Technical Manual
for

Diverter II
FlexJoint® Assembly

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TM-0005, Rev. G

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1 INTRODUCTION

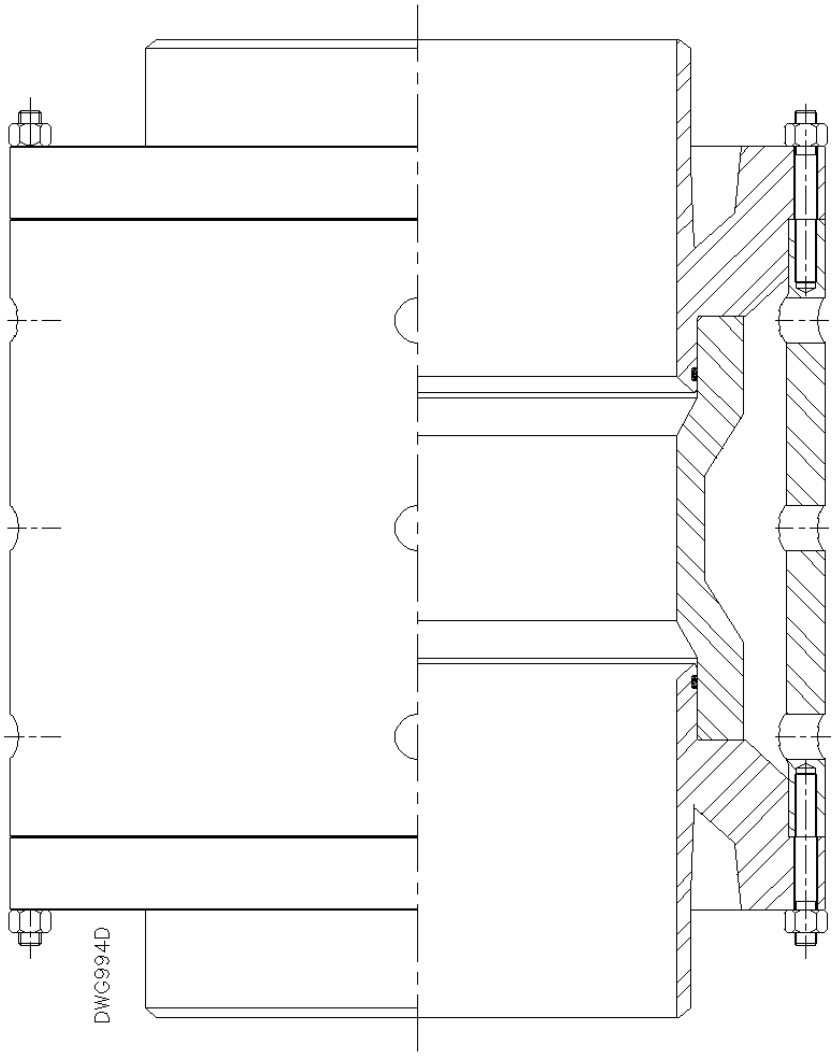
1.1 GENERAL

This manual provides the operating and maintenance information necessary to use and maintain the Diverter II FlexJoint® Assembly (flexible joint) manufactured by Oil States Industries (OSI). The Diverter II is an improved design that is functionally equivalent to our original Diverter flexible joint, while providing the advantages of a smaller diameter and higher operating pressures than the original. OSI offers Diverter II flexible joints for 500, 1,000, 2,000, 2,500, 3,000, and 3,500 kip axial tension applications in a variety of flanged configurations. This section provides a general description of the units and defines their operating parameters. Section 2 provides a list of tools and materials required for maintenance. Section 3 provides complete inspection and repair procedures. Information pertaining to storage and shipment is provided in Section 4 and Section 5 contains complete parts lists for the units.

1.2 DESCRIPTION

1.2.1 General. The Diverter II flexible joints are flexible couplings designed as a direct replacement for a standard ball joint and are used to couple the drilling riser to the diverter. Refer to Figure 1-1. All units share a common design. Materials used in the flexible joints consist of high-grade steels and various nitrile elastomers that offer a high resistance to oil well fluids. These elastomers also exhibit extremely long life under the conditions encountered during drilling and production operations.

Figure 1-1
Typical Diverter II
Flexible Joint



1.2.2 <u>Construction</u>. The major functioning components of the Diverter II flexible joints are the four flex elements. Refer to Figure 1-1. Each flex element is constructed as a sandwich of elastomer layers and spherically shaped metal reinforcements molded with an approximately 3/8 inch (1 cm) thick elastomer coating. The two pairs of flex elements (a primary plus one secondary) are functionally identical. Each primary (outer) flex element is molded with a retainer

flange and a nipple. The secondary flex element assembly contains two flex elements that mate with the nipple of each primary. The flex elements are secured within the housing by bolting the retainer flanges of each primary element to one end of the housing using various retainer studs and nuts (with the size and quantity depending on the axial tension rating).

1.2.3 Operation. In operation, a pair of flex elements at each end permit the nipples to deflect up to 15° relative to each other. The primary flex elements react all tension forces while the smaller secondary elements react the compressive forces. This accounts for the lower compressive forces allowed in operation. End connections, as specified by the customer, are welded to each nipple to provide for connection to the diverter and the telescopic joint.

1.3 TECHNICAL CHARACTERISTICS

Each Diverter II flexible joint permits cocking displacements up to ±15 degrees. The flexible joints range from 36 to 43.5 inches (0.9 to 1.1 m) in diameter and weigh between 9,000 to 15,000 lbs (4,100 to 6,800 kg). The length of the unit depends on the end connections selected as well as the tension rating of the unit. Table 1.1 and Figure 1-2 illustrate typical envelope dimensions for the Diverter II –1, –2, –3, –5, and –8 flexible joints. Table 1.2 provides the performance characteristics of the Diverter II –1, –2, –3, –5, and –8 flexible joints.

NOTE:

Where differences exist between the US customary and metric values within this manual, the US customary value is the standard.

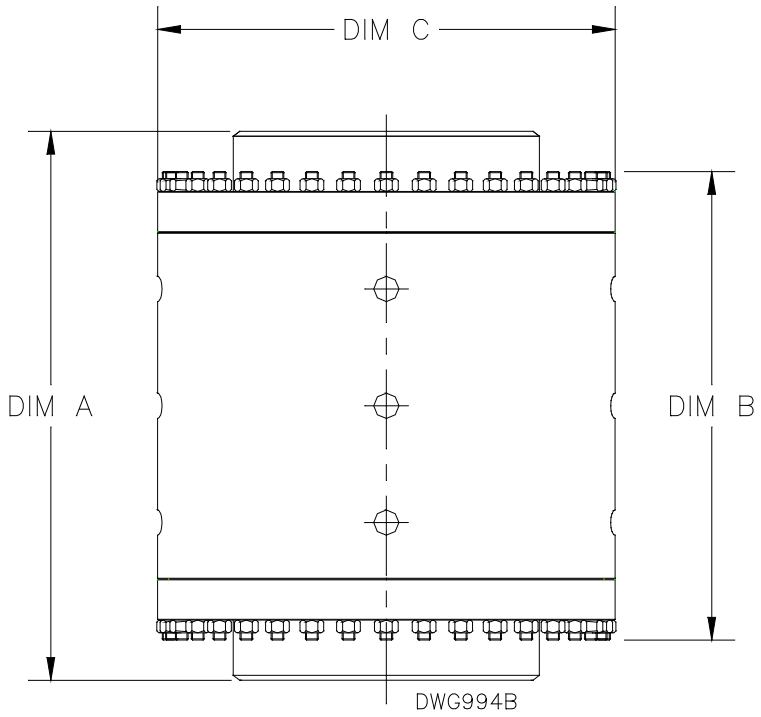


Figure 1-2
Diverter II Flexible Joint
Envelope Dimensions

Table 1.1
Envelope Dimensions

	Dim. 'A'	Dim. 'B'	Dim. 'C'
Diverter II –1	43.46 in.	37.08 in.	36.25 in.
Diverter II –2	43.46 in.	37.08 in.	36.25 in.
Diverter II –3	46.86 in.	40.86 in.	39.62 in.
Diverter II –5	46.86 in.	40.86 in.	39.62 in.
Diverter II –8	50.63 in.	46.24 in.	43.52 in.

Table 1.2
Performance Characteristics

Diverter II –1 Flexible Joint

Characteristic	Value
Bore Size:	23 in. (58 cm)
Normal Operating Pressure:	1-35 psi (2.4 bar)
Maximum Operating Pressure:	500 psi (34.5 bar)
Maximum Test Pressure:	750 psi (51.7 bar)
Normal Operating Tension:	40,000 lbs (178 kN)
Maximum Operating Compression:	20,000 lbs (89 kN)
Maximum Tension:	500,000 lbs (2,224 kN)
Maximum Deflection:	±15 degrees
Angular Spring Rate:	6,630 ft-lb/deg (9.0 kNm/deg) @ 15 degrees rotation
Pivot Location:	Housing Center
Maximum Outer Diameter:	36.25 in. (92 cm)
Estimated Final Weight:	9,000 lbs (4,100 kg)

Diverter II –2 Flexible Joint

Characteristic	Value
Bore Size:	23 in. (58 cm)
Normal Operating Pressure:	1-35 psi (2.4 bar)
Maximum Operating Pressure:	500 psi (34.5 bar)
Maximum Test Pressure:	750 psi (51.7 bar)
Normal Operating Tension:	40,000 lbs (178 kN)
Maximum Operating Compression:	20,000 lbs (89 kN)
Maximum Tension:	1,000,000 lbs (4,448 kN)
Maximum Deflection:	±15 degrees
Angular Spring Rate:	6,630 ft-lb/deg (9.0 kNm/deg) @ 15 degrees rotation
Pivot Location:	Housing Center
Maximum Outer Diameter:	36.25 in. (92 cm)
Estimated Final Weight:	9,500 lbs (4,300 kg)

Diverter II –3 Flexible Joint

Characteristic	Value
Bore Size:	21 in. (53 cm)
Normal Operating Pressure:	1-35 psi (2.4 bar)
Maximum Operating Pressure:	500 psi (34.5 bar)
Maximum Test Pressure:	750 psi (51.7 bar)
Normal Operating Tension:	40,000 lbs (178 kN)
Maximum Operating Compression:	20,000 lbs (89 kN)
Maximum Tension:	2,000,000 lbs (8,896 kN)
Maximum Deflection:	±15 degrees
Angular Spring Rate:	13,140 ft-lb/deg (17.82 kNm/deg) @ 15 degrees rotation
Pivot Location:	Housing Center
Maximum Outer Diameter:	39.62 in. (102 cm)
Estimated Final Weight:	11,500 lbs (5,200 kg)

Diverter II –5 Flexible Joint

Characteristic	Value
Bore Size:	21 in. (53 cm)
Normal Operating Pressure:	1-35 psi (2.4 bar)
Maximum Operating Pressure:	500 psi (34.5 bar)
Maximum Test Pressure:	750 psi (51.7 bar)
Normal Operating Tension:	40,000 lbs (178 kN)
Maximum Operating Compression:	20,000 lbs (89 kN)
Maximum Tension:	2,500,000 lbs (11,121 kN)
Maximum Deflection:	±15 degrees
Angular Spring Rate:	13,140 ft-lb/deg (17.82 kNm/deg) @ 15 degrees rotation
Pivot Location:	Housing Center
Maximum Outer Diameter:	39.62 in. (102 cm)
Estimated Final Weight:	11,500 lbs (5,200 kg)

Diverter II –8 Flexible Joint

Characteristic	Value
Bore Size:	21 in. (53 cm)
Normal Operating Pressure:	1-35 psi (2.4 bar)
Maximum Operating Pressure:	500 psi (34.5 bar)
Maximum Test Pressure:	750 psi (51.7 bar)
Normal Operating Tension:	40,000 lbs (178 kN)
Maximum Operating Compression:	20,000 lbs (89 kN)
Maximum Tension:	4,000,000 lbs (17,793 kN)
Maximum Deflection:	±15 degrees
Angular Spring Rate:	14,200 ft-lb/deg (19.25 kNm/deg) @ 15 degrees rotation
Pivot Location:	Housing Center
Maximum Outer Diameter:	43.52 in. (111 cm)
Estimated Final Weight:	15,000 lbs (6,800 kg)

2 TOOLS AND MATERIALS REQUIRED

2.1 GENERAL

This section provides detailed information on the tools and materials required for maintenance of a Diverter II flexible joint. In addition to the standard tools identified below, a crane is required for handling the unit and the various parts during inspection and maintenance. The minimum lift capacity of the crane should be checked against the estimated weights given in Table 1.2.

2.2 TOOLS AND MATERIALS

Table 2.1 lists the tools and materials required for maintenance of a Diverter II flexible joint, and explains the intended purpose of each.

NOTE:

Equivalent tools or materials may be substituted for those listed as long as the intended purpose is achieved.

Table 2.1
Tools and Materials Required for Flexible Joint Maintenance

Diverter II –1 and –2 Flexible Joints

Item	Purpose
Torque Wrench (1,000 ft-lb)	Torque Retainer Nuts
Socket 1-5/8 in. (hex)	Retainer Nuts
Eyebolt 1/2 in., 8-UNC	Lift Secondary Assembly
Eye Nuts 1 in., 8-UNC	Lift Housing
Sling for Crane	Connect to Eyebolts
Grease, Alemite Multi-Purpose #2	Lube O-ring
Thread Lubricant	Lube Retainer Studs, Nuts
Trichloroethylene	Clean Metal
Methyl Ethyl Ketone (MEK)	Clean Rubber
Emery Cloth (400 grit or finer)	Refinish O-ring Grooves
Loctite 242	Secure Retainer Studs
API #SA2	Coat Metal Surfaces

Diverter II –3 and –5 Flexible Joints

Item	Purpose
Torque Wrench (2,000 ft-lb)	Torque Retainer Nuts
Socket 2-3/16 in. (hex)	Retainer Nuts
Eyebolt 1/2 in., 8-UNC	Lift Secondary Assembly
Eye Nuts 1 in., 8-UNC	Lift Housing
Sling for Crane	Connect to Eyebolts
Grease, Alemite Multi-Purpose #2	Lube O-ring
Thread Lubricant	Lube Retainer Studs, Nuts
Trichloroethylene	Clean Metal
Methyl Ethyl Ketone (MEK)	Clean Rubber
Emery Cloth (400 grit or finer)	Refinish O-ring Grooves
Loctite 242	Secure Retainer Studs
API #SA2	Coat Metal Surfaces

Diverter II –8 Flexible Joint

Item	Purpose
Torque Wrench (3,000 ft-lb)	Torque Retainer Nuts
Socket 2-3/4 in. (hex)	Retainer Nuts
Eyebolt 1/2 in., 8-UNC	Lift Secondary Assembly
Eye Nuts 1 in., 8-UNC	Lift Housing
Sling for Crane	Connect to Eyebolts
Grease, Alemite Multi-Purpose #2	Lube O-ring
Thread Lubricant	Lube Retainer Studs, Nuts
Trichloroethylene	Clean Metal
Methyl Ethyl Ketone (MEK)	Clean Rubber
Emery Cloth (400 grit or finer)	Refinish O-ring Grooves
Loctite 242	Secure Retainer Studs
API #SA2	Coat Metal Surfaces

3 MAINTENANCE

3.1 GENERAL

This section presents complete procedures for installation and removal, disassembly, cleaning, inspection, and reassembly of each Diverter II flexible joint. The procedures are directed toward identification and replacement of worn or damaged parts, since field repair of these parts is impractical. Maintenance procedures are essentially the same for each flexible joint size. However, there are options that may be present on any size of flexible joint. The various options are summarized below and procedures for each are presented as part of the maintenance process. When performing maintenance, select the appropriate procedure for the unit being worked on.

3.1.1 End Connections. Various end connections are available for the flexible joints. Generally, no maintenance is required for these other than replacement of worn or damaged studs or seal rings. This manual assumes that typical end connections are used. If your unit uses a different end connection, it may be necessary to adjust the size of eyebolts used for lifting the end connection or to make other minor adjustments in the procedures. Where special end connections are provided as specified by the customer, maintenance procedures are provided as a supplement to this manual.

3.1.2 Parts. Due to the difference in tension ratings between the various models of flexible joints, certain parts are changed. When ordering replacements for worn or damaged parts, be sure you are referring to the parts list (Section 5) for your size unit or to the OSI unit serial number.

3.2 REMOVAL

The flexible joint should be removed from the diverter and the riser following the operators' standard procedures. After the unit has been removed, it should be positioned upright in an area that is free of obstacles and permits easy access to all parts of the flexible joint.

3.3 FLEXIBLE JOINT DISASSEMBLY

WARNING:

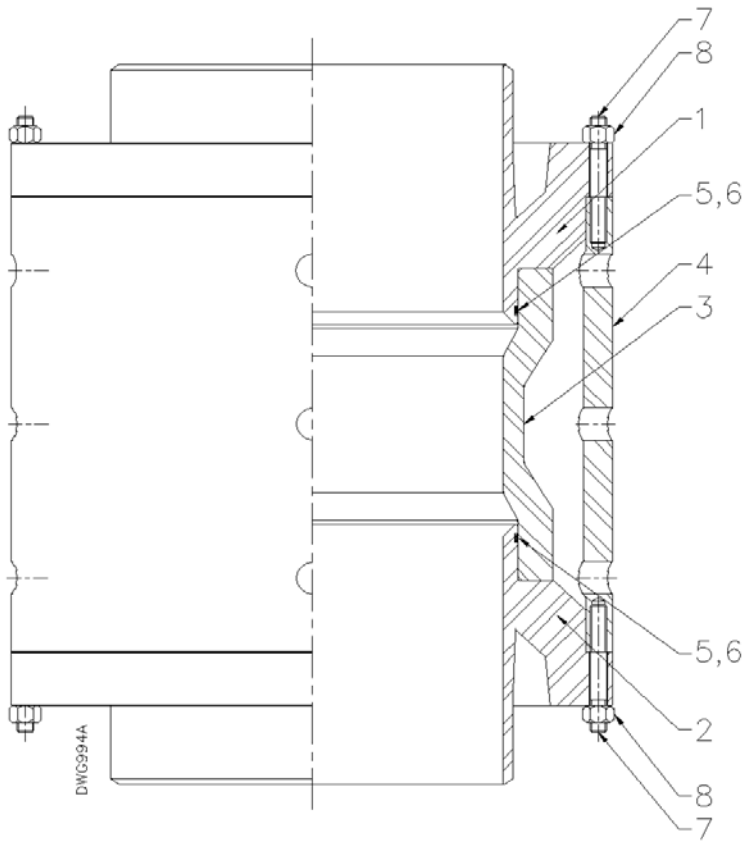
The flexible joint and its parts are extremely heavy. Never work in a position that places you under the unit or its parts when they are being lifted. Failure to follow the maintenance procedures or to observe this WARNING could result in injury or death.

Perform the following procedures, in sequence, to disassemble the flexible joint. The procedures are keyed (via the numbers in parenthesis) to the numerical list of components shown in Figure 3-1. It is recommended that if disassembly is started, the unit be completely disassembled and inspected for worn or damaged parts before reassembling.

NOTE:

It is recommended that disassembly and flipping of the flexible joint are done on thick cardboard or a rubber mat. Damage to the unit may result otherwise.

Figure 3-1
Diverter II Flexible Joint Components



1.	Upper Primary Flex Element
2.	Lower Primary Flex Element
3.	Secondary Flex Element Assembly
4.	Housing
5.	O-ring
6.	Backup Ring
7.	Retainer Stud
8.	Retainer Nut

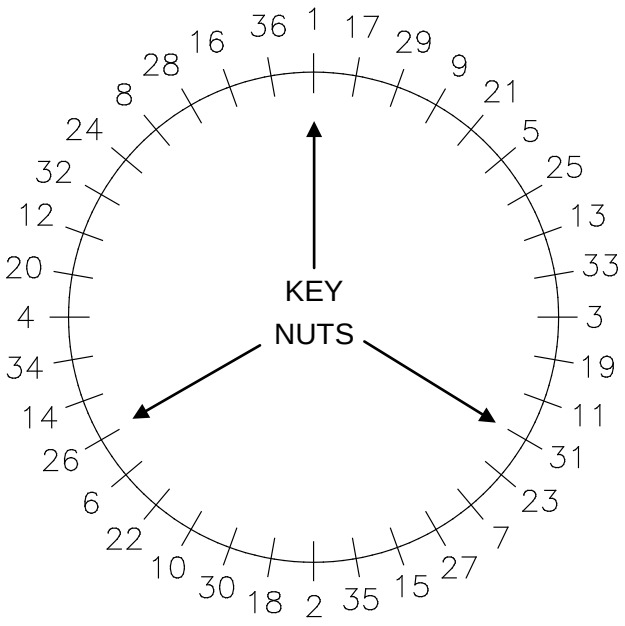
1. Position the flexible joint on its end (either end is allowable).

WARNING:

The retainer flange is installed with approximately 20,000 lbs preload. Be sure to follow the sequence of loosening each key nut one turn at a time until the preload is completely removed.

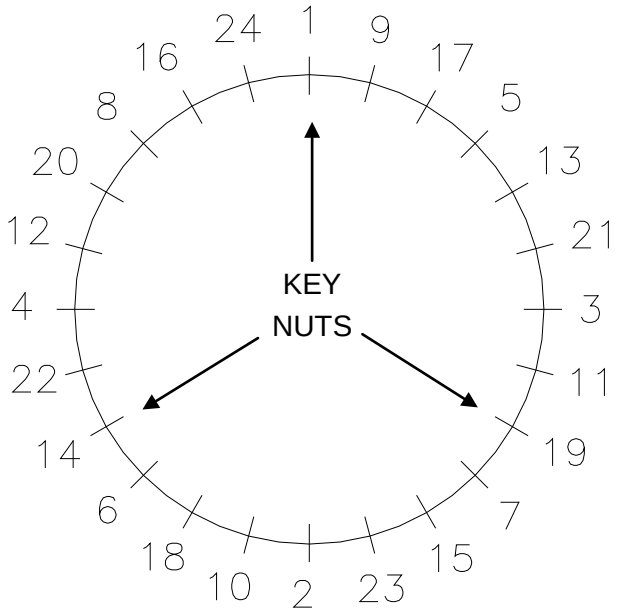
2. With the exception of the key nuts (See Figures 3-2 through 3-4), remove all of the upper retainer nuts (8) from the upper retainer studs (7).

Figure 3-2
36 Bolt Torque Pattern



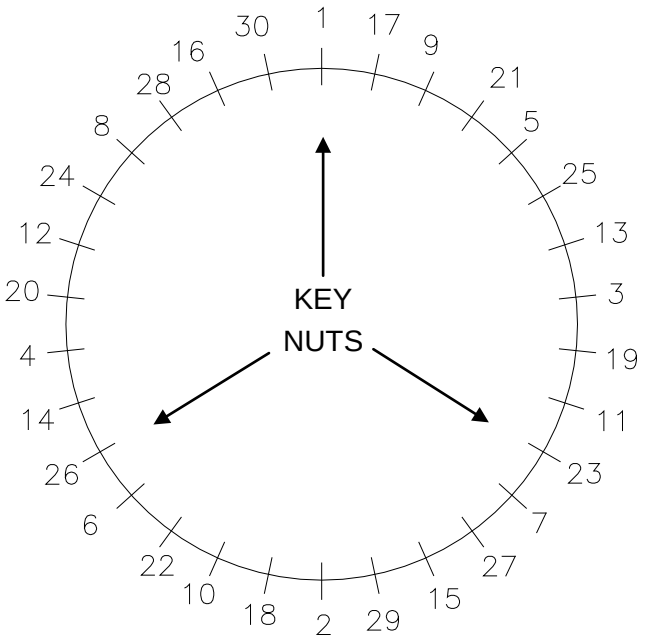
36 Stud Unit (-2): key nuts every 12 places

Figure 3-3
24 Bolt Torque Pattern



24 Stud Unit (-1): key nuts every 8 places

Figure 3-4
30 Bolt Torque Pattern



30 Stud Unit (-3): key nuts every 10 places
30 Stud Unit (-5): key nuts every 10 places
30 Stud Unit (-8): key nuts every 10 places

3. Loosen each key nut one turn and then repeat this until the entire preload has been removed. Once the preload is relieved, remove the remaining retainer nuts (8).
4. Install three eyebolts in the upper end connection.
5. Connect the crane to the eyebolts with the lifting chain.

WARNING:

Be extremely careful when working under parts of the flexible joint to ensure that they are not lowered while you are working on them. One person should be assigned to remain at the crane controls while you are working to prevent operation of the crane.

CAUTION:

Be extremely careful when removing the primary flex elements not to damage the mating surfaces inside the housing or on the nipple. Damage to these areas will require that the housing or flex elements be replaced.

6. Remove the upper primary flex element (1) from the housing (4) by lifting straight up until the element clears the housing. Set the element on a pallet and remove the chains.
7. Install three 1/2 inch eyebolts in the secondary flex element assembly (3) and connect the crane to them.
8. Remove the secondary flex element assembly (3) from the housing (4) by slowly lifting it straight up out of the housing. Set it on a pallet and disconnect the crane.
9. Install two 1 inch eye nuts on the retainer studs (7) at the top of the housing (4) and connect the crane to them. Raise the unit and lay the unit on its side on a pallet. Disconnect the crane and remove the eye nuts.
10. Attach three eye bolts in the lower end connection and connect the crane to them. Lift the unit and position it so that the unit is resting on the housing end. Use a pallet to protect the housing end.

11. Remove the lower retainer nuts (8) from the lower retainer studs (7) on the housing (4).
12. Carefully raise the lower primary flex element (1) from the housing (4) by lifting straight up until the element clears the housing. Set the flex element on a pallet and remove the chains and eye bolts.
13. Remove the O-rings (5) and backup rings (6) from both the upper and lower primary flex elements (1) and (2). Discard the O-rings.

NOTE:

Do not remove undamaged retainer studs. Retainer studs should be removed as directed below only if there is obvious damage to the stud or the stud is improperly installed.

14. Damaged retainer studs (7) may be removed from the housing (4) by installing two nuts on a stud and then applying a torque to the bottom nut.

3.4 CLEANING AND INSPECTION

Cleaning and inspection of the parts within the flexible joint are described in the following subparagraphs. Always clean the part before performing the inspection. Replace all worn or damaged parts with new parts before reassembling the flexible joint.

OSI recommends that under normal operating conditions, the flexible joint should be disassembled and inspected for damage / wear every 5 years. In order to issue a new OSI Certificate of Conformance, a disassembly and inspection of critical areas and dimensional checks to verify conformance must be completed by an OSI facility per SP2U-0248. See Section 5.3 to contact the nearest OSI facility.

3.4.1 Cleaning.

WARNING:

The solvents used for cleaning the parts within the flexible joint are toxic. Avoid getting the solvents on your skin or breathing the fumes. Cleaning operations should be performed in a well ventilated area.

Methyl Ethyl Keytone (MEK) is extremely flammable. Do not smoke or allow welding or other operations involving open flames or sparks nearby when it is being used.

1. Clean all metal parts within the flexible joint with a clean rag soaked with Trichloroethylene or equivalent solvent. Be especially careful to remove all dirt and grease from the O-ring grooves, mating surfaces, and the threads of the studs and nuts.

CAUTION:

MEK will attack the elastomer after an extended period of contact. After wiping the elastomer clean, be sure to remove all excess MEK.

2. Clean the elastomer of each primary and secondary flex element with a clean rag soaked in MEK.

3.4.2 Inspection.

1. Elastomer. Inspect all elastomer surfaces for abrasion or wear. Cuts, cracks, or gouges in the elastomer that exceed 1/8 inch (3 mm) in depth are cause for replacement of an element.
2. Nipples. The extension protruding from the middle of each flex element assembly is referred to as the nipple. Check the bearing

surface of the nipple for excessive or uneven wear. Return the entire flexible joint to the manufacturer for repair or replacement if severe scoring, galling, or wear in excess of 1/4 inch is found. Inspect the remainder of the nipple for cracks or other defects, paying particular attention to the weld area. Return the unit to the manufacturer for repair or replacement if cracks or other defects occur for reasons other than normal wear or if significant damage to the O-ring grooves is present.

3. Housing. Inspect the housing (4) for cracks, other defects, and particularly damage to the mating surfaces. Return the entire unit to the manufacturer if defects are found.

4. Flex Element Retainer Flanges. The integrally bonded heavy metal ring surrounding each primary flex element (and containing the through holes for the retainer studs) is referred to as the retainer flange. Inspect the retainer flanges for damage to the mating surfaces. Return the unit to the manufacturer for repair or replacement if substantial damage to the mating surfaces is present.

5. Threads. Inspect all threaded parts for damage to the thread. Minor thread damage may be repaired by using an appropriate tap or die to renew the threads. Studs or nuts with excessive damage to the threads should be replaced. If interior threads are badly damaged, return the unit to the manufacturer for repair or replacement.

6. Backup Rings. Inspect the backup rings (6) for damage to mating surfaces. Replace the rings if noticeable damage to the mating surfaces is found.

7. O-ring Grooves. Minor damage to O-ring grooves may be repaired by smoothing out the defect with #400 grit or finer emery cloth. Ensure that the groove is cleaned completely before installing new O-rings (5).

3.5 FLEXIBLE JOINT ASSEMBLY

Assembly of the flexible joint is essentially a reversal of the disassembly procedures. Perform the procedures outlined in the following paragraphs, being sure to observe the **WARNINGS** and **CAUTIONS** during reassembly of the flexible joint.

CAUTION:

Be extremely careful when assembling the unit not to damage the O-ring mating surfaces. Damage to these areas will require that the damaged part be replaced.

After a flex element is installed, check for any rubber that may have been sheared off the O-ring or backup rings. If any is found, remove the flex element and replace the O-ring and backup rings.

3.5.1 Retainer Studs. Retainer studs (7) that have been removed should be installed as follows:

1. Ensure that both the retainer stud (7) and the threaded hole are clean and free of old adhesive.
2. Coat the threads of the retainer stud (7) liberally with Loctite 271 or equivalent adhesive.
3. Screw the retainer stud (7) into the housing (4), using the double-nut method, until it bottoms in the hole.
4. Clean excess adhesive from around the retainer stud (7) and allow to set for at least two hours before continuing assembly.

3.5.2 Lower Primary Flex Element. Install the lower primary flex element (1) as follows.

1. Install three 1 inch eye nuts on the retainer studs (7) at one end of the housing (4) and connect the crane to them.
2. Lift and position the housing (4) on one end. Place the housing on a pallet for protection.
3. Install three 1 inch eyebolts in the lower end connector and connect the crane to them.
4. Raise the lower primary flex element (2) and install a new O-ring (5) and a pair of backup rings (6) coated with Alemite multipurpose #2 grease in the O-ring groove. Apply additional lubricant to the new O-rings and metal surface after they are installed.

CAUTION:

Be extremely careful not to damage the retainer studs while lowering the lower primary flex element onto the housing.

CAUTION:

Be extremely careful while installing the flex element assembly into the body, not to damage the O-rings or mar the mating surfaces. Damage to the body or flange surfaces may require replacement of the entire unit.

5. Position the lower primary flex element (2) over the housing (4) and lower it carefully onto the retainer studs (7).
6. Lubricate the retainer studs (7) liberally with thread lubricant or equivalent.

7. Install the retainer nuts (8) on the retainer studs (7) and tighten them finger tight.
8. Refer to Figures 3-2 through 3-4 and torque each nut in the indicated order to 100 ft-lbs.

NOTE:

The torque tables referenced in steps 9 and 10 are a guide to torque application depending on the thread lubricant used by the technician. The torque values provided are based on the friction coefficient of various lubricants available.

9. Torque each nut to the applicable value in Table 3.1, based on the thread lubricant used, in the order indicated in Figures 3-2 through 3-4.

Table 3.1
50 Percent Torque Applied

Flexible Joint	Friction Coefficients (Fc) for Thread Lubricants				
	Dry 0.2 Fc (ft-lbs)	MIL-L-24479B 0.08 Fc (ft-lbs)	Other Lubricants with the following Friction Coefficients (Fc)		
			0.15 Fc (ft-lbs)	0.10 Fc (ft-lbs)	0.06 Fc (ft-lbs)
-1 -2	340	135	270	190	120
-3 -5	935	405	730	500	325
-8	2000	1040	1550	1060	670

10. Torque each nut to the applicable value in Table 3.2, based on the thread lubricant used, in the order indicated in Figures 3-2 through 3-4. Repeat the torque sequence to ensure even torquing.

Table 3.2
100 Percent Torque Applied

Flexible Joint	Friction Coefficients (Fc) for Thread Lubricants				
	Dry 0.2 Fc (ft-lbs)	MIL-L-24479B 0.08 Fc (ft-lbs)	Other Lubricants with the following Friction Coefficients (Fc)		
			0.15 Fc (ft-lbs)	0.10 Fc (ft-lbs)	0.06 Fc (ft-lbs)
-1 -2	680	270	540	375	245
-3 -5	1,870	810	1,460	1,000	650
-8	4000	2080	3100	2120	1340

11. Allow the unit to sit for at least one hour and then recheck the torque for the values given in Table 3.2. Torque any nuts that are below the specified value.
12. Lay the unit on its side and disconnect the crane and remove the eye nuts.
13. Install three 1 inch eye nuts on the retainer studs (7) at the top of the housing (4) and connect the crane to them.
14. Raise the unit and position it on the lower end connector.
15. Disconnect the crane and remove the eye nuts.

3.5.3 Secondary Flex Element Assembly. Install the secondary flex element assembly (3) as follows:

1. Lubricate a new O-ring (5) and backup rings (6) liberally with Alemite multipurpose #2 grease and install them in the O-ring groove of the lower primary flex element (2).
2. Install three 1/2 inch eyebolts in the upper element of the secondary flex element assembly (3) and connect the crane to them.
3. Lift the secondary flex element assembly (3) and lower it carefully onto the lower primary flex element (2). Be sure that the secondary flex element assembly is completely seated and that the O-ring (5) was not damaged during installation.
4. Disconnect the crane and remove the eyebolts from the secondary flex element assembly (3).

3.5.4 Upper Primary Flex Element. Install the upper primary flex element (1) as follows.

1. Install three 1 inch eyebolts in the upper end connector and connect the crane to them.
2. Raise the upper primary flex element (1) and install a new O-ring (5) and backup rings (6) coated with Alemite multipurpose #2 grease in the O-ring groove. Apply additional lubricant to the new O-rings and metal surface after they are installed.

NOTE:

The retainer flange of the upper primary flex element will not seat completely on the housing during the following step. This is normal and is due to the allowance for precompression in the unit.

3. Position the upper primary flex element (1) over the housing (4) and lower it carefully onto the retainer studs (7) and secondary flex element assembly (3). Ensure that the upper primary flex element is completely seated on the secondary flex element assembly.
4. Measure the gap between the housing (4) and the retainer flange. If this measurement is greater than 1.06 inches, the upper primary flex element (1) is not completely seated on the secondary flex element assembly (3). If the measurement is less than 0.53 inches, this indicates that the flex elements may have taken a set and available precompression may be inadequate. In this case, contact the manufacturer for recommended corrective action.
5. Install the retainer nuts (8) on the retainer studs (7) and tighten them finger tight.
6. Tighten three retainer nuts (8), identified on Figure 3-2 as key nuts, evenly in increments of two turns until the retainer flange contacts the housing (4).
7. Torque the remaining retainer nuts (8) to 100 ft-lbs in the sequence indicated on Figures 3-2 through 3-4 and then the key nuts.
8. Repeat the torquing procedures in section 3.5.2, steps 6 and 7.
9. Allow the unit to sit for at least one hour and then recheck the torque for the values given in Table 3.2. Torque any nuts that are below the specified value.
10. Inspect the unit to ensure that all mating surfaces are flush and for any other indications of improper assembly.

4 PREPARATION FOR STORAGE OR SHIPMENT

4.1 GENERAL

This section presents information on the packing and preservation required to prepare the flexible joint for storage or shipment.

4.2 PRESERVATION

Prior to storing or shipping the flexible joint, the following steps should be taken to ensure that no deterioration occurs during storage.

4.2.1 Clean Metals. Clean the metal surfaces of the unit completely inside and out with Trichloroethylene or an equivalent solvent.

4.2.2 Coat. Coat the metal surfaces with a liberal coat of API #SA2 grease or equivalent.

4.2.3 Clean Elastomer. Clean the elastomer surfaces inside and out with Methyl Ethyl Ketone (MEK).

4.2.4 Install Shield. Place a shield over the open end of the flexible joint and secure it in place.

4.2.5 Cover. If the unit will be exposed to direct sunlight, cover the entire unit to protect the elastomer from deterioration due to sunlight. The best option is an aluminum cover that completely protects the unit from sunlight and rain, but any cover that is waterproof and shields

the elastomer from the sun may be used.

4.3 PACKING

Packing of the flexible joint is limited to securing the unit to an appropriate pallet and ensuring that the steps required for preservation outlined in Section 4.2 have been accomplished.

4.4 STORAGE

The flexible joint should be stored in a cool, dry area where it is protected from moisture and sunlight. The temperature during storage should not be below -20°F (-29°C).

NOTE:

To protect the bottom sealing surfaces of the flexible joint, do not place the flexible joint on uneven surfaces such as rocks or steel as this may damage the sealing surfaces.

5 PARTS LIST

5.1 GENERAL

This section provides typical parts lists for each Diverter II flexible joint. Coverage is limited to those items that may be replaced by usual maintenance procedures.

5.2 USING PARTS LIST

NOTE:

If the top assembly drawings for your flexible joint are available, refer to them to verify part numbers before ordering. If not, the top assembly drawing number is stamped on the flexible joint body. In addition, each individual part is stamped with the drawing number and serial number for that part.

To use the parts lists, first determine the model you have and turn to the parts list (Figures 5-1 through 5-5) for that model. Locate the part(s) you need and note the number of the part on the illustration. Find the corresponding part on the parts list and use the information provided to order parts. Each list provides the item number, name of the part, Oil States part number, and the quantity used in one flexible joint for all replacement parts.

5.3 ORDERING INFORMATION

Replacement parts for any member of the Diverter II FlexJoint® family may be ordered from Oil States Industries at the addresses given below. Always include all of the following information when ordering parts.

1. Rig Name
2. Unit Size
3. Unit Serial Number
4. Part Name
5. Part Number
6. Quantity Required
7. Your Company Name
8. Address and Phone Number
9. Shipping Instructions

CONTACT INFORMATION:

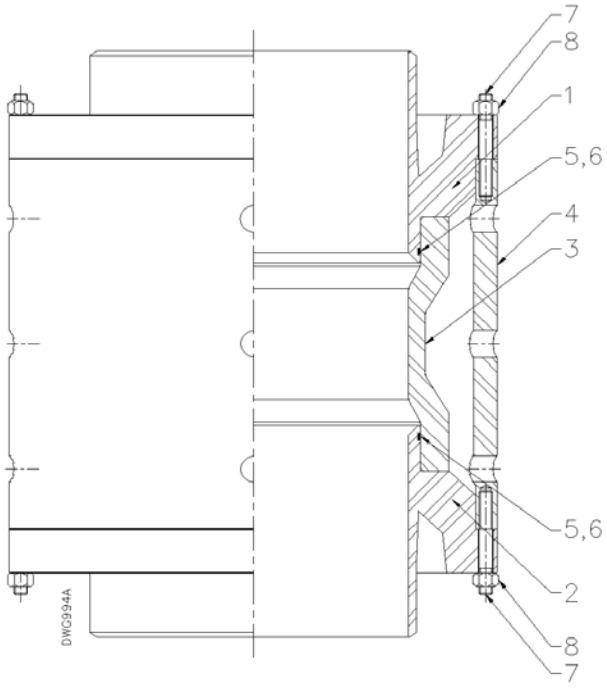
North America
Special Products
Oil States Industries, Inc.
P. O. Box 670
1031 Commercial Blvd. North
Arlington, Texas 76001
Tel.+1 817 548 4200
Fax.+1 817 804 7198
specprod@oilstates.com

South America
Macae, Brazil
Oil States Industries do Brasil Ltda.
Rua Professora Ivone Alves de Barcelos
No. 205
Novo Cavaleiros
CEP 27930-490
Macae, RJ Brazil
Tel.+55 22 2763 4300
Fax.+55 22 2773 5625

Europe
Oil States Heartlands
Broadfold Road
Bridge of Don
Aberdeen AB23 8EE
Scotland, UK
Tel. +44 1224 708 700
Fax. +44 1224 708 400

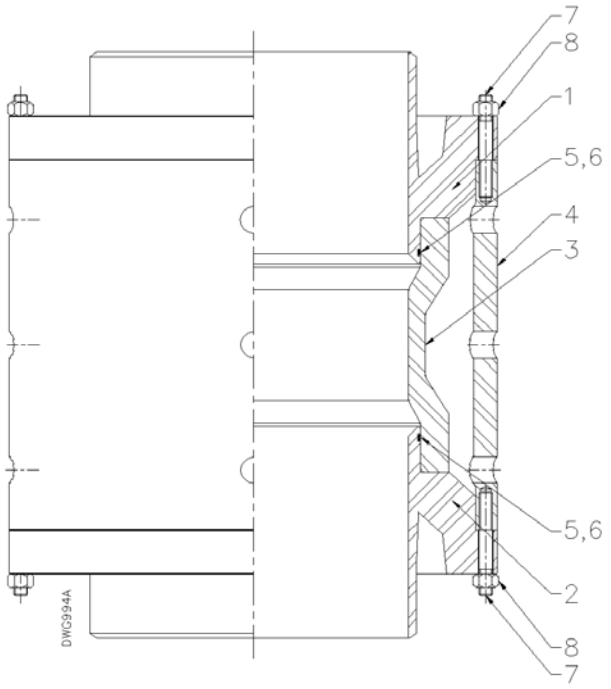
Asia
Oil States Industries (Asia) Pte Ltd.
42-H Penjuru Road
Singapore 609158
Tel.+65 6773 7555
Fax.+65 6773 7667
sales.singapore@oilstates.com

Figure 5-1
Diverter II –1 Flexible Joint
Parts List



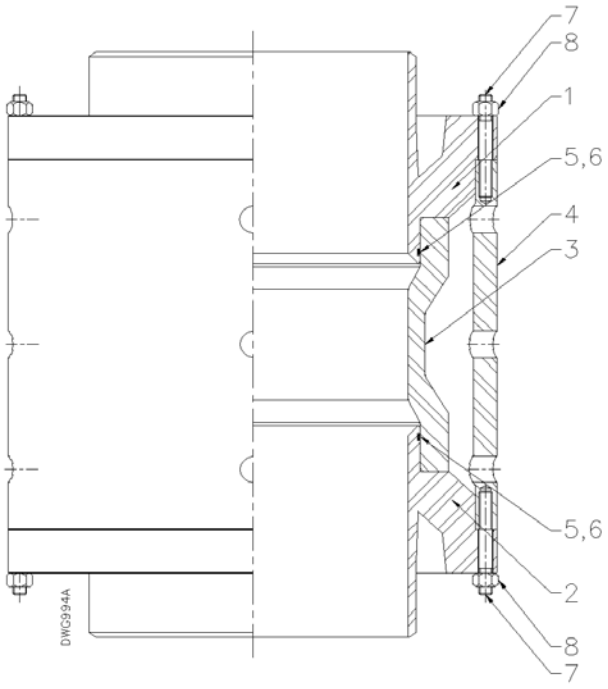
Item	Description	Part Number	Quantity Required
1	Upper Primary Flex Element	PD2078-1	1
2	Lower Primary Flex Element	PD2078-1	1
3	Secondary Flex Element Assembly	PD2414	1
4	Housing	PD2074-1	1
5	O-ring	PB2087	2
6	Backup Ring	PB2174	4
7	Retainer Stud	PB2085	48
8	Retainer Nut	PB2175	48

Figure 5-2
Diverter II –2 Flexible Joint
Parts List



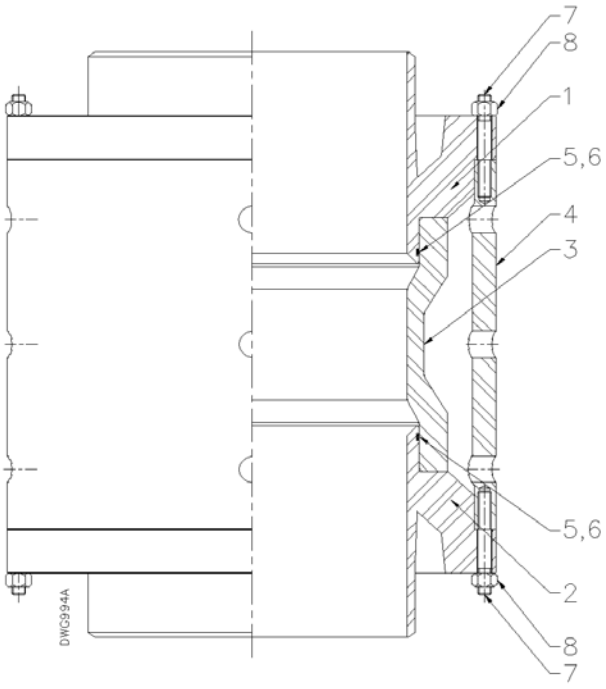
Item	Description	Part Number	Quantity Required
1	Upper Primary Flex Element	PD2078-2	1
2	Lower Primary Flex Element	PD2078-2	1
3	Secondary Flex Element Assembly	PD2414	1
4	Housing	PD2074-2	1
5	O-ring	PB2087	2
6	Backup Ring	PB2174	4
7	Retainer Stud	PB2085	72
8	Retainer Nut	PB2175	72

Figure 5-3
Diverter II –3 Flexible Joint
Parts List



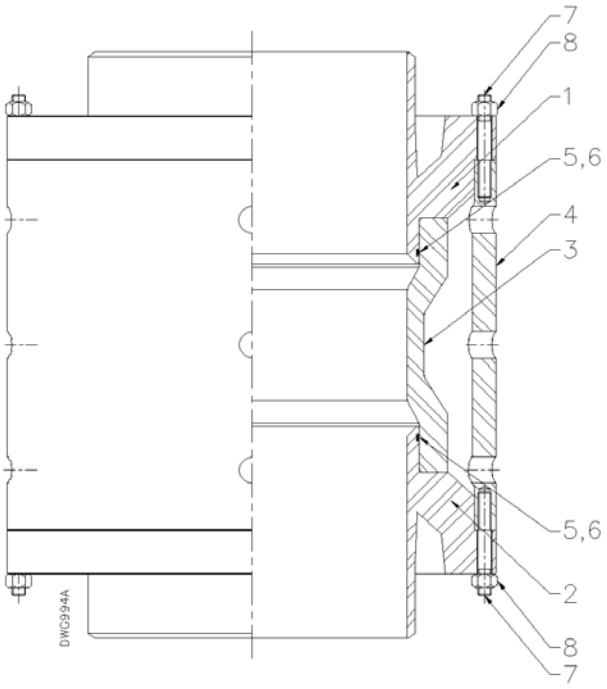
Item	Description	Part Number	Quantity Required
1	Upper Primary Flex Element	PD3460	1
2	Lower Primary Flex Element	PD3460	1
3	Secondary Flex Element Assembly	PD2414	1
4	Housing	PD3464	1
5	O-ring	PB2087	2
6	Backup Ring	PB2174	4
7	Retainer Stud	PB3462	60
8	Retainer Nut	PB3463	60

Figure 5-4
Diverter II –5 Flexible Joint
Parts List



Item	Description	Part Number	Quantity Required
1	Upper Primary Flex Element	PD3460	1
2	Lower Primary Flex Element	PD3460	1
3	Secondary Flex Element Assembly	PD2414	1
4	Housing	PD3464	1
5	O-ring	PB2087	2
6	Backup Ring	PB2174	4
7	Retainer Stud	PD3462	60
8	Retainer Nut	PD3463	60

Figure 5-5
Diverter II –8 Flexible Joint
Parts List



Item	Description	Part Number	Quantity Required
1	Upper Primary Flex Element	PD10852	1
2	Lower Primary Flex Element	PD10852	1
3	Secondary Flex Element Assembly	PD11412	1
4	Housing	PD10851	1
5	O-ring	PB2087	2
6	Backup Ring	PB2174	4
7	Retainer Stud	PB10949	60
8	Retainer Nut	PB2265	60