

SHAFFER ROTARY VANE

SUBSEA ACTUATOR INSTALLATION & OPERATION MANUAL

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SHAFER SUBSEA ROTARY VANE ACTUATOR INSTALLATION & OPERATION MANUAL

I. SCOPE

The following illustrations and instructions pertain to Shafer subsea hydraulic double acting Rotary Vane actuators. The manual includes a typical schematic, but may not include every optional schematic offered. In addition to this manual, refer to the specific Shafer supplied General Arrangement and Assembly drawings not supplied in this manual.

This manual contains product descriptions, features, installation instructions, and actuator purging instructions. The attached illustrations depict typical subsea actuator assemblies, but may not include every subsea configuration. Actuator assemblies not included in this manual will have additional instructions, procedures and illustrations.

II. SCHEMATIC FUNCTION DESCRIPTION

Refer to standard schematics: 10623-S (Pg. 2)

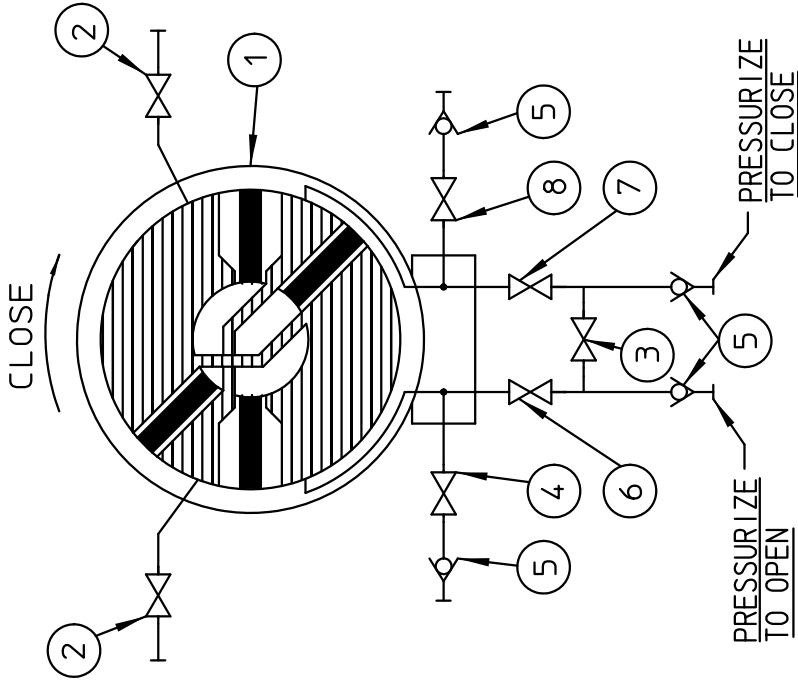
Schematic # 10623-S (Double Acting subsea Rotary Vane 2-way Hydraulic)

Schematic consists of the Rotary vane actuator (1), hydraulic manifold, actuator purging isolation valves (2), primary & spare quick disconnect couplings (5), actuator isolation valves (4), (8), (6) & (7), and by-pass isolation valve (3).

FUNCTION DESCRIPTION:

The hydraulic umbilical is attached to the two primary quick disconnect couplings, item (5), described by “Pressure to Open & Pressure to Close”. By-Pass valve, item (3) is closed, and is only opened to communicate both umbilical hoses to each other for umbilical flushing. Both secondary quick disconnect isolation valves, item (4) & (8) remain closed, and are only opened and used as back-up connections for the two primary quick disconnects, items (5). Both actuator purging isolation valves, items (2) remain closed, unless purging the actuator assembly.

- To “Open” the actuator, open isolation valves (6) & (7), and pressure the Open Quick Disconnect hose.
- To “Close” the actuator, pressure the Close Quick Disconnect hose.



1. SHAFER OPERATOR (SHOWN IN OPEN POSITION)
2. ISOLATION VALVES USED FOR PURGING THE OPERATOR.
3. BY-PASS VALVE
4. ISOLATION VALVE FOR SPARE OPENING PORT.
5. QUICK DISCONNECT COUPLINGS PRIMARY VALVE FOR OPENING
6. PRIMARY VALVE FOR CLOSING
7. ISOLATION VALVE FOR SPARE CLOSING PORT.
- 8.

12U-02222

SHAFER

MANSFIELD, OHIO, U.S.A.

2-WAY HYDRAULIC SCHEMATIC

REVISIONS

MATL SPEC.	

SCALE NONE	JOB NO FILE	DRAWING NO.
DATE 2-12-06	1	10623-S
DR. BY JTH	ASSY	REV. 1 2 3 4 5 6
APPD BY JMK		NO. 7 8 9 10
APPD BY		

III. ACTUATOR ASSEMBLY COMPONENT DESCRIPTION: (1) **ONE PIECE SPOOL/COUPLING DESIGN**

Refer to FIG. 1 (Pg. 5) This description pertains to the actuator assembly primary components. The specific project General Arrangement, Assembly drawing, and bills of material will include all components.

ROTARY VANE ACTUATOR

Actuator (A), including the attached hydraulic manifold with isolation valves and umbilical quick disconnect couplings. The manifold is equipped with a permanent instruction tag illustrating the Opening & Closing quick disconnect couplings. The Opening quick disconnect couplings are “male”, the Closing couplings are “female”. This configuration pertains to both Primary and Secondary spare sets of quick disconnect couplings. The manifold includes the By-Pass isolation valve used to communicate both umbilical hoses to each other for flushing the umbilical. The actuator assembly is equipped with two purging isolation valves located on the actuator upper head, and these isolation valves are common to the open and close operating chambers of the actuator assembly.

ACTUATOR LOWER HEAD & ROTOR

The **Actuator Lower Head (B)** is designed to mount directly to the **Valve Mounting Spool (H)**. The **Actuator Rotor (C)** has female sockets which accept the male **Coupling Locating Pin and Torque Pins (I)** of the **Valve Coupling (J)**.

The **Actuator Lower Head (B)** is equipped with threaded inserts to engage the two **Diver Quick Release Handles (E)**. See figure 3.

The **Actuator Lower Head (B)** is equipped with an irregular configuration of stainless steel female sockets to accept the male **Stab & Torque Pin(s) (D)** located on the **Valve Mounting Spool (H)**.

The **Actuator Lower Head (B)** is equipped with an elastomer O-Ring seal between the lower head and spool upper flange.

VALVE MOUNTING SPOOL & COUPLING

Valve Mounting Spool (H) is attached to the specific valve topworks, with specified fasteners, which may include bolts, studs, and nuts. Torque values for these fasteners, will be designated by the size and type of fastener.

Valve Coupling (J) is installed to the valve stem by use of one or both keyways (whichever applies). **Note:** Special valve stem couplings can be designed to fit specific valve stem requirements, such as square or splined valve stems.

Valve Mounting Spool (H) is equipped with two **Diver Quick Release Handle Assemblies (E)**. These two handle assemblies extend into the thread inserts located in the **Actuator Lower Head (B)**. Both handle assemblies are captivated in the **Valve Mounting Spool (H)** to prevent loss of handles when actuator and spool are disengaged in subsea condition. See figure 3.

Valve Mounting Spool (H) is equipped with a **Relief Valve (F)** set at 50 PSIG cracking pressure. This is used to exhaust excessive pressure in the spool assembly due to valve stem packing leakage. Although the spool assembly is designed for service depths up to 1000 feet, they are not certified pressure vessels, and must be protected with the described relief valve.

Valve Mounting Spool (H) is equipped with an **Isolation Valve & Flushing Quick Disconnect (G)**, used to flush the spool assembly of sea water after re-engagement in subsea condition. **Note:** See Actuator/Spool Assembly Purging and Filling Procedure for specific instruction.

Valve Mounting Spool (H) is equipped with a **Stab Pin(s) (D)**, used to locate the **Actuator Lower Head (B)** with the **Valve Mounting Spool (H)**. The **Stab Pin(s) (D)** engage into non-metallic bushings located in the **Actuator Lower Head (B)**.

Note: **Actuator Lower Head (B)** & **Valve Mounting Spool (H)**, are designed with male torque pins in the **Valve Mounting Spool (H)**, and sockets in the **Actuator Lower Head (B)**. Male torque pins and female sockets are designed with an irregular configuration to prevent the spools from engaging in the incorrect position.

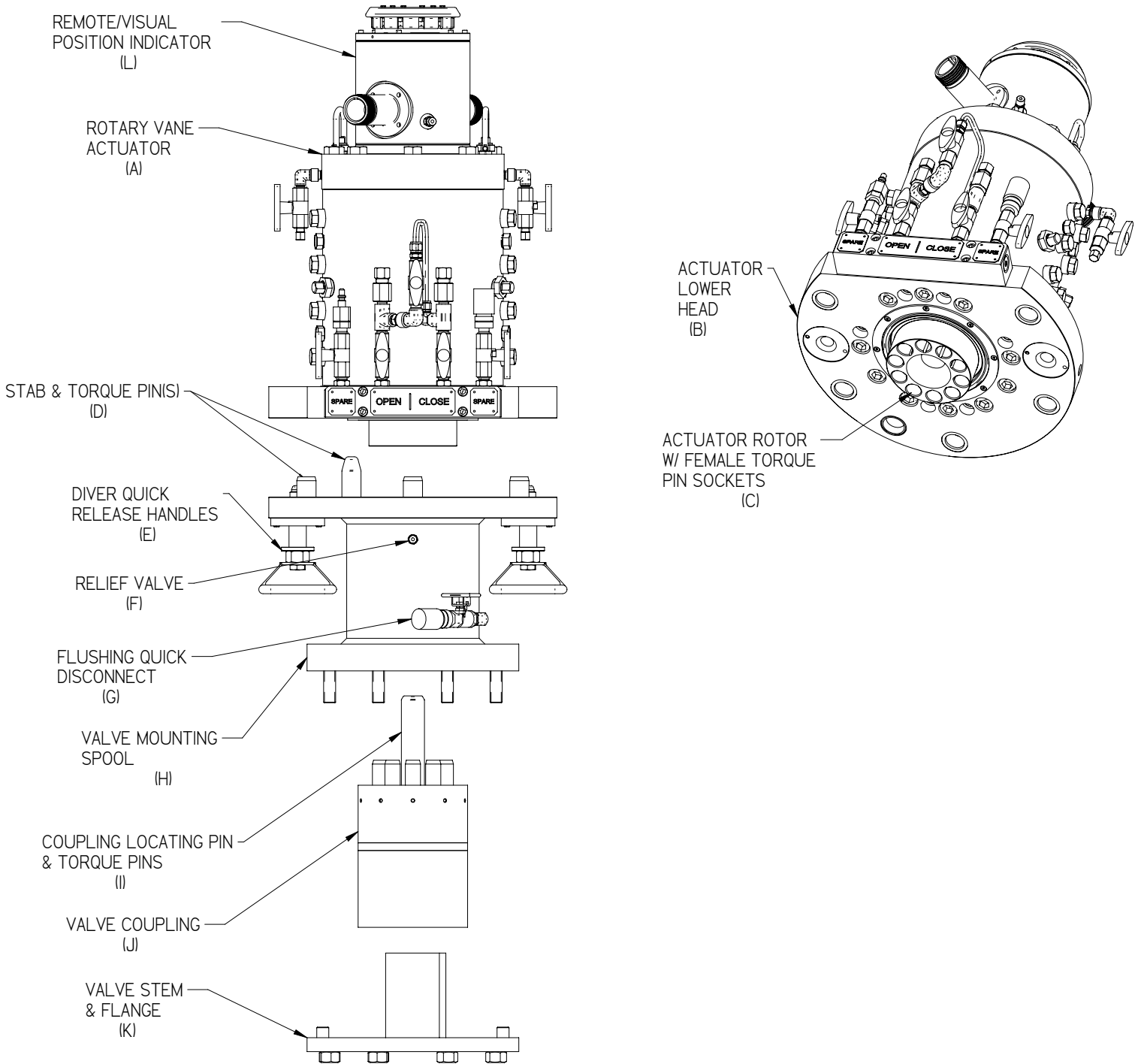


FIGURE 1

IV. ACTUATOR ASSEMBLY COMPONENT DESCRIPTION: (1) ONE PIECE SPOOL / (2) TWO PIECE COUPLING DESIGN

Refer to FIG. 2 (Pg. 8) This description pertains to the actuator assembly primary components. The specific project General Arrangement, Assembly drawing, and bills of material will include all components.

ROTARY VANE ACTUATOR

Actuator (N), including the attached hydraulic manifold with isolation valves and umbilical quick disconnect couplings. The manifold is equipped with a permanent instruction tag illustrating the Opening & Closing quick disconnect couplings. The Opening quick disconnect couplings are “male”, the Closing couplings are “female”. This configuration pertains to both Primary and Secondary spare sets of quick disconnect couplings. The manifold includes the By-Pass isolation valve used to communicate both umbilical hoses to each other for flushing the umbilical. The actuator assembly is equipped with two purging isolation valves located on the actuator upper head, and these isolation valves are common to the open and close operating chambers of the actuator assembly.

ACTUATOR MOUNTING SPOOL & COUPLING

The **Actuator Lower Head (O)** is designed to mount directly to the **Valve Mounting Spool (U)**, and the **Actuator Coupling (P)** is bolted and keyed to the male rotor extension of the actuator. **Actuator Coupling (P)** is equipped with female sockets which accept the male **Coupling Torque Pins (V)** of the **Valve Coupling (W)**.

Note: the actuator/valve spools and couplings are assembled to each actuator before shipment.

The **Actuator Lower Head (O)** is equipped with threaded inserts to engage the two **Diver Quick Release Handles (S)**. See figure 3.

The **Actuator Lower Head (O)** is equipped with an irregular configuration of stainless steel female sockets to accept the male **Stab & Torque Pin(s) (Q)** located on the **Valve Mounting Spool (U)**.

The **Actuator Lower Head (O)** is equipped with an elastomer O-Ring seal between the lower head and spool upper flange.

Note: **Actuator Coupling (P)** will remain with the actuator assembly during diver disengagement of **Valve Mounting Spool (U)**, and **Valve Coupling (w)**.

VALVE MOUNTING SPOOL & COUPLING

Valve Mounting Spool (U) is attached to the specific valve topworks, with specified fasteners, which may include bolts, studs and nuts. Torque values for these fasteners, will be designated by the size and type fastener.

Valve Coupling (W) is installed to the valve stem by use of one or both keyways (whichever applies). **Note:** Special valve stem couplings can be designed to fit specific valve stem requirements, such as square or splined valve stems.

Valve Coupling (W) is equipped with an irregular stainless steel male pin configuration. The configuration matches the same configuration located on the **Actuator Coupling (P)**. **Coupling Torque Pins (V)** engage into the female sockets located on the **Actuator Coupling (P)** when the **Actuator Lower Head (O)**, and **Valve Mounting Spool (U)** are engaged.

Valve Mounting Spool (U) is equipped with two **Diver Quick Release Handle Assemblies (S)**. These two handle assemblies extend into the thread inserts located in the **Actuator Lower Head (O)**. Both handle assemblies are captivated in the **Valve Mounting Spool (U)** to prevent loss of handles when actuator and spool are disengaged in subsea condition. See figure 3.

Valve Mounting Spool (U) is equipped with a **Relief Valve (R)** set at 50 PSIG cracking pressure. This is used to exhaust excessive pressure in the spool assembly due to valve stem packing leakage. Although the spool assembly is designed for service depths up to 1000 feet, they are not certified pressure vessels, and must be protected with the described relief valve.

Valve Mounting Spool (U) is equipped with an **Isolation Valve & Flushing Quick Disconnect (T)**, used to flush the spool assembly of sea water after re-engagement in subsea condition. **Note:** See Actuator/Spool Assembly Purging and Filling Procedure for specific instruction.

Valve Mounting Spool (U) is equipped with two **Stab Pins (Q)**, used to locate the **Actuator Lower Head (O)** with the **Valve Mounting Spool (U)**. The two **Stab Pins (Q)** engage into non-metallic bushings located in the **Actuator Lower Head (O)**.

Note: **Actuator Lower Head (O)** & **Valve Mounting Spool (U)**, are designed with male torque pins in the **Valve Mounting Spool (U)**, and sockets in the **Actuator Lower Head (O)**. Male torque pins and female sockets are designed with an irregular configuration to prevent the spools from engaging in the incorrect position.

V. ACTUATOR & VALVE MOUNTING INSTALLATION INSTRUCTIONS

Refer to attached FIG. 1 or 2, 3 & 4

- 1) Install **Valve Coupling (W)** to valve stem & key with the valve in the open position. The actuator must be stroked open before mounting the valve stem coupling. In order to mount the **Valve Coupling (W)** in the correct position, the **Valve Coupling (W)** male pin irregular configuration must match the **Actuator Coupling (P)** configuration. This ensures both the actuator and valve are both in the open position, and the two couplings will engage correctly.

Note: Actuators designed with a one piece coupling (Figure 1) do not have an irregular pattern on the valve stem coupling. Ensure that both the valve and actuator are in the fully opened position before mating actuator to valve mounting stool.

- 2) Refer to FIG.1 or 2. Attach **Valve Mounting Spool (H or U)** to the valve flange, and install the specified studs or bolts, lock-washers and nuts. Tighten each bolt or nut per valve manufacturer's recommended torque.
- 3) Refer to FIG. 2. Shafer Rotary Vane subsea actuators with the two piece coupling design are shipped with **Actuator Coupling (P)** assembled to the actuator, and all actuators are shipped in the open position as indicated by the visual or tactile position indicator located on the top of the actuator assembly upper head.
- 4) As the **Actuator Lower Head and Coupling assemblies (O) & (P)** are lowered by the diver to engage with the **Valve Mounting Spool and Coupling assemblies (U) & (W)**, the **Stab Pins (Q)** located in the **Valve Mounting Spool (U)** will start to engage into the non-metallic bushings located in the **Actuator Lower Head (O)**. The male torque pins in the **Valve Mounting Spool (U)** will engage into the female sockets in the **Actuator Lower Head (O)**. Both **Actuator Coupling (P)** and **Valve Coupling (W)** will also engage at this time.
- 5) Refer to FIG. 1 or 2 & 3. After both **Actuator & Valve Spool assemblies (O) & (U) or (B) & (H)**, and both **Actuator & Valve Couplings (P) & (W)** are engaged properly, the two **Diver Quick Release Handle assemblies (E or S)** can be engaged. The **Diver Handle assemblies (E or S)** are engaged by rotating "clockwise" into the stainless steel thread inserts located in the **Actuator Lower Head (O or B)**.

Note: The **Diver Quick Release Handle assemblies (E or S)** do not require any tools to engage or tighten, and are to be hand tightened only.

VI. SUBSEA ROTARY VANE ACTUATOR PURGING PROCEDURE:

Refer to FIG. 1, 2, & 5.

PRODUCT DESCRIPTION:

All Shafer subsea Rotary vane actuators are equipped with purging ports and **Purging Isolation Valves (P1 & P2)** located on the actuator upper head. **Purging Isolation Valve (P1)** communicates with actuator opening chamber, **Purging Isolation Valve (P2)** communicates with the closing chamber. The **Valve Mounting Spool (H & U)** are equipped with purging isolation valves and quick disconnect couplings.

ACTUATOR PURGING PROCEDURE:

Refer to FIG. 5

Actuator purging procedure eliminates trapped air pockets inside the actuator open and closing operating chambers during hydraulic fluid filling. Both purging ports are located at the highest points in the actuator upper head.

After filling the actuator with project specified hydraulic fluid using the open and close **Quick Disconnect Couplings (A) & (B)** in FIG 5., perform the following actuator purging procedure. **Note:** The by-pass valve remains closed during this entire procedure.

- 1.) Remove both hex head plugs from both the actuator **Purging Isolation Valves (P1 & P2)**. **Note:** both **Purging Isolation Valves (P1 & P2)** remain closed at this point in the procedure.
- 2.) Connect umbilical or HPU hydraulic hoses to the primary open and close **Quick Disconnect Couplings (A & B)**.
- 3.) Open both quick disconnect isolation valves common to **Quick Disconnect Couplings (A & B)**, and stroke the actuator completely open using **Quick Disconnect Coupling (A)** common to the HPU hydraulic power source, and **Quick Disconnect Coupling (B)** common to the HPU reservoir.
- 4.) After completing the actuators opening stroke, slowly open **Purging Isolation Valve (P1)**, and vent any trapped air located inside the actuator opening chambers.
- 5.) Close **Purging Isolation Valve (P1)**, and reverse the hydraulic hoses. Power hose to **Quick Disconnect Coupling (B)**, return hose to **Quick Disconnect Coupling (A)**.
- 6.) Stroke the actuator completely closed, using **Quick Disconnect Coupling (B)**.
- 7.) After completing the actuators closing stroke, slowly open **Purging Isolation Valve (P2)**, and vent any trapped air inside the actuator opening chambers.

- 8.) Close **Purging Isolation Valve (P2)**, and repeat steps 3 thru 7 as many times as necessary to insure trapped air in the actuator operating chambers is purged.
- 9.) Replace the hex plugs on **Purging Isolation Valves (P1) & (P2)**.

VII. ACTUATOR/SPOOL ASSEMBLIES PURGING AND FILLING PROCEDURE:

Refer to FIG. 5

PRODUCT DESCRIPTION:

The actuator valve mounting spool is equipped with isolation valves and female quick disconnect couplings to purge and fill the spool assembly with hydraulic fluid.

The valve mounting spool is also equipped with a factory set relief valve to prevent excessive pressure from potential valve stem leakage. The relief valve is set at 50 psig cracking pressure and will exhaust excessive pressure into the sea.

VALVE MOUNTING SPOOL PURGING PROCEDURE:

- 1) After actuator and valve mounting spool has been engaged, and both diver quick release handle tightened, connect hydraulic hose to the female quick disconnect coupling.
- 2) Open the isolation valve and begin filling the spool assembly. Pressure will build up inside the spool assembly until the relief valve cracking pressure of 50 PSI is reached.
- 3) Continue filling the spool assemblies with hydraulic fluid until all air or sea-water is purged through the relief valve.

Note: It is not absolutely necessary to have the spool assemblies filled with hydraulic fluid, if the actuator and valves are assembled together before deploying to subsea conditions. The upper and lower spools are equipped with an O-Ring seal to prevent water ingress during the submerging process. Spool assemblies fill and purge isolation valves and quick disconnect couplings are intended to be used by divers after the actuator and valve have been disengaged and later re-engaged subsea.

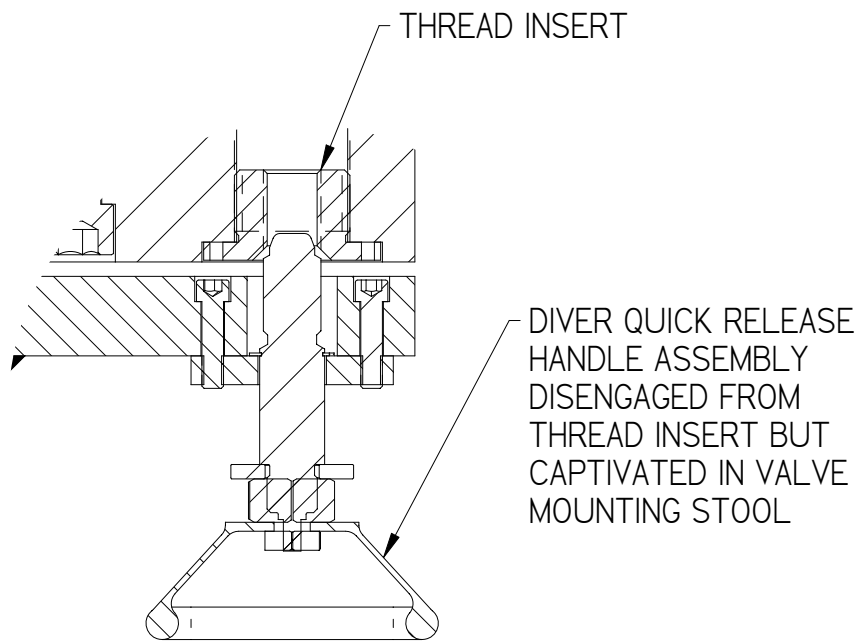
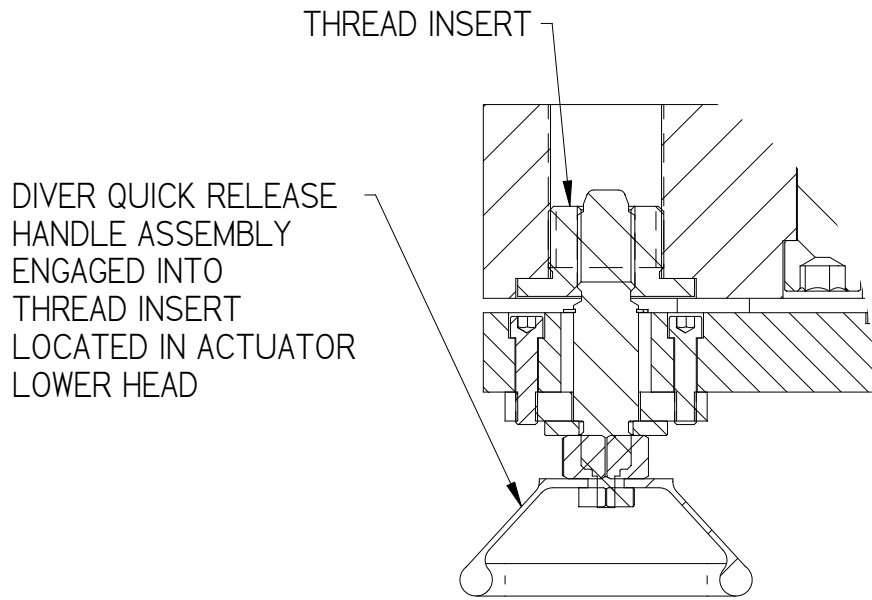
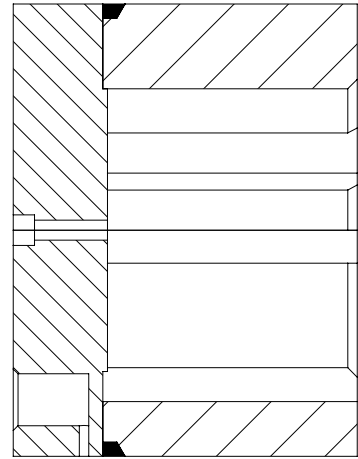
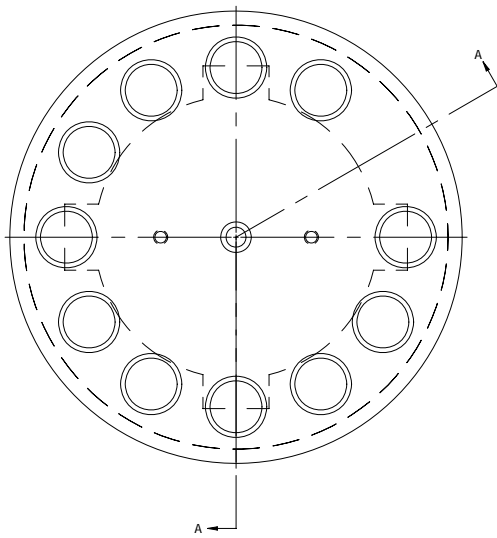
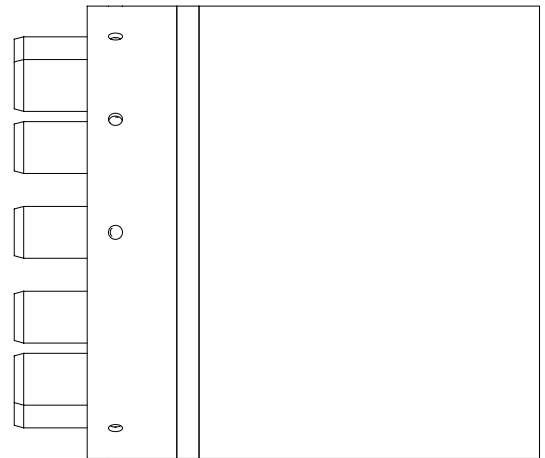
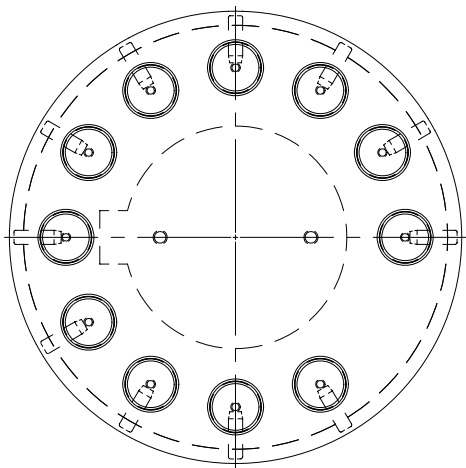


FIGURE 3



ACTUATOR COUPLING (FEMALE SOCKET)



VALVE STEM COUPLING (MALE DRIVE PIN)

FIGURE 4

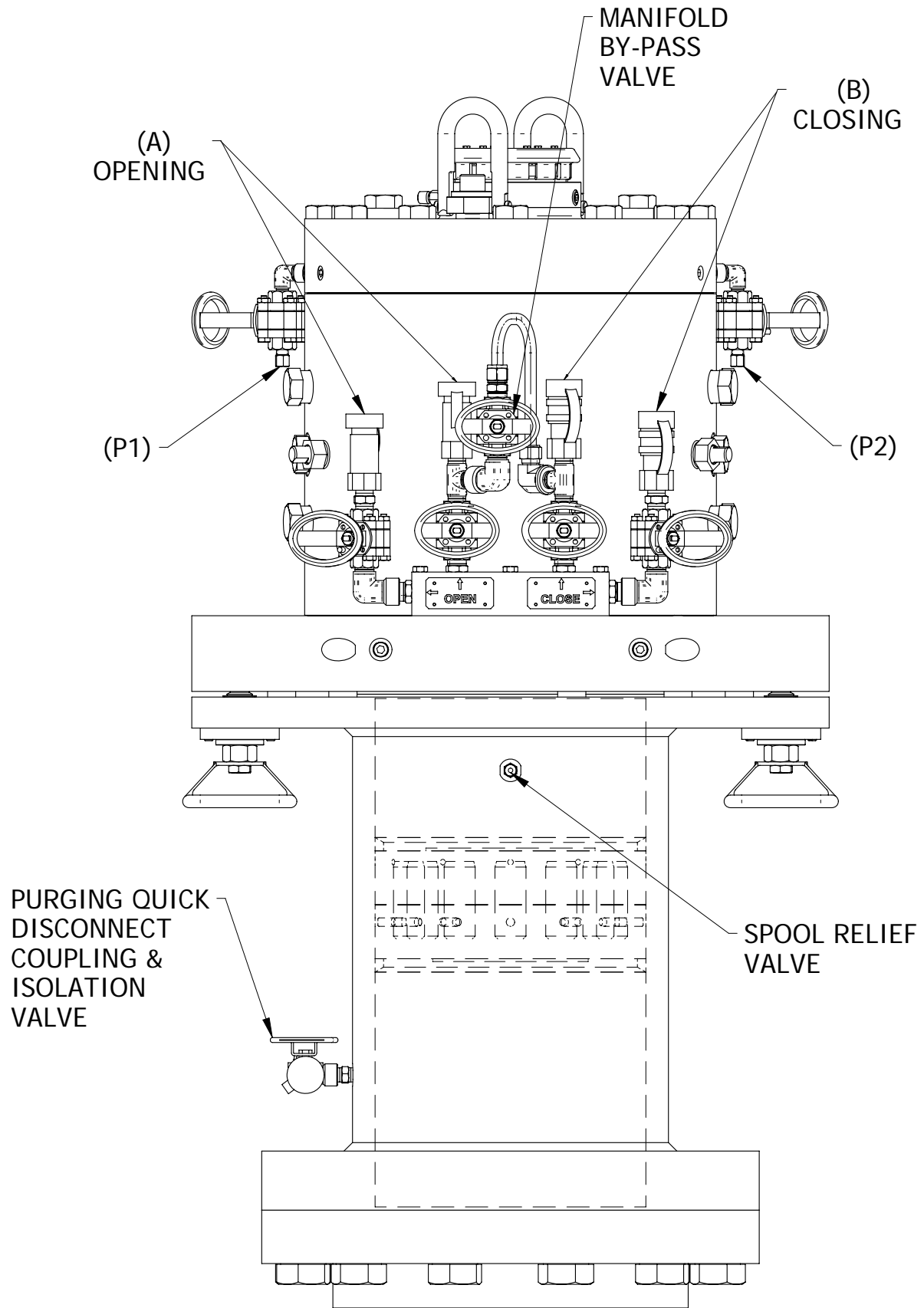


FIGURE 5