



USER INSTRUCTIONS

Worcester Controls

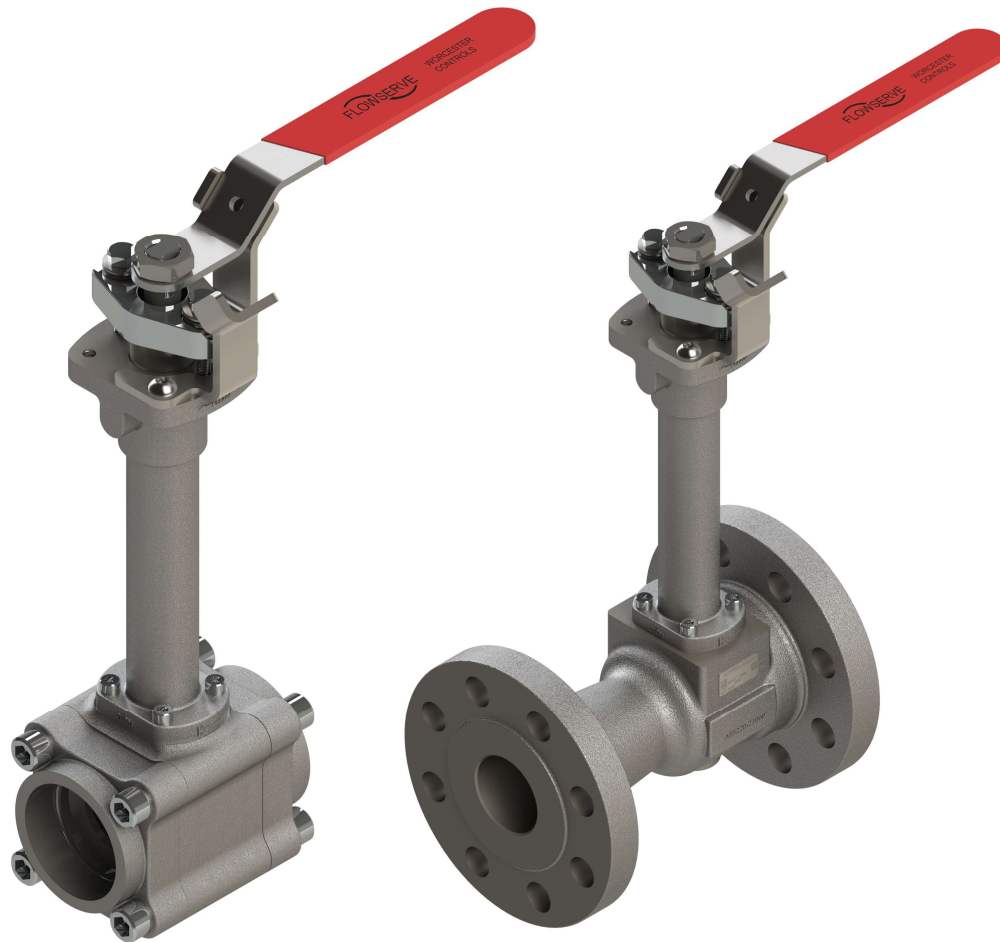
Three-Piece (CF44) / Single piece flanged (CF51/CF52)
bolt on bonnet cryogenic Ball Valves

VAIOM001121

Installation
Operation
Maintenance



These instructions must be read prior to installing, operating, and maintaining this equipment.





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1 General Information

1.1 Scope of manual



These instructions must be kept close to the product's operating location or directly with the product.



These instructions must be read prior to installing, operating, using, or maintaining the equipment in any region worldwide. The equipment must not be put into service until all of the safe operating conditions noted in the instructions have been met. **Failure to comply with the information provided in the User Instructions is considered to be misuse. Personal injury, product damage, delay in operation, or product failure caused by misuse are not covered by the Flowserve warranty.**

The following user information covers the Installation, Operation & Maintenance procedure for Worcester 3-Piece/Single piece flanged bolt on bonnet cryogenic Ball Valves.

CF44 Series:

Size Range : **NPS ½" – NPS 2" (DN15 – DN50)**

Pressure rating : Class 600

CF51/CF52 Series:

Size Range : **NPS ½" – NPS 8" (DN15 – DN200)**

Pressure rating : Class 150 & Class 300

Assembled with a Handle or pneumatic or electric linear actuator and comes with or without ancillary equipment.

These instructions are intended to familiarize the reader with the product and its permitted use. Operating the product in compliance with this instruction is important to help ensure reliability in service and avoid risks. These instructions may not take into account all local regulations; ensure such regulations are observed by all, including those installing the product. Always coordinate repair activities with operations personnel and follow all plant safety requirements and applicable safety and health legislation.

1.2 Disclaimer

Information in this User Instruction is believed to be complete and reliable. In spite of all Flowserve's efforts to provide comprehensive information and instructions, sound engineering and safety practices should always be used. Please consult with a qualified engineer.

Flowserve manufactures products to applicable International Quality Management System Standards as certified and audited by external Quality Assurance organizations. Genuine parts and accessories have been designed, tested, and incorporated into the products to help ensure continued product quality and performance in use. As Flowserve cannot test parts and accessories sourced from other vendors the incorrect incorporation of such parts and accessories may adversely affect the performance and safety features of the product. The failure to properly select, install, or use authorized Flowserve parts and accessories is considered to be misuse. Damage or failure caused by misuse is not covered by Flowserve's warranty. In addition, any modification of Flowserve products or removal of original components may impair the safety of these products in use.

1.3 Certification instruction

It is a legal requirement that machinery and equipment put into service within certain regions of the world shall conform to the Marking Directives applicable to Flowserve products (i.e., Machinery Directive, Low Voltage Directive, Electromagnetic Compatibility (EMC) Directive, Pressure Equipment Directive (PED), Equipment for Potentially Explosive Atmospheres (ATEX), etc.).

NOTICE Certificates defined in the Contract requirements are provided with these instructions where applicable. Examples of the certificates can be found in the Annex of this document. If required, copies of other certificates sent separately to the Purchaser should be obtained from the Purchaser for retention with this User Instruction.

1.4 Units

Dimension & Torque units

All dimensions' unit : Inches (Metric)

Torque unit : lb-ft (Nm)

2 Safety Information

2.1 Intended use



The product/system must not be operated beyond the parameters specified for the application. If there is any doubt as to the suitability of the product/system for the application intended, contact Flowserve for advice, quoting the serial number.

- Installing, operating, or maintaining the product/system in any way that is not covered in this User Instruction could cause death, serious personal injury, or damage to the equipment. This includes any modification to the product/system or use of the parts not provided by Flowserve.
- Only operate the product/system when it has successfully passed all inspection acceptance criteria
- Do not operate the product/system in a partially assembled condition.
- If the conditions of service on the customer's purchase order change (i.e., pumping fluid, temperature, or duty conditions) it is requested that the user seeks written agreement from Flowserve before starting up.
- Observe equipment labels, such as arrows designating the direction of rotation, warning signs, etc., and keep them in a legible condition. Replace any damaged and/or illegible labels immediately.

2.2 Safety symbols and description

This User Instruction contains specific safety markings where non-observance of an instruction would cause a hazard. The specific safety markings are:

Table I: Definition of safety symbols and markings

Symbol	Description
	DANGER This symbol indicates a hazardous situation which, if not avoided, will result in death or serious injury
	WARNING This symbol indicates a hazardous situation which, if not avoided, could result in death or serious injury
	CAUTION This symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury
	Safety Instruction This symbol indicates specific safety-related instruction or procedures
	NOTICE This symbol is used to address practices not related to physical injury
	This is the safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Table II: Additional symbols

Symbol	Description
	ELECTRICAL HAZARD This symbol indicates electrical safety instructions where non-compliance would affect personal safety and could result in loss of life
	TOXIC HAZARD This symbol indicates "hazardous substances and toxic fluid" safety instructions where non-compliance would affect personal safety and would damage the equipment or property
	ATEX EXPLOSION PROTECTION This symbol indicates explosive atmosphere marking according to ATEX. It is used in safety instructions where non-compliance in the hazardous area would cause the risk of an explosion

2.3 General hazard sources

2.3.1 Mechanical Hazards

a) Lifting limits and guidelines

NOTICE The load values mentioned in this section are Flowserve recommendations only. All lifting must be done in compliance with site safety protocol, local regulations, and related industry standards.

Many precision parts have sharp corners which require appropriate personal protective equipment during handling. Prior to any attempt to lift a Worcester cryogenic ball valve, employees must first determine the approximate weight and stability of the load.

- Large, unstable, or awkward loads should always be handled with the assistance of additional personnel or appropriate mechanical means.
- Loads in excess of 23 kg (50 lb.) should only be lifted by appropriate mechanical means and in accordance with current local legislation or with the assistance of additional personnel.
- Lifting items less than 23 kg (50 lb.) may be prohibited without assistance if the lift is repetitive and/or awkward (i.e., away from the body, above the shoulders or below the knees) thus placing excessive stress on the personnel.
- Repetitive lifting of any kind should be evaluated as part of a documented end-user safety program.
- Do not stand near the valve when it is lifted from ground. Keep the same gap.
- Do not use bonnet bolting or pressure controlling parts to lift the valves.
- Do not vibration / Hammer stem and bonnet bolting while installing the valve.

2.4 Qualified personnel and targeted group

All personnel involved in the operation, installation and maintenance of the unit must be qualified to carry out the work involved. If the personnel in question does not already possess the necessary knowledge and skill, appropriate training and instruction must be provided. If required, the operator may commission the manufacturer / supplier to provide applicable training.

Always co-ordinate repair activities with operation and health and safety personnel and follow all plant safety requirements and applicable safety and health laws and regulations.

2.5 Potential explosive areas



Measures are required to:

- Avoid excess temperature
- Prevent build-up of explosive mixtures
- Prevent the generation of sparks
- Prevent leakages
- Maintain the pump to avoid hazard

All instructions for equipment installed in potentially explosive atmospheres must be followed to help ensure explosion protection.



Use equipment only in the zone for which it is appropriate. Always check that all equipment is suitably rated and/or certified for the classification of the specific atmosphere in which they are to be installed.

2.6 Protective equipment

Wear the necessary protective equipment, like safety goggle, Hand gloves, Safety shoes during the unpacking, commissioning, installation, operation, and maintenance of Worcester ball valve.

3 Installation

3.1 General

NOTICE Valves intended for ammonia service must be of stainless (not brass) material.

CAUTION Flowserve recommends that all products which must be stored prior to installation be stored indoors, in an environment suitable for human occupancy. Do not store product in areas where exposure to relative humidity above 85%, acid or alkali fumes, radiation above normal background, ultraviolet light, or temperatures above 120°F or below 40°F may occur. Do not store within 50 feet of any source of ozone.

Check Body bolting, bonnet bolting and gland flange nut fastener torques prior to testing or installation and re-tighten as needed (see tables 1 to 5). These fasteners may loosen during shipment, which could result in external leakage. For valves operating at temperatures above 400°F (200°C) body bolting, bonnet bolting and gland flange nut torques should be re-checked and tightened as necessary.

WARNING Do not attempt any maintenance of these valves while in operation or under pressure. Actuated valve air and/or electrical power supplies must be locked off and isolated prior to any maintenance work. To do otherwise may result in significant equipment damage, hazardous material discharge, or serious personal injury. Ball valves can trap pressurized fluids in ball cavity when closed.

NOTICE DO NOT install valves with extended bonnets with the extension tilted more than 30° from the upright vertical position.

The valve is designed to maintain stem seals at normal ambient temperature. Do not insulate the extension fully — allow 3" – 4" of tube to protrude above the insulation.

3.2 Worcester Cryogenic ball valves

- 3.2.1 The Worcester Cryogenic ball valves are unidirectional for flow in one direction only and therefore can only be installed in one direction i.e., these valves are vented & should be installed with the arrow on the body pointed in the direction of normal flow. With the valve in the closed position, install it with the relief hole in the ball on the upstream side. The arrow on the body or bonnet will point downstream when the valve is open (Fig. 1).

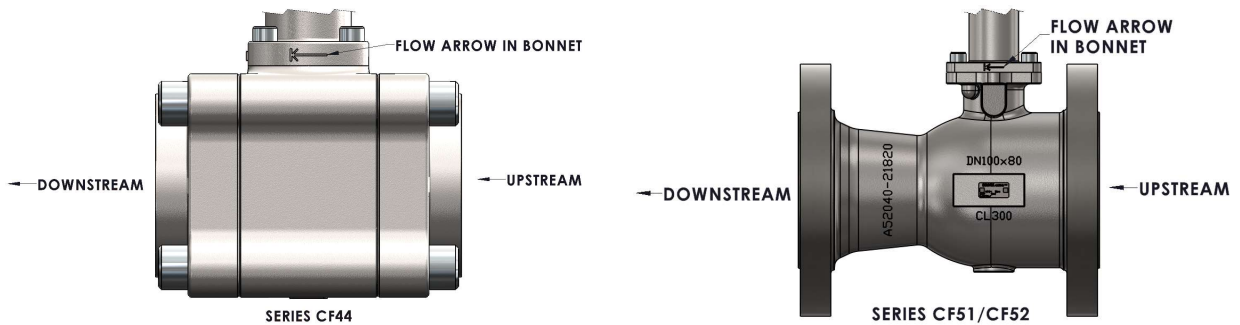


Figure 1 : Flow Direction

The Worcestercryogenic Diverter Valve must be installed with the bottom port on the upstream line.

3.2.2 Screwed End (SE) Valves (CF44)

SE valves are shipped with graphite body seals, do not dismantle these valves to install. Ensure that the pipeline and valve threads are clean. Apply a suitable thread sealant to the pipe threads and screw into the valve being careful not to over-tighten tapered threads. Do not use the valve wrench or stem as a lever to tighten the valve onto the pipe thread.

3.2.3 Weld end valves (BW, SW, SWO or TE) (CF44)

NOTICE Prior to welding thoroughly clean all joint surfaces to prevent contamination.

Worcestercryogenic brass valves are of leaded forging brass. Brazing cannot be successfully accomplished unless a white flux is used.

- Fully assembled weld end valves (butt and socket) must only be tack-welded into position, as the full weld heat will damage the seats and seals.
- After tack welding, remove the body centre section as per Section 7.1.1
- Complete the welding procedure after protecting the connector end faces from weld spatter. When gas welding, DO NOT play the flame upon the valve body.
- Allow the pipe ends to cool and then reassemble with ball, seats and new gaskets that are included with the valve. Refer Section 7.1.2 for reassembly.
- The body seals are NOT reusable. Upon removal from valve, they should be discarded and replaced with new parts.
- Avoid scratching/tearing of body seal during installation. Light lubrication of these seals can help to prevent damage.
- Swing center section back in line. Tighten and torque body bolts evenly and diagonally opposite each other, alternating in a criss-cross pattern. Use torque figures below:

Valve size		CF44 Body Bolting Torque			
NPS	DN	Bolt Diameter	Nm	lb-in	lb-ft
½"	15	M8	24 - 28	216 - 252	18 - 21
¾"	20	M8	25 - 29	228 - 264	19 - 22
1"	25	M10	27 - 31	240 - 276	20 - 23
1.5"	40	M12	35 - 39	312 - 348	26 - 29
2"	50	M14	98 -103	864 - 912	72 - 76

Table 1:
CF44 Valve Body Bolt Torque

Valve size		CF51/CF52 Body Insert		
NPS	DN	N-m	lb-in	lb-ft
½"	15	65 - 75	575 - 664	48 - 55
¾"	20	65 - 75	575 - 664	48 - 55
1"	25	70 - 80	620 - 708	51 - 59
1.5"	40	105 - 115	924-1020	77 - 85
2"	50	125 - 135	1104-1200	92 - 100
3"	80	760 -1100	6732-9732	561 - 811
4"	100	1120 - 1620	9912-14340	826 - 1195
6"	150	1810 - 2580	16020-22836	1335 - 1903
8"	200	3720 - 4980	32928-44076	2744 - 3673

Table 2:
CF51/CF52 Valve Body Insert Torque

Valve size		CF44 & CF51/CF52 Bonnet Bolting			
NPS	DN	Bolt Size	N-m	lb-in	lb-ft
½"	15	M5	5 - 7	46 - 60	4 - 5
¾"	20	M5	5 - 7	46 - 60	4 - 5
1"	25	M5	5 - 7	46 - 60	4 - 5
1.5"	40	M6	9 - 12	79 - 108	7 - 9
2"	50	M6	9 - 12	79 - 108	7 - 9
3"	80	M10	43 - 60	378 - 528	32 - 44
4"	100	M10	43 - 60	378 - 528	32 - 44
6"	150	M12	75 - 103	659 - 912	55 - 76
8"	200	M16	185 - 257	1635 - 2280	136 - 190

Table 3:
CF44 & CF51/CF52 Bonnet Bolting Torque

Valve size		CF44 & CF51/CF52 Gland Bolting			
NPS	DN	Bolt Size	N-m	lb-in	lb-ft
½"	15	M8	4.5 – 5.5	40 – 48.5	3.3 - 4
¾"	20	M8	4.5 – 5.5	40 – 48.5	3.3 - 4
1"	25	M8	4.5 – 5.5	40 – 48.5	3.3 - 4
1.5"	40	M8	4.5 – 5.5	40 – 48.5	3.3 - 4
2"	50	M8	4.5 – 5.5	40 – 48.5	3.3 - 4
3"	80	M10	4.5 – 5.5	40 – 48.5	3.3 - 4
4"	100	M10	4.5 – 5.5	40 – 48.5	3.3 - 4
6"	150	M14	26.5 - 29	234.5 – 256.5	19.5 – 21.4
8"	200	M14	26.5 - 29	234.5 – 256.5	19.5 – 21.4

Table 4:
CF51/CF52 Gland bolting Torque

4 Operation

4.1 General

- A. **▲CAUTION** DO NOT leave the ball partly open. DO NOT throttle with Worcester cryogenic valves. It will result in seat breakage.
- B. **▲CAUTION** DO NOT allow media that can solidify, crystallize, or polymerize to stand in the valve cavity.

4.2 Worcester Cryogenic Ball Valve

To operate the Worcester Cryogenic Ball Valve, turn the stem ¼ turn clockwise to close and ¼ turn counter-clockwise to open.

On manually operated valves, the handle, and the arrow on the top stem flat act as pointers. When they point across the pipeline, the valve is closed. When they point downstream, the valve is open.

4.3 Worcester Cryogenic Diverter Valve

To operate the Worcester Cryogenic Diverter Valve, rotate handle ¼ turn to divert the flow from the bottom port to either of the side ports. The diverter valve comes with a 90° ball (V1) and the arrow on the top stem flat can be disregarded. The diverter valve also comes with a special 180° ball (V2). In this case the handle would be rotated ½ turn and the handle and the arrow on the top stem flat would point to the port to which flow was diverted.

These valves will provide positive shutoff when used in accordance with the Worcester Cryogenic Valve pressure/temperature chart.

4.4 Torque Requirements

- a. The valve torque will vary depending on the length of time between cycles, line pressure, type of valve seats, and the media in the system.

- b. All figures in the following tables are based on calculated torque values. These figures should approximate the actual valve torque. For a more detailed analysis of valve torque requirements, see the Worcester Actuator Sizing Manual.
- c. Below torque values are Polyfill /Fluorofill seated valves at rated pressure, reach out to Flowserve for other seat variant torque values.

Valve size		CF44 Valve torque (3-pc) @ 1480 psi (102 bar)		
NPS	DN	N-m	lb-in	lb-ft
½"	15	10	89	8
¾"	20	16	142	12
1"	25	20	177	15
1.5"	40	41	363	30
2"	50	56	496	41

**Table 5:
CF44 Valves Torque**

Valve size		CF51 Valve Torque @ 290 psi (20 Bar) (Flanged)			CF52 Valve Torque @ 725 psi (50 Bar) (Flanged)		
NPS	DN	N-m	lb-in	lb-ft	N-m	lb-in	lb-ft
½"	15	10	89	8	10	89	8
¾"	20	12	106	9	13	115	10
1"	25	14	124	10	17	150	13
1.5"	40	27	239	20	32	283	24
2"	50	37	327	27	44	389	32
3"	80	99	876	73	133	1177	98
4"	100	148	1310	109	193	1708	142
6"	150	228	2018	168	271	2398	200
8"	200	341	3018	252	422	3735	311

**Table 6:
CF51 /CF52 Valves Torque**

5 Maintenance

5.1 General

Good operating and maintenance procedures include periodic inspection of valves and other piping system components, to ensure that they are operating properly. Inspection schedules must be determined by individual user, but as a minimum should consist of visually examining valves for external leakage and making adjustments as necessary.

▲WARNING Do not attempt any maintenance of these valves while in operation or under pressure. Actuated valve air and/or electrical power supplies must be locked off and isolated prior to any maintenance work. To do otherwise may result in significant equipment damage,

hazardous material discharge, or serious personal injury. Ball valves can trap pressurized fluids in ball cavity when closed.

5.2 Stem Seal Adjustment

The Worcester Cryogenic Valve with the extended bolt on bonnet normally operates with the bonnet at a higher temperature than the valve. Because of this, there will be a frost line about two-thirds of the way up the extension. If the bonnet should become covered with frost, that would be an indication that the packing rings were leaking.

If stem leakage is noted, then adjust Gland Bolts or Nuts per following procedure:

⚠ CAUTION Excessive tightening causes higher torque and shorter stem seal life.

- C. Packing ring readjustment procedure if possible:
 - a. Allow the valve to warm to ambient temperature to allow packing rings to become more flexible.
 - b. Tighten the gland bolts or gland nuts per [Table 4](#).

⚠ CAUTION The Gland Bolts or Gland Nuts is difficult to tighten and must fully flatten Belleville washers before backing off.

6 Repair Kits

- 6.1 A standard repair kit can be ordered for the Worcester Cryogenic Valve containing all necessary parts for normal valve rebuilding (Seat, Body seal, Bonnet seal, Fire-Safe bonnet seal and stem packings). To order a repair kit, reach out to Flowserve Cookeville sales team.
- 6.2 If the valve is a non-standard product, then there will be a special code attached to valve smart code. To order a special repair kit, reach out to Flowserve Cookeville sales team.

⚠ CAUTION If the seats and seals installed differ from those removed, the valve nameplate or stop must be replaced or remarked to indicate the altered materials and ratings, or valve tagged to so indicate.

- 6.3 If replacement parts other than those included in the repair kit are needed, order the part by name and size, and include the complete valve codes along with order no if possible.

7 Rebuilding

⚠ WARNING Do not attempt any maintenance of these valves while in operation or under pressure. Actuated valve air and/or electrical power supplies must be locked off and isolated prior to any maintenance work. To do otherwise may result in significant equipment damage, hazardous material discharge, or serious personal injury. Ball valves can trap pressurized fluids in ball cavity when closed.

SAFETY INSTRUCTIONS THIS MANUAL CONTAINS EXPLODED VIEWS (FIGURE 2 & FIGURE 3) OF THE VALVES COVERED BY THE TEXT. THEY HAVE BEEN INCLUDED TO AID IN THE REBUILDING OF VALVES. PLEASE REFER TO THEM WHEN FOLLOWING THE WRITTEN INSTRUCTIONS.

IF THE VALVE HAS BEEN USED TO CONTROL HAZARDOUS MEDIA, IT MUST BE DECONTAMINATED BEFORE DISASSEMBLY.

7.1 Disassembly Instructions

▲CAUTION It is recommended that the following steps be taken for safe removal and disassembly:

- Relieve the line pressure. Operate the valve prior to attempting removal from line.
- Place valve in half-open position and flush the line to remove any hazardous material from valve.
- All persons involved in the removal and disassembly of the valve should wear the proper protective clothing such as face shield, gloves, apron, etc.

7.1.1 Disassembly of CF44 Cryogenic (3-PC) Valves:

1. Set the valve in open position (wrench / stem flats in line with the pipeline) to prevent the ball protruding out of the body and fouling on the pipe end when the body is removed. (Refer [Figure 2](#) Exploded view for parts identification)
2. Remove automation package if fitted on the valve.
3. Follow below only if the valve is Wrench Operated if not skip these points:
 - a. Remove Handle Nut and then Lock Washer from stem stop and then remove Handle.
 - b. Unscrew Socket Cap screws from Bonnet and remove Locking Bracket.
4. The pipe end must be pulled apart slightly to prevent scoring of the machined faces. In these valves, the pipe end must be pulled apart even further to allow clearance for the body seal spigot. (Refer [Figure 2](#) Body seal arrangement for clarity)
5. Extract all the body screws and slide the body assembly completely from the two body connectors. Take care not to damage the connector sealing faces.
6. Remove the seat from each side and the body seals can now be discarded from the body if it doesn't slide out along with the pipe end.
7. Close the valve and using a soft drift, tap out the ball.
8. To dismantle the stem, remove:
 - Bonnet Screws and take the bonnet assembly apart
 - Wrench Assembly or Automation package (if fitted)
 - Gland bolts or nuts
 - Belleville Washers
 - Gland Flange
 - Gland Follower
9. Remove the stem through the bonnet. If it is harder to take out the stem from the bonnet, slightly tap the stem top so that it slide from the bonnet.
10. The gland packing (Packing Rings & Chevron Packing) and the stem bearing can now be removed from top of the bonnet.
11. Fire-safe seal, thrust seal and support washer can be removed from the bottom of the bonnet if these doesn't slide out with the stem.
12. Remove Stem bearing, Fire-safe bonnet seal and bonnet seal from the body.
13. All components not replaced by parts in the repair kit should be thoroughly cleaned and stored in a clean, secure area.
14. Care should be taken not to damage any sealing faces while removal and all sealing faces on the body, pipe end and ball must be checked for corrosion, erosion, and scratches. If damage is found or there is any reason to believe that a part is damaged, replace the part.

15. Clean all sealing surfaces of valve including ball. Valve parts should be cleaned using a suitable degreasing agent. Hard deposits can be removed using stainless steel wire wool. Care should be taken to avoid damaging sealing faces.

NOTICE The ball and the surfaces against which the seats and seals are installed should be undamaged, clean, and free of pit marks and scratches. Light marring from the action of the ball against the seats is normal and will not affect the operation of the valve. Flaws which can be seen but barely detected with fingertips are acceptable. The stem and body surfaces that the thrust bearings and packing ring contact must be undamaged, clean and free from pit marks or scratches.

7.1.2 To Reassemble Series CF44 Cryogenic (3-PC) Valves:

NOTICE Usage of Lubricants: It is recommended to apply lubricants while different steps of the assembly on stem bearing, bonnet bearing, ball and seats with a lubricant compatible with media. White petroleum jelly is a good general-purpose lubricant. Light lubrication on support washer, packing arrangement and follower with a PTFE-based lubricant such as Fluorolube S-30 or equivalent is recommended, except for valves which are assembled dry.

1. Ensure that the repair kit and/or spare parts are suitable for the valve being refurbished.
2. Cleanliness is essential for long valve life. The seats may be lightly lubricated with a light oil to aid bedding in. Ensure that the lubricant is compatible with the pipeline media, and the pressure and temperature of the application.
3. Take the stem and slide out the parts one by one starting from Support Washer, new thrust seals & new Fire-safe seals from top. Consider this as stem assembly. (Refer [Figure 2](#) Exploded view for all parts identification)
4. Take the bonnet and insert the Stem assembly from the bottom of the bonnet. Then insert parts one by one starting from stem bearing, packing ring bottom, new chevron packing, packing ring top, Gland Follower,
5. Place the gland Flange, new Belleville washers and tighten the gland bolts or gland nuts until per [Error! Reference source not found.4](#). Consider this as bonnet assembly.
6. Take the body and place the stem bearing, new Fire-safe bonnet seal, new bonnet seal into the body and then assemble the bonnet assembly while making sure all the holes are aligned between body and the bonnet. Tighten the body-bonnet screws per the recommended torque from [Table 3](#) (or) Tighten to metal to metal. Rotate the stem so that it will be in closed condition.
7. Place the ball (see notes below) in the body inserting into the projection extending from the bottom of the stem tang into the slot machined in the ball. The relief hole in the face of the ball should be on the upstream side of the valve, when in the closed position, to ensure that cavity relief is upstream i.e., when the ball is opened the hole in the ball should be opposite to the flow arrow that is in the bonnet.

NOTICE For diverter valves, install ball as follows:

- V1 (90° Valves):
With handle and/or stem flats in line with body main axis, viewed from upstream side, one ball port is to the right, one is down, and the other is on opposite end of valve.
- V2 (180° Valves):
Using same convention as V1, one ball port is down and the other is on opposite end of valve.

8. Turn the ball to the valve open position using the stem flats to stop the ball from falling out and from fouling the pipe end when the valve is placed back into the pipeline.
9. Install new seats and new body seals in the body, which are specially prepared by Flowserve for cryogenic service.
10. Clean the sealing faces of the pipe ends before refitting. The pipe end must be pulled apart to place the body back into position without damaging the seats, seals, and sealing faces.
11. Centralise the body, place the body screw and tighten diagonally and evenly to the correct torque on both sides. Tighten the body-pipe ends screws per the recommended torque from [Table 1](#).
12. Follow below only if the valve is Wrench Operated if not skip these points:

NOTICE Note:
Flow Arrow direction and Handle end should be opposite to each other after installation, refer [Figure 2](#) Exploded view for clarity on the installation)

 - a. Place Locking Bracket on Bonnet top and install Socket Cap screws on top of it.
 - b. Insert Handle and then Lock Washer from the top of the stem and then install Handle Nut.
13. Cycle the valve 4-5 times to ensure displacement of cryogenic lubrication on seats.

7.1.3 Disassembly of CF51/CF52 Cryogenic (Flanged) Valves:

1. Remove automation package if fitted on the valve.
2. Follow below only if the valve is Wrench Operated if not skip this point:
 - a. For CF51/52 (1/2" to 2"):
Remove Handle Nut and then Lock Washer from stem stop and then remove Handle. Unscrew Socket Cap screws from Bonnet and remove Locking Bracket
 - b. For CF51/52 (3" & 8"):
Remove Hex Cap screw from Wrench Block, then slide out the pipe from the side and then remove Wrench Block. Unscrew Socket Cap screws from Bonnet and remove Locking Bracket & stop plate.
3. Remove the valve from line. Unscrew the insert and set aside. (Refer [Figure 3](#) Exploded view for parts identification).

NOTICE If required, insert disassembly tools are available from your supplier or from Flowserve.
4. If the body seal was not removed with the inert, remove it from the valve and discard. Remove and discard the near seat and seat back seal (if any).
5. Place valve in closed position and remove the ball and as well the other seat from far end.
6. To dismantle the stem, remove:
 - Bonnet Screws and take the bonnet assembly apart
 - Wrench Assembly
 - Gland bolts or nuts
 - Belleville Washers
 - Gland Flange
 - Gland Follower
7. Remove the stem through the bonnet. If it is harder to take out the stem from the bonnet, slightly the tap the stem top so that it slide from the bonnet.
8. The gland packing (Packing Rings & Chevron Packing) and the stem bearing can now be removed from top of the bonnet.
9. Fire-safe seal, thrust seal and support washer can be removed from the bottom of the bonnet if these doesn't slide out with the stem.
10. Remove Stem bearing, Fire-safe bonnet seal and bonnet seal from the body.

11. All components not replaced by parts in the repair kit should be thoroughly cleaned and stored in a clean, secure area.
12. Care should be taken not to damage any sealing faces while removal and all sealing faces on the body, insert and ball must be checked for corrosion, erosion, and scratches. If damage is found or there is any reason to believe that a part is damaged, replace the part.
13. Clean all sealing surfaces of valve including ball. Valve parts should be cleaned using a suitable degreasing agent. Hard deposits can be removed using stainless steel wire wool. Care should be taken to avoid damaging sealing faces.

NOTICE The ball and the surfaces against which the seats and seals are installed should be undamaged, clean, and free of pit marks and scratches. Light marring from the action of the ball against the seats is normal and will not affect the operation of the valve. Flaws which can be seen but barely detected with fingertips are acceptable. The stem and body surfaces that the thrust bearings and packing ring contact must be undamaged, clean and free from pit marks or scratches.

7.1.4 To Reassemble Series CF51/CF52 Cryogenic (Flanged) Valves:

NOTICE Usage of Lubricants: It is recommended to apply lubricants while different steps of the assembly on stem bearing, bonnet bearing, ball and seats with a lubricant compatible with media. White petroleum jelly is a good general-purpose lubricant. Light lubrication on support washer, packing arrangement and follower with a PTFE-based lubricant such as Fluorolube S-30 or equivalent is recommended, except for valves which are assembled dry.

1. Ensure that the repair kit and/or spare parts are suitable for the valve being refurbished.
2. Cleanliness is essential for long valve life. The seats may be lightly lubricated with a light oil to aid bedding in. Ensure that the lubricant is compatible with the pipeline media, and the pressure and temperature of the application.
3. Place the stem bearing and new Fire-safe bonnet seal, new bonnet seal into the body
4. Take the stem and slide out the parts one by one starting from Support Washer, new thrust seals & new Fire-safe seals from top. Consider this as stem assembly. (Refer [Figure 3](#) Exploded view for all parts identification)
5. Take the bonnet and insert the Stem assembly from the bottom of the bonnet. Then insert parts one by one starting from stem bearing, packing ring bottom, new chevron packing, packing ring top, Gland Follower, Gland Flange, new Belleville washers and tighten the gland bolts per torque [Table 4](#).
6. Take the body and place the stem bearing, new Fire-safe bonnet seal, new bonnet seal into the body. Insert one new seat (Mandatory for smaller size valves ½"-1" CF51/CF52) to the far end and then assemble the bonnet assembly while making sure all the holes are aligned between body and the bonnet. Tighten the body-bonnet screws per the recommended torque from [Table 3](#) (or) Tighten to metal to metal. Rotate the stem so that it will be in closed condition.
7. Insert the ball (see notes below) in the body inserting into the projection extending from the bottom of the stem tang into the slot machined in the ball. The relief hole in the face of the ball should be on the upstream side of the valve (insert side), when in the closed position, to ensure that cavity relief is upstream i.e., when the ball is opened the hole in the ball should be opposite to the flow arrow that is in the bonnet.

NOTICE For diverter valves, install ball as follows:

- V1 (90° Valves):

With handle and/or stem flats in line with body main axis, viewed from upstream side, one ball port is to the right, one is down, and the other is on opposite end of valve.

- V2 (180° Valves):

Using same convention as V1, one ball port is down and the other is on opposite end of valve.

8. Insert the new body seal to the body. Take the insert and install the second new seat. The insert must now be assembled in the body and fully tightened against machined step in the body. If in doubt, assemble end plug without seat and seal, make a witness mark, and reassemble the full assembly.

9. Follow below only if the valve is Wrench Operated if not skip these points:

NOTICE Note: Flow Arrow direction and Handle end should be opposite to each other after installation, refer [Figure 3](#) Exploded view for clarity on the installation)

- a. For CF51/CF52 (1/2" to 2"):

Place Locking Bracket on Bonnet top and install Socket Cap screws on top of it. Insert Handle and then Lock Washer from the top of the stem and then install Handle Nut.

- b. For CF51/CF52 (3" to 8"):

From top, insert the stop plate onto the stem and then place Locking Bracket on Bonnet top and install Socket Cap screws on top of it. Insert Wrench Block on the top of the stem and then slide the pipe into the Wrench block from the side. Note that Pipe is adjustable and can either be installed on the end or at the centre. Align the holes on the pipe (either on the end or on the centre) to the Wrench Block hole on the top and insert the Hex Cap Screw and tighten it.

10. Cycle the valve several 4-5 times to ensure displacement of cryogenic lubrication on seats.

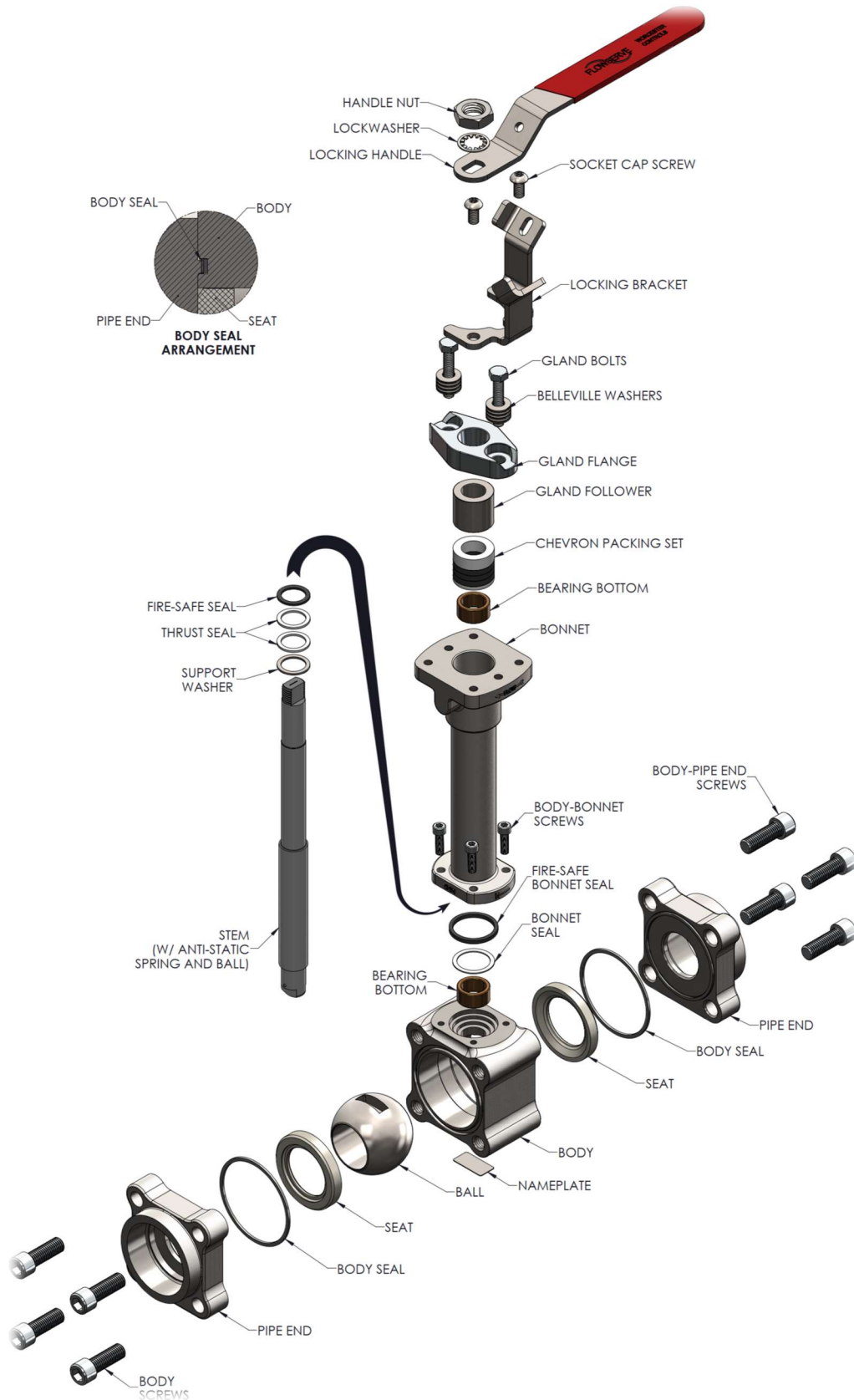


Figure 2 :
Series CF44 Exploded View (3-PC)

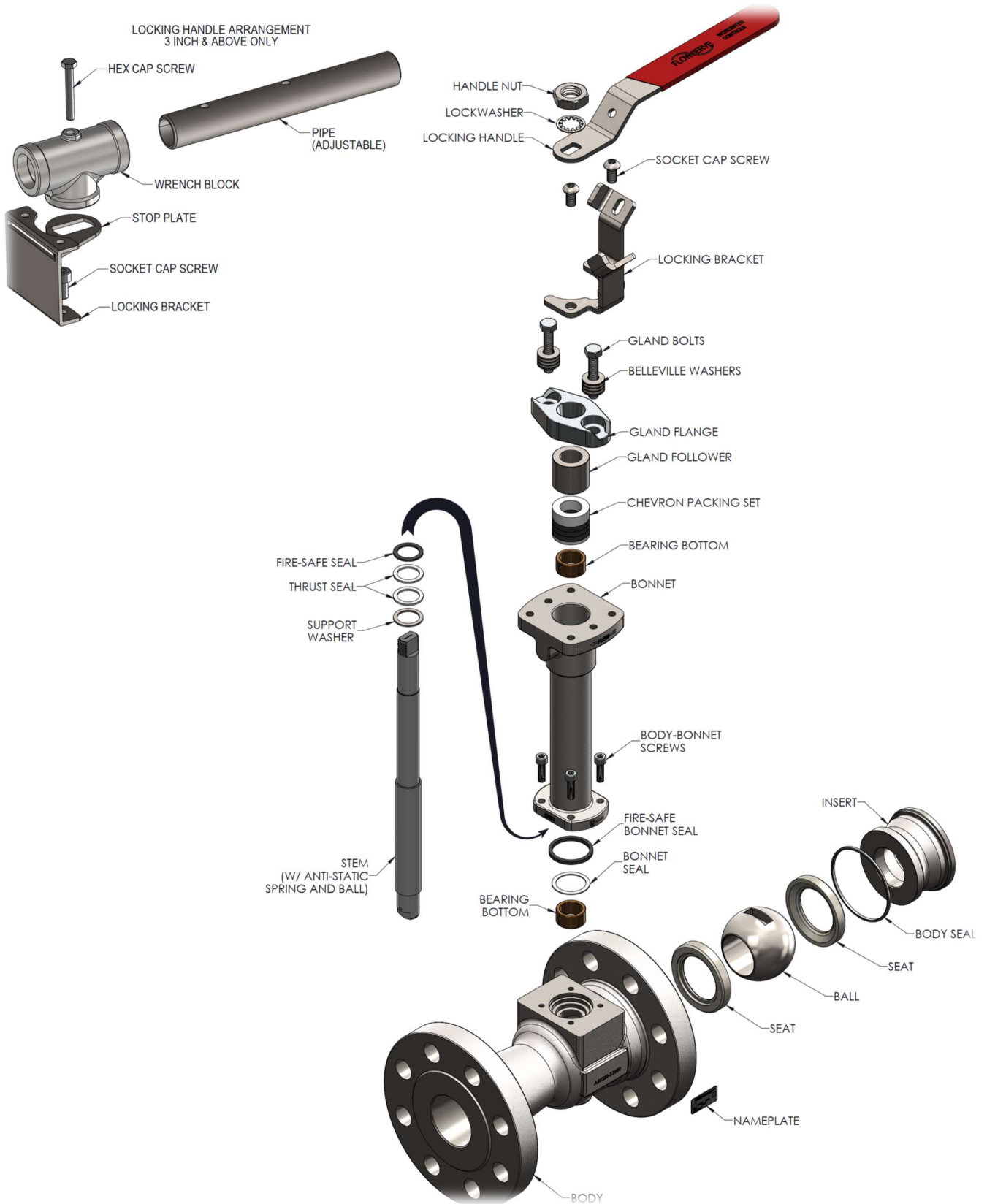


Figure 3 :
Series CF51/CF52 Exploded View

8 Troubleshooting

⚠️WARNING Do not attempt any maintenance of these valves while in operation or under pressure. Actuated valve air and/or electrical power supplies must be locked off and isolated prior to any maintenance work. To do otherwise may result in significant equipment damage, hazardous material discharge, or serious personal injury. Ball valves can trap pressurized fluids in ball cavity when closed.

Sl. No.	Problems	Problem Descriptions	Possible Causes	Recommended actions
1	External Leakage	Leakage between body-pipe end (CF44) or between body-insert (CF51/CF52) or body-bonnet connections	Body bolting loose (CF44)	Tighten body bolting (Follow Table 1)
			Body seals not compressed as recommended (CF51/CF52)	Tighten body insert recommended torque value (Follow Table 2)
			Bonnet bolting loose (CF44 & CF51/CF52)	Tighten bonnet bolting (Follow Table 3) (or) Tighten to metal to metal.
			Damaged body seals & bonnet seals	Remove body (or) bonnet from pipeline at no pressure condition & replace both body seals / bonnet seals. Refer disassembly / reassembly Section of this IOM.
		Leakage through Stem packing	Gland bolting loose	Tighten gland bolting (Follow Table 4)
			Packing not compressed	Compress packing by tightening gland bolting
			Packing damage	Remove stem packing from bonnet and replace new stem packings. Refer disassembly / reassembly Section of this IOM.
		Leakage through Pipeline connections (CF51/CF52)	Flange gasket	Tighten flange bolting / Replace Gasket
			Flange serrations	Remove body valve from pipeline at no pressure and re-machine the serration and reassemble. Contact Flowserve engineering team if any guidance is required.
		Leakage through welding connection** (CF44)	Welding not penetrated well	Clean the welded region and reweld again with help of certified welder.
Welding porosity	Clean the welded region and reweld again with help of certified welder.			
2	Internal Leakage	Leakage through seats	Sudden leakage	Operate the valve 4-5 times and see if any leakage
			Valve not fully closed condition	Adjust the lever and make sure that it is at 90° angle to pipeline.
		Due to ball and seat surface contact	Seat sealing surface / Damage seat	Remove ball & seat from pipeline and replace new seats as per disassembly / reassembly Section of this IOM.

			Ball surface finish	Remove ball from valve and replace new Ball as per disassembly / reassembly Section of this IOM
			Ball & seat both are not aligned	Disassemble the valve and assemble again. Contact Flowserve engineering team if any guidance is required. Refer disassembly / reassembly Section of this IOM.
3	High Torque	High valve torque due to ball and seat	Ball & seat pushed to one side	Disassemble the valve and check ball & seat conditions if required replace new components or Contact Flowserve engineering team. Refer disassembly / reassembly Section of this IOM.
		Valve not operated for long time	Deposits on ball and seat contact surface	Depressurize the valve and disassemble the valve. Clean ball & seat surface and assemble again. Refer disassembly / reassembly Section of this IOM.
		Due to galling	Stem, Bonnet & gland galling mainly on Bonnet stem bore surface.	Disassemble the valve and check Stem & Bonnet conditions. Refer disassembly / reassembly Section of this IOM.
			Ball & seat material surface galling (only applicable for metal seated valves)	Disassemble the valve and check Seat & Ball conditions. Replace ball and seat If any scratch mark on the contact surface. Refer disassembly / reassembly Section 7 of the IOM.

**Table 7:
Valve Troubleshooting**

NOTICE

** Welding to be performed per ASME Section IX, also that no excess heat should be applied to the seat areas, to avoid distortion.

Below are the Recommended Repair Parts for Troubleshooting

- Seats
- Body Seals
- Bonnet Seal
- Fire-Safe Bonnet Seal
- Thrust Seal
- Fire-Safe Seal
- Chevron Packing
- Belleville Washers

9 Storage

9.1 Short Term Storage Instructions/Recommendation

- 9.1.1 The following instructions are recommended where valve storage is intended for valves that are to be stored on site prior to installation up to six months. Extended storage beyond six months may require additional instructions depending on the location.
- 9.1.2 During on-site storage, all valves with special cleaning and/or preparation, should be kept in original special packaging as shipped from Flowserve for protection from contamination.
- 9.1.3 Valves should be stored indoors, above ground and protected from harsh environments.
- 9.1.4 Always store valves in a clean dry location and away from dust, dirt, debris, corrosive materials and wet areas. Water must not be allowed to enter actuated pneumatic cylinder or electrical connections.
- 9.1.5 Keep the valves in a cool location and out of exposure to direct sunlight and excessive heat.
- 9.1.6 Ball and plug valves should be stored in the open position.
- 9.1.7 Actuated valves should be stored in a horizontal position.

9.2 Long Term Storage Instructions/Recommendation

- 9.2.1 In addition to short term instructions the following instructions are recommended where valve storage is intended for valves that are to be stored on site for periods exceeding six months.
- 9.2.2 Valves should be stored indoors, above ground and protected from harsh environments where temperature exceeds minimum of -20°F (or) maximum of 180° F to prevent seal compression set.

9.3 Recommended six-month maintenance for Long Term Storage

- 9.3.1 Visually inspect valve assembly ensuring valve original special packing as shipped from Flowserve is in its original condition.
- 9.3.2 Cycle manual valve three complete cycles.
- 9.3.3 Cycle automated valves using dry instrument air or dry Nitrogen.
- 9.3.4 Replace desiccants and reseal protective packaging.

9.4 Elastomers/Soft Goods

- 9.4.1 Per the manufacturers, "All mechanisms by which rubber deteriorates with time are attributed to environmental conditions. Therefore, storage conditions, not time, determine the life of rubber seals."
- 9.4.2 To preserve the physical properties of the components containing elastomers widely used in our valves, the following storage conditions must be adhered to:
 - Ambient temperatures not to exceed 120 degrees F.
 - Exclusion of all significant contaminants and foreign materials.
 - Exclusion of direct sunlight.
 - Exclusion of significant radiation.
 - Exclusion of significant ozone.

9.5 Age control

- 9.5.1 It is recommended that users refer to the IOM for recommended adjustments to be performed prior to using shelf stored valves that fall within the short- and long-term conditions specified in this procedure.
- 9.5.2 Fasteners and packing nut torque checks are recommended to ensure fasteners and nuts remain per IOM published values prior to using stored valves.
- 9.5.3 For most commonly used elastomers used on Flowserve Cookeville Valves see table 9.

Description	Projected shelf life
Nitrile, Buna-N	10 Yrs.
Viton O-rings	20 Yrs.
EPDM	10 Yrs.
PTFE	Unlimited

**Table 8:
Age Controls for different Elastomers**



NOTICE

Worcester Valves are designed and manufactured using good workmanship and materials, and they meet all applicable industry standards. Flowserve Corp. is anxious to avoid injuries and property damage which could result from misapplication of the product. Proper valve selection is imperative. Examples of the misapplications or misuse of a valve include but are not limited to use in a service in which the pressure/temperature rating is exceeded or in a chemical service incompatible with the valve materials; use of undersized valve actuators; use of extremely fast valve actuation and/or continuous valve cycling on standard valves; making modifications of the product of any kind; failure to use caution in operating valves in high temperature, high pressure, or highly hazardous services; and the failure to maintain valves as recommended. The right is reserved to change or modify product design or construction without prior notice and without incurring any obligation to make such changes and modification on products previously or subsequently sold.

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