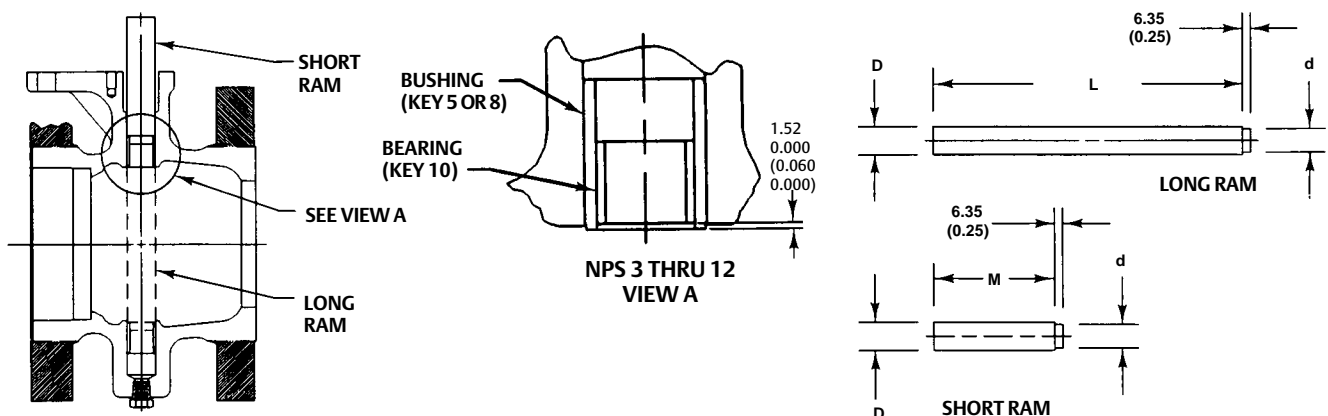
Figure 30. Bushing Location



A5684-1

BUSHING (KEY 5) LOCATION

Figure 31. Metal Bearing Ram Location



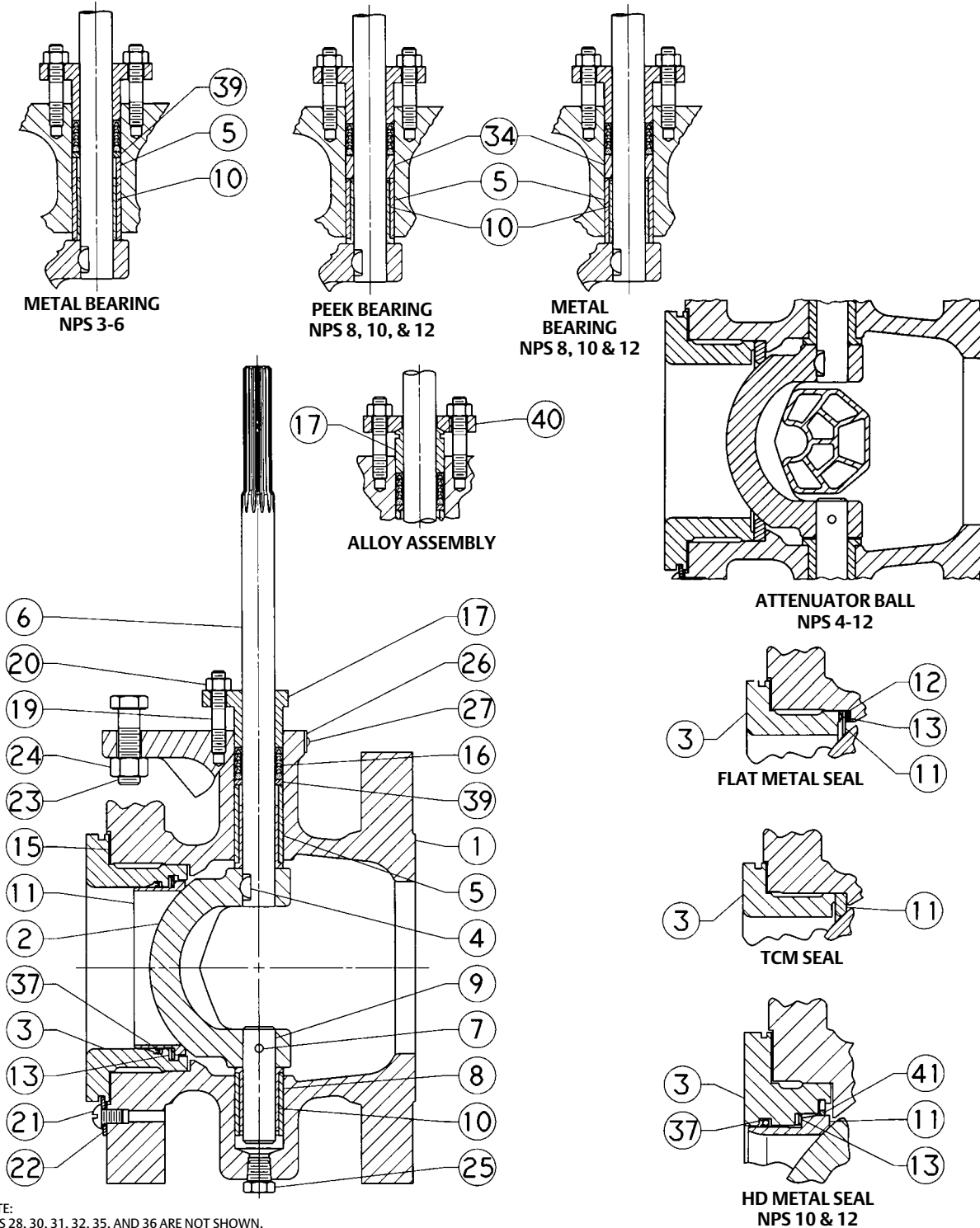
A5683-2

NOTES:  
 [1] DIMENSION B IS THE DISTANCE BETWEEN THE GUIDE BUSHING AND THE CENTER OF DIAMETER A.

BEARING RAM

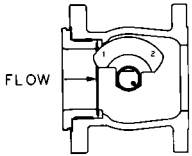
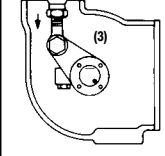
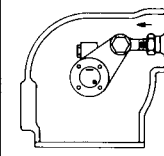
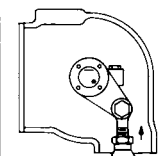
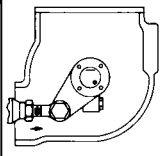
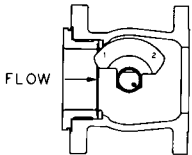
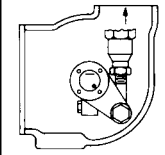
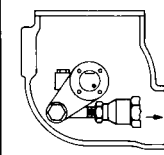
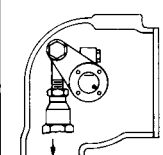
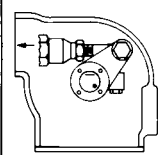
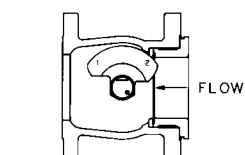
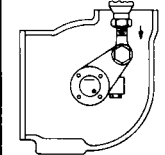
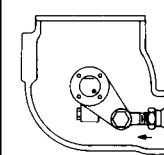
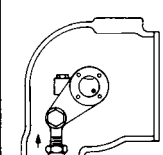
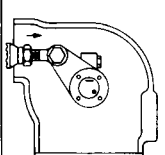
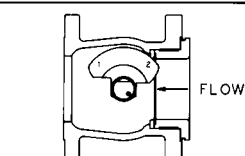
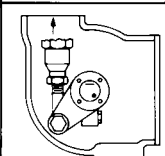
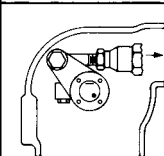
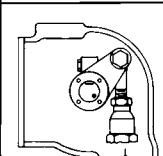
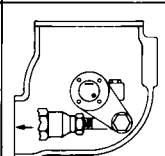
mm  
(INCHES)

Figure 32. Fisher V150 and V300 Non-Series B Valve Assembly (NPS 3-12)  
 (Details are typical for V200 Valves except V200 does not have flanges)



42B4652-C

**Figure 33. Index Marks for Actuator Lever Orientation for Non-Series B Valves**

ACTUATOR		VALVE OPEN	ACTUATOR POSITION			
MOUNTING	STYLE		1	2	3	4
RIGHT-HAND <sup>(1)</sup>	STYLE A (PDTC) <sup>(2)</sup>					
	STYLE B (PDTO) <sup>(2)</sup>					
LEFT-HAND <sup>(1)</sup>	STYLE C (PDTC) <sup>(2)</sup>					
	STYLE D (PDTO) <sup>(2)</sup>					

1. Right-hand mounting controls with v notch no. 1; Left-hand mounting controls with v notch no. 2  
 2. PDTC-push down to close; PDTO-push down to open  
 3. Arrow on lever indicates direction of actuator thrust to close valve

B2703





**Neither Emerson, Emerson Automation Solutions, nor any of their affiliated entities assumes responsibility for the selection, use or maintenance of any product. Responsibility for proper selection, use, and maintenance of any product remains solely with the purchaser and end user.**

Fisher, ENVIRO-SEAL, Vee-Ball, Cavitol, and FIELDVUE are marks owned by one of the companies in the Emerson Automation Solutions business unit of Emerson Electric Co. Emerson Automation Solutions, Emerson, and the Emerson logo are trademarks and service marks of Emerson Electric Co. All other marks are the property of their respective owners.

The contents of this publication are presented for informational purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available upon request. We reserve the right to modify or improve the designs or specifications of such products at any time without notice.

**Emerson Automation Solutions**  
Marshalltown, Iowa 50158 USA  
Sorocaba, 18087 Brazil  
Cernay, 68700 France  
Dubai, United Arab Emirates  
Singapore 128461 Singapore

[www.Fisher.com](http://www.Fisher.com)

