FLOWSERVE

USER INSTRUCTIONS

Installation
Operation
Maintenance Instructions

Flowserve Valtek®
Mark 10 Survivor Control Valves

Experience In Motion

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1 General Information

1.1 Usage

The following instructions are designed to assist in unpacking, installing and performing maintenance as required on Flowserve products. Product users and maintenance personnel should thoroughly review these Installation, Operation and Maintenance (IOM) instructions prior to unpacking, installing, operating, or performing any maintenance. In most cases, Flowserve valves, actuators and accessories are designed for specific applications (e.g. with regard to medium, pressure, and temperature). For this reason, they should not be used in other applications without first contacting the manufacturer. The product IOM instructions provide important additional safety information.

1.2 Applicability

The following instructions are applicable to the maintenance and installation of Mark 10 Survivor control valves. These instructions cannot claim to cover all details of all possible product variations, nor can they provide information for every possible example of installation, operation or maintenance. This means that the instructions normally include only the directions to be followed by qualified personnel where the product is being used for its defined purpose. If there are any uncertainties in this respect, particularly in the event of missing product-related information, clarification must be obtained via the appropriate Flowserve sales office. All Flowserve User Manuals are available at www.flowserve.com.

1.3 Terms Concerning Safety

1.3.1 The safety terms **DANGER, WARNING, CAUTION** and **NOTE** are used in these instructions to highlight particular dangers and/or to provide additional information on aspects that may not be readily apparent.

DANGER: Indicates that death, severe personal injury and/or substantial property damage will occur if proper precautions are not taken.

WARNING: Indicates that death, severe personal injury and/or substantial property damage can occur if proper precautions are not taken.

CAUTION: Indicates that minor personal injury and/or property damage can occur if proper precautions are not taken.

NOTE: Indicates and provides additional technical information, which may not be obvious even to qualified personnel.

1.3.2 Compliance with other notes, which may not be particularly emphasized, with regard to transport, assembly, operation and maintenance and with regard to technical documentation (e.g. in the operating instructions, product documentation or on the product itself) is essential, in order to avoid faults, which can directly or indirectly cause severe personal injury or property damage.

1.4 Protective Clothing

DANGER: Flowserve products are often used in problematic applications (e.g. under extremely high pressures with dangerous, toxic or corrosive mediums). When performing service, inspection or repair operations, always ensure that the valve and actuator are depressurized and that the valve has been cleaned and is free from harmful substances. In such cases, pay particular attention to personal protection (e.g. protective clothing, gloves, glasses, etc.).

1.5 Qualified Personnel

Qualified personnel are people who, on account of their training, experience and instruction and their knowledge of relevant standards, specifications, accident prevention regulations and operating conditions, have been authorized by those responsible for the safety of the plant to perform the necessary work and who can recognize and avoid possible dangers. Contact your local Flowserve representative for a schedule of training schools.

1.6 Spare Parts

Use only Flowserve original spare parts. Flowserve cannot accept responsibility for any damages that occur from using spare parts or fastening materials from other manufacturers. If Flowserve products (especially sealing materials) have been on store for long periods of time, check them for corrosion, contamination, or deterioration before putting them into use.

1.7 Service / Repair

To avoid possible injury to personnel or damage to products, safety terms must be strictly adhered to. Modifying this product, substituting non-factory parts, or using maintenance procedures other than those outlined in these Installation, Operation, and Maintenance Instructions could drastically affect performance, be hazardous to personnel and equipment, and may void existing warranties.

Apart from the operating instructions and the obligatory accident prevention directives valid in the country of use, all recognized regulations for safety and good engineering practices must be followed.

● ***WARNING: Before products are returned to Flowserve for repair or service, Flowserve must be provided with Safety Data Sheets (SDSs) for all fluids that have flowed through the valve, and a certificate that confirms that the product has been decontaminated and is clean. Flowserve will not accept deliveries without the SDSs and a decontamination certificate. Return authorization is also required before parts are returned. Contact your local Flowserve representative to obtain return authorization.***

1.8 Storage

In many cases, Flowserve products are manufactured from stainless steel. Products not manufactured from stainless steel are provided with an epoxy resin coating. This means that Flowserve products are well protected from corrosion. Nevertheless, Flowserve products must be stored adequately in a clean, dry environment. Plastic caps or plywood protectors are fitted to help protect the flange faces and prevent the ingress of foreign materials. These caps should not be removed until the valve is mounted into the system.

2 Unpacking

2.1

While unpacking the valve, check the packing list against the materials received. Lists describing the valve and accessories are included in each shipping container.

! **NOTE:** The following instructions are intended for Survivor valves with Valtek actuators. If the actuator is not part of the Valtek product line, refer to the actuator manufacturer's IOM for lifting instructions.

2.2

When lifting the valve from the shipping container, use straps through the yoke legs, or the lifting lugs or hoist rings attached to the bonnet flange for valves over four inch, or the adjusting screw for valves four inch and under. Take care to position lifting straps to avoid damage to the tubing, mounted accessories or stroke plate.
See document FCAIMO105 for more details on control valve unpacking and lifting.

● ***WARNING: When lifting a valve, be aware that the center of gravity may be above the lifting point. Therefore, support must be given to prevent the valve from rotating. Failure to do so can cause serious injury to personnel and damage to the valve and nearby equipment.***

! **NOTE:** Most Survivor valve assemblies include a lower housing or seat extension located at the valve outlet that is held to the valve body with seat bolting, see Figure 1. The purpose of these bolts is to hold the assembly together during transport and while the valve outlet flange is being connected to the pipe flange. Note that there will be a small gap between the valve outlet flange and the lower housing until the valve outlet flange is bolted to the downstream flange. The seat bolting should not be removed during valve installation.

● ***WARNING: The lower housing/extension should not be used to support the valve weight. DO NOT strap around the lower housing/extension as the seat bolting is not strong enough to support such loads.***

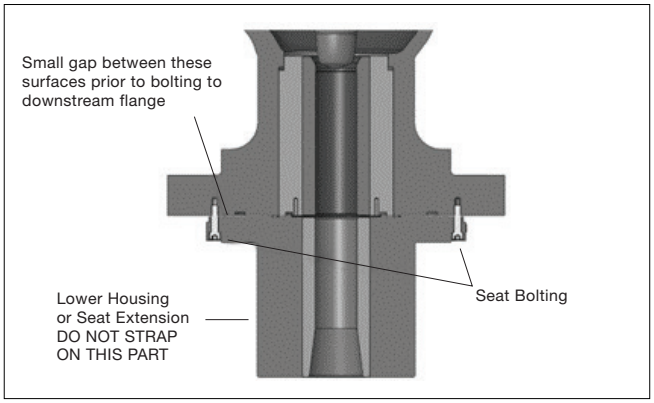

Figure 1 Example of seat bolting that holds the lower housing or seat ring to the valve body

2.3

Contact your shipper immediately if there is shipping damage.

2.4

Should any problem arise, call your Flowserve representative.

3 Installation

DANGER: Before installation, check the purchase order number, serial number, and/or the tag number to ensure that the valve and actuator being installed are correct for the intended application.

WARNING: The maximum air supply for most Valtek cylinder actuators is 150 psi (10.3 bar). In some cases, the air supply must be limited to less than 150 psi (10.3 bar). This is indicated on a sticker found near the upper air port on the actuator cylinder. An air regulator should be installed to ensure the supply pressure does not exceed the actuator design pressure indicated on the sticker.

CAUTION: Do not insulate extensions that are provided for hot or cold services.

NOTE: Selecting the proper fastener material is the responsibility of the customer. Flowserve typically does not have complete pertinent information regarding service conditions and environment. The customer therefore must consider the material's resistance to stress corrosion cracking, galvanic corrosion, and general corrosion. As with any mechanical equipment, periodic inspection and maintenance is required. For more information about fastener materials, contact your Flowserve representative.

3.1

Pipelines must be correctly aligned to ensure that the valve is not fitted under improper loading.

3.2

Fire protection, where applicable, must be provided by the user.

3.3

Before installing the valve, clean the line of dirt, welding chips, scale and other foreign material.

3.4

Check the flow direction to be sure the valve is installed correctly. Flow direction for the Survivor is always over the plug for both fail-closed and fail-open valves and is indicated by an arrow on the bonnet flange.

3.5

Whenever possible, the valve should be installed in an upright position. Vertical installation permits easier valve maintenance. Contact factory for any valve requiring horizontal mounting.

3.6

Be sure to provide proper overhead clearance for the actuator to allow for disassembly of the plug from the valve body. Refer to the appropriate actuator User Instructions for proper clearances. Actuator User Instructions are available at www.flowserve.com.

NOTE: It is critical that valves with ceramic or tungsten carbide trim maintain the proper gap between the plug and seat (or slight contact for ANSI Class IV shutoff valves) per their specific designs. The valve is shipped from the Flowserve factory with the plug and actuator set properly. If any adjustments are made to the valve that would affect this, after it has shipped from the factory, the plug and actuator settings must be re-set to ensure proper function and prevent valve damage. See Section 8 for plug/seat adjustment procedures.

NOTE: Most Survivor valve assemblies include a lower seat housing or seat extension located at the valve outlet that is held to the valve body with seat bolting, see Figure 1. The purpose of these bolts is to hold the assembly together during transport and while the valve outlet flange is being connected to the pipe flange. The seat bolts are not intended to compress the seat gaskets so there will be a small gap between the valve outlet flange and the lower housing until the valve outlet flange is bolted to the downstream flange. The seat bolting should not be removed during valve installation.

WARNING: The lower housing/extension should not be used to support the valve weight. DO NOT strap around the lower housing/extension as the seat bolting is not strong enough to support such loads.

3.7

Check that the seat bolts are hand tight. These bolts are not intended to compress the gaskets in the valve assembly, but they should be tight enough to prevent the seat ring(s) from moving while handling the valve.

CAUTION: If the seat bolts are loose, they may cause damage to the valve and/or the downstream pipe flange. Loose seat bolts may also prevent proper gasket compression and prevent proper valve shutoff.

3.8

Lower the valve assembly onto the mating downstream pipe flange. Install the bolting to connect the valve outlet flange to the downstream pipe flange, finger tight.

3.9

Torque line bolting per ASME PCC-1 Appendix F or equivalent plant standard. After the line bolting has been fully torqued, the small gap shown in Figure 1 should no longer exist. If the gap still exists, verify that the gasket between the valve body and lower housing/seat extension is located properly and that the proper line bolting torque is applied.

! **NOTE:** It is critical to follow the bolting procedure in ASME PCC-1 Appendix F, or equivalent plant standard, when connecting the valve outlet flange to the mating downstream flange. As the bolting is torqued, gaskets inside the valve will compress. Proper gasket compression and plug to seat alignment are important for proper sealing and to accurately control the gap between the plug and seat.

⬢ ***WARNING: Keep hands, hair and clothing away from all moving parts when operating the valve. Failure to do so can cause serious injury.***

3.10

Connect the air supply and instrument signal lines. Throttling control valves are equipped with a valve positioner. Refer to the appropriate positioner bulletin for connections, maximum air supplies, and maintenance instructions. An air filter should be installed before the positioner. All connections must be free of leaks.

! **NOTE:** Thread sealant paste should be used for all pneumatic fittings. PTFE tape should not be used.

⚠ ***CAUTION: On valves equipped with air filters, the air filter must be installed per manufacturer orientation requirements.***

4 Quick-Check

Prior to start-up, check the control valve by following these steps:

4.1

Stroke the valve and observe the plug position indicator on the stem clamp compared to the stroke indicator plate. The plug should change position in a smooth, linear fashion.

⬢ ***WARNING: Keep hands, hair and clothing away from all moving parts when operating the valve. Failure to do so can cause serious injury.***

4.2

Check for full stroke by making appropriate instrument signal changes.

4.3

Check all air connections for leaks.

4.4

Check packing box bolting for correct adjustment. Refer to the packing layout and bill of materials provided with the valve to determine packing style (e.g. SureGuard XT, SafeGuard, etc). Then refer to the Standard and Environmental Packing Systems Technical Bulletin FCD VLENTB0040 (latest revision) for specific details on maintaining the style of packing supplied, including torque requirements for gland flange bolting. Note that Survivor valves typically have custom packing configurations that don't exactly match the configurations shown in FCD VLENTB0040 so it is critical to refer to the packing layout provided with the valve for the specific packing configuration.

⚠ ***CAUTION: Do not overtighten packing. This can cause excessive packing wear, high stem friction that may impede plug movement and can damage the packing. Over-tightening packing will lead to packing damage and will decrease the life of the packing and valve performance. Damaged packing should be replaced.***

4.5

Make sure the valve fails in the correct direction in case of air failure. This is done by turning off the air supply, allowing the air to vent, and observing the failure direction.

4.6

After process temperature excursion has occurred, bonnet flange bolting should be retightened to ensure bonnet gaskets do not leak. See Table 1 for flange bolting torque values.

Bolt Size (in,)	Flange Bolting Torque per Bolt Material							
	A193-B7; A193-B16 A320-L7 (lubricated)		A193-B7M A320-L7M (lubricated)		A193-B8 Cl 1 A193-B8M Cl 1 (lubricated)		A193-B8 Cl 2 (lubricated)	
	Ft-lb	N-m	Ft-lb	N-m	Ft-lb	N-m	Ft-lb	N-m
5/8-11UNC	80 ± 8	110 ± 11	70 ± 7	90 ± 9	60 ± 6	80 ± 8	80 ± 8	110 ± 11
3/4-10UNC	150 ± 15	200 ± 20	120 ± 12	160 ± 16	110 ± 11	150 ± 15	150 ± 15	200 ± 20
7/8-9UNC	240 ± 24	320 ± 32	190 ± 19	260 ± 26	180 ± 18	240 ± 24	190 ± 19	260 ± 26
1-8UNC	350 ± 35	480 ± 48	280 ± 28	380 ± 38	270 ± 27	360 ± 36	280 ± 28	380 ± 38
1 1/8-8UN	520 ± 52	710 ± 71	420 ± 42	570 ± 57	390 ± 39	530 ± 53	390 ± 39	530 ± 53
1 1/4-8UN	740 ± 74	1010 ± 101	590 ± 59	800 ± 80	560 ± 56	760 ± 76	560 ± 56	760 ± 76
1 3/8-8UN	1010 ± 101	1370 ± 137	810 ± 81	1100 ± 110	760 ± 76	1030 ± 103	760 ± 76	1030 ± 103
1 1/2-8UN	1340 ± 134	1820 ± 182	1070 ± 107	1450 ± 145	1010 ± 101	1370 ± 137	1010 ± 101	1370 ± 137

Table 1 Bonnet Flange Bolting Required Torque Values

5 Valve Maintenance

At least once every six months, check for proper operation by following the preventative maintenance steps outlined below. These steps can be performed while the valve is in-line and, in some cases, without interrupting service. If an internal problem is suspected, refer to Valve Disassembly and Inspection.

5.1

Look for signs of gasket leakage through the end flanges and bonnet. Re-torque flange and bonnet bolting (if required). Refer to Table 1 for bonnet bolt torque values.

5.2

Examine the valve for damage caused by corrosive fumes or process drippings.

5.3

Clean valve and repaint areas of severe oxidation.

5.4

Check gland flange bolting for proper tightness and packing leakage. If packing leakage is noticed, packing maintenance is required. Refer to the packing layout provided with the valve to determine packing style (e.g. SureGuard XT, SafeGuard, etc.). Then refer to the Standard and Environmental Packing Systems Technical Bulletin FCD VLENTB0040 (latest revision) for specific details on maintaining the style of packing supplied, including torque requirements for gland flange bolting. Note that Survivor valves typically have custom packing configurations that don't exactly match the configurations shown in FCD VLENTB0040 so it is critical to refer to the packing layout provided with the valve for the specific packing configuration.

! **NOTE:** Survivor valves are often used in critical services where solids in the process fluids are expected. To maximize the service intervals, it is recommended that all packing be replaced whenever the valve is opened for maintenance.

⚠ ***CAUTION: Do not overtighten packing. This can cause excessive packing wear and high stem friction that may impede stem movement. Packing that is tightened too tight will typically not seal correctly.***

5.5

If the valve is supplied with a lubricator port in the bonnet, check lubricant supply and add lubricant if necessary. See Table 2 for suggested lubricants.

5.6

If possible, stroke the valve and check for smooth, full-stroke operation. Unsteady stem movement could indicate an internal valve problem.

! **NOTE:** Due to excessive friction, a dry graphite packing can cause the plug stem to move in a jerky fashion. Lubrication of graphite packing will provide smoother stroking. Lubrication can be done by using a bonnet lubricator or by liberally coating each packing ring by hand during installation. Refer to Table 2 for lists of common lubricants.

● ***WARNING: Keep hands, hair and clothing, away from all moving parts when operating the valve. Failure to do so can cause serious injury.***

5.7

Make sure positioner linkage and stem clamp are securely fastened. Tighten if they have become loose. See Table 3 and Table 4 for torque values based on bolt/screw size and material. Refer to bill of materials for bolt/screw size and material information.

! **NOTE:** Refer to the appropriate User Manuals when adjusting positioners and providing maintenance to actuators. Current User Manuals are available at www.flowserve.com.

5.8

Verify that the takeoff arm and follower arm are not binding at either end of the stroke. The follower arm attached to the positioner should be free to move slightly when the valve is at both ends of the stroke.

5.9

Ensure all accessories, brackets and bolting are securely fastened. See Table 3 and Table 4 for torque values based on bolt/screw size and material. Refer to bill of materials for bolt/screw size and material information.

5.10

If possible, remove air supply and observe actuator for correct fail-safe action.

5.11

Check rubber actuator bellows for splits, cuts or wear and replace if damage is found.

5.12

Spray a soap solution around the actuator cylinder retaining ring and actuator stem guide to check for air leaks through the o-rings.

5.13

Clean any dirt and other foreign material from the plug stem.

5.14

If an air filter is supplied, check and replace cartridge if necessary. Drain any moisture accumulated in the air filter.

Lubricant	Manufacturer	Temperature		Description/ Applications
		°F	°C	
Krytox®	E.I. DuPont	-5 to 550	-20 to 285	Fluoronated general purpose grease; handles common liquids and gases; good lubricity in harsh mediums; nonflamable, chemically inert; will not harm plastic or metal parts
GP 460	Acheson Colloids Company	32 to 1000	0 to 540	Graphite in petrolatum; high pressure; anti-galling; graphite remains above 600ºF/316ºC

Table 2 Common Packing Lubricants

Machine Screw Size	Accessory Bolting Torque by Bolt Material			
	B18.6.3 unhardened (dry)		18-8 stainless (dry)	
	In-lb	N-cm	In-lb	N-cm
#4-40UNC	5.4	60	3.8	43
#4-48UNF	5.9	66	4.1	47
#6-32UNC	9.9	112	7.0	79
#6-40UNF	11	125	7.8	89
#8-32UNC	18	206	13	145
#8-36UNF	19	212	13	150
#10-24UNC	26	298	19	211
#10-32UNF	30	340	21	240
#12-24UNC	41	467	29	330
#12-28UNF	44	499	31	352

Table 3 Accessory bolting torque based on bolt material, for machine screws

Bolt Size (in.)	Accessory Bolting Torque by Bolt Material							
	SAE J429 Gr. 2 (lubricated)		SAE J429 Gr. 5 (lubricated)		18-8 or ASTM A193 B8/B8M class 1 (lubricated)		ASTM F593 304/316 cond. CW (lubricated)	
	Ft-lb	N-m	Ft-lb	N-m	Ft-lb	N-m	Ft-lb	N-m
1/4-20UNC	4.1	5.6	6.3	8.6	2.4	3.2	5.2	7.0
1/4-28UNF	4.7	6.4	7.2	9.8	2.7	3.7	5.9	8.0
5/16-18UNC	8.4	11	13	18	4.9	6.6	11	14
5/16-24UNF	9.3	13	14	20	5.4	7.3	12	16
3/8-16UNC	15	20	23	31	8.7	12	19	26
3/8-24UNF	17	23	26	36	9.9	13	21	29
7/16-14UNC	24	33	37	50	14	19	30	41
7/16-20UNF	27	36	41	56	16	21	34	46
1/2-13UNC	37	50	57	77	21	29	46	63
1/2-20UNF	41	56	64	86	24	33	52	70
9/16-12UNC	53	71	81	110	31	42	66	90
9/16-18UNF	59	80	91	123	34	46	74	100
5/8-11UNC	73	99	113	153	42	57	92	124
5/8-18UNF	82	112	127	173	48	65	104	141
3/4-10UNC	129	175	200	271	75	102	113	153
3/4-16UNF	144	196	223	302	84	114	126	171
7/8-9UNC	125	169	322	437	121	164	182	247
7/8-14UNF	138	187	355	482	134	181	201	272
1-8UNC	187	254	483	655	182	246	273	370
1-14UNF	210	285	542	735	204	277	306	415

Table 4 Accessory bolting torque based on material

6 Valve Disassembly and Inspection

6.1

To disassemble the valve body, first disconnect the valve outlet flange from the downstream pipe flange. Refer to Figure 5 and proceed as follows:

● ***WARNING: Depressurize line to atmospheric pressure and drain all fluids before working on the valve. Full personal protective equipment should be worn as required by the process fluid. Failure to do so can cause serious injury.***

● ***WARNING: Disassembly of the valve may involve handling fractured ceramic/tungsten carbide components which are extremely sharp. Proper personal protective equipment must be warn when handling such parts.***

6.2

If valve is air-to-open, apply air under the piston to lift the plug off the seat before taking the valve apart. If valve is air-to-close, proceed to step 6.3.

6.3

Some Survivor valve designs require that the plug be removed by pulling it through the bottom of the valve because the plug head is too large to fit through the opening at the top of the valve body. **If the plug can be pulled out from the top of the valve body, skip to step 6.4, otherwise do the following:**

6.3.1 Loosen the stem clamp and completely unthread the plug stem from the actuator stem.

! **NOTE:** With air-to-close, fail-open valves, it may be necessary to apply a small amount of air to the top of the actuator to move the plug away from the bonnet. Otherwise, some galling on the plug may occur.

6.3.2 Remove the bonnet flange bolting (also known as body bolting) and lift the actuator and bonnet assembly (called top works) off the valve while pulling the plug stem out through the bottom of the bonnet, leaving the plug sitting on the seat ring while still inside the body. Be careful to not allow any impact between the plug head and seat ring

● ***WARNING: When lifting an actuator, be aware that the center of gravity may be above the lifting point. Therefore, support must be given to prevent the valve from rotating. Failure to do so can cause serious injury to personnel and damage to the valve or nearby equipment.***

⚠ ***CAUTION: Heavy actuators may require a hoist. For Valtek actuators, lift the top works with the yoke legs using a lifting strap and a hoist. For non-Valtek actuators, refer to the actuator manufacturer's IOM for lifting instructions.***

6.3.3 Once removed, the top works should be lowered and set on a flat surface. Use blocks, or something similar, to prevent the top works assembly from rolling during disassembly.

6.3.4 To remove the seat ring components and plug, first remove the seat bolting, if the valve has them, then slide the seat ring components and plug out from the bottom of the valve.

● ***WARNING: When removing a two-piece seat, the upper seat may remain in the valve body and subsequently drop, causing harm to personnel, the seat ring, or nearby equipment. Care must be taken to prevent the seat ring from dropping accidentally. If the seat ring is stuck, some possible methods to remove the seat ring are:***

1) If the upper seat ring housing has threaded holes in it, use wooden blocks or plates and screws to pull the seat ring out as shown in Figure 2. Note that as the seat ring moves, thicker block spacers will be needed.

2) Use wooden blocks or plates, nuts, and a threaded rod in the configuration shown in Figure 3 to pull the seat ring out. The plug will need to be lifted up slightly to provide space for this method.

3) If the upper seat ring housing has threaded holes in it, use a slide hammer configuration similar to Figure 4.

4) If the valve is large enough, fit a hydraulic cylinder inside the valve body and try to align it to brace against the internal surfaces of the body and push against the top of the upper seat ring housing. Place a soft material between the cylinder and internal surfaces of the valve body to prevent damage to the body.

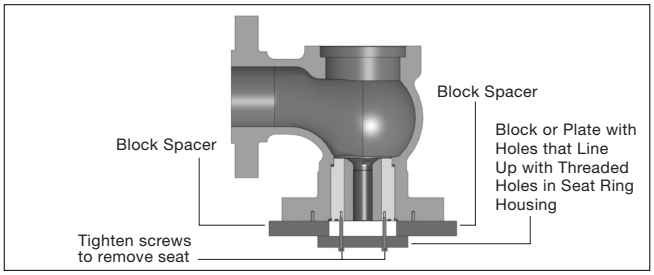

Figure 2 Possible method to remove upper seat with blocks, plate and screws

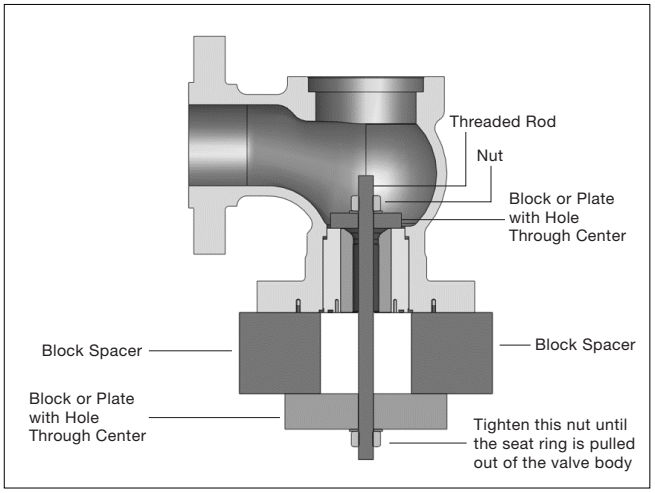

Figure 3 Possible method to remove upper seat with blocks, plate, and threaded rod

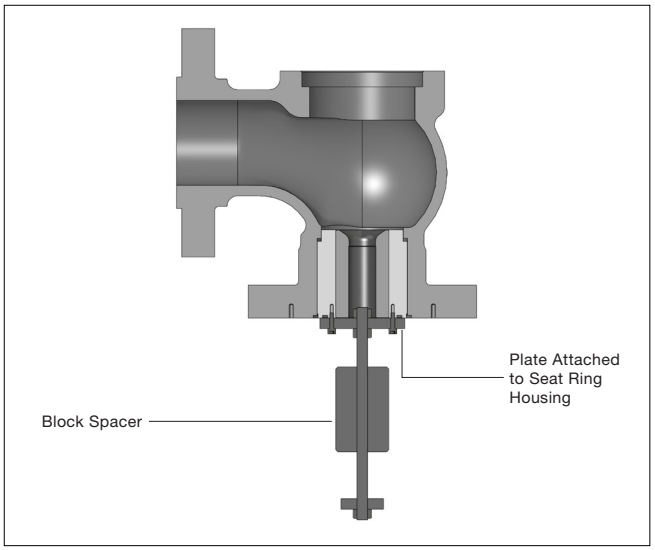

Figure 4 Possible method to remove upper seat with slide hammer

6.3.5 Inspect gasket surfaces on the seat ring(s), bonnet and body, making sure they are clean and undamaged.

6.3.6 Examine the plug stem and bonnet bore for scoring, scratches, pitting or other damage.

6.3.7 Proceed to step 6.5.

6.4 If the plug can be pulled out from the top of the valve body, do the following:

6.4.1 Remove the bonnet flange bolting (also known as body bolting) and lift the actuator, bonnet and plug assembly (called top works) out of the valve. Once removed, the top works should be lowered and set on a flat surface. Use blocks, or something similar, to prevent the top works assembly from rolling during disassembly.

WARNING: When lifting an actuator, be aware that the center of gravity may be above the lifting point. Therefore, support must be given to prevent the valve from rotating. Failure to do so can cause serious injury to personnel and damage to the valve or nearby equipment.

CAUTION: Heavy actuators may require a hoist. Lift the top works with the yoke legs using a lifting strap and a hoist. Great care should be taken to lift the actuator and plug straight out of the body to avoid damage to the plug and seat.

6.4.2 Inspect the plug and seat sealing surfaces for damage. If the seat needs to be removed, first remove the seat bolting, if the valve has them, then slide the seat ring components out from the valve.

WARNING: When removing a two-piece seat, the upper seat may remain in the valve body and subsequently drop, causing harm to personnel, the seat ring, or nearby equipment. Care must be taken to prevent the seat ring from accidentally dropping. If the seat ring sticks, there are several methods that may be used to remove it. A piece of wood may be inserted through the top of the valve body and pushed against the top of the seat ring while hitting the exposed end of the wood with a hammer. This may fracture ceramic/tungsten carbide seat rings, so this method is only recommended when ceramic/tungsten carbide seat rings are already damaged or when the seat ring is not composed of ceramic/tungsten carbide. Alternative methods to remove the upper seat are shown in Figures 2, 3 and 4.

6.4.3 Inspect gasket surfaces on the seat ring(s), bonnet and body, making sure they are clean and undamaged.

6.4.4 To inspect the plug, remove it by loosening stem clamp and gland flange and unscrew it out of the actuator stem. Pull the plug carefully through the packing box.

6.4.5 Examine the plug stem and bonnet bore for scoring, scratches, pitting or other damage.

! NOTE: With air-to-close, fail-open valves, it may be necessary to apply a small amount of air to the top of the actuator to move the plug away from the bonnet. Otherwise, some galling on the plug may occur.

6.5

If seat surfaces are metal and need re-machining, both surfaces on the plug and seat ring must be reworked. The seat angle on the metal plug is 30 degrees from the axis, and the seat angle on the metal seat ring is 33 degrees from the axis. Lapping will not be necessary if proper assembly procedures are followed.

⚠ ***CAUTION: If re-machining metal surfaces, protect stem during turning. Ensure concentricity of the seat surface with the plug stem (or outside diameter of seat ring if machining seat).***

6.6

Remove the actuator from the bonnet subassembly, by first removing the gland flange and then removing the yoke bolting/clamp. Finally disconnect the bonnet from the actuator.

6.7

Remove the packing assembly from the packing box using an appropriately sized dowel to push it out.

⚠ ***CAUTION: Do not score or gall the packing box bore or stem guides.***

⬢ ***WARNING: For valves equipped with separable end flanges, use extreme care to not over machine body gasket surfaces. Removing excessive body material could cause failure of the separable flange lip, causing end gasket leakage and failure of the valve. Contact Flowserve for rework instructions prior to reworking this type of end connection.***

6.8

Refer to the appropriate actuator IOM for detailed instructions on actuators.

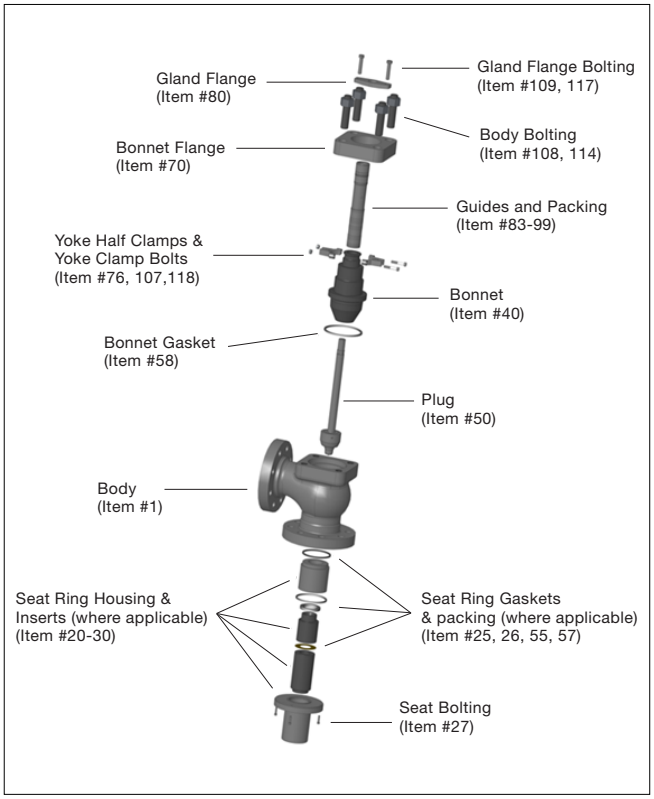

Figure 5 Exploded view of Survivor body assembly

7 Disassembly and Reassembly of Self-Centering Plug

If the solid ceramic or tungsten carbide plug head on self-centering plugs becomes damaged and the rest of the plug assembly is still in good condition, the plug head may be replaced according to the following procedure. The self-centering plug is the only plug design that allows for repair outside of Flowserve facilities. If repair of other plug designs is required, they must be sent back to a Flowserve facility for inspection and potential repair.

7.1 Disassembly of Self-Centering Plug

7.1.1 Carefully compress the internal Belleville washers in the plug assembly by placing the plug assembly in a vice or lathe and compressing it in the axial direction. Care must be taken to protect the surfaces of any parts that will be re-used, for example padded lathe jaws should be used to prevent damage to the plug stem.

7.1.2 Attempt to unscrew the nuts/bolts that hold the clamshell pieces together. The threads were peened or tack welded during assembly so it might not be possible to do this. It is also acceptable to apply enough torque to break the bolts. Alternatively, using a grinder, saw, or similar tool, cut through the bolts that hold the clamshell pieces together at the locations shown in Figure 6.

⚠ ***CAUTION: When cutting the bolts, be careful to not damage any of the other plug assembly components.***

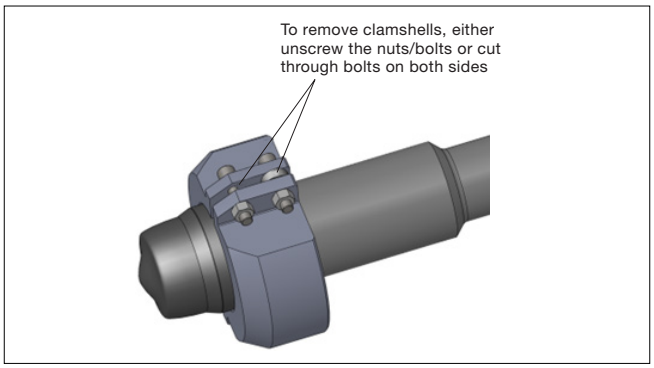

Figure 6 Clamshell removal on self-centering plugs

7.1.3 Once the bolts are unscrewed or cut, the clamshells can be separated and removed from the assembly.

7.1.4 Slowly remove the axial compression from the assembly, being careful to not allow the individual components to fall.

7.2 Assembly of Self-Centering Plug

! **NOTE:** Although not required, using a lathe will simplify the assembly process for self-centering plugs. Whatever method is used, care must be taken to prevent damage to any of the parts.

7.2.1 Refer to Figure 8 through Figure 10 for the assembly.

7.2.2 Clamp onto the plug stem using padded jaws in a lathe. Ensure the end with the grooves for the Belleville washers is exposed. Keep the lathe brake engaged.

7.2.3 Install the Belleville washers into the groove at the end of the plug stem per the orientation shown in Figure 7, and hold the flat side of the plug head against the Belleville washers to keep them in place.

7.2.4 Move a live center with cone-shaped end toward the plug until it contacts the plug head and compresses the Belleville washers enough that the flat end of the plug head contacts the end of the plug stem. If a live center with cone-shaped end is not available, a soft material such as a piece of wood may be used to push against the plug head.

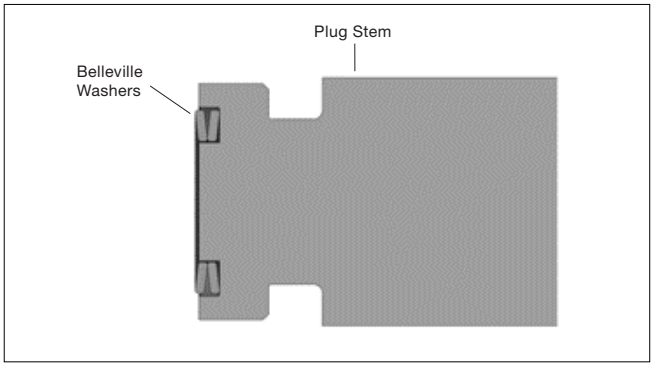

Figure 7 Belleville washer orientation

⚠ ***CAUTION: Only use enough force to compress the Belleville washers so that the flat end of the plug head contacts the end of the plug stem. Excessive force may damage the plug head.***

7.2.5 With the Belleville washers compressed, place the clamshells on the plug head and plug stem.

! **NOTE:** Using tape to hold the clamshells in place is helpful while setting the bolts.

7.2.6 Apply anti-seize to the nuts and bolts and install the nuts, bolts and spacers per Figure 8 and Figure 10. See the bill of materials and Table 5 for the torque values for the bolts based on material and thread type. Note that the torque values are different for upper and lower bolts. Contact your Flowserve representative to obtain torque values for bolting not shown in Table 5.

! **NOTE:** Spacers are only used for the two upper bolts. They are used to maintain proper spacing between the clamshells at the upper locations which allows the assembled plug head to “float” on the plug stem. At the lower locations, the clamshells should clamp tight onto the ceramic or tungsten carbide plug head.

7.2.7 Release the live center and remove the plug assembly out of the jaws.

7.2.8 To double check that the plug was assembled correctly, a feeler gauge may be used to measure the gap between the flat ends of the plug head and plug stem. See Figure 9. This gap should be .005” to .015”.

7.2.9 Clamp onto the clamshell and use a punch or similar tool to peen the bolt and nut threads to secure the nuts in place, see Figure 10.

⚠ ***CAUTION: It is important to clamp directly onto the clamshell (not onto the plug head) while peening the bolt and nut threads. Clamping directly onto the plug head while peening may damage/crack the plug head.***

7.2.10 Before installing the plug into the valve, it is recommended to get the plug head seating surface as concentric as possible with the plug stem. This may be done by holding the plug stem in a lathe and measuring the runout on the plug head seating surface. Lightly tap the outer diameter of the clamshells with a rubber mallet to move the floating head until the runout has been minimized. Do not hit the ceramic plug head with the mallet.

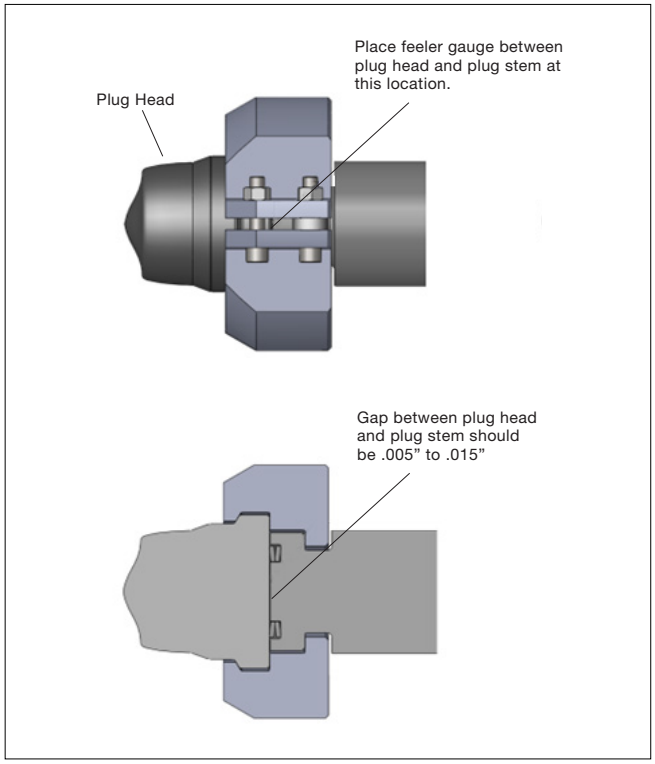

Figure 9 Gap between plug head and plug stem

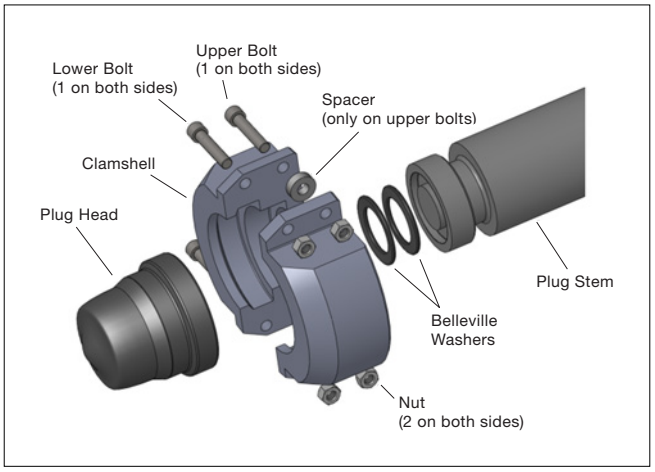

Figure 8 Self-Centering plug assembly

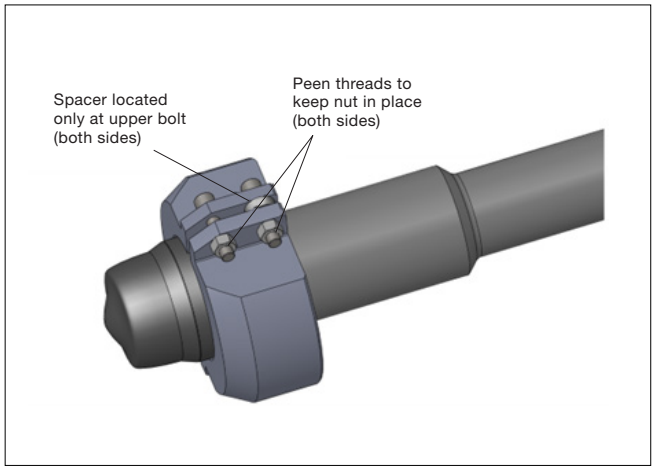

Figure 10 Assembled self-centering plug

Bolt Size (in.)	Self-Centering Plug Torque per Location & Material			
	Upper Bolting Torque (in-lb)		Lower Bolting Torque (in-lb)	
	Duplex 2507 (S32750) & S32760	Titanium Grade 12	Duplex 2507 (S32750) & S32760	Titanium Grade 12
1/4-20UNC	48 ± 2	30 ± 2	71 ± 3	46 ± 2
5/16-18UNC	98 ± 3	62 ± 3	147 ± 5	95 ± 3

Table 5 Bolting torques for self-centering plugs

8 Valve Assembly and Installation

! **NOTE:** Separate User Manuals with instructions on assembling actuators, positioners and other equipment can be found on www.flowserve.com. Review any relevant User Manual before proceeding.

! **NOTE:** It is recommended that all soft goods are replaced when rebuilding Mark Ten Survivor control valves. Soft goods include seat ring gaskets, seat ring packing (where applicable), guide liners, packing sets and Grafoil gaskets (where applicable). Replacing these parts helps to ensure proper functioning of the control valve.

! **NOTE:** Assembly of Survivor valves should occur in a shop setting after the valve has been disconnected from the pipe and disassembled. Even when only the plug needs to be replaced, the valve should be removed from the line to facilitate proper plug installation.

8.1

Some Survivor valve designs require that the plug be installed through the bottom of the valve because the plug head is too large to fit through the top of the valve body. If the plug cannot be installed through the top of the valve body, install the plug up through the bottom of the valve body and install the bonnet gasket in the body before proceeding to the next step.

8.2

Insert the plug stem into the bonnet, being careful to not score the plug stem or the guides. Clamp the bonnet vertically into a vise with the plug supported on a soft surface.

⚠ ***CAUTION: Be careful to not strike the plug head against any object.***

8.3

Reinstall the bonnet packing, guides and packing spacers per the packing layout and the Standard and Environmental Packing Systems Technical Bulletin FCD VLENTB0040 (latest revision). The packing set for Survivor valves typically contains extra components that are not shown in VLENTB0040, therefore, it is critical to follow the configuration shown in the packing layout which was provided with the valve order.

8.3.1 Lubrication of the packing is recommended. See Table 2 for suggested lubricants. Applying lubrication to the packing at this stage will facilitate re-assembly.

8.3.2 Packing sets for Survivor valves typically have more packing rings than standard, therefore soft packing components should be compressed in intermediate stages as they are installed into the bonnet, i.e. install a few soft packing components, then use a Packing Compression Tool to compress the components before installing the next components. See Table 6 for a list of Packing Compression Tool part numbers for each plug stem size. Contact your local Flowserve representative to determine the plug stem diameter in your valve. The plug stem diameter can also be found in the description on the packing layout or bill of materials.

! **NOTE:** It is important to only use Flowserve-supplied Packing Compression Tools in order to avoid damage to the bonnet bore or plug stem. Tooling must be inspected regularly to ensure no sharp edges or burrs are present. Such defects may cause damage to the bonnet bore or plug stem.

Plug Stem Diameter (inch)	Packing Compression Tool Part Number
0.562	097158.444.000
0.875	097159.444.000
1.125	097160.444.000
1.5	097161.444.000
2	097162.444.000
2.5	097163.444.000
3	672293.444.000

Table 6 Packing compression tools

8.3.3 Compress the packing such that approximately 1/8-inch is left at the top of the packing box for the top stem guide to sit into the bonnet. Different packing spacer lengths permit a wide variety of packing configurations.

8.4

Slide the bonnet flange over the bonnet so it seats on the bonnet shoulder.

8.5

Slide the gland flange over the plug stem until it seats on top of the upper stem guide.

! **NOTE:** Do not allow the gland flange to contact and gall the polished plug stem.

8.6

Install the actuator assembly over the bonnet/plug assembly.

8.7

Thread the plug stem threads up into the actuator stem by hand as far as it will go. This will ensure there will be a large gap between the plug head and seat ring later in the assembly process.

8.8

Install the yoke bolting, including yoke clamp where applicable, and tighten firmly. Do not tighten gland flange bolting yet.

8.9

Install new bonnet gasket (if not already installed) and lower the bonnet/plug/actuator assembly into the valve body.

8.10

Begin tightening the bonnet flange bolting in a manner that will keep the space parallel between the bonnet flange and the body. All nuts should be tightened in an alternating pattern directly opposite of each other. Use a minimum of four tightening steps to achieve the final torque shown in Table 1. There should not be more than 25% to 30% of the required bolt torque value applied in a single tightening step. The bonnet will seat metal-to-metal with the body when the bonnet bolts are correctly tightened.

8.11

Installation of the plug and seat ring(s) in Survivor valves is dependent upon the specific type of trim being used. Table 7 shows which assembly instructions to follow based on the type of trim. Contact your local Flowserve representative to determine which type of trim your valve has. Additionally, you may compare the parts of your valve to the parts in the following sections to help determine the type of trim.

8.12 Metal Plug & Seat

The terms “metal plugs” and “metal seats” refer to plugs and seat rings that do not contain solid ceramic or solid tungsten carbide components. Metal plugs and seats will often have a hard overlay such as HVOF or Stellite® to prevent erosion.

There are several different configurations for valves with metal plugs and seats. Figure 11 shows a general layout. Figure 12 through Figure 15 show examples of the various configurations.

8.12.1 Check to make sure the seat ring and plug are clean of dirt, debris or any other contamination.

8.12.2 With both seat gaskets removed, install the seat ring(s), including upper and lower seat rings, where applicable. If applicable, also install the separate housing to hold the seat ring in place, as shown in Figure 14.

8.12.3 Using only hand pressure, hold the seat ring(s) so they are positioned in their final installed location. See notes in Figure 12 through Figure 15 for explanation of which surfaces should be in contact in the installed position.

! **NOTE:** If the seat ring(s) is too heavy to hold in place by hand, a potential solution is to place the valve on its side, install the seat ring(s) with loose seat bolting, and use a lifting crane with strap to support the weight of the lower seat ring. With the lower seat ring supported with the strap, push the seat ring up against the body by hand.

Trim Type	Seat Ring Type	Plug Installation Instructions
Metal Plug & Seat	All Applicable Types	8.12
Valves with Ceramic or Tungsten Carbide Trim	Valves with Shrink-Fit Seat Ring	8.13
	Valves with Clamped Seat Ring	8.14

Table 7 List of plug installation instructions based on trim type

8.12.4 Stroke the valve partially open (between 20% and 95% open), so the plug head is not contacting the seat or the bonnet and such that there is ample access to the wrench flats on the plug stem.

⚠ ***CAUTION: The plug and seat surfaces can be damaged by turning the plug while the plug is in contact with the seat. Ensure the plug is raised off the seat before adjusting the plug.***

8.12.5 Unthread the plug stem out from the actuator stem by ¼ turn.

8.12.6 Stroke the valve closed. Note if the plug contacts the seat ring. This can be felt by hand as the seat ring moves due to contact with the plug.

! **NOTE:** By stroking the valve closed, the piston bottoms out on the yoke.

8.12.7 Repeat steps 8.12.4 through 8.12.6 until the plug just contacts the seat. Stop as soon as the two are in contact.

8.12.8 Stroke the valve partially open again (between 20% and 95% open). Unthread the plug stem from the actuator stem by 1 turn. This will ensure that the plug will contact the seat ring properly.

⚠ ***CAUTION: Make sure to only unthread the plug stem from the actuator stem by 1 turn. Unthreading it more than this may result in overloading the seat bolting once they are installed.***

8.12.9 Set and tighten the stem clamp.

⚠ ***CAUTION: If the actuator stem is slotted, make sure the slots are perpendicular to the stem clamp bolting. See Figure 25.***

8.12.10 Tighten gland flange bolting. Refer to the packing layout provided with the valve to determine packing style (e.g. SureGuard XT, SafeGuard, etc.). Then refer to the Standard and Environmental Packing Systems Technical Bulletin FCD VLENTB0040 (latest revision) for gland flange bolting torque requirements based on the packing style.

⚠ ***CAUTION: Do not overtighten packing. This can cause excessive packing wear and high stem friction that may impede stem movement.***

8.12.11 Remove the seat ring(s) from the body.

8.12.12 Place the upper and lower seat gaskets in the appropriate locations as shown in Figure 12 through Figure 15 and reinstall the seat ring(s), including upper and lower seat rings, where applicable. If applicable, install the separate housing to hold the seat ring in place, as shown in Figure 14.

8.12.13 If the valve design uses seat bolting to keep the seat rings in place, install the seat bolting hand tight. These small bolts are not intended to compress the gaskets in the valve assembly, but they should be tight enough to prevent the seat ring(s) from moving while handling the valve.

CAUTION: If the seat bolts are loose, they may cause damage to the valve and/or the downstream pipe flange. Loose seat bolts may also prevent proper gasket compression and prevent proper valve shutoff.

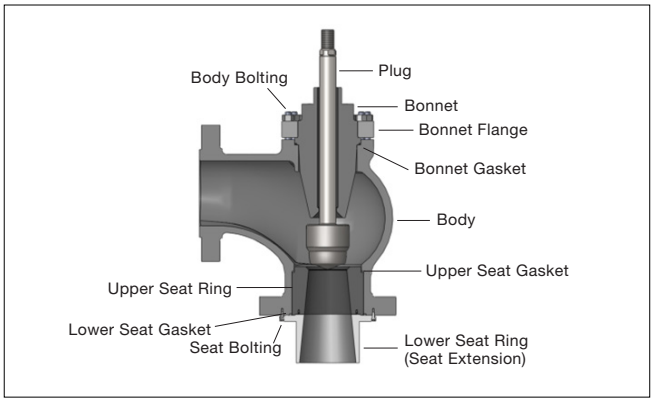

Figure 11 Valve with metal plug and seat ring

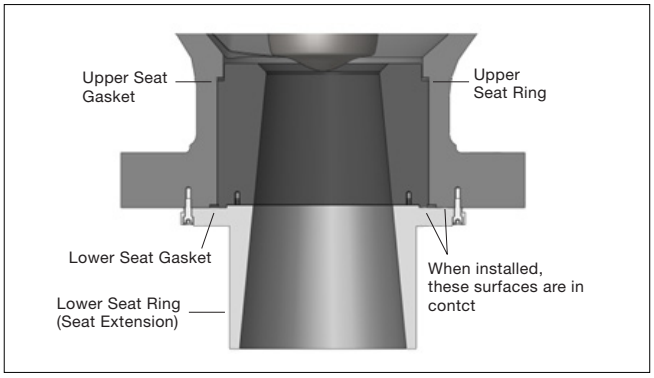

Figure 12 Metal plug with metal upper and lower seat with seat extension

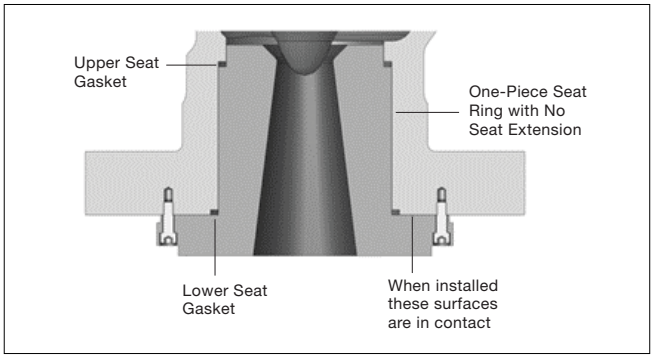

Figure 13 Metal plug with metal upper seat ring with no seat extension

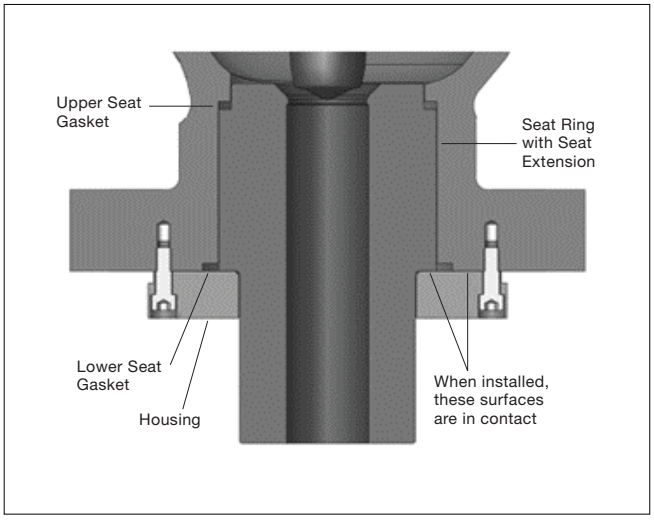

Figure 14 Metal plug with one-piece metal seat ring with seat housing and seat extension, with separate housing

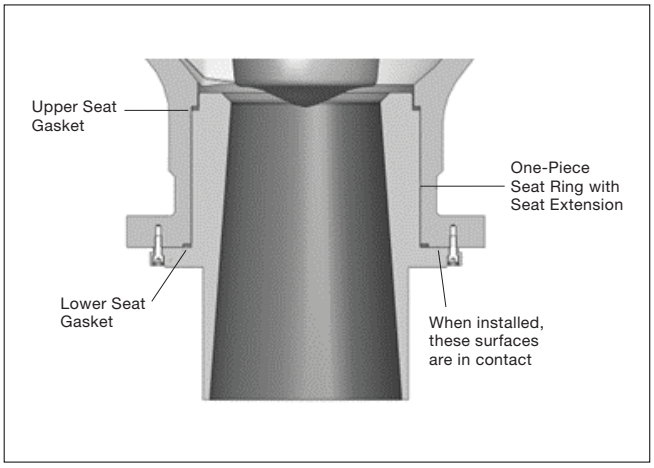

Figure 15 Metal plug with one-piece metal seat ring with seat extension

8.13 Valves with Ceramic or Tungsten Carbide Trim and Shrink-Fit Seat Ring Inserts

There are several different configurations for valves with ceramic or tungsten carbide trim and shrink-fit seat ring inserts. Figure 16 shows a general layout. Figure 17 through Figure 19 show examples of the various configurations.

8.13.1 Check to make sure the seat ring and plug are clean of dirt, debris or any other contamination.

8.13.2 If a spacer will be used to control the gap between the plug and seat, ensure the spacer is made of a soft material that won't damage the seat or plug. The spacer thickness depends on the ANSI shutoff class and is specified in Table 8. As shown in Figure 16, place the spacer on the top surface of the upper seat ring insert, making sure the spacer covers the inner radius of the insert so it will prevent the plug from contacting the seat ring and maintain a gap between the two components equal to the thickness of the spacer.

ANSI Shutoff Class	Spacer Thickness
Class II	0.04" (1mm)
Class III	0.02" (0.5mm)

Table 8 Recommended spacer thickness based on ANSI shutoff classes

! **NOTE:** Spacers should not be used with equal percent trims or for valves requiring ANSI Class IV shutoff. Contact your local Flowserve representative or Performance Specification supplied with your valve to determine if your trim is equal percent.

! **NOTE:** Flowserve cannot guarantee any shutoff class unless the valve is assembled at a Flowserve facility where specialized equipment is used to verify leakage at shutoff. The spacer thicknesses listed in Table 8 are only estimates to achieve desired shutoff classes.

8.13.3 With both seat gaskets removed, install the seat ring(s), including upper and lower seat rings, where applicable. If applicable, also install the separate housing to hold the seat ring in place, as shown in Figure 18.

8.13.4 Using only hand pressure, hold the seat ring(s) so they are positioned in their final installed location. See notes in Figure 17 through Figure 19 for details on which surfaces should be in contact in the installed position.

! **NOTE:** If the seat ring(s) is too heavy to hold in place by hand, a potential solution is to place the valve on its side, install the seat ring(s) with loose seat bolting, and use a lifting crane with strap to support the weight of the lower seat ring. With the lower seat ring supported with the strap, push the seat ring up against the body by hand.

8.13.5 If using a spacer to control the gap between the plug and seat, skip to step 8.13.6, otherwise do the following:

8.13.5.1 Stroke the valve partially open (between 20% and 95% open), so the plug head is not contacting the seat or the bonnet and such that there is ample access to the wrench flats on the plug stem.

⚠ ***CAUTION: The plug and seat surfaces can be damaged by turning the plug while the plug is in contact with the seat. Ensure the plug is raised off the seat before adjusting the plug.***

8.13.5.2 Unthread the plug stem out from the actuator stem by ¼ turn or less.

8.13.5.3 Stroke the valve closed. Note if the plug contacts the seat ring. This can be felt by hand as the seat ring moves due to contact with the plug

⚠ ***CAUTION: Contacting the plug to the seat ring with ceramic or tungsten carbide trimmed valves could cause the seat ring or plug to fracture. Take great care in allowing these two surfaces to contact. The seat ring should be allowed to slide out of the body smoothly, with only light hand pressure to hold it in place. If the seat ring begins to bind, immediately stroke the valve open, and remove the seat and check for dings or dirt. Stroke the valve slowly to avoid slamming the plug into the seat ring.***

! **NOTE:** By stroking the valve closed, the piston bottoms out on the yoke.

8.13.5.4 Repeat steps 8.13.5.1 through 8.13.5.3 until the plug just contacts the seat. Stop as soon as the two are in contact.

8.13.5.5 Stroke the valve partially open again (between 20% and 95% open). Thread the plug stem back into the actuator stem by the number of turns shown in Table 9. Note that shutoff classes II and III require a small gap between the plug and seat at shutoff and Class IV requires contact between the plug and seat at shutoff.

! **NOTE:** Flowserve cannot guarantee any shutoff class unless the valve is assembled at a Flowserve facility where specialized equipment is used to verify leakage at shutoff. The number of turns listed in Table 9 are only estimates to achieve desired shutoff classes.

8.13.6 If using a spacer to control the gap between the plug and seat, do the following, otherwise skip to step 8.13.6.6.

8.13.6.1 Ensure the spacer is on top of the upper seat ring insert and will prevent contact between the seat and plug.

8.13.6.2 Stroke the valve partially open (between 20% and 95% open), so the plug head is not contacting the spacer or the bonnet and such that there is ample access to the wrench flats on the plug stem.

8.13.6.3 Unthread the plug stem out from the actuator stem by ¼ turn or less.

ANSI Shutoff Class	# of Turns for Plug Stem
Class II	1/2
Class III	1/4
*Class IV	0

Table 9 Number of turns to thread plug stem into actuator stem

**Flowserve recommends that any plug installations for ANSI Shutoff Class IV be performed by Flowserve field technician or at a Flowserve facility. Class IV shutoff is inherently at a higher risk for plug/seat fracture.*

8.13.6.4 Stroke the valve closed. Note if the plug contacts the spacer. This can be felt by hand as the seat ring moves due to contact with the plug.

8.13.6.5 Repeat steps 8.13.6.2 through 8.13.6.4 until the plug just contacts the spacer. Stop as soon as the two are in contact.

8.13.6.6 Stroke the valve partially open again (between 20% and 95% open).

8.13.7 Set and tighten the stem clamp.

⚠ ***CAUTION: If the actuator stem is slotted, make sure the slots are perpendicular to the stem clamp bolting. See Figure 25.***

8.13.8 Tighten gland flange bolting. Refer to the packing layout provided with the valve to determine packing style (e.g. SureGuard XT, SafeGuard, etc.). Then refer to the Standard and Environmental Packing Systems Technical Bulletin FCD VLENTB0040 (latest revision) for gland flange bolting torque requirements based on the packing style.

⚠ ***CAUTION: Do not overtighten packing. This can cause excessive packing wear and high stem friction that may impede stem movement.***

8.13.9 Remove the seat ring(s) and spacer, if used, from the body.

8.13.10 Place the upper and lower seat gaskets in the appropriate locations and reinstall the seat ring components per Figure 17 through Figure 19.

8.13.11 If the valve uses seat bolting to keep the seat rings in place, as shown in Figure 16, install the seat bolting hand tight. These small bolts are not intended to compress the gaskets in the valve assembly, but they should be tight enough to prevent the seat ring(s) from moving while handling the valve.

⚠ ***CAUTION: If the seat bolts are loose, they may cause damage to the valve and/or the downstream pipe flange. Loose seat bolts may also prevent proper gasket compression and prevent proper valve shutoff.***

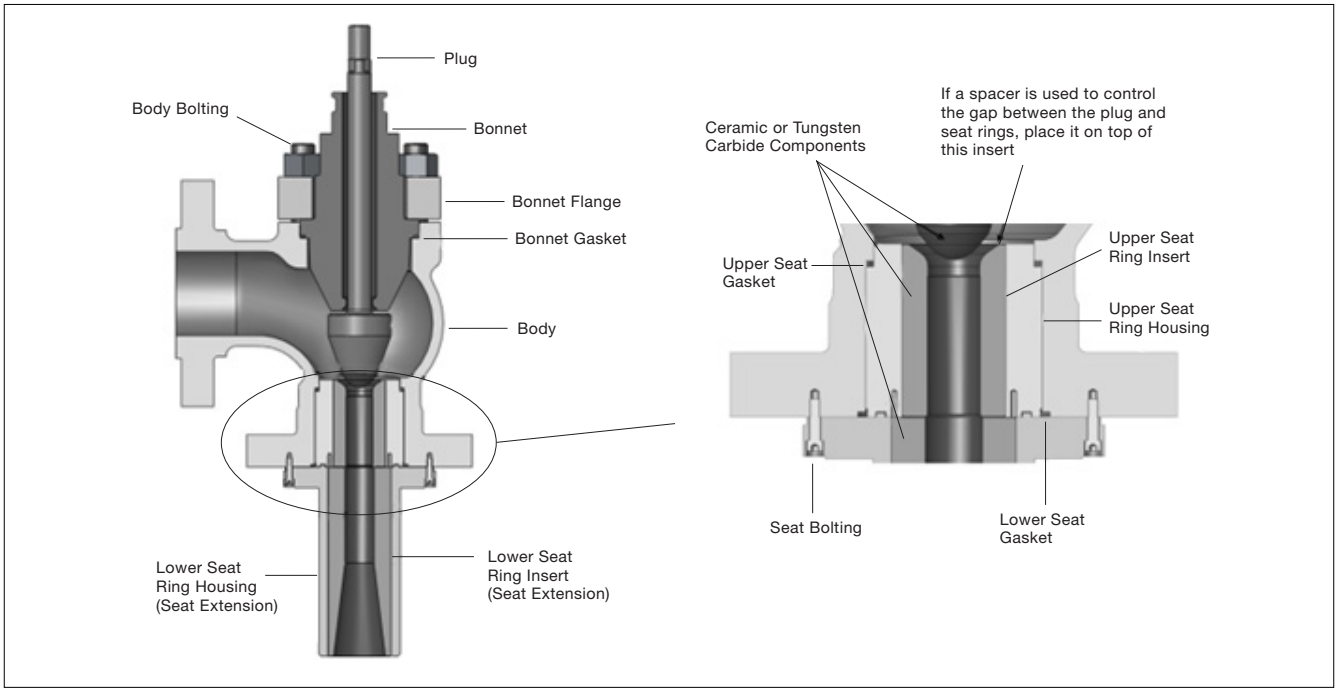

Figure 16 Survivor valve with ceramic or tungsten carbide trim and shrink-fit seat inserts

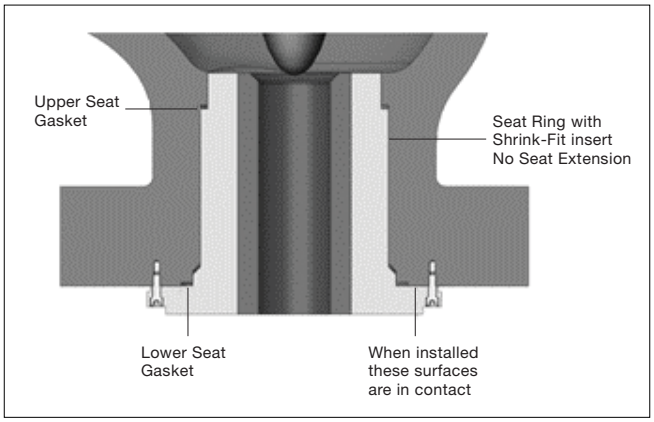

Figure 17 Shrink-fit ceramic/tungsten carbide plug/seat with no seat extension

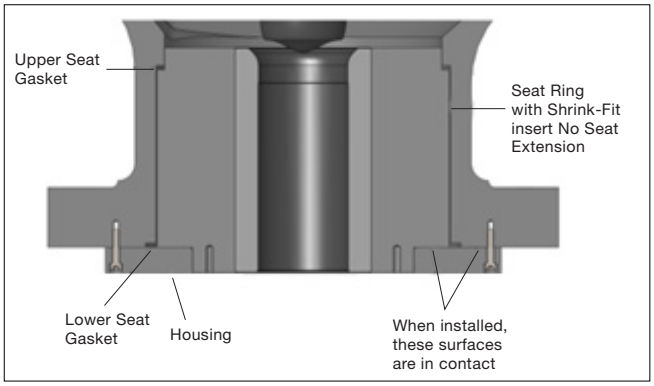

Figure 18 Shrink-fit ceramic/tungsten carbide plug/seat with no seat extension, with separate housing

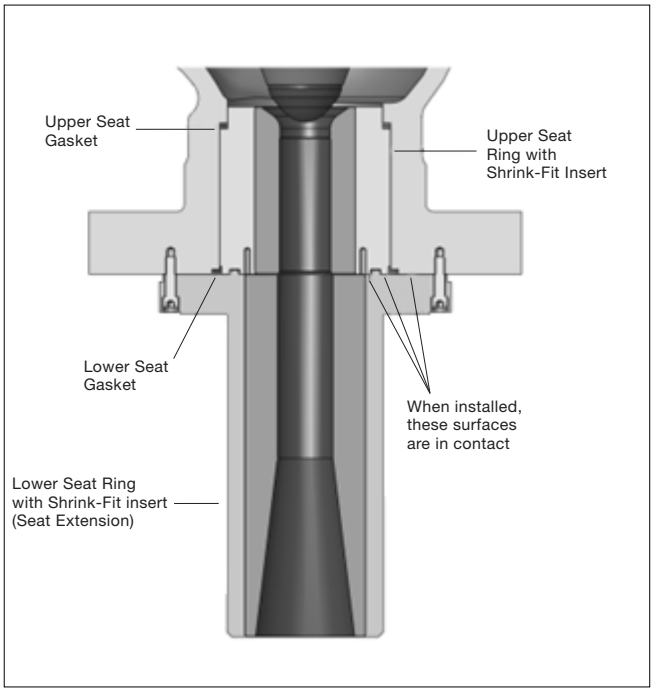

Figure 19 Shrink-fit ceramic/tungsten carbide plug/seat with seat extension

8.14 Valves with Ceramic or Tungsten Carbide Trim and Clamped Seat Ring Inserts

There are several different configurations for valves with ceramic or tungsten carbide trim and clamped seat ring inserts. Figure 20 shows a general layout. Figure 21 through Figure 24 show examples of the various configurations.

8.14.1 Check to make sure the seat ring and plug are clean of dirt, debris or any other contamination.

8.14.2 If a spacer will be used to control the gap between the plug and seat, ensure the spacer is made of a soft material that won't damage the seat or plug. The spacer thickness depends on the ANSI shutoff class and is specified in Table 10 below. As shown in Figure 20, place the spacer on the top surface of the upper seat ring insert, making sure the spacer covers the inner radius of the insert so it will prevent the plug from contacting the seat ring and maintain a gap between the two components equal to the thickness of the spacer.

ANSI Shutoff Class	Spacer Thickness
Class II	0.04" (1mm)
Class III	0.02" (0.5mm)

Table 10 Recommended spacer thickness based on ANSI shutoff classes

! **NOTE:** Spacers should not be used with equal percent trims or for valves requiring ANSI Class IV shutoff. Contact your local Flowserve representative or Performance Specification supplied with your valve to determine if your trim is equal percent.

! **NOTE:** Flowserve cannot guarantee any shutoff class unless the valve is assembled at a Flowserve facility where specialized equipment is used to verify leakage at shutoff. The spacer thicknesses listed in Table 10 are only estimates to achieve desired shutoff classes.

8.14.3 With upper/lower seat gaskets and seat packing (if applicable) removed, install the seat ring(s), including all applicable housings and inserts. Where applicable, ensure the Grafoil gasket is installed between the inserts as shown in Figure 21 and Figure 23.

8.14.4 Using only hand pressure, hold the seat ring(s) so they are positioned in their final installed location. See notes in Figure 21 through Figure 24 for details on which surfaces should be in contact in the installed position.

! **NOTE:** If the seat ring(s) is too heavy to hold in place by hand, a potential solution is to place the valve on its side, install the seat ring(s) with loose seat bolting, and use a lifting crane with strap to support the weight of the lower seat ring. With the lower seat ring supported with the strap, push the seat ring up against the body by hand.

! **NOTE:** It is critical that the seat ring(s) are held in the installed position during this procedure so the plug is installed and adjusted correctly to avoid contact with the seat ring.

8.14.5 If using a spacer to control the gap between the plug and seat, skip to step 8.14.6 otherwise do the following:

8.14.5.1 Stroke the valve partially open (between 20% and 95% open), so the plug head is not contacting the seat or the bonnet and such that there is ample access to the wrench flats on the plug stem.

⚠ ***CAUTION: The plug and seat surfaces can be damaged by turning the plug while the plug is in contact with the seat. Ensure the plug is raised off the seat before adjusting the plug.***

8.14.5.2 Unthread the plug stem out from the actuator stem by ¼ turn or less.

8.14.5.3 Stroke the valve closed. Note if the plug contacts the seat ring. This can be felt by hand as the seat ring moves due to contact with the plug.

⚠ ***CAUTION: Contacting the plug to the seat ring with ceramic or tungsten carbide trimmed valves could cause the seat ring or plug to fracture. Take great care in allowing these two surfaces to contact. The seat ring should be allowed to slide out of the body smoothly, with only light hand pressure to hold it in place. If the seat ring begins to bind, immediately stroke the valve open, and remove the seat and check for dings or dirt. Stroke the valve slowly to avoid slamming the plug into the seat ring.***

! **NOTE:** By stroking the valve closed, the piston bottoms out on the yoke.

8.14.5.4 Repeat steps 8.14.5.1 through 8.14.5.3 until the plug just contacts the seat. Stop as soon as the two are in contact.

8.14.5.5 Stroke the valve partially open again (between 20% and 95% open). Thread the plug stem back into the actuator stem by the number of turns shown in Table 11. Note that shutoff Class II and III require a small gap between the plug and seat at shutoff and Class IV requires contact between the plug and seat at shutoff.

! **NOTE:** Flowserve cannot guarantee any shutoff class unless the valve is assembled at a Flowserve facility where specialized equipment is used to verify leakage at shutoff. The number of turns listed in Table 11 are only estimates to achieve desired shutoff classes.

ANSI Shutoff Class	# of Turns for Plug Stem
Class II	1/2
Class III	1/4
*Class IV	0

Table 11 Number of turns to thread plug stem into actuator stem

**Flowserve recommends that any plug installations for ANSI Shutoff Class IV be performed by a Flowserve field technician or at a Flowserve facility. Class IV shutoff is inherently at a higher risk for plug/seat fracture.*

8.14.6 If using a spacer to control the gap between the plug and seat, do the following, otherwise skip to step 8.14.7.

8.14.6.1 Ensure the spacer is on top of the upper seat ring insert and will prevent contact between the seat and plug.

8.14.6.2 Stroke the valve partially open (between 20% and 95% open), so the plug head is not contacting the seat or the bonnet and such that there is ample access to the wrench flats on the plug stem.

8.14.6.3 Unthread the plug stem out from the actuator stem by ¼ turn or less.

8.14.6.4 Stroke the valve closed. Note if the plug contacts the seat ring. This can be felt by hand as the seat ring moves due to contact with the plug.

8.14.6.5 Repeat steps 8.14.6.2 through 8.14.6.4 until the plug just contacts the spacer. Stop as soon as the two are in contact.

8.14.6.6 Stroke the valve partially open again (between 20% and 95% open).

8.14.7 Set and tighten the stem clamp.

⚠ ***CAUTION: If the actuator stem is slotted, make sure the slots are perpendicular to the stem clamp bolting. See Figure 25.***

8.14.8 Tighten gland flange bolting. Refer to the packing layout provided with the valve to determine packing style (e.g. SureGuard XT, SafeGuard, etc.). Then refer to the Standard and Environmental Packing Systems Technical Bulletin FCD VLENTB0040 (latest revision) for gland flange bolting torque requirements based on the packing style.

⚠ ***CAUTION: Do not overtighten packing. This can cause excessive packing wear and high stem friction that may impede stem movement.***

8.14.9 Remove the seat ring(s) and spacer, if used, from the body.

8.14.10 Place the seat gaskets and packing, where applicable, in the appropriate locations and reinstall the seat ring components per Figure 21 through Figure 24.

8.14.11 If the valve uses seat bolting to keep the seat rings in place, as shown in Figure 20, install the seat bolting hand tight. These small bolts are not intended to compress the gaskets in the valve assembly, but they should be tight enough to prevent the seat ring(s) from moving while handling the valve.

⚠ ***CAUTION: If the seat bolts are loose, they may cause damage to the valve and/or the downstream pipe flange. Loose seat bolts may also prevent proper gasket compression and prevent proper valve shutoff.***

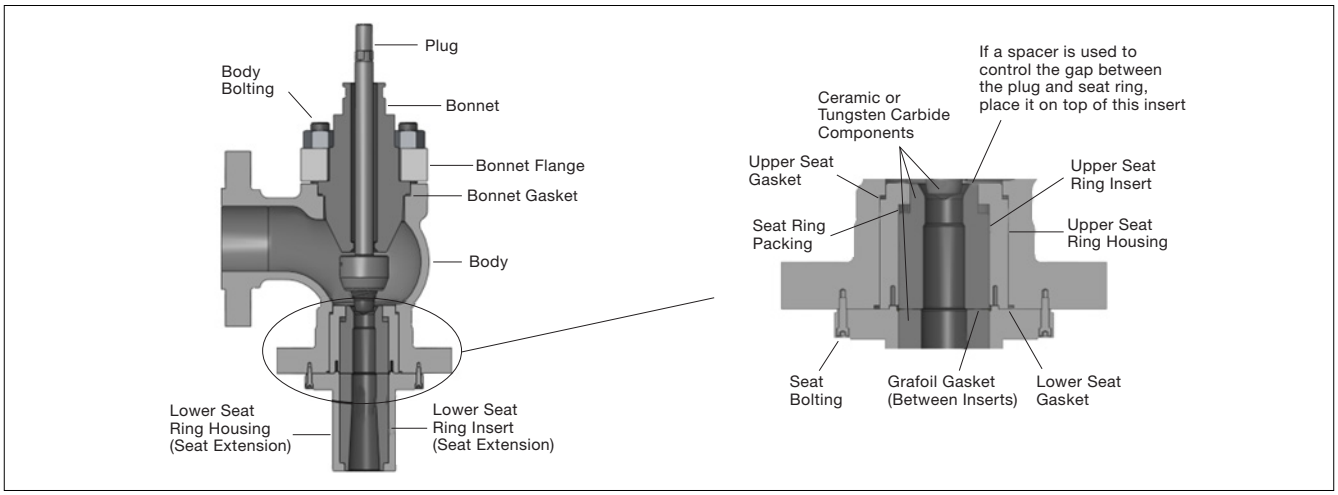

Figure 20 Survivor valve with ceramic or tungsten carbide trim and clamped seat inserts

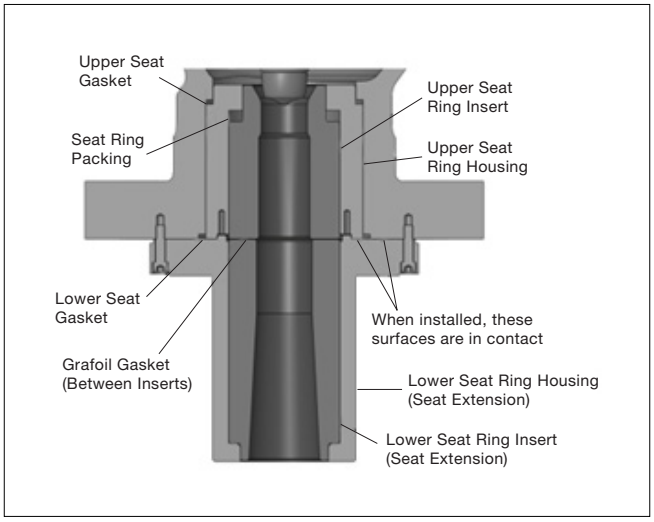

Figure 21 Clamped ceramic/tungsten carbide seat with seat extension

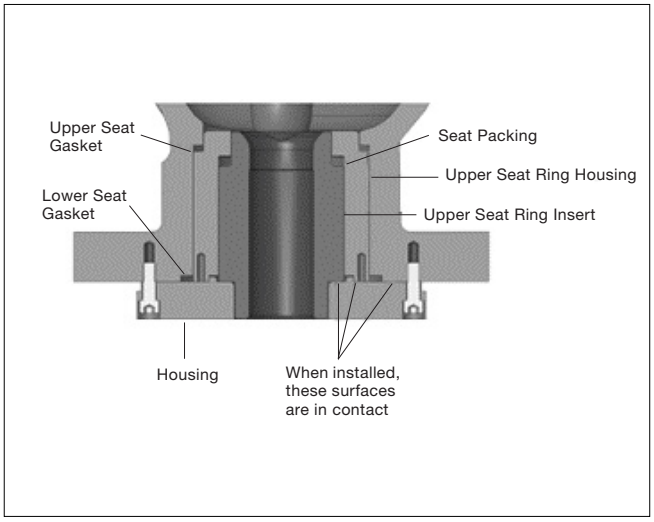

Figure 22 Clamped ceramic/tungsten carbide seat with upper seat ring housing and no seat extension

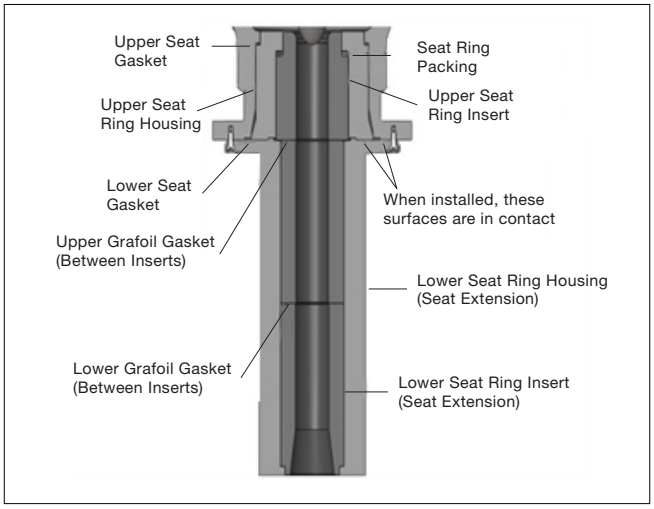

Figure 23 Clamped ceramic/tungsten carbide seat with two inserts in seat extension

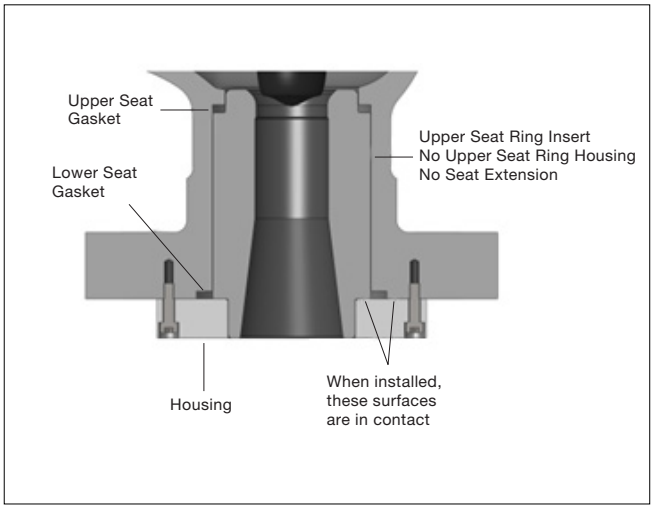

Figure 24 Clamped ceramic/tungsten carbide seat with no upper seat ring housing and no seat extension

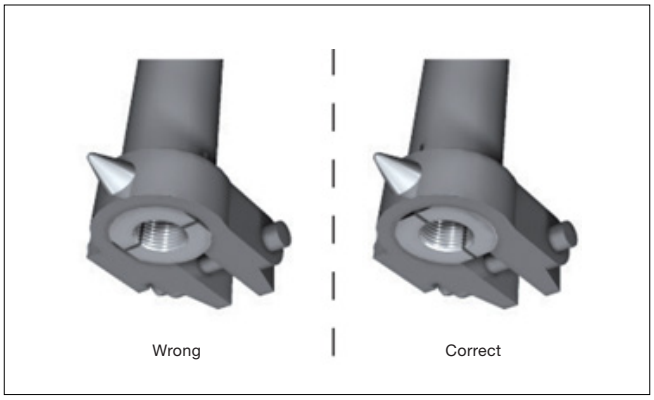

Figure 25 Slotted actuator stem / stem clamp alignment

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