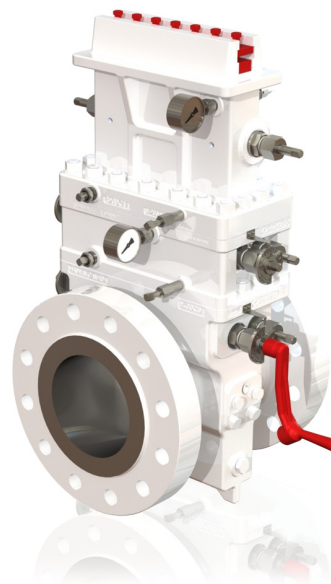


FPD220

Dual-chamber orifice fitting with double block and bleed

Measurement made easy



Introduction

ABB's FPD220 dual chamber orifice fitting with double block and bleed is a proven system for safely and quickly inspecting and changing orifice plates in conformance with strict Oil & Gas industry guidelines.

To ensure safe removal of the orifice plate while the line remains pressurized and the product continues to flow, the device must demonstrate that it offers proven isolation of the process from the plate removal area. The FPD220 solution meets these requirements by complying with the HSG253 publication *The safe isolation of plant and equipment* and having been classified as having 'Category II Proved Isolation'. The FPD220 displays the pressures in each chamber using full safety pattern pressure gauges and, before plate removal, these can be monitored; either for absolute value or for time-dependent degradation, as required.

These operating instructions provide installation, operation and maintenance procedures for the FPD220 dual chamber orifice fitting with double block and bleed.

For more information

Further publications for the FPD220 dual chamber orifice fitting are available for free download from www.abb.com/measurement or by scanning this code:



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1 Health & Safety

1.1 Document symbols

Symbols that appear in this document are explained below:



DANGER – Serious damage to health / risk to life

This symbol in conjunction with the signal word 'DANGER' indicates an imminent danger. Failure to observe this safety information will result in death or severe injury.



WARNING – Bodily injury

This symbol in conjunction with the signal word 'WARNING' indicates a potentially dangerous situation. Failure to observe this safety information may result in death or severe injury.



CAUTION – Minor injuries

This symbol in conjunction with the signal word 'CAUTION' indicates a potentially dangerous situation. Failure to observe this safety information may result in minor or moderate injury. The symbol may also be used for property damage warnings.



NOTICE – Property damage

This symbol indicates a potentially damaging situation. Failure to observe this safety information may result in damage to or destruction of the product and / or other system components.



IMPORTANT (NOTE)

This symbol indicates operator tips, particularly useful information or important information about the product or its further uses. The signal word 'IMPORTANT (NOTE)' does not indicate a dangerous or harmful situation.

1.2 Safety precautions

Be sure to read, understand and follow the instructions contained within this manual before and during use of the equipment. Failure to do so could result in bodily harm or damage to the equipment.



WARNING – Bodily injury

Pressurized equipment

- Installation, operation, maintenance and servicing of pressurized equipment must be performed:
- by suitably trained personnel only
 - in accordance with the information provided in this manual
 - in accordance with relevant local regulations
-

1.3 Potential safety hazards



WARNING – Bodily injury

To ensure safe use when operating this equipment, the following point must be observed:

- Orifice fittings and their components present both heavy lifting and tip-over hazards. Operators must wear suitable PPE at all times and have strategies in place for safely lifting, moving and storing orifice fittings and their components.

Safety advice concerning the use of the equipment described in this manual or any relevant Material Safety Data Sheets (where applicable) can be obtained from the Company, together with servicing and spares information.



NOTICE – Property damage

The soft-seat valve seal design does not require lubrication through the grease port. Attempting to lubricate the FPD220 orifice fitting equipped with a soft-seat slide valve causes the inner O-ring seal to be ejected from the dovetail groove resulting in valve failure.

1.4 Product recycling and disposal (Europe only)



IMPORTANT (NOTE) For return for recycling, please contact the equipment manufacturer or supplier for instructions on how to return end-of-life equipment for proper disposal.

1.5 Lifting and handling

This product requires mechanical lifting devices and techniques. All safety activities associated with lifting techniques and equipment must be in accordance with local laws and the receiving company's HSE policies and procedures, and shall be followed without exception. Extreme care must be exercised throughout the operation to prevent both injury to personnel and damage to the meter. Proper rigging and lifting techniques must be followed. Do not stand under suspended loads. Improper handling may cause injury and / or damage. SAFETY FIRST.

This product is delivered to its destination in a wooden crate or strapped to a wooden pallet and is easily moved using a standard forklift. There are scenarios, however, where a meter run or fitting must be moved without the aid of a frame. In both cases, care must be taken to assess the weight of the package and ensure that the machinery and lifting aids are appropriate to the items being handled. Crate, pallet and / or meter run weights are documented on the commercial invoice or packing slip accompanying the shipment.

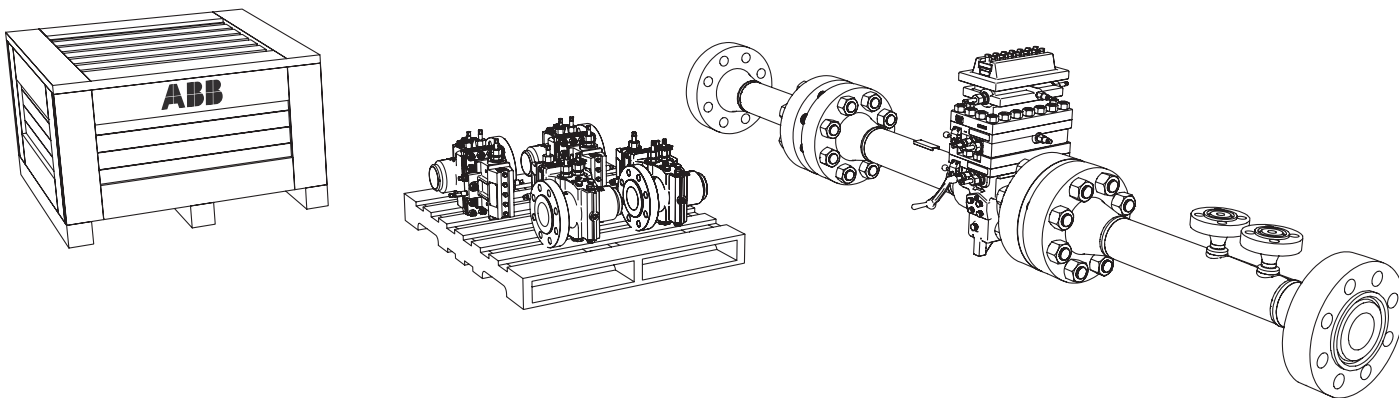


Fig. 1.1 Product packaging

1.5.1 Lifting / moving products in crates and on pallets

Select an appropriate forklift based on the weight of the package being handled. Use fork extensions if necessary.

Center the forks so the load is evenly distributed. Ensure the load is balanced and secure prior to lifting. Use extra strapping to secure unstable loads.

Drive the forks into the load as far as possible. Avoid contact with any parts of the load that may extend past the edge of the pallet. Tilt the load back slightly, then lift.

Keep the load as low as possible while traveling, keep an even pace and avoid fast starts and sudden stops.

1.5.2 Lifting / moving meter runs

Select an appropriate forklift and lifting straps based on the weight of the meter run being handled. Position the forks as narrowly as possible to create a single lifting point.

Determine the meter run's center of gravity and position the lifting straps as shown in Fig. 1.2, ensuring the meter run is balanced when lifted. Ensure the lifting straps are wrapped in opposing directions to prevent the meter run from rotating and swinging.

Slide the ends of the lifting straps over the forks, positioning them as close to the forklift body as possible, while ensuring the meter run does not make contact with the forklift.

Tilt the load back slightly, then lift. Keep the forks as low as possible while traveling, keep an even pace and avoid fast starts and sudden stops.

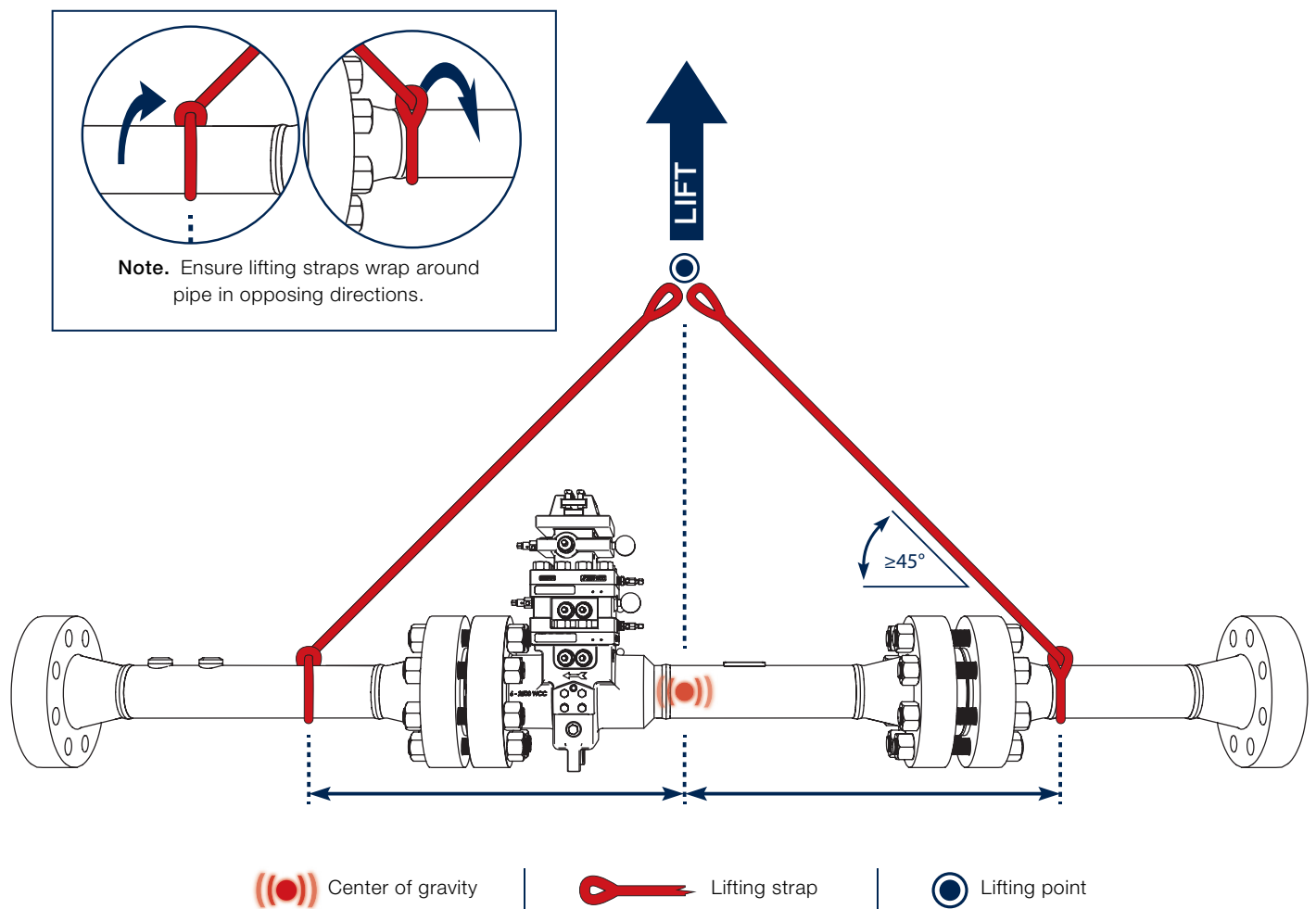


Fig. 1.2 Lifting meter runs



IMPORTANT (NOTE)

Fig. 1.2 does not reflect all configurations. Centers of gravity may not be exactly as shown.

1.5.3 Lifting / moving orifice fittings

Select an appropriate forklift and lifting strap based on the weight of the fitting being handled. Position the forks as narrowly as possible to create a single lifting point.

Wrap the lifting strap around the fitting, under the shoulder of the upper chamber as shown in Fig. 1.3.

Slide the end of the lifting strap over the forks, positioning the strap as close to the forklift body as possible while ensuring the fitting does not make contact with the forklift. Adjust as necessary.

Tilt the load back slightly, then lift. Keep the forks as low as possible while traveling, keep an even pace and avoid fast starts and sudden stops.

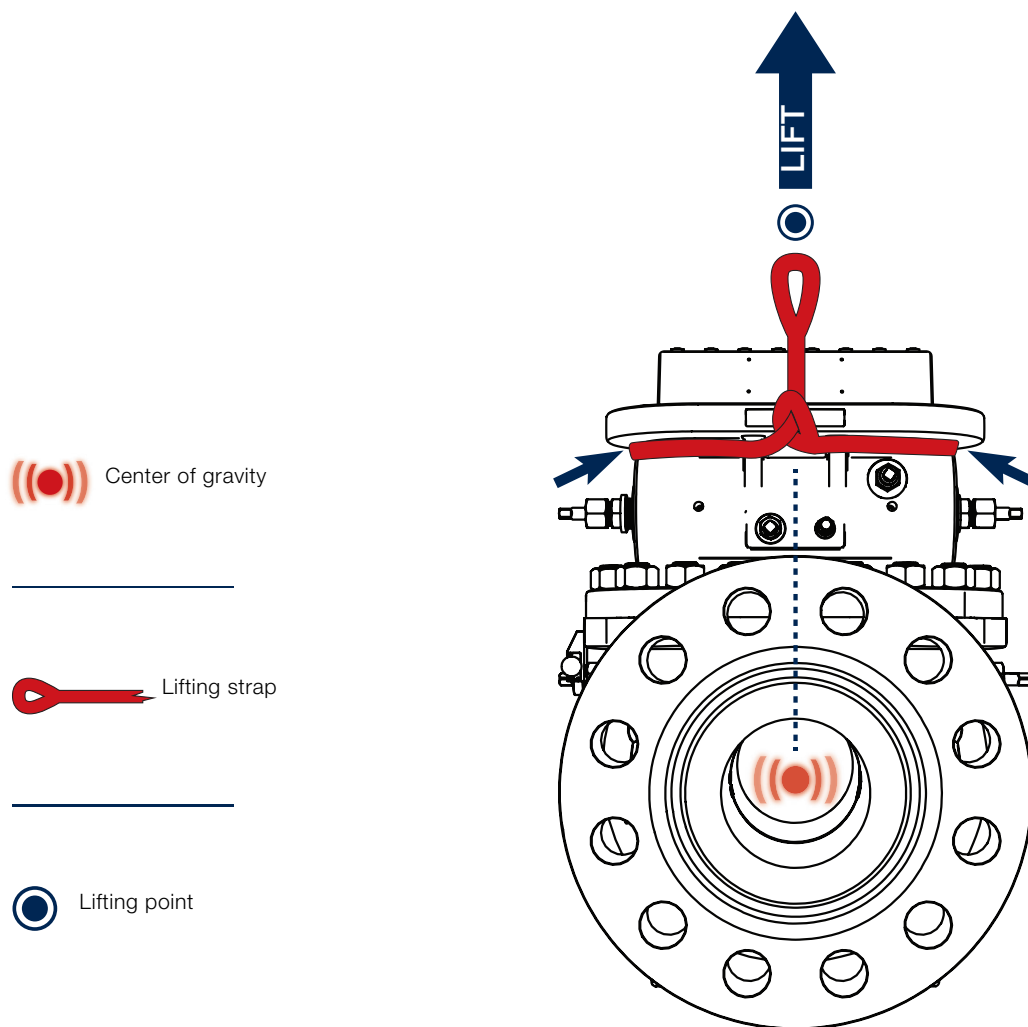


Fig. 1.3 Lifting orifice fittings

i IMPORTANT (NOTE)

Fig. 1.3 does not reflect all configurations. Centers of gravity may not be exactly as shown.

2 Operation

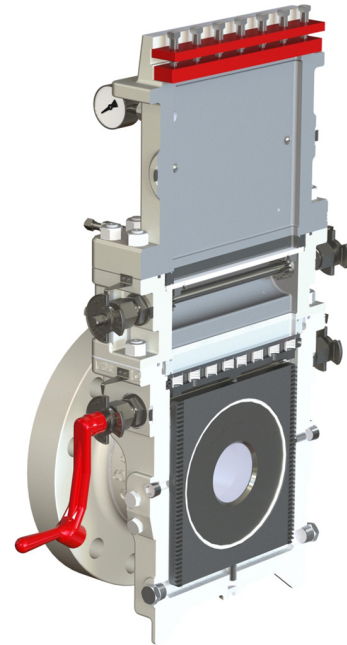
The FPD220 dual chamber orifice fitting enables accurate placement of an orifice plate in a pipeline, together with easy removal and replacement, without interrupting the flow or dismantling the pipeline. The flow of a gas or liquid through the orifice plate creates the differential pressure that is measured and used to calculate the flow rate through the pipeline.

Referring to Fig. 2.1, the orifice fitting is in normal metering mode when:

- the plate carrier and orifice plate are in the lower chamber, concentric to the pipeline
- both inner slide valves are closed
- the center and upper chamber equalizer valves are closed
- the center and upper chamber bleed valves are closed
- the center and upper chamber pressure gauges are indicating atmospheric pressure in both chambers
- the clamping bar is tight.

Pressure sensors installed in the lower chamber's meter taps read the differential pressure across the orifice plate and transmit the readings to a flow computer or chart recorder.

Orifice plate condition is critical to accurate metering. The orifice plate must be removed and inspected for damage, general wear and particulate build-up regularly. Prior to beginning the orifice plate removal procedure, the operator must confirm that the clamping bar is tight and that both bleeder valves are fully close.



During normal operation, only the lower chamber is pressurized. Atmospheric pressure in the two upper chambers is indicated by the pressure gauges.

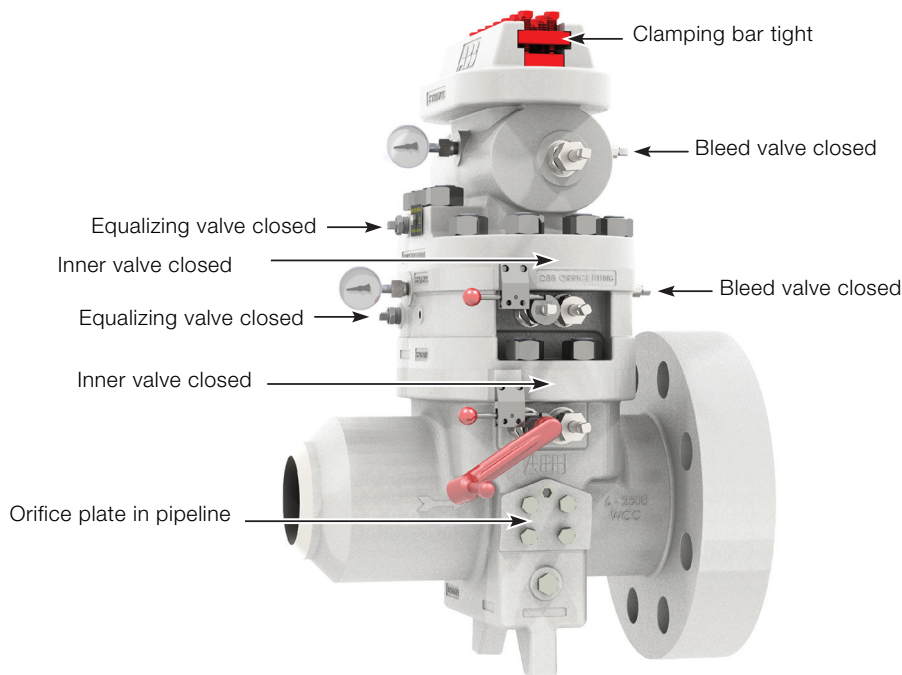
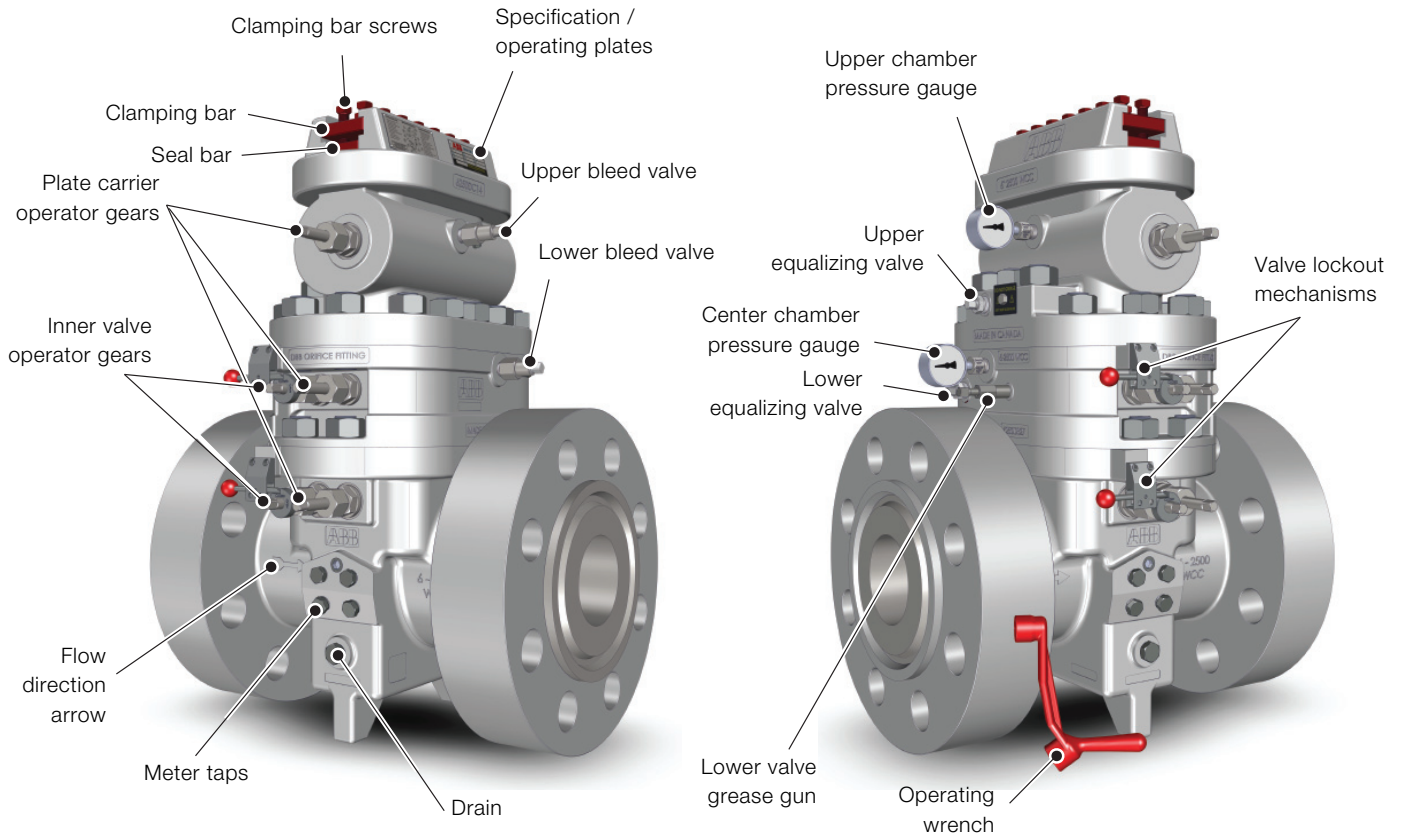


Fig. 2.1 Normal metering mode

3 Key operating parts

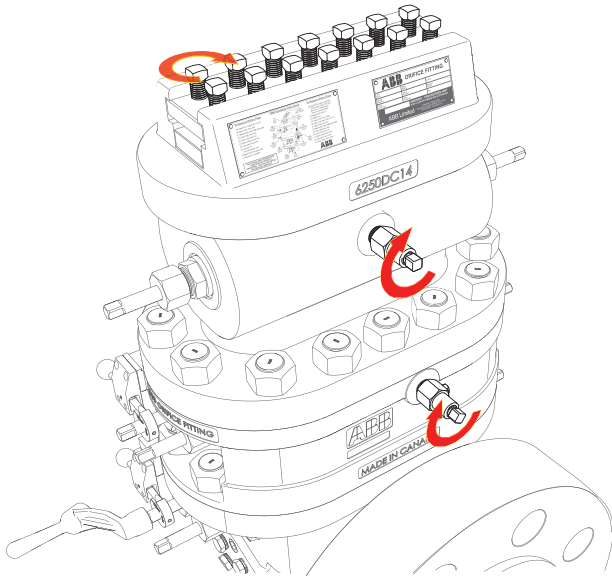
The FPD220 dual chamber orifice fitting is operated by relatively few parts, all of which are controlled with the use of the included operating wrench. The spatial separation of these operating parts, along with the visual differences between them, reduce the chances of operator error.



4 Orifice plate – removal

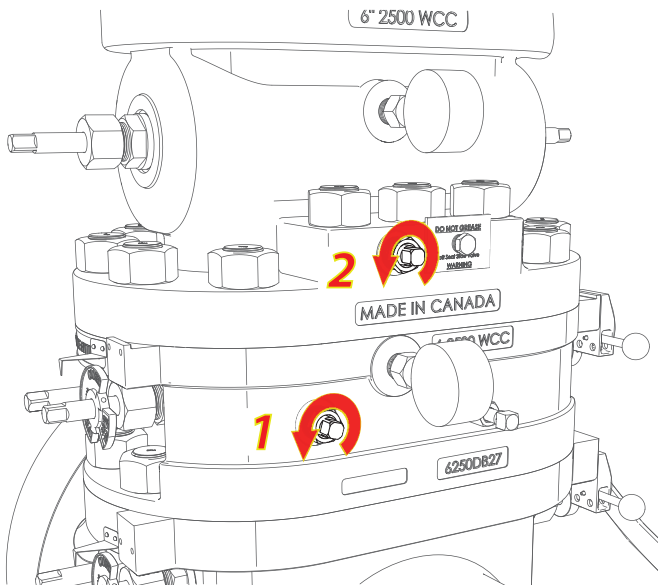


WARNING – Bodily injury Ensure the clamping bar is tight and the bleed valves are fully closed before proceeding.

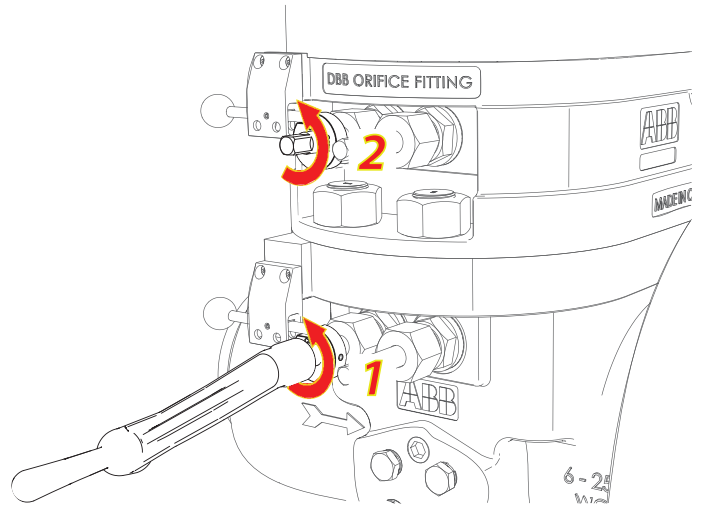


To remove the orifice plate:

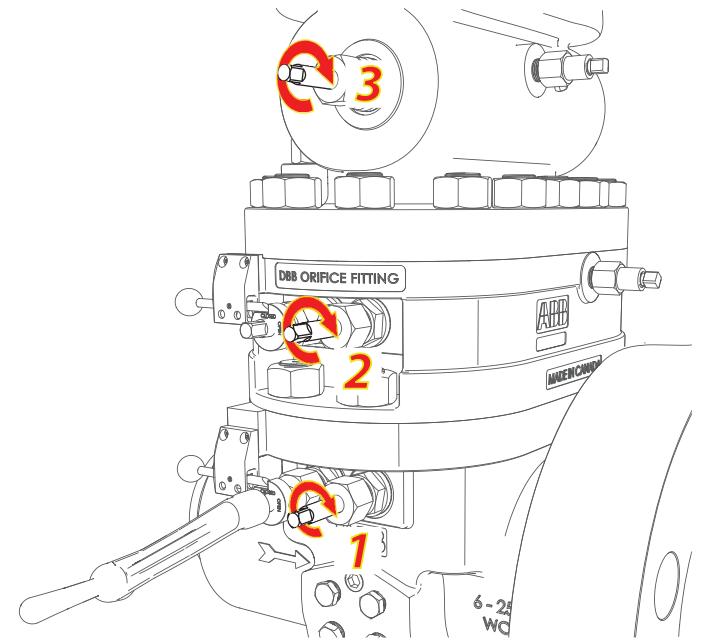
1. Open equalizer valves to pressurize center and upper chambers.



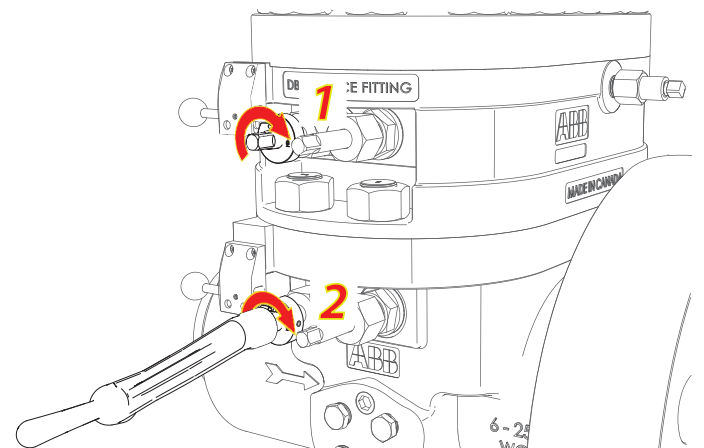
2. Open lower and upper slide valves.



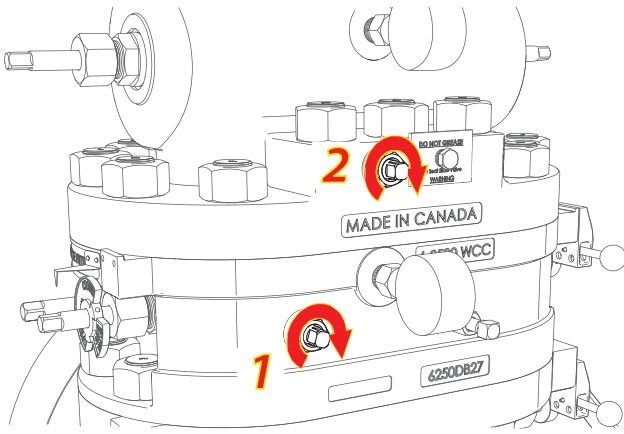
3. Raise orifice plate carrier with operator gears.



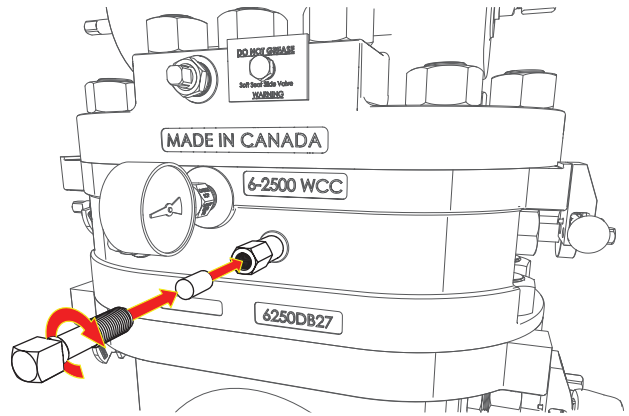
4. Close upper and lower slide valves.



5. Close lower and upper equalizer valves.



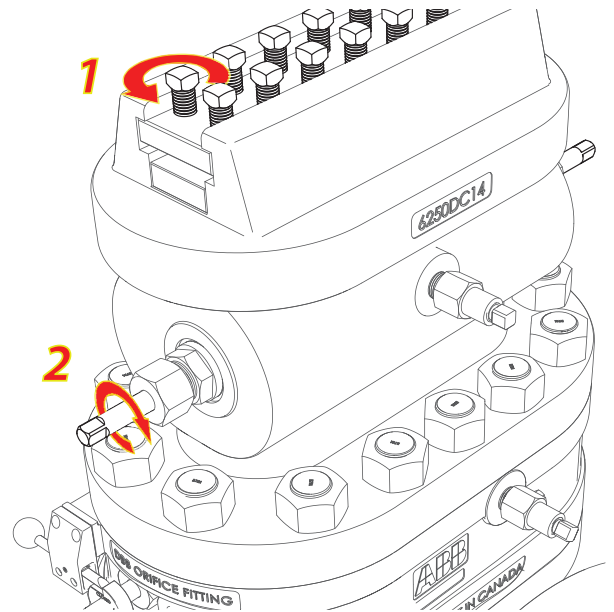
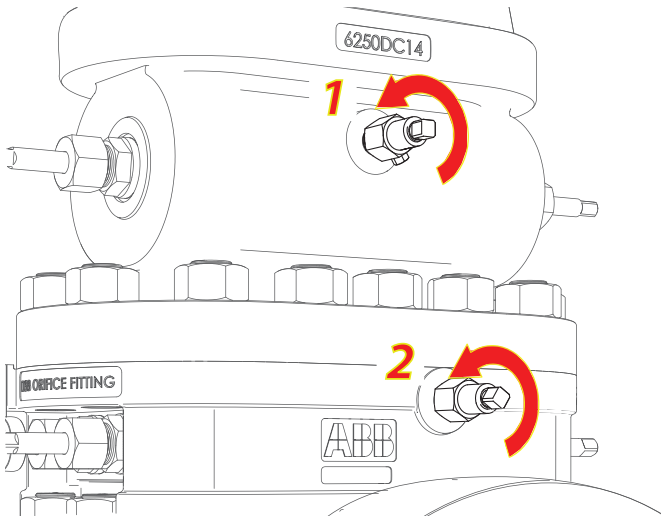
7. Perform greasing procedure for lower slide valve – see Section 9, page 16.



WARNING – Bodily injury Ensure both equalizer valves are fully closed before proceeding.

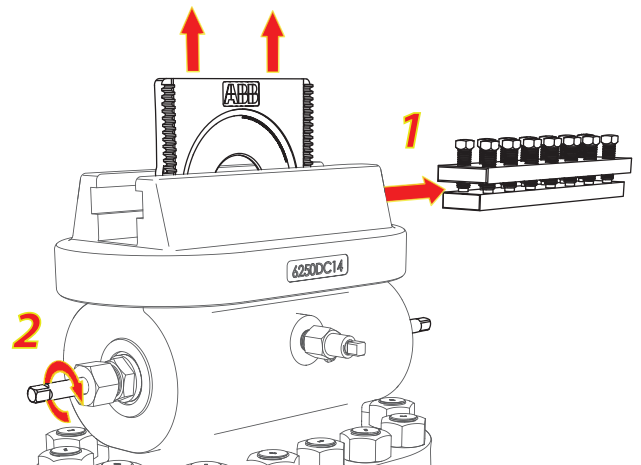
8. Loosen clamping bar, dislodge seal bar with plate carrier.

6. Open upper then lower bleed valve.



WARNING – Bodily injury Do not close lower bleed valve while top opening is unsecured.

9. Remove clamping and seal bars, rotate orifice plate carrier up through opening.



5 Orifice plate – inspection

Regular orifice plate inspections are crucial to measurement accuracy. ABB recommends that the orifice plate is removed from the orifice fitting and inspected monthly. AGA-3 / API 14.3 sections 2.4.1 and 2.4.2 outline orifice plate parameters that can be affected by service conditions. Damage, excessive wear and build-up can lead to a reduction in flow meter accuracy.

Pay particular attention to dirt, grease or ice accumulation, pitting due to corrosion, nicks, dings and other impact damage, as well as general wear and erosion of the normally sharp bore edges. Replace the orifice plate as necessary.

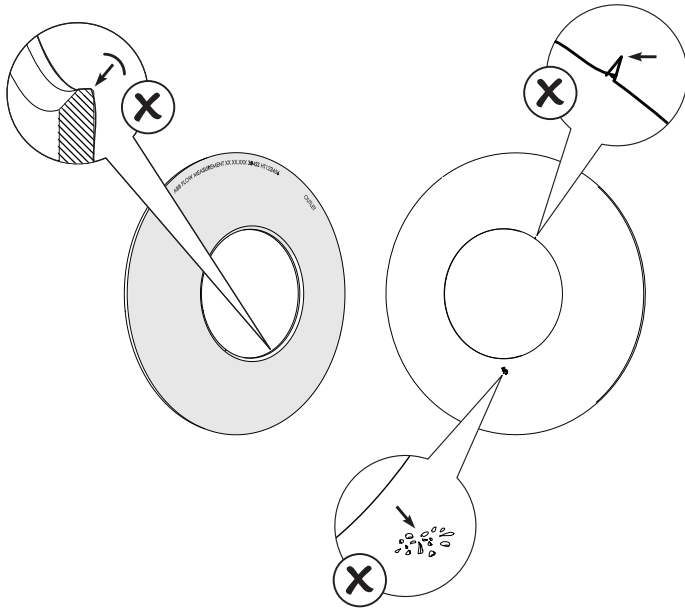


Fig. 5.1 Examples of unacceptable damage to the orifice plate

Orifice plate seals must also be inspected to reduce the possibility of bypass. Pay attention to dirt or grease accumulation, cracks, tears or cuts and swelling. Replace seals as necessary.

6 Orifice fitting – quick inspection and assessment



WARNING – Bodily injury DO NOT open the slide valve to inspect the lower chamber if the upper chamber is open and the fitting is under process pressure.

When the clamping and seal bars have been removed from the orifice fitting and the upper chamber is open, visually inspect the interior of the fitting.

Pay attention to the condition of the interior surfaces of the orifice fitting, the pinion gears, seal bar face and O-ring. Excessive corrosion, fluid build-up or other visible damage may indicate the need for more extensive maintenance and replacement of parts. Similarly, excessive resistance when turning gear shafts during operation may indicate the need for the replacement of parts.

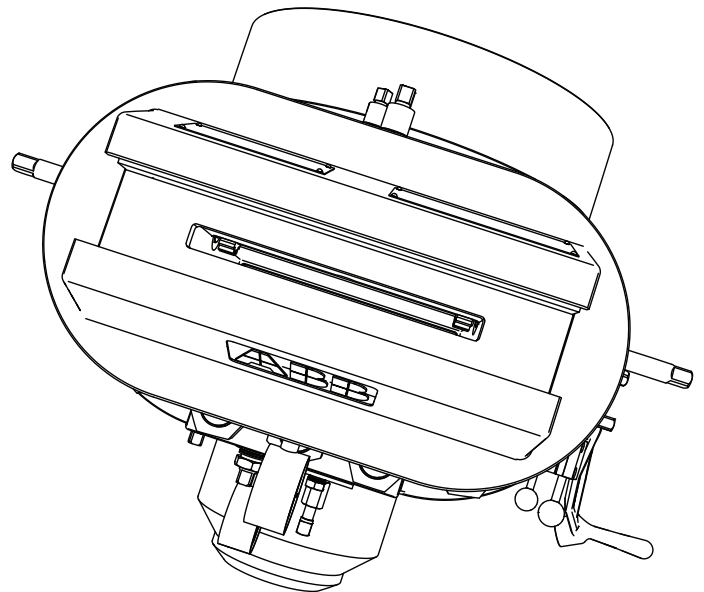


Fig. 6.1 Top view of orifice fitting (clamping and seal bars removed)

7 Scheduled teardown maintenance

Both measurement accuracy and orifice fitting performance in general can benefit from periodic maintenance. ABB recommends that maintenance is performed every two years or earlier if deemed necessary.

1. De-pressurize the process line.

! WARNING – Bodily injury Ensure the process line is de-pressurized before removing the upper and center chambers from the orifice fitting body. Failure to de-pressurize could result in serious injury or death.

2. Remove the upper chamber.
3. Remove the center chamber
4. Visually inspect all interior surfaces of the orifice fitting body for excessive build-up or corrosion.
5. Inspect gear shafts for broken or bent teeth. Replace as necessary.
6. Inspect valve seat surfaces for abrasion or corrosion. Replace as necessary.

i IMPORTANT (NOTE) Step 7 is applicable only to fittings fitted with grease-type slide valves.

7. Replace the valve seat grease in the grease track.
8. Replace the valve strip and all accessible O-rings (including valve seat O-rings on soft-seat units).
9. Remove the drain plugs and remove all accumulated debris from the lower chamber.
10. Inspect all differential pressure tap holes for build-up. Clean as necessary.
11. Refit the center chamber.
12. Refit the upper chamber.

! WARNING – Bodily injury Steps 13 to 16 **MUST** be performed before re-pressurizing the process line. Failure to follow this procedure could result in serious injury or death.

13. Ensure the orifice plate is in the upper chamber.
14. Ensure both slide valves are closed.
15. Ensure all equalizing and bleed valves are closed.
16. Ensure the seal and clamping bars are in place and tightened down.
17. Repressurize the process line.

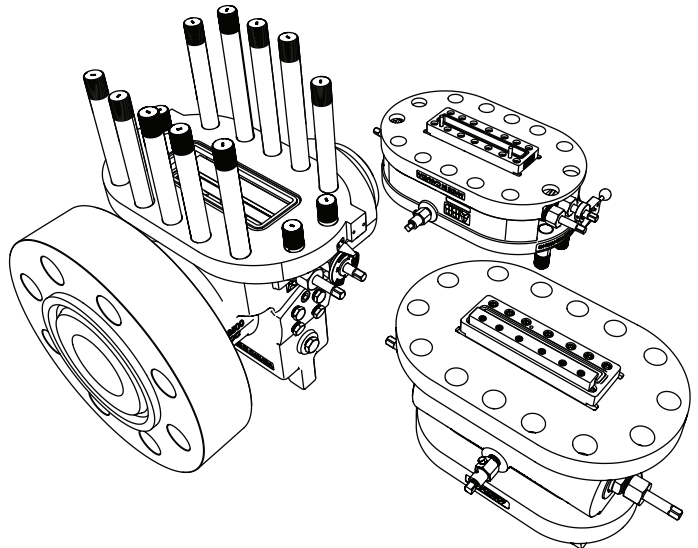


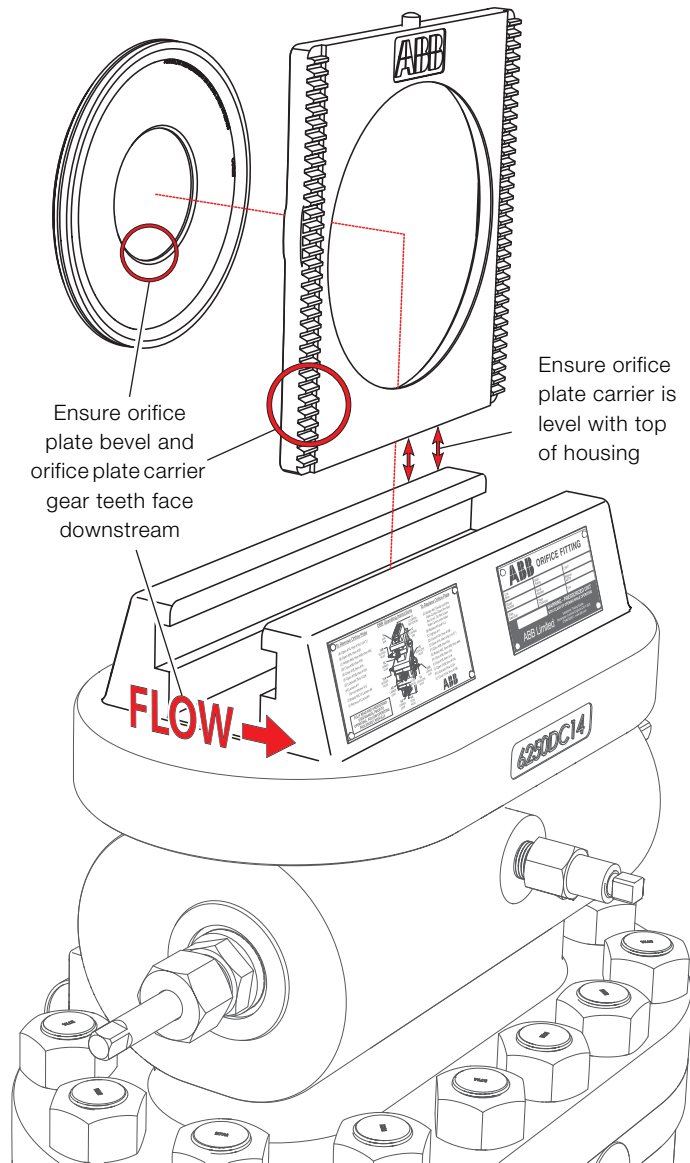
Fig. 7.1 Orifice fitting dismantling

8 Orifice plate – replacement

! NOTICE – Property damage When refitting the orifice plate, proper positioning of the orifice plate and plate carrier is crucial to both correct operation and metering accuracy.

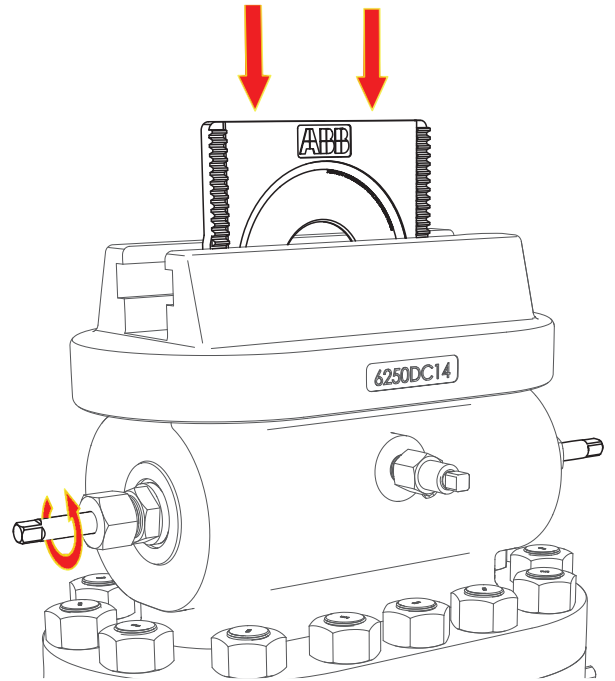
To refit the orifice plate:

1. Align the orifice plate in the orifice plate carrier and insert orifice plate carrier into top opening, ensuring correct positioning as shown.

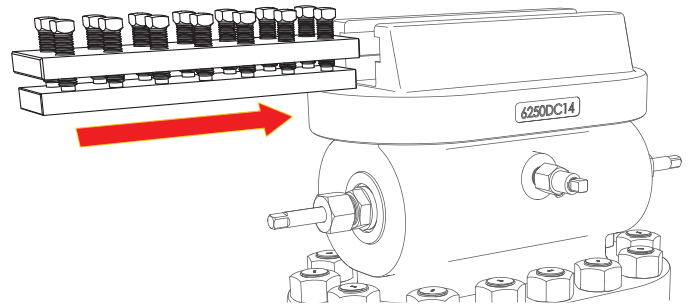


! NOTICE – Property damage During step 2, do not lower orifice plate carrier onto upper slide valve.

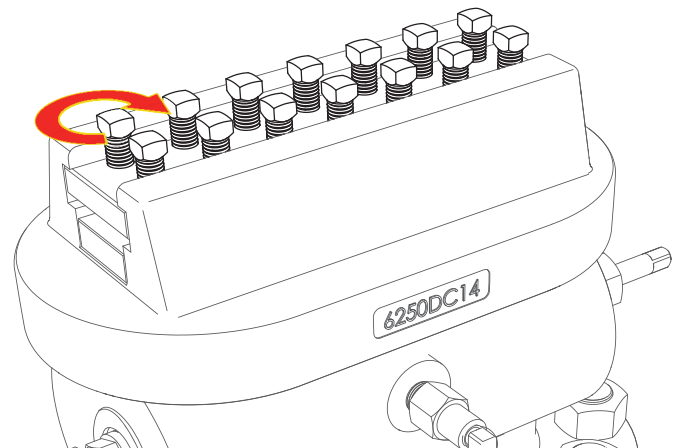
2. Lower orifice plate carrier into upper chamber.



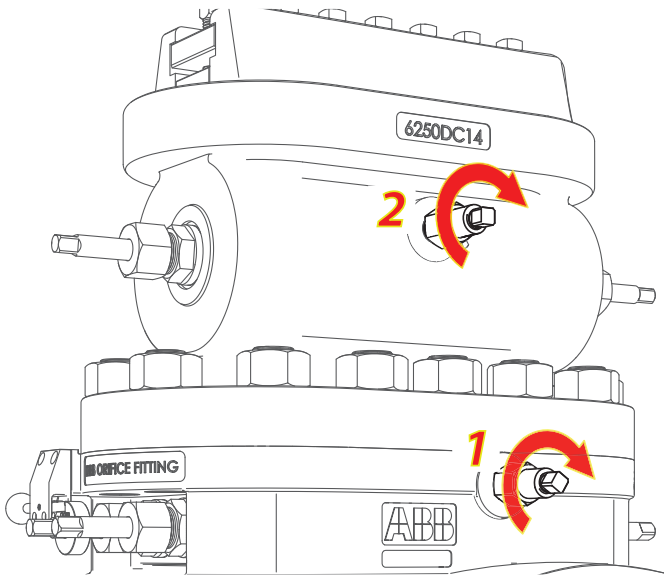
3. Install seal and clamping bars.



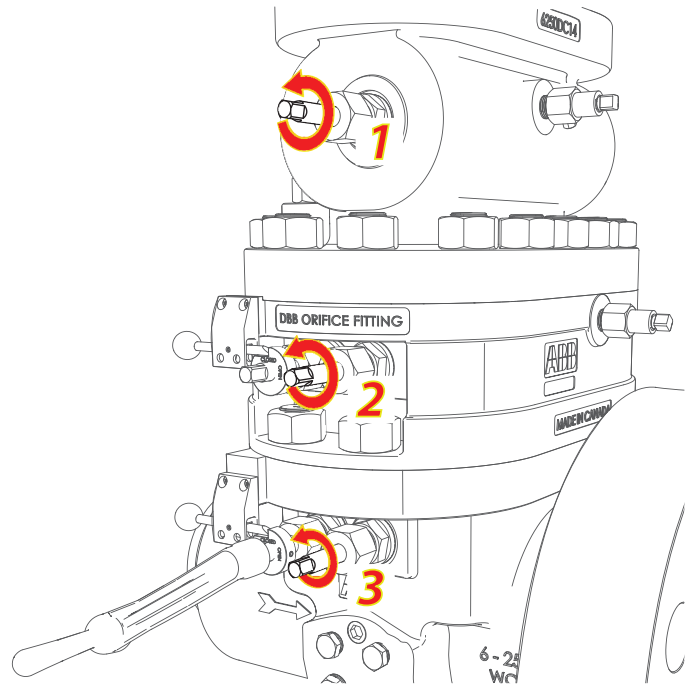
4. Tighten clamping bar screws.



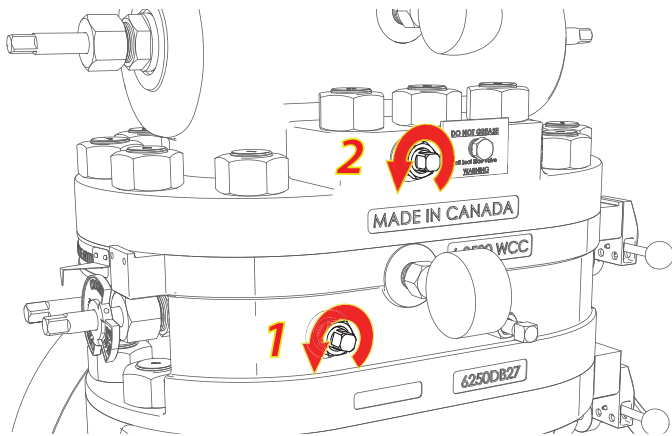
5. Close lower, then upper bleed valve.



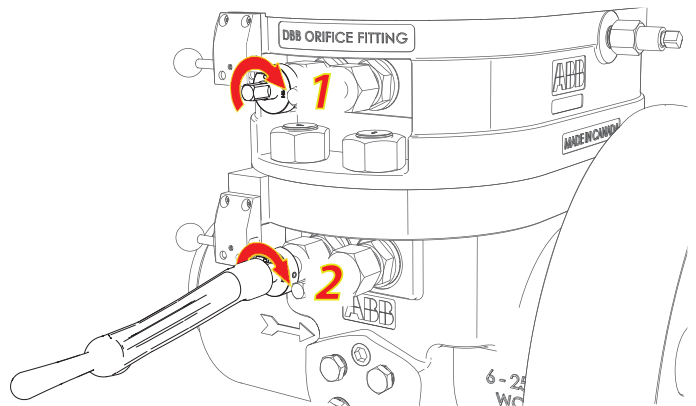
8. Lower plate carrier with operator gears.



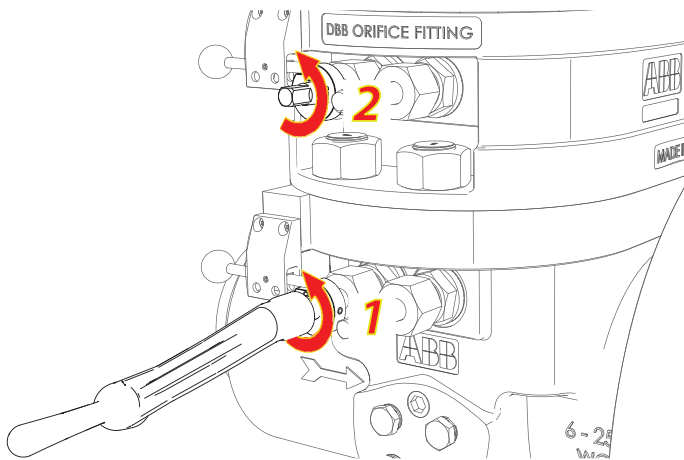
6. Open lower and upper equalizer valves.



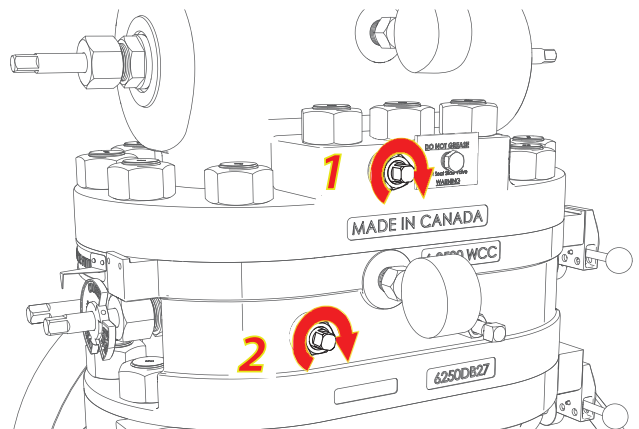
9. Close both inner slide valves.



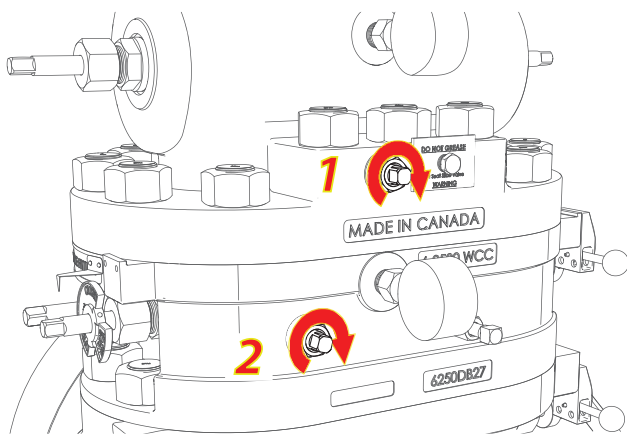
7. Open lower and upper inner slide valves.



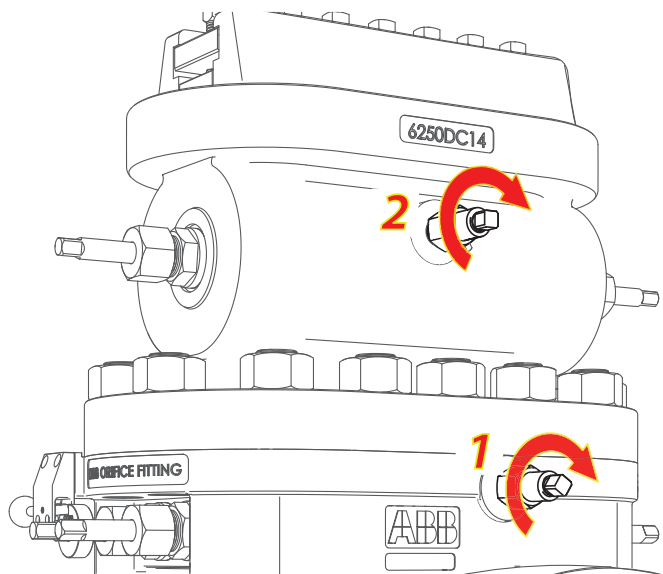
10. Close upper and lower equalizer valves.



11. Close upper and lower equalizer valves.

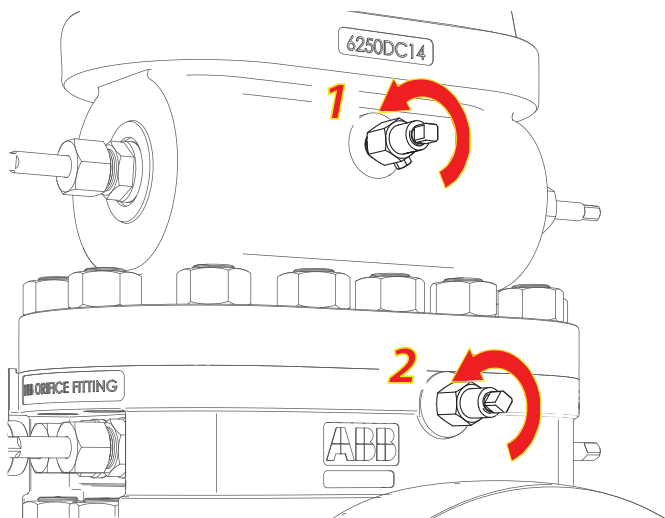


14. Close lower, then upper bleed valve.

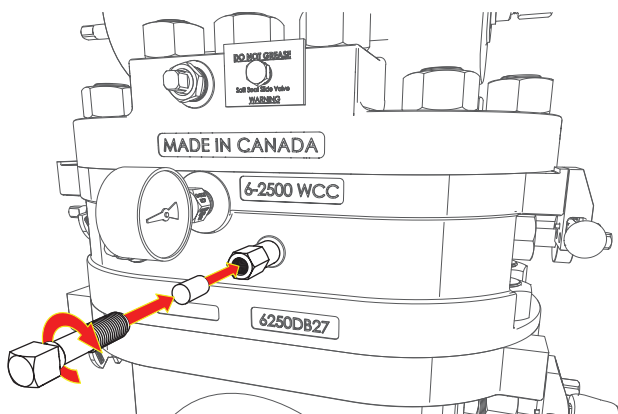


WARNING – Bodily injury Ensure both equalizer valves are fully closed before proceeding.

12. Open upper then lower bleed valve.



13. Perform greasing procedure for lower slide valve – see Section 9, page 16.



9 Greasing procedure

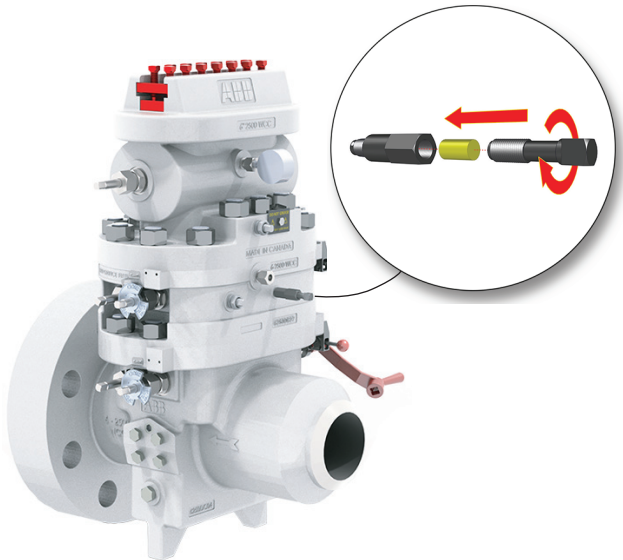
! **NOTICE – Property damage** This procedure is not applicable to orifice fittings equipped with the soft-seat valve seal design. Attempting to lubricate an FPD220 orifice fitting equipped with a soft-seat slide valve causes the inner O-ring seal to be ejected from the dovetail groove resulting in valve failure.

The metal-to-metal grease seal design requires lubrication on a regular basis. For the procedure to be successful, a pressure differential across the slide valve being serviced is required, with the chamber immediately below the valve having a higher pressure and forcing the valve strip up against the seat. The double ball grease check valves prevent process pressure from coming through the grease ports. For best results, use only valve seal grease supplied by ABB and recommended for the applicable service.

1. Ensure that both inner slide valves and equalizer valves are fully closed and the center and upper chambers are de-pressurized, as indicated on the pressure gauges.
2. Open the lower bleed valve.

A pressure differential now exists between the lower and center chambers, and the lower slide valve is ready to be greased.

3. Remove the threaded stem from the lower grease gun assembly. Insert one stick of grease.
4. Replace the grease gun stem and turn in slowly so as not to rupture the grease channel seal.



5. Repeat steps 3 and 4 if additional grease is required. Larger fittings require more grease.
6. Close the lower bleed valve.

10 Preservation and storage

Take the following measures to preserve and store orifice fittings that are not currently in service:

Store in dry conditions, preferably indoors to prevent rust and corrosion.

Fit the end caps supplied with the fitting.

Apply rust inhibitor inside the bore every 3 to 6 months.

Remove orifice plate and seals from the seal gap and ensure soft-seat slide valves remain in the open position during storage. Soft-seat units require no additional maintenance during storage. Do not apply valve seal grease to soft-seat units.

For grease-type units, apply valve seal grease every 90 days to prevent hardening of the sealant medium. Ensure grease-type valves remain in the closed position during storage.

Hydrostatic testing is required before entering service if stored for more than 1 year. Replace / re-lubricate seals as required.

11 Specification

Body configuration

- Flange x flange
- Flange x weld
- Weld x weld

Flanges to FF, RF and RTJ are available in the following formats:

- ANSI 16.5 or 16.47
- Techlok & SPO
- Grayloc®
- API 6A
- or to specific client specification

Design codes

- HSG 253 The safe isolation of plant and equipment
- NACE MR-01-75
- ASME B31.1 Power Piping
- ASME B31.3 Liquid Petroleum Transportation Piping Systems
- PED 97/23/EC Pressure Equipment Directive

Measurement standards

- ISO 5167
- API MPMS 14.3.2 (AGA Report No. 3)

Standard materials of construction

Body casting

- ASTM A216 WCP, WCC
- ASTM A352 LCC
- ASTM A487 4D
- ASTM A351 CF8M
- ASTM A995 Gr.4A, Gr.6A
- Other materials are available on request

Internal components

- Stainless steel 316
- Stainless steel A351 CF8M
- Carbon steel AISI430

Pressure tappings

- 1 or 2 sets per side; 1/2 in. NPT female

External bolting

- ASTM A194 Gr.4 (Zinc coated)
- ASTM A320 L7 (Zinc coated)
- Other materials are available on request, including optional coatings such as PTFE, Xylan and Xylar

Seals

Seal bar

- HNBR O-ring (standard); gasket (optional)

Shafts

- PTFE packing (standard); HNBR O-ring (optional)

Inner valves

- Grease seal (standard); HNBR O-ring (optional)

Orifice plate

- Type 'K' 2000 edition formed HNBR seal on a 316 SS retainer ring
- Dual ring HNBR O-rings standard on a 316 SS retainer ring
- PTFE snap seal two-piece virgin PTFE assembly

Orifice plates

- Industry-standard orifice plate thicknesses as per the guidelines set out within ISO 5167 and API 14.3.

Pressure gauges

- Full safety pattern type scaled:
 - LP chamber: 0 to 29 psi (0 to 2 bar)
 - HP chamber: 0 to 1160 / 3625 / 9427 psi (0 to 80 / 250 / 650 bar), depending on meter pressure rating.
- Dials: standard or fluorescent
- Gauge material: Inconel, stainless steel 316

Manifold valves

- Fire tested to BS6755 Part 2 and API 6FA (optional)

Maximizing performance

- To ensure absolute metering accuracy, it is recommended that industry practice is followed and meter tubes are purchased and manufactured to complement the orifice fitting. This ensures concentricity between the pipe and the fitting and eliminates uncertainties associated with misalignment.

ABB can supply the following items for a complete metering solution:

- orifice fitting with meter tube including straightening vane / profiler
- DP transmitters and process transmitters
- flow computer and enclosure
- spare parts for service and commissioning
- product service training

Temperature rating

- 29 to 38 °C (-20 to 100 °F) standard

Pressure rating

Size in. (mm)	ANSI pressure class (fully-rated)
2 (50) to 12 (300)	150, 300, 600, 900, 1500, 2500
14 (350) to 24 (600)	150, 300, 600, 900, 1500
18 (450) to >24 (>600)	150, 300, 600, 900

- Note. 600, 900, 1500 and 2500 flanges are available as RF or RTJ. 150 and 300 flanges are available as RF only.

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Sales



Service