



Unit 12 Barratt Trading Estate, Denmore Road, Bridge of Don, Aberdeen AB23 8JW

## **User Manual Modular BOP System**

**This Manual Covers the Following Part Numbers:**

**193-3568-HV0**

This is a certified safety critical product and modifications or changes not authorised by Phuel Oil Tools may compromise the Safety, Functionality and Certification of the assembly.

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### Revision History

Issue, Release Date	Description
Rev A, 11 Jan 10	Initial Issue
Rev B, 10 May 11	Update after NORSOK Qualification
Rev C, 24 May 11	Spares Part No Correction for Inner Seals
Rev D, 23 Mar. 12	Addition of Redress Kit RDK-3318-HV0
Rev E, 11 Apr. 12	Torque Value added for 3/4 Hex Nuts (HNC-0670-STL)
Rev F, 17 Jan 13	Updated with improved seals per FB-029. Added improved shear blades. Added details of metal to metal seal.

### **Safety**

**WARNING: Trapped air requires considerable time to compress and when it is compressed is highly dangerous. It has enough stored energy to separate parts with considerable force.**

This product contains high pressures, when in operation. Failure of any part may cause injury. Welding, corrosion, rough handling, or other abuse may affect the Integrity of this product.

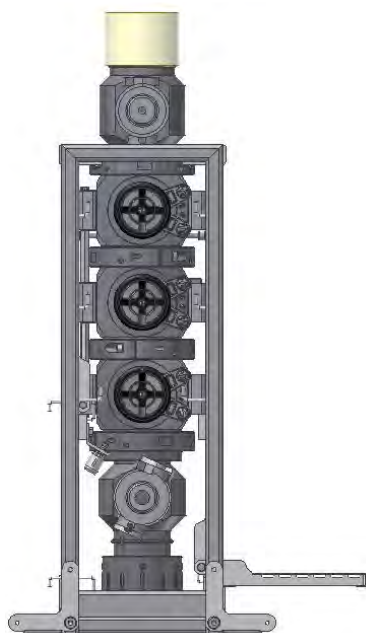
All pressure equipment has a particular pressure rating and care must be taken to ensure that no item is used in a situation that may cause its working pressure to be exceeded.

All personnel involved in pressure testing must be formally trained, competent and utilise the appropriate PPE.

Ensure the identification plate is fitted and is displaying the correct information

This equipment and the equipment it is attached to is heavy never position yourself below a suspended load

The Actuator piston has two seal with a vent hole to prevent communication of well pressure to the hydraulic chambers (on opposite side of grease nipple). This vent hole must never be blanked off.



## 1 Introduction

### 1.1 General

The Modular Blow Out Preventer (BOP) provides essential safety barriers against well pressure during wireline operations. It is usually located directly above the christmas tree flange. The BOP (Depending on configuration) can have one or more sets of wireline rams for sealing against well pressure on slick line and/or braided line. Shear and seal rams are also available these are capable of cutting through the wire and then sealing against the well pressure.

The modular concept allows the operator to configure the BOP as required to suit even special operations. The main advantage comes when maintaining the equipment as ram bodies can be easily changed out with spares more cost effectively allowing the asset use to be maximised.

The ram consists of a hydraulic piston that can be extended or retracted to energise or retract the ram. The ram has a set of inner and horse shoe outer seals that when compressed against the opposite ram forms a continuous seal that is further energised by the application of pressure in one direction. The ram consequently can be arranged so that it holds pressure from below the BOP or from above.

Across the rams there is an equalisation valve assembly. This is used to equalise pressure across the rams so that the rams can be withdrawn to open up the well bore. The equalisation valve assembly consists of a cone seal set on a screw. Unwinding the screw opens the valve and allows equalisation across the rams. Tightening the screw closes the seal and prevents pressure from passing through the valve assembly. There is also a circuit to allow the injection of chemicals into the well or across the equalisation valves, and can be used to prevent the valves freezing while bleeding down gas (by injecting glycol for example). The injection port has a check valve to prevent well pressure entering the injection system.

Between upper and middle ram, it is possible to inject grease through the injection port located at the rear of the BOP. For braided line operations or in cases where an effective seal cannot be achieved, the injection port can be used to inject grease at pressures greater than the well head pressure, limited to the maximum working pressure of the BOP. The injection port has a check valve to prevent well pressure entering the injection system.

The BOP is mounted to a crash frame assembly that provides forklift pockets protection during transport. The crash frame has foldable platforms for the operators to stand on when operating the BOP and stabbing in the lubricator.

This user manual serves as an introduction to the equipment and contains the relevant specifications, operation, planning and maintenance instructions, parts list and drawings.

## 1.2 Product Identification

Phuel products are identified by a unique serial number that facilitates full product traceability. Each product is supplied with a documentation pack that contains product certification and material/inspection reports. The serial number is always etched on the surface of the product but can sometimes be difficult to find or read after painting. A customer identification number is also included to allow the customer to track the asset in their system.

A stainless steel band secures the nameplate tag that is stamped with the information shown below. This tag should be located in the first instance to ensure that this manual refers to the correct equipment.

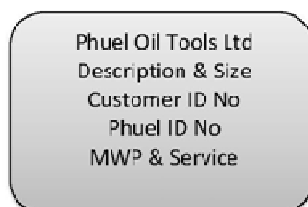


Figure 1: Typical identification tag

## 1.3 Modular Traceability Map

The modular BOP consists of individually certified assemblies that are used to form an overall BOP. The standard configuration is a triple BOP (this manual) but the modular design allows the BOP to be reconfigured to a single or dual BOP by removal of one or more of the individual assemblies or for individual modules to be replaced due to wear or damage. It is essential that the documentation is maintained for each module in the assembly so that the traceability records reflect the modules that have been assembled.

The modular traceability map is intended to assist the user in recording the important trace information and also ensuring that certified components remain with the relevant assemblies. The parts list section of this manual should be used to determine how assemblies and components are grouped together. It is recommended that the manufacturing documentation supplied with the BOP is reviewed before splitting the BOP to ensure that the assemblies can be put back together correctly with the traceability intact.

Record the numbers for each of the modules and ensure that it matches on the corresponding product certificate

### Top Level (Tag)

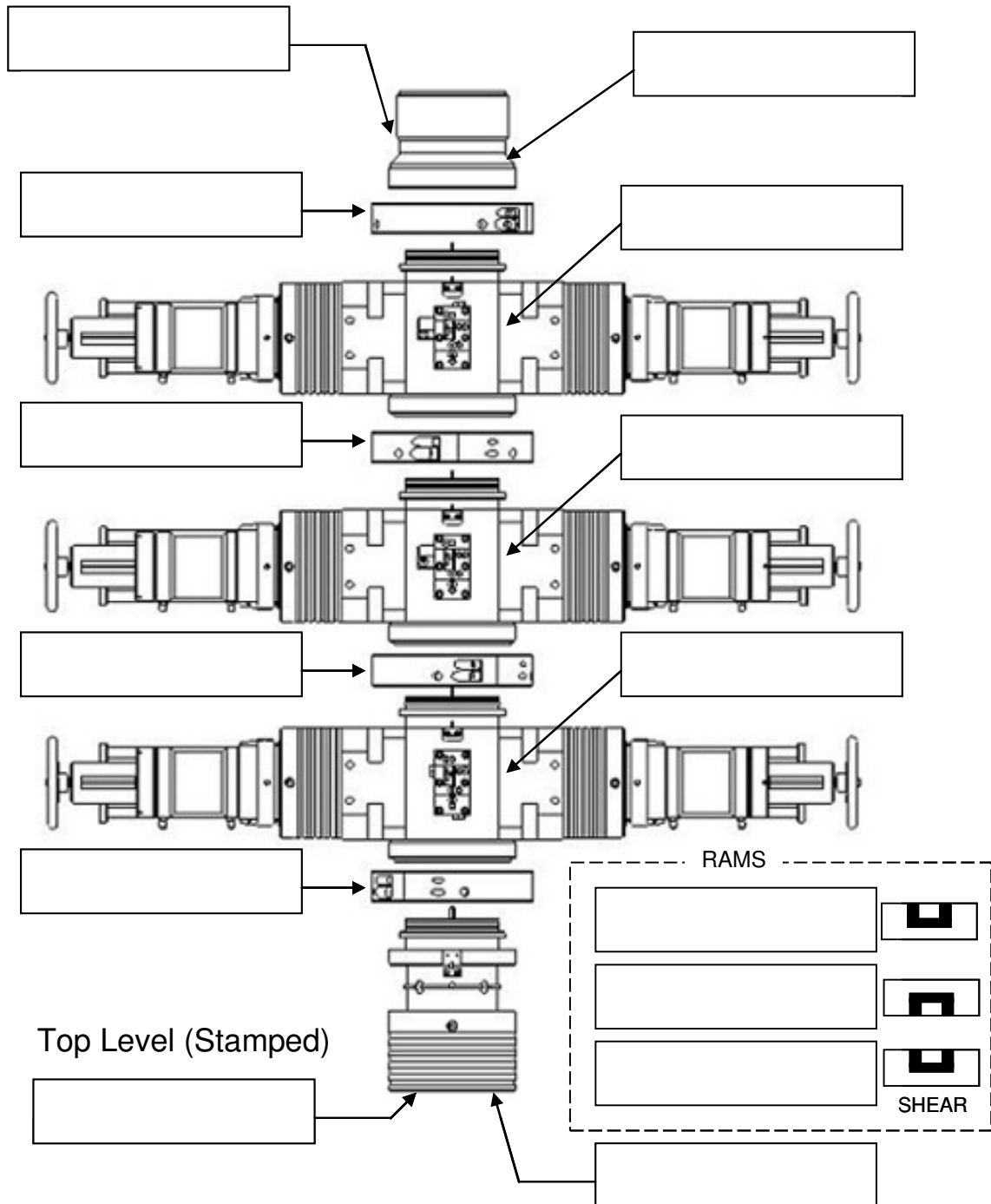


Figure 2: Modular Map

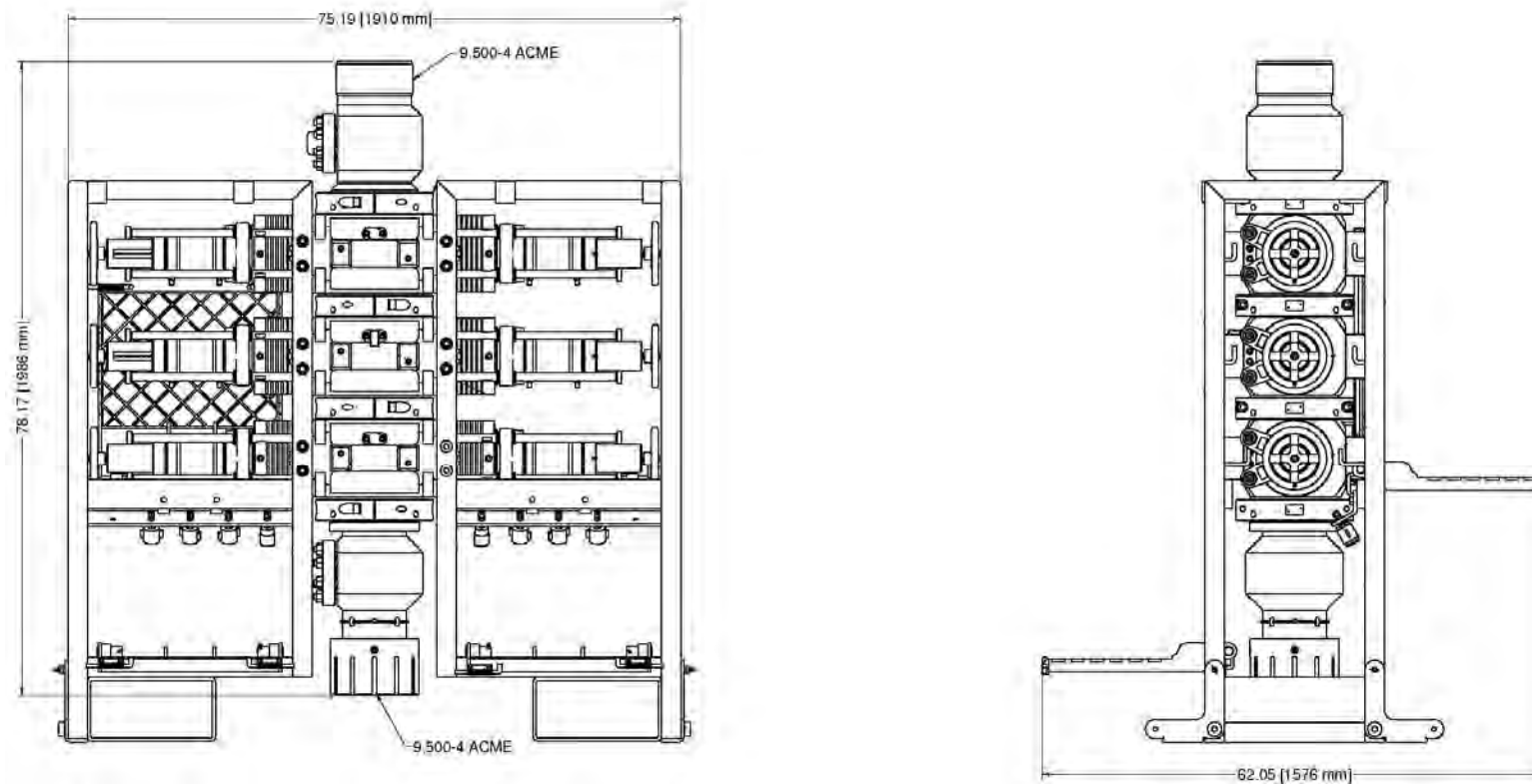


# User Manual Triple BOP System

## 2 Technical Specification

Part Number	193-3658-HV0
Top Connection	9.5-4 ACME Quick Union Box
Bottom Connection	9.5-4 ACME Quick Union Pin/ Collar
Height	79.5"/ 2.02 m
Width	75.2"/1.91 m
Working Pressure	6,500 PSI (448 Bar)
Test Pressure	10,000 PSI (690 Bar)
Service	H <sub>2</sub> S
Hydraulic Pressure	3,000 psi (200 Bar) Max (Standard Actuators)
Stroke Volume (Standard Act)	52 cu-in to close – 48 cu-in to open – Total =107 cu-in (1.64 litres)
Stroke Volume (Shear Act)	52 cu-in to close – 48 cu-in to open – Total =107 cu-in (1.64 litres)
Weight	4880 lbs / 2214 kg
Hydraulic Connections	Wireline Rams - 3/8" Phoenix Beattie HP Quick Release Coupling (QR74 Range)
	Shear Rams – 3/8" Phoenix Beattie HP Quick Release Coupling (QR74 Range)
	Actuators – 1/4" NPT x 3/8" Tube
	Grease Injection – 3/8" Phoenix Beattie HP Quick Release Coupling (QR74 Range)
	Chemical Injection Port – 3/8" Phoenix Beattie HP Quick Release Coupling (QR74 Range)
	Gauge Port – 1/2" NPT (10,000 psi max WP)

**Table 1: Technical Data**

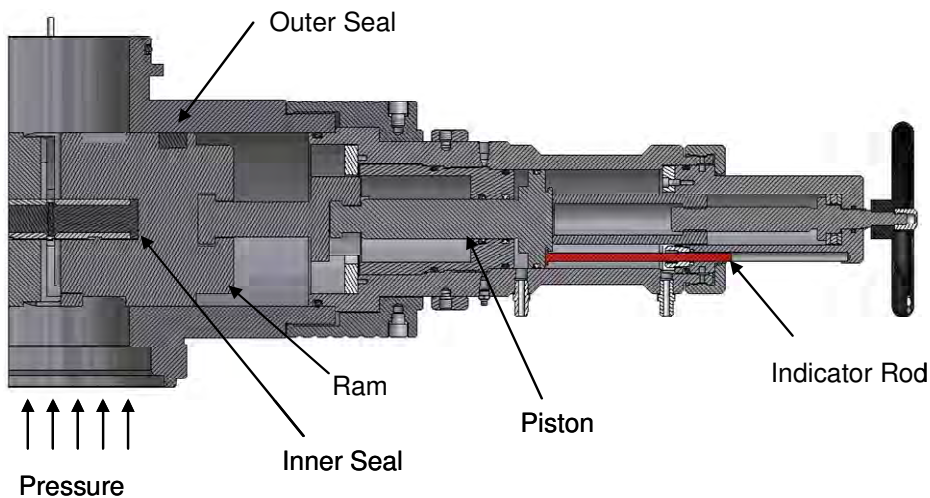


**Figure 3: BOP Dimensions**

## 3 Technical Description

### 3.1 Basic Description

The Phuel BOP provides a positive barrier against well pressure while performing intervention operations. The equipment consists of three sets of hydraulically operated rams that can be individually pumped closed to form a seal against pressure. The orientation of the ram outer seal determines whether the rams hold pressure from above or below. By opposing adjacent ram sets it is possible to apply pressure between the rams through a grease injection port, normally at a pressure greater than the well pressure, and thus form a positive protection barrier. This technique is particularly effective when sealing against braided wire-line as a leak tight seal cannot be obtained due to the construction of the wire. The high viscosity of the grease allows the pressure to be maintained even though a small leak (of grease) still exists.



**Figure 4: Section through BOP rams (closed position)**

The rams are driven by a hydraulic actuator, which consists of a piston with an indicator rod to provide visual confirmation of the position of the rams. A manual locking mechanism is also provided to ensure that when the BOP is closed hydraulically during operations it cannot be opened again until the mechanism is deliberately withdrawn. Each of the actuators assemblies are identical on the Phuel BOP and so can be positioned in any ram bore. This provides excellent flexibility for maintenance and redress of the equipment.

## 4 Basic Operation

### 4.1 Operating the Rams

**Note – Always ensure that the pressure across the rams has been equalised before opening.**

#### 4.1.1 Hydraulic Operation

The BOP has been provided with flexible armoured piping to offer the required fire protection level. Two connections are required for each ram set for open and close. It is important that both connections are connected, as the fluid displaced by the movement of the piston must be allowed to pass through the valve system back to the reservoir.

A Well Control Unit (WCU) is normally used to operate the BOP in an offshore environment. Refer to the relevant manual for that equipment for details of operation and connection. An alternative pump pack may be used for onshore maintenance work but the operation of this equipment is out with the scope of this manual.

#### 4.1.2 Manual Operation

The rams can be closed manually (but not opened again) by turning the hand wheel in a clockwise direction some 30-40 turns providing that the hydraulic fluid from the other side (open port) is allowed to escape. The hydraulic connections must still, therefore, be made up to the WCU even when intending to operate the rams manually.

Once the rams have been closed using the manual method it is not possible to open them again without hydraulic pressure. The Hand wheel, however, must still be turned in an anti-clockwise direction until it stops to allow the piston to move fully back.

#### 4.1.3 Locking the Rams

After closing with hydraulic pressure the piston can be mechanically locked by winding in the manual mechanism. Turning the hand wheel in a clockwise direction will advance the locking mechanism by 3mm per turn. It is therefore necessary to turn the hand wheel 30-40 turns to lock in the piston. Continue to turn until the hand wheel stops, indicating that the piston is now against the back-up lock.

For safety reasons and to reduce the mechanical effort required, **Phuel recommends that the hydraulic pressure be removed or reduced while closing the mechanical back up.** This reduces the risk of injury caused by

the failure of a seal under hydraulic pressure and decreases the time required to implement the back up feature.

**It is important to remember that the manual lock must be fully withdrawn before the rams can be opened.** The mechanism is rated for operation at full working pressure or at full hydraulic pressure but not both at the same time. Strict measures must be taken to ensure that the BOP is not accidentally opened against the back up mechanism when the well pressures are in excess of 4,500 psi. Damage to the mechanism may result and it may not be possible to fully withdraw the rams. There would, however, be no expected loss of pressure containment as a result if this failure.

#### 4.1.4 Proper Use

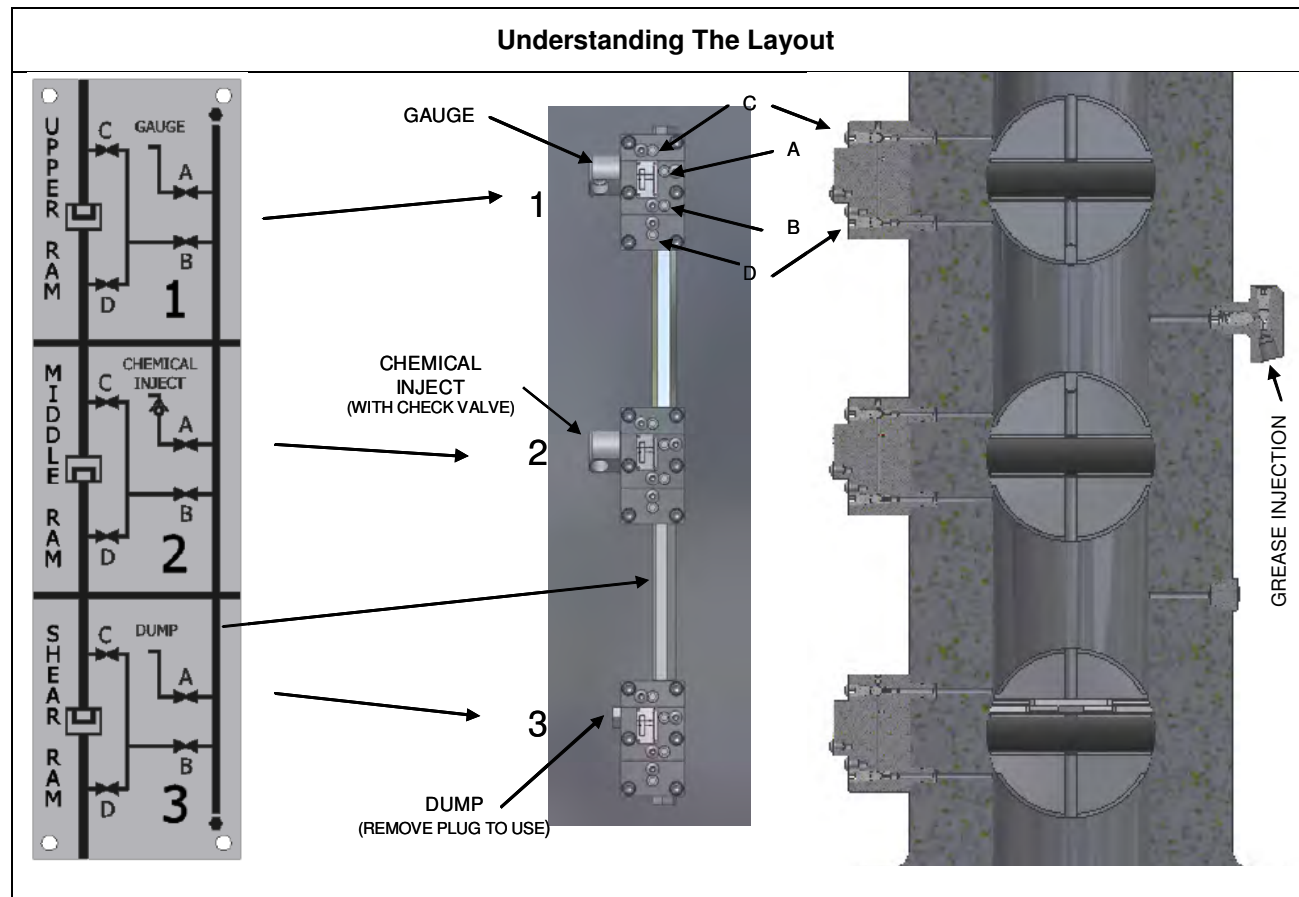
In the event that the BOP is closed against wire during an operation, it is essential that the Inner seals are replaced after that job has been completed. Working practice and procedures must reflect this requirement.

Blind shear seals should always be fitted on the shear rams. They should be tested regularly to verify that they are suitable for operation. If they are ever closed during a live well operation they should be replaced when the operation is complete.

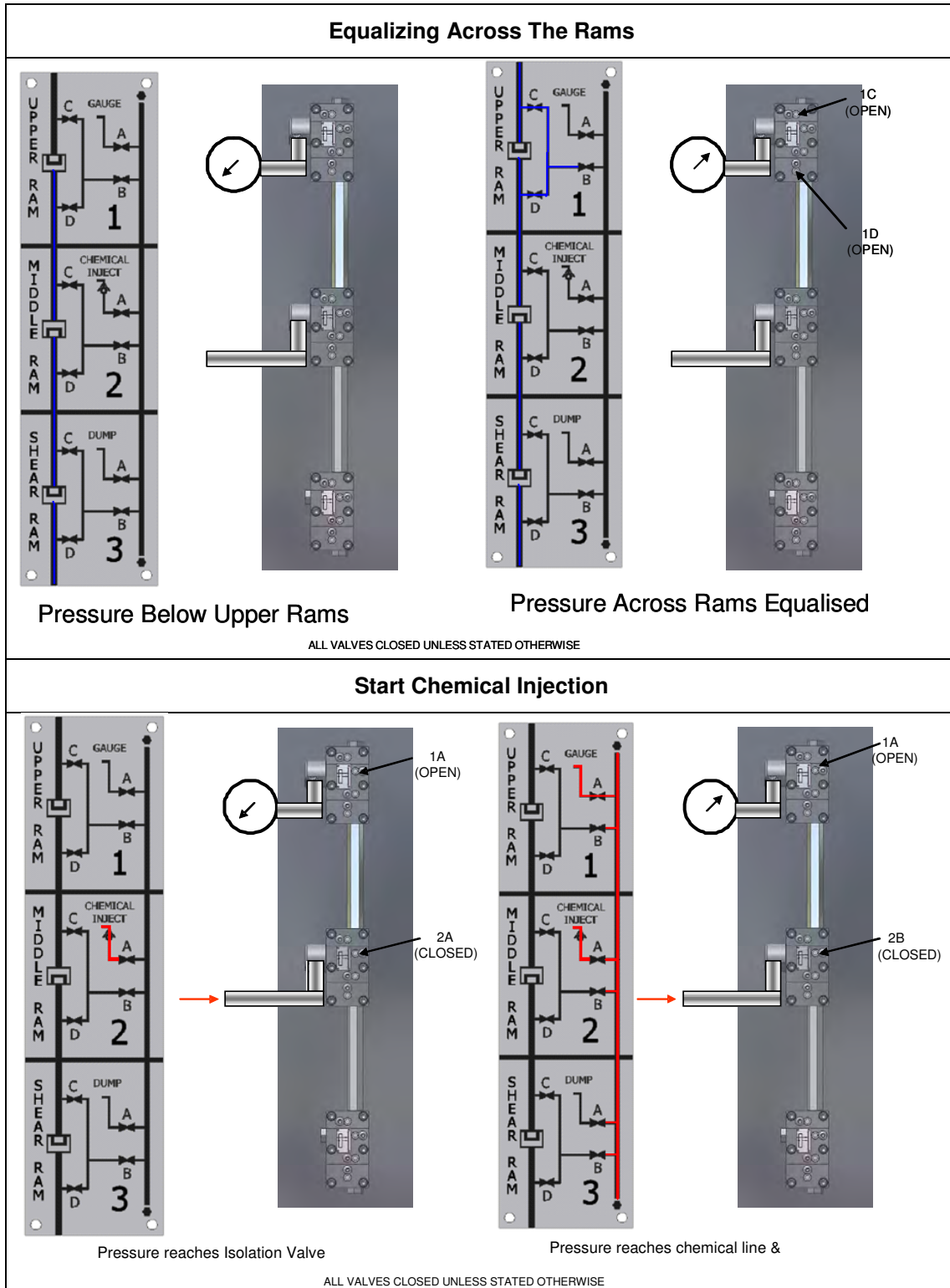
### 4.2 Equalising across the rams

Each ram has a dedicated equalising valve block and these blocks are connected together to allow single point chemical injection, pressure measurement and dump facility.

There are four valves on each block, two are for equalising and two are for isolation. By opening and closing the appropriate valves it is possible to either equalize the pressure across closed rams, inject chemicals above or below any of the rams or a combination of both. There are two isolated external ports that allow the connection of a pressure gauge and drain hose if required.

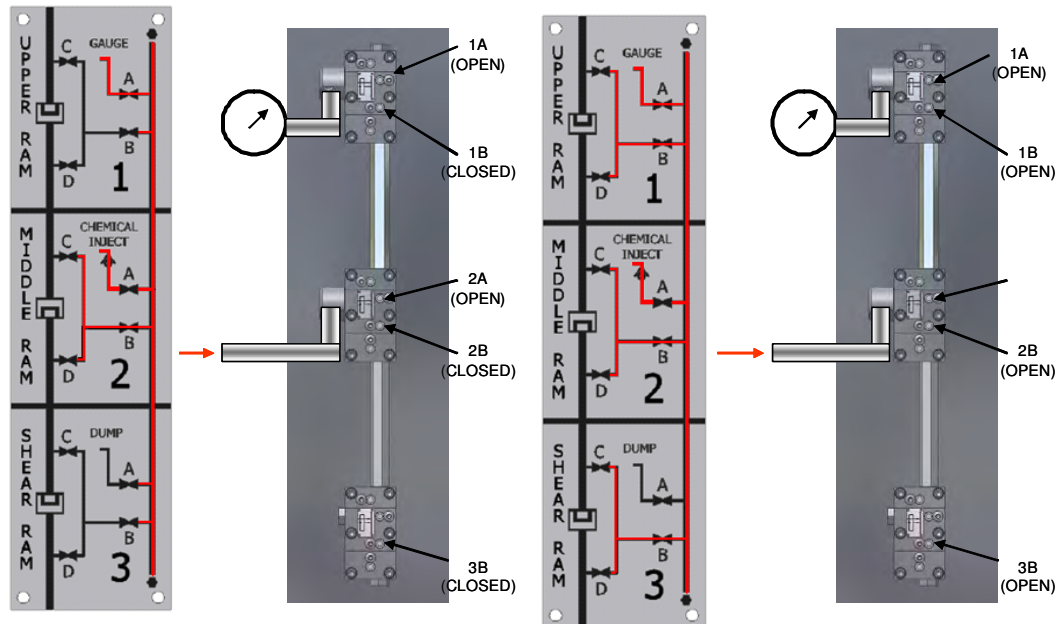


**Figure 5: Equalisation Layout**

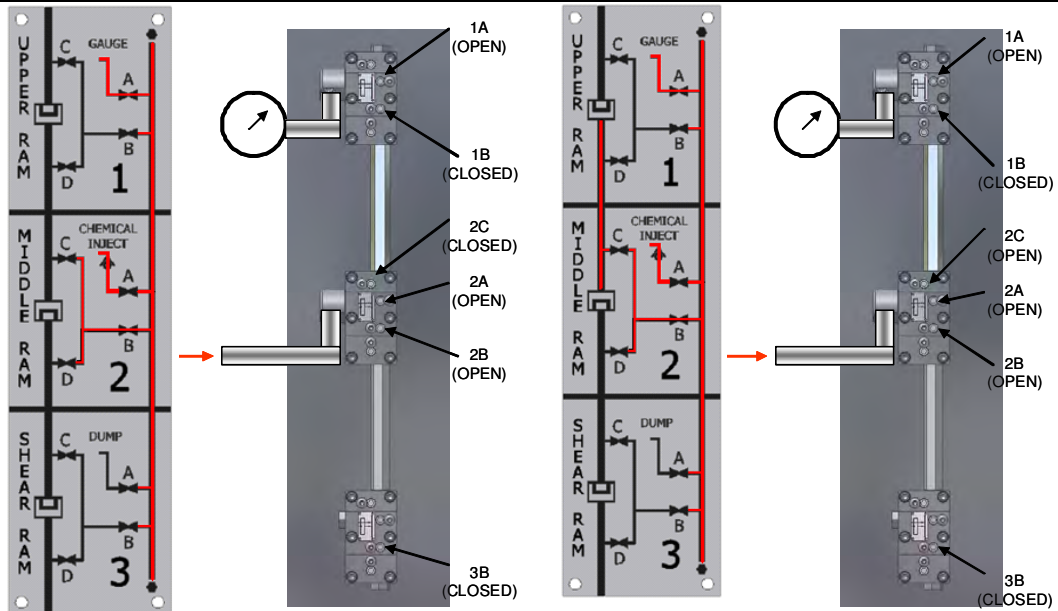


**Figure 6: Equalisation Operation 1**

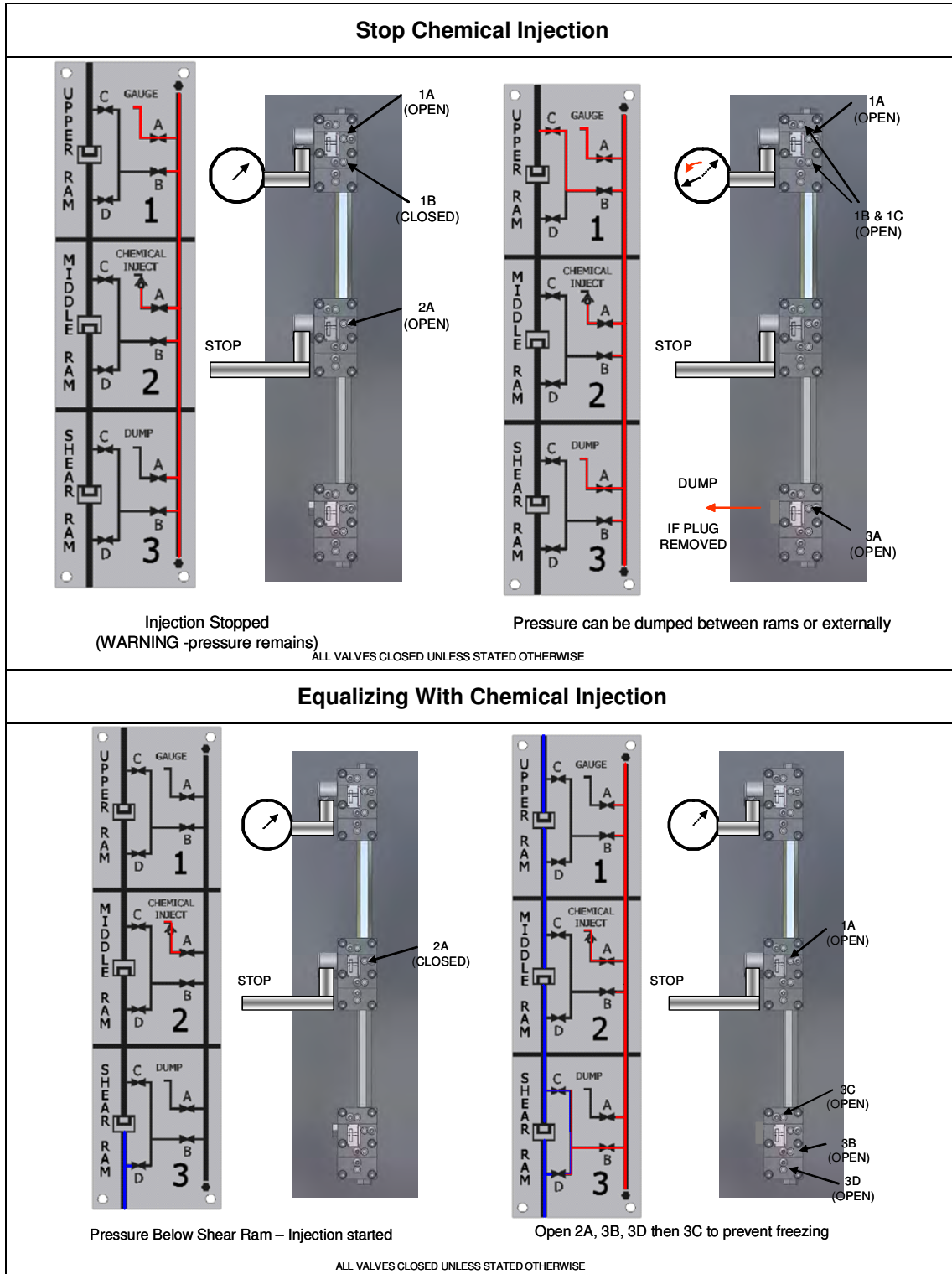
### Using Isolation Valve B



### Injection Between Rams



**Figure 7: Equalisation Operation 2**



**Figure 8: Equalisation Operation 3**

### 4.3 Job Planning

#### 4.3.1 Before the Job

- Check that the certification is within date and that the scheduled maintenance is up to date.
- All inner seals need to be replaced after 30 pressure cycles. A record of functional testing must be maintained.
- Examine the BOP Assembly, to make sure that it is good operating order and assembled with the Rams in the correct orientation for the desired operation.
- Functioning of the Rams may be checked, by running both Rams to the closed position. Do not exceed the maximum operating pressure when closing the Rams. Pressure test the rams from the direction of the well (or applied) pressure that is expected during the operation. This also verifies that the rams are in the correct orientation.

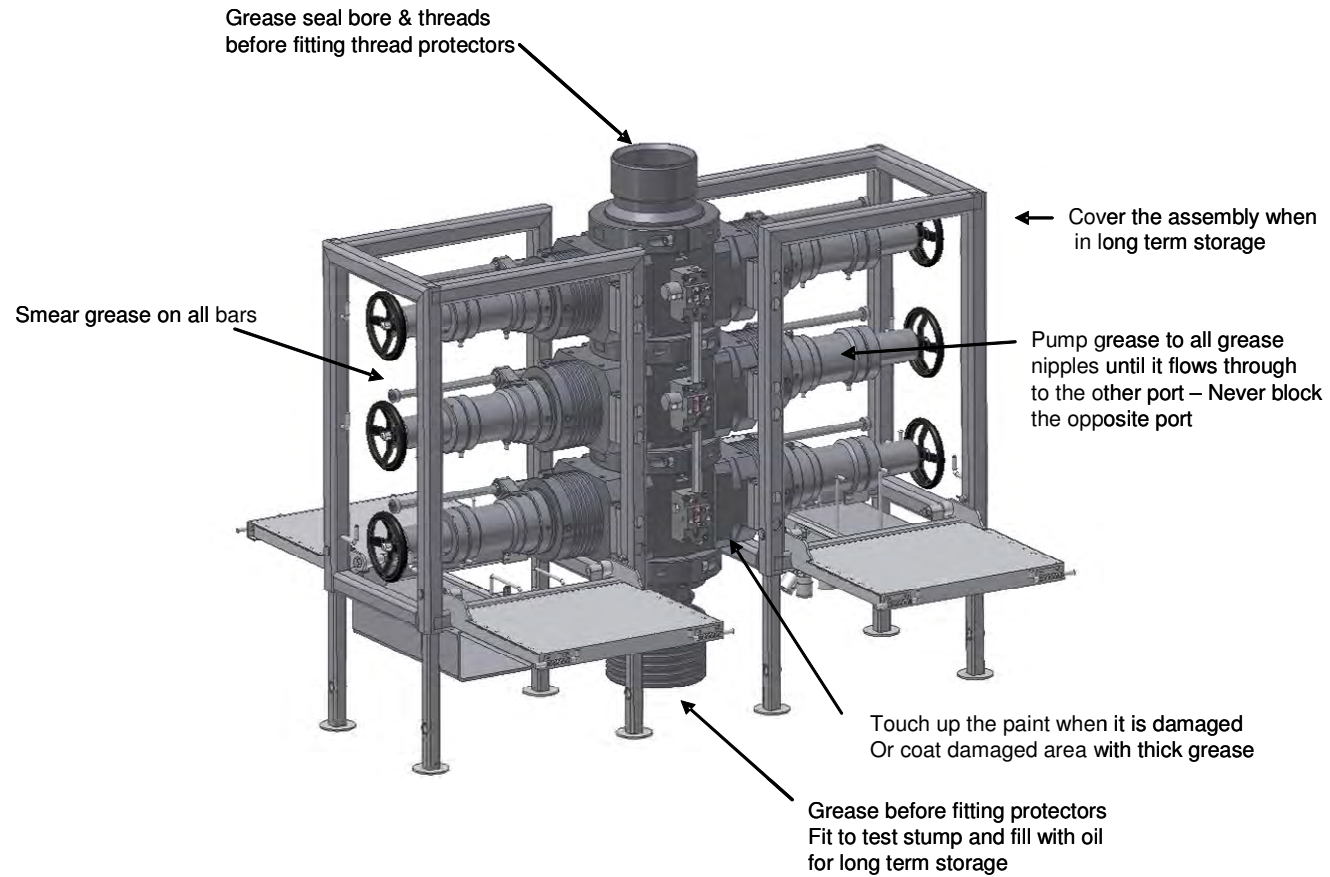
#### 4.3.2 During the Job

- Special care should be taken that the Rams are fully open when passing any equipment through them. The impact of the tool string hitting a Ram may damage the Ram to such an extent that the Ram may no longer Seal, or prevents it from fully opening.
- Only lift the BOP using suitable lift caps. Do not sling or attach lifting equipment to the crash frame to lift the BOP assembly.
- Care should be taken to completely remove any residual pressure or accumulated pressure existing on Lubricator equipment above the BOP, before disconnecting the Lubricator.
- Hydraulic Hose ends should never be allowed to drop in to dirt or grit, or otherwise become contaminated with foreign matter. If end connections become dirty, they should be cleaned thoroughly with solvent and dried.
- Only clean Hydraulic fluid should be used (Shell Tellus 22 is recommended) to operate the BOP. The use of mixed types, dirty, or very old fluid of unknown origin is not recommended. When one of these conditions is known or suspected, the hydraulic system should be flushed and the hydraulic fluid replaced.

#### 4.3.3 After the Job

After each job, the BOP should be thoroughly cleaned, repaired as may be required and redressed.

The BOP should be protected against the effects of corrosion to ensure that the expected functionality is achieved. The diagram overleaf highlights the key areas to consider.



**Figure 9: Correct lubrication for storage**

## 5 Operational Characteristics

### 5.1 Sealing Characteristics

#### 5.1.1 Minimum Hydraulic Pressure

Testing has confirmed that the BOP requires 1500 psi minimum hydraulic closing pressure to close and seal when there is no initial well bore pressure. The required closing pressure increases as the well bore pressure increases due to the effects of the well pressure acting against the piston rod. The table below should be used as a guideline of the minimum closing pressure that can be applied for various well pressure levels.

Initial Well Bore Pressure	Min Hydraulic Pressure
zero to 4,000 psi	1,500 psi
4,000-6,000 psi	2,000 psi
6,000 to 6.500 psi	3,000 psi

Table 2: Minimum hydraulic pressure to seal

#### 5.1.2 Opening the BOP with differential pressure

It is not recommended that the BOP should be opened with differential pressure across the rams. The pressure should always be equalised first, using the equalising valves.

With differential pressures lower than 2,000 psi across the rams it is possible for the well pressure to force the BOP open if the hydraulic closing pressure is removed. This is not the case when the differential pressure across the rams is greater than 2,000 psi. The manual locking feature should therefore be used when the BOP is closed to prevent accidental opening

### 5.2 Fatigue Testing

Testing has been performed to establish the fatigue limit of the actuators and rams so that preventative maintenance can be scheduled to replace worn seals or parts.

A total of 546 close/open cycles have been completed without failure including 78 pressure cycles to maximum working pressure. This test simulates closing and opening the BOP once per day and testing well bore pressure at 300 psi and 10,000 psi once per week for 1.5 years of service. Records must be maintained to ensure that the seals are replaced before this limit is exceeded. If records do not exist then the seals should be changed every year as a minimum.

## 5.3 Ram Access Testing

Testing has been performed to determine the ability of the BOP to undergo repeated ram changes without affecting operating characteristics. The tests have shown that the rams were accessed a total of 200 times (test limit) without failure of the sealing or locking mechanism. Records must be maintained to ensure that the seals are replaced before this limit is exceeded. If records do not exist then the seals should be changed every year as a minimum.

## 5.4 Shearing Performance and limitations

Testing has been conducted to verify the shearing and sealing capabilities of the shear rams. The table below shows the results of these tests.

Wire Size (dia)	No of wires	Wire Type	Hydraulic Pressure needed to shear at zero bore pressure	Maximum Wellbore Pressure (psi)
0.125"	1	Slick line	400psi	6,500 psi
0.125"	6	Slick line	800 psi	6,500 psi
0.160"	1	Slick line	400 psi	6,500 psi
7/32"	1	Braided	500 psi	6,500 psi
7/32"	2	Braided	1300 psi	6,500 psi
9/32"	1	Braided	750 psi	6,500 psi
5/16"	1	Braided	700 psi	6,500 psi
7/16"	1	Braided	1400 psi	6,500 psi
15/32"	1	Braided	1500 psi	6,500 psi

**Table 3: Shearing performance and limitations**

Note – The shear blades are designed to cut only once. The blades must always be replaced once they are used to cut wire.

## 5.5 Performance of Ram Guides

Testing has been conducted to verify that the wireline rams can centralise the cable without cutting – at extreme wire positions and with applied side loadings. The rams always closed without incident or damage to the cable. Operational planning and set up should still attempt to minimise the expected side loading on the wire by ensuring the lubricators are vertical and that the tool string is centralized as much as possible in the well bore.

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## 5.6 Temperature and Pressure Limitations

Testing has been conducted to verify the performance of the BOP at extreme operating temperatures.

### 5.6.1 General Sealing

The BOP seals (typically of 90 hard Viton material with part numbers listed in this manual) have been qualified for operating temperatures between -10C and 121C with no restrictions to the operating pressure.

### 5.6.2 Blind Ram Shear Seals

Bind inner seals part number 190-3921-H80 have been superseded with part number 190-5306-H80 which offer improved sealing at higher temperature.

The shear rams have been qualified for operation between -10C and 121C with no restrictions to the working pressure.

### 5.6.3 Wireline Multi-Seals

The wireline multi-seal part number 190-3689-H90 has been superseded with part number 190-5307-H80 which incorporates Phuel's anti-extrusion pad which improves the sealing capability at higher temperature, as show in the operating envelope below.

If operations dictate that the expected surface temperatures and pressures exceed the operating envelope then wire specific inner seals must be used instead of the standard multi-seal.

It should be noted that the point (82C, 690 bar) has been qualified on the basis of extrapolated test results and not directly confirmed by testing. API 16A does not require qualification below 82C. Care should be taken when operating close to this point and further qualification testing may be required to confirm suitability.

Consult Phuel Oil Tools for advice and part numbers.

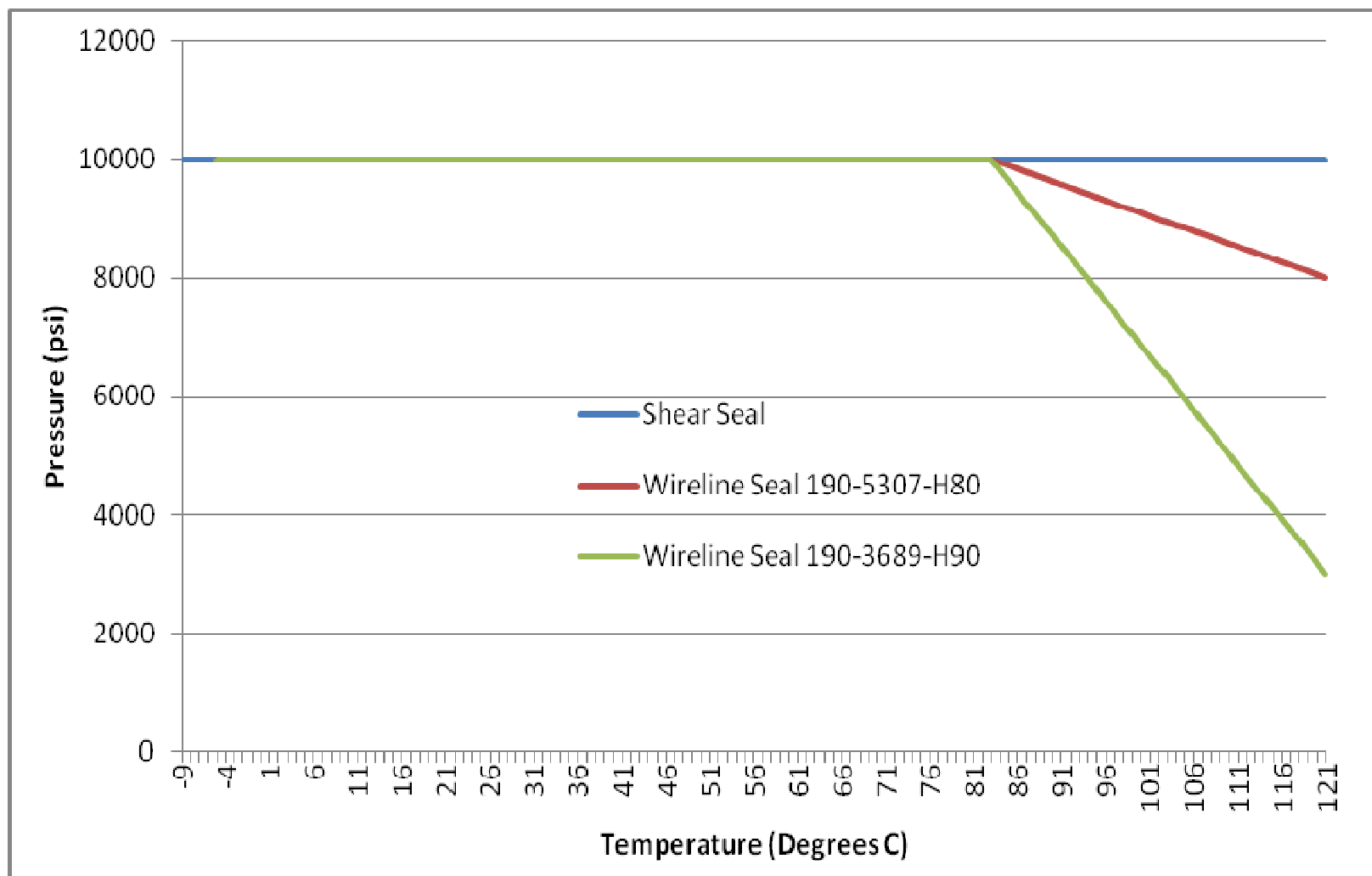


Figure 10: Qualified Operating Envelope

## 6 Maintenance

**All maintenance to be carried out by suitably qualified and competent personnel**

### 6.1 Introduction

Regular maintenance of the equipment using Phuel redress kits or approved spares is essential to its continued safe operation. Ensure that the pre and post job operating procedures are followed and that maintenance records are kept.

### 6.2 Schedule

The maintenance schedule may be governed by international or company standards and the following is considered to be the minimum requirements.

#### 6.2.1 Pre & Post Job

Refer to Section 4.3.1 and Section 4.3.3 for details.

#### 6.2.2 Yearly

- Disassemble BOP
- Clean and degrease all components.
- Discard screws from ram plate and replace with new ones
- Remove rust using a non toxic rust remover gel or liquid.
- Inspect the condition of sealing surfaces and surface coatings, repair/replace as necessary.
- Re-coat threads and sealing surfaces if necessary. Contact Phuel if in doubt. Apply protective coating like Boeshield T-9 to non painted surfaces
- Replace all elastomeric seals.
- Re-assemble BOP.
- Pressure Test to 300 psi and to maximum working pressure.
- Inspect paintwork and repair where necessary.

#### 6.2.3 Five Yearly

- Yearly maintenance, plus the following.
- Carry out surface NDE on all component threads and damaged surfaces.
- Pressure Test to 300 psi and maximum test pressure per API 6A – PSL3 (Witnessed by certifying authority).

### 6.3 Safety

- This product contains high pressures, when in operation. Failure of any part may cause injury. Welding, corrosion, rough handling, or other abuse may affect the Integrity of this product.

- Many of the components are heavy and should not be lifted without lifting aids.
- Wear appropriate personal protective equipment.
- Do not over exert yourself while using torque wrenches. Use appropriate mechanical advantages when available.
- Ensure that all tools and equipment are in good condition and are suitable for intended use.

### 6.4 Tools

The following tools are recommended.

- Non marking Memac Chain Wrench.  
Other pipe wrenches may be used but will mark equipment.
- Piston Seal Sub Assembly Tool (Part No. 900-1577-400).
- Allen Key's (7/32, 5/16" & 3/8" long version for removing Actuators from the BOP).
- External Circlip Pliers.
- 1/4"-20 UNC Socket Head Cap Screw x 1" Long.
- Pair of Long Nose Pliers.
- Large Flat ended Screwdriver.
- Hide or Rubber Mallet.
- Seal Grease
- Oil spillage-cleaning kits.
- 5K Hydraulic pump and Gauge to operate Actuators.
- Lifting equipment/Aids, as required.

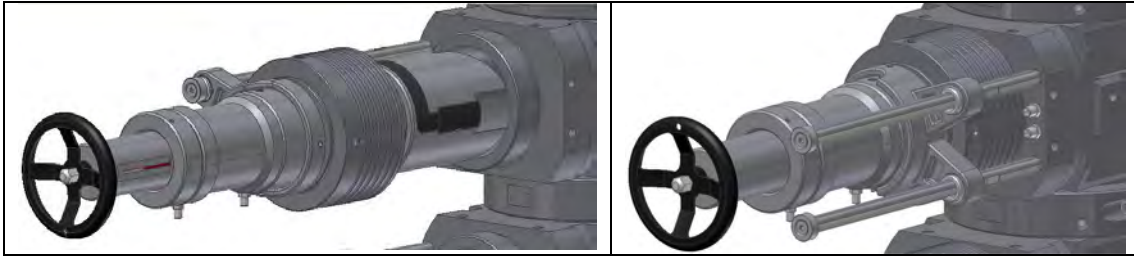
### 6.5 Ram Seal Redress

**Note: If rams are required to be removed ensure they have been pumped forward until only 2" of the indicator rod is visible**

#### 6.5.1 Access Rams

This procedure results in the removal of the actuator assembly from the BOP body in order to gain access to the rams.

- Ensure Rams are fully opened.
- Back off the Actuator from the BOP using the extended 3/8" Allen Key in the Cap Screw heads on the Locking Sleeve. Do not loosen the cap screws during this process.
- Once the thread is fully disengaged, pull the Actuator fully back to the End Stops.



**Figure 11: Accessing the rams**

### 6.5.2 Ram Removal (not required to redress ram seals)

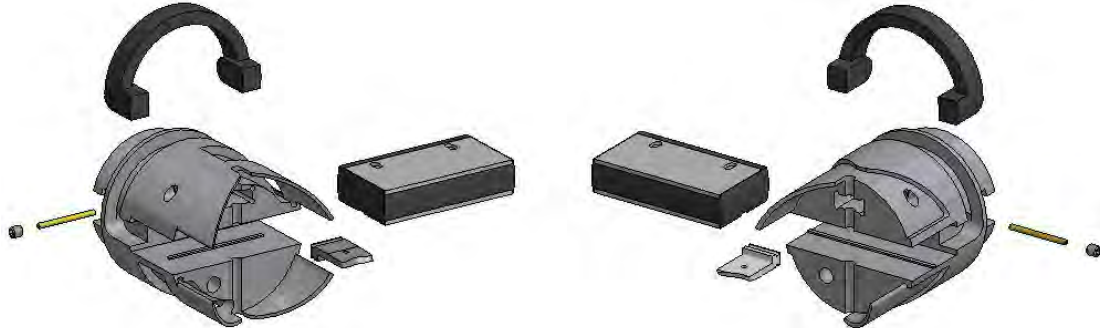
- Remove Ram from Actuator, by sliding the Ram off the Ram Tee.

### 6.5.3 Ram Seal Redress

- The Inner Ram Seals can be removed by simply sliding the seal out to either side
- The Outer Seal can be removed by levering out one end with a suitable instrument and simply pulling off.
- The Ram is now completely stripped down. Clean and inspect all parts for evidence of damage or excessive wear. Check the seals and replace if required. Repair or replace any damaged or worn parts. If the seals are to be redressed use the parts from the specified redress kit.
- Assemble Outer Seals by pushing the tab into the slot in the ram and working it around the radius of the ram. Tap home using a rubber or hide mallet and if required use a screwdriver to lever the second tab over the edge of the slot. Take care not to damage the Seal during assembly but expect that some slithers of rubber will be produced as the corners of the rubber seals are removed by the assembly operation. Tap all around the circumference of the seal to ensure that it is bedded into the groove and that the seal is not protruding above the ram diameter.
- Slide the Inner Seals into Ram taking care not to dislodge the outer seal in the process.



**Figure 12: BOP Wireline Rams**



**Figure 13: BOP Shear Rams**

#### **6.5.4 Re-attach to BOP Body**

- If the rams were removed from the actuator (Section 6.5.2) then slide the ram back onto the Tee taking careful note of the orientation of the rams depending on its intended use for the BOP assembly. (i.e. if pressure is to be held from below then the outer seal must be on top – otherwise it must be on the bottom). Attach a hydraulic pump to the open port of the actuator and pump the rams back into the recess in the actuator ensuring that the ram does not hang up on the actuator front face. When fully back remove the hydraulic pump.

**Note - It is still possible to assemble the actuator to the BOP without pumping back the rams but more effort may be required to allow the thread to make up.**

- Apply a generous coating of grease to the inner and outer seals.
- Push the Actuator back into BOP Body taking care that the edges of the guide pass into the seal bore and make-up the thread using a 3/8" hex key in the cap head screws to provide the torque. Making up the thread will drive the actuator assembly fully home.
- The Ram Assembly is now fully made up. Repeat this procedure for each ram seal that need to be replaced.

### 6.6 Modular Connection

The Modular BOP allows modules to be separated and re-configured to suit operation needs. Follow this procedure to split and re-make the modules as required.

**Note – This must be carried out in a workshop environment with pressure testing facilities by suitably qualified personnel**

#### 6.6.1 Splitting the Connection

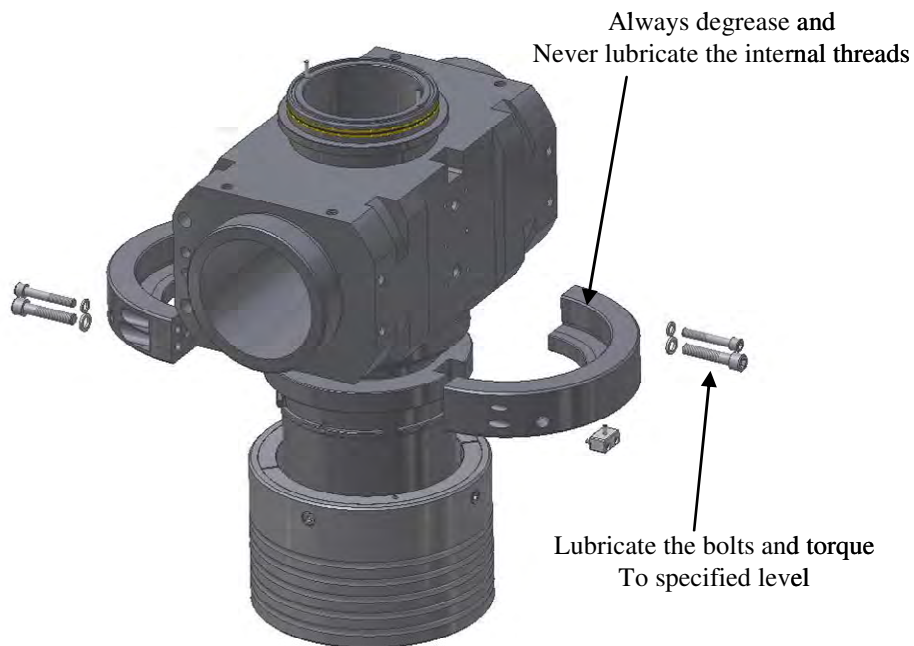
- Locate and remove lock block (equalisation blocks may need to be removed to allow access)
- Remove the bolts that hold the Collar together. There are two design options – one with two bolts on each half and one with a single bolt.
- Split the Bolted collar using a cold chisel if required. The two halves of the collar must be kept together and never mixed with those from another assembly
- The two assemblies can now be pulled apart
- Inspect the T-Seal and replace if necessary
- Inspect the Pins to make sure they are not damaged. Replace if necessary

#### 6.6.2 Re-Making the Connection

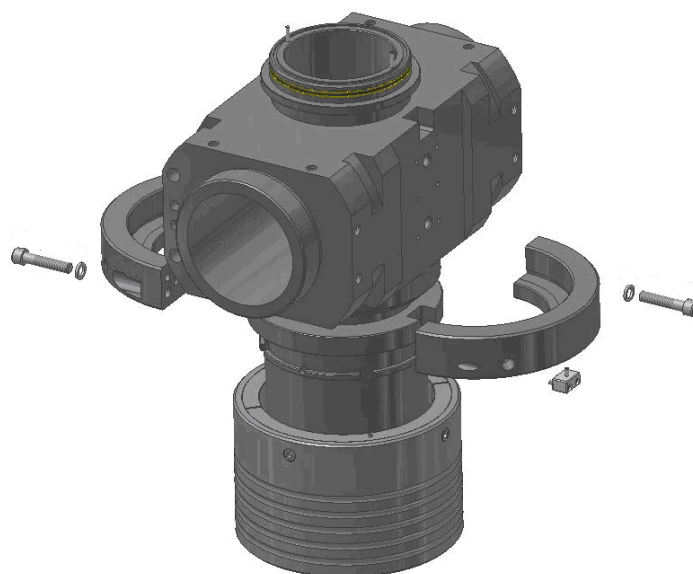
**Note - Take note of new body serial number to allow update of traceability**

- Ensure that the Pins and T-Seals are in good condition
- Lower the upper module down to locate the pins in the holes then push down to engage the seal. Drive down with a weight or blows with a soft face hammer if required. The end faces should be almost flush within 1mm.
- The buttress threads of the bolted collar must be degreased before assembly and must **never** be coated with grease or lubricant. This would increase the radial loading on the retaining bolts and could lead to failure during operation.
- Fit Bolted collars ensuring that the gap between the two halves is completely closed – rotate the collar (tighten) until it bottoms out then back it off to line up the holes for the Lock Block.
- Fit lock block to hold collar in place
- Assemble bolts and washers. Bolts should be cleaned and lubricated with thread compound tested in accordance with ISO 13678.  
Two Bolts – Torque to **155Nm large bolt and 80Nm small bolt**  
Single Bolt – Torque to **270Nm**

- Carry out pressure testing to maximum working pressure see Test Procedure below
- Update paperwork with new numbers for traceability

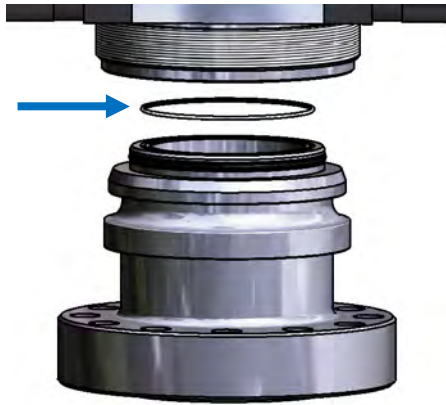


**Figure 14: Example of Two bolted collar and lock block**



**Figure 15: Example of Single bolted collar and lock block**

### 6.7 Optional metal to metal seal


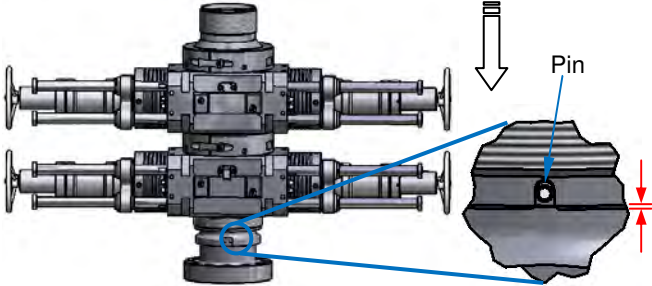
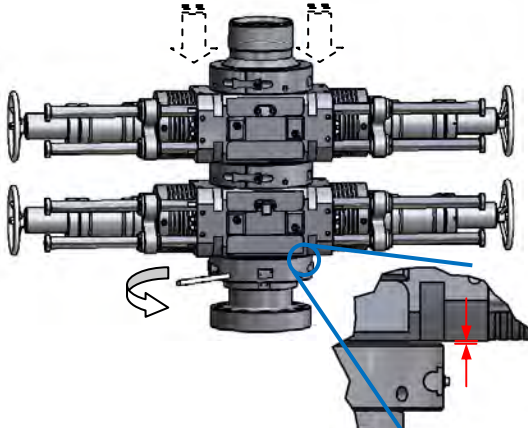
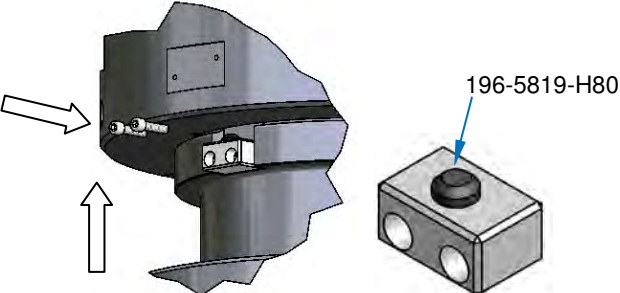


This seal fits between any of the main body and bottom/top sub modules and is backed up by the elastomeric seal. The seal comes as standard on flanged bottom subs only.

The seal crushes during installation and is therefore a single fit seal, so once fitted the connection should not be disturbed. If the connection is broken the metal to metal seal should be replaced.

*Note: This requires an alternative collar locking mechanism (where fitted), contact Phuel Oil Tools for further details.*

### 6.7.1 Procedure for fitting metal to metal seal in 6-3/8 Modular BOP

 <p>Polish seal groove and mating surface with fine emery – both should be smooth to the finger touch. Fit the metal seal into the groove</p>	 <p>Lower the BOP down &amp; locate the pin in the groove then push down to engage the seal. Drive down with a weight or blows with a soft face hammer if required. The end faces should be almost flush within 1mm</p>
<p>Assemble the bolted collar as detailed in section 6.6.2</p>	
 <p>Tighten the locking collar fully. Top of collar to underside of BOP body should be no more than 0.135". Additional load may need to be applied to achieve this gap.</p>	 <p>Lock block (were fitted) to be fitted with Mushroom Plug. Push the lock block up to the collar and fit the two socket head screws.</p>

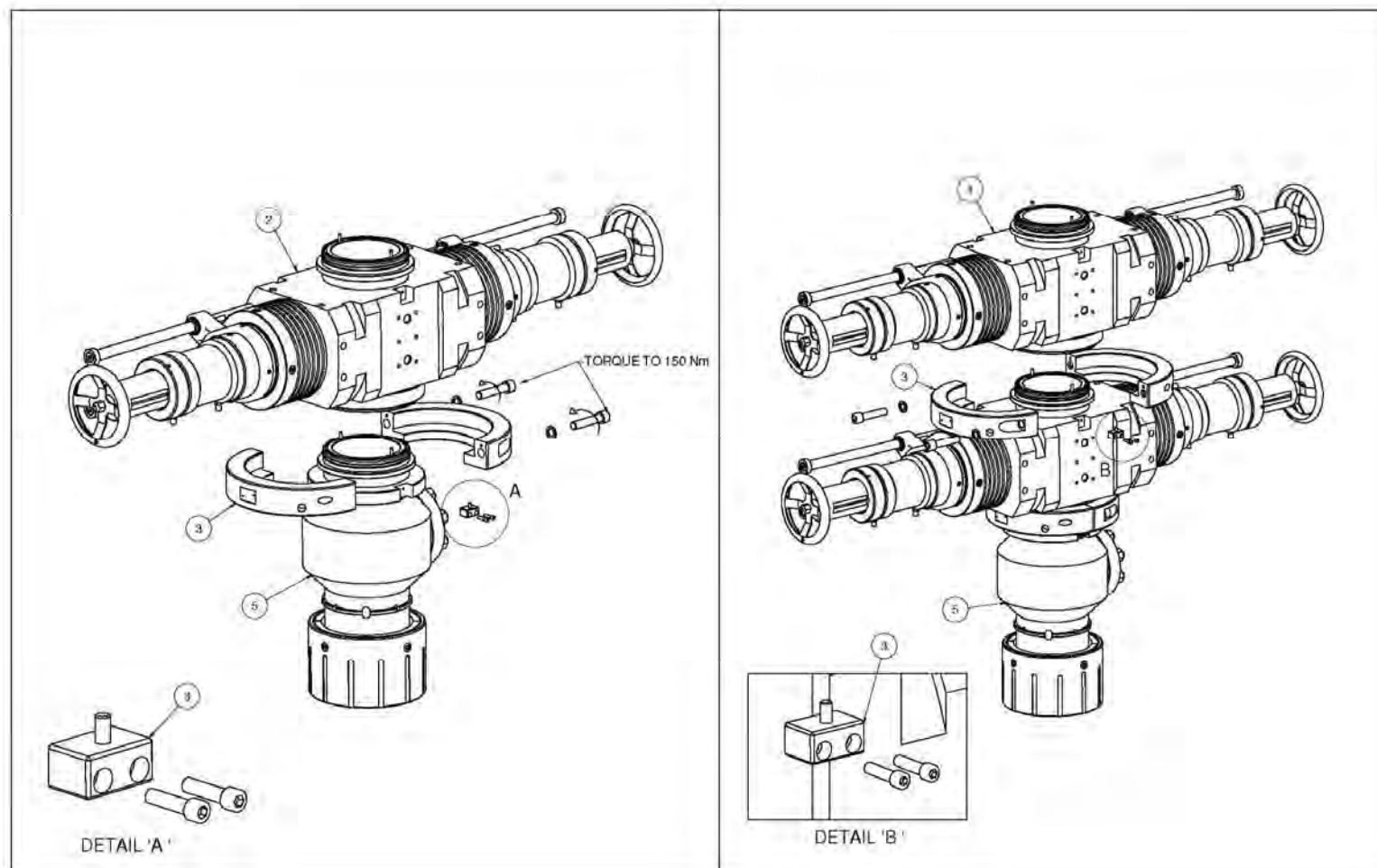
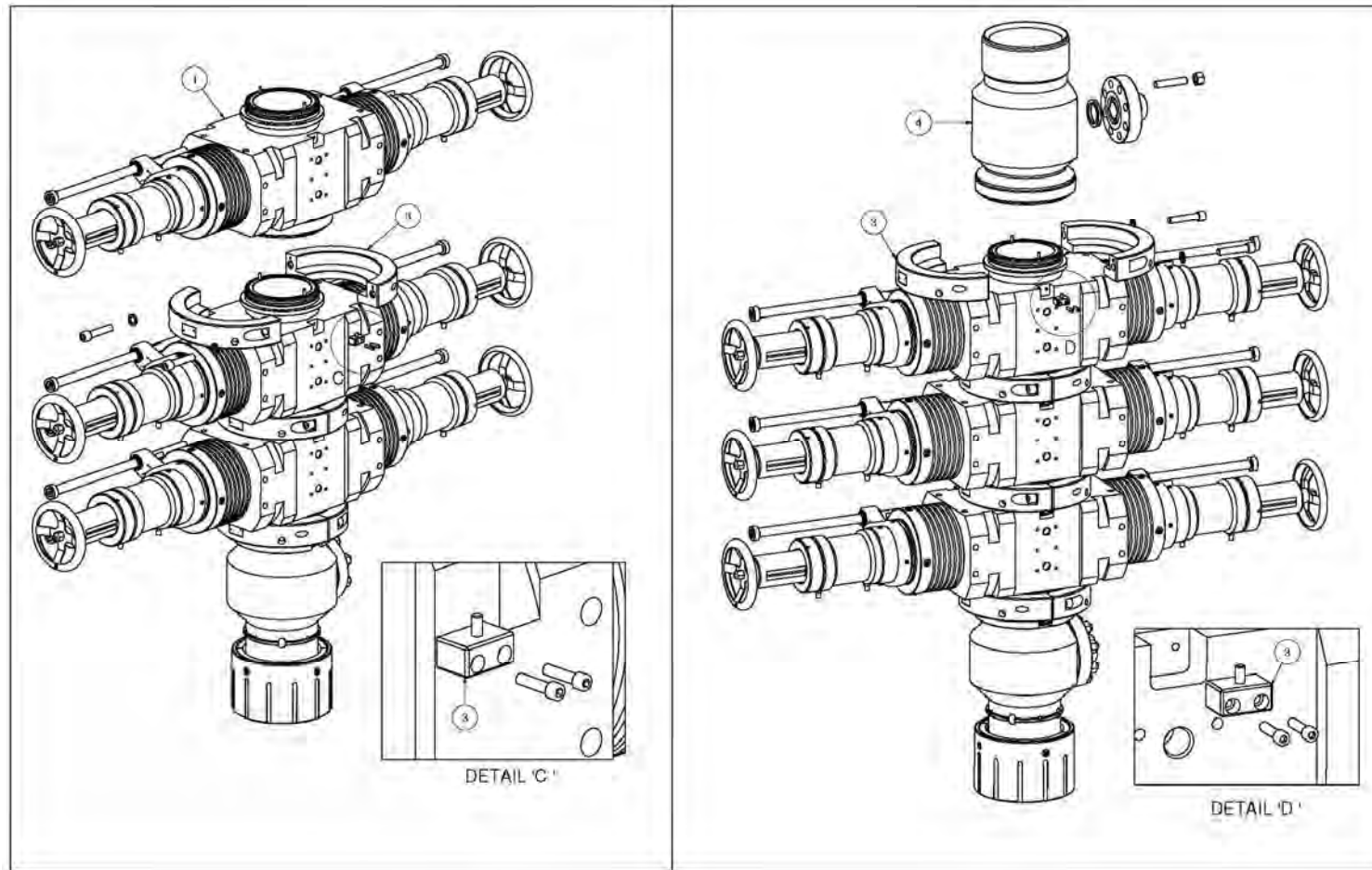
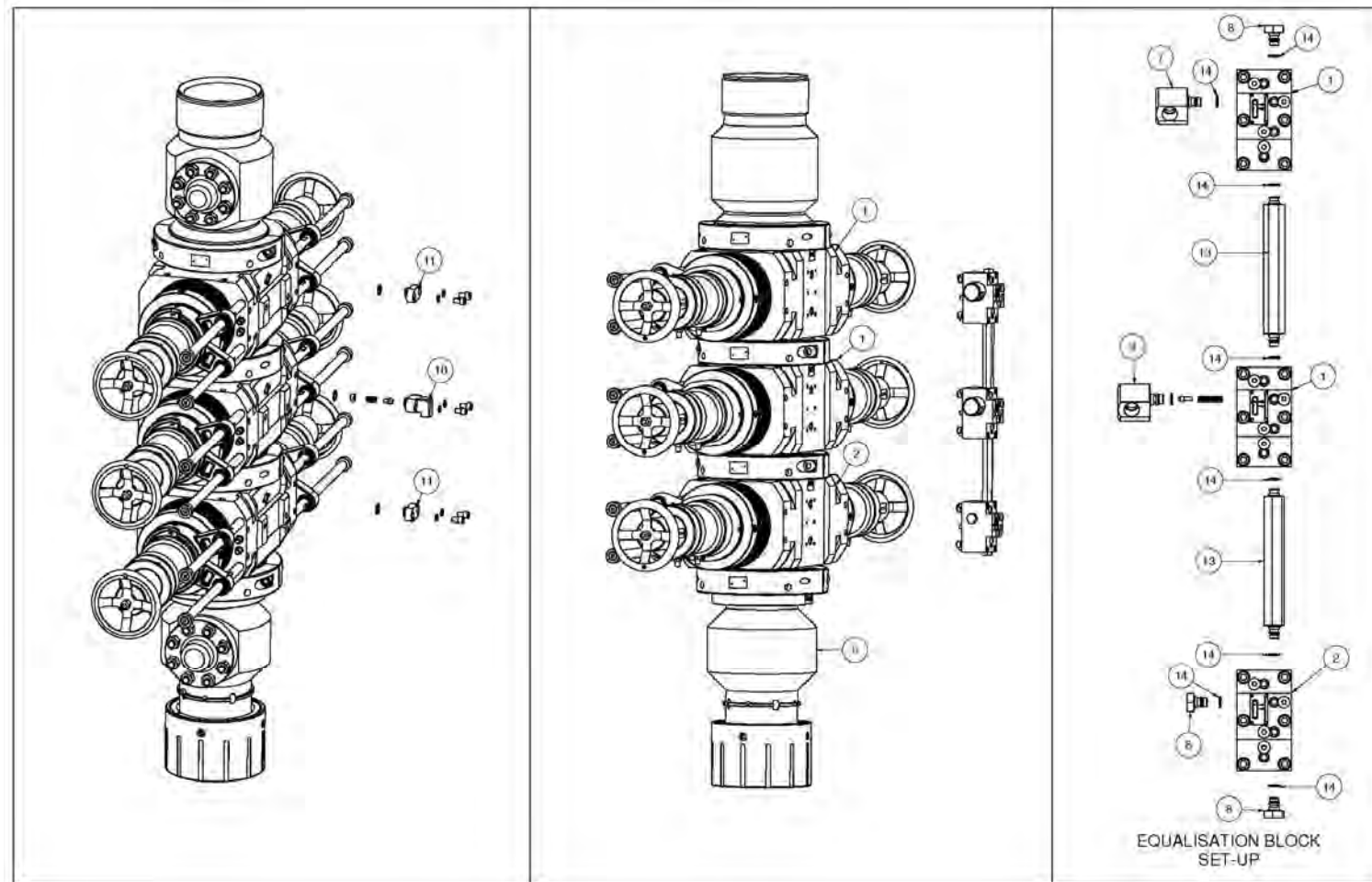


Figure 16: Assembling the Modules (Part 1)



**Figure 17: Assembling the Modules (Part 2)**



**Figure 18: Assembly of the Equalising Block**

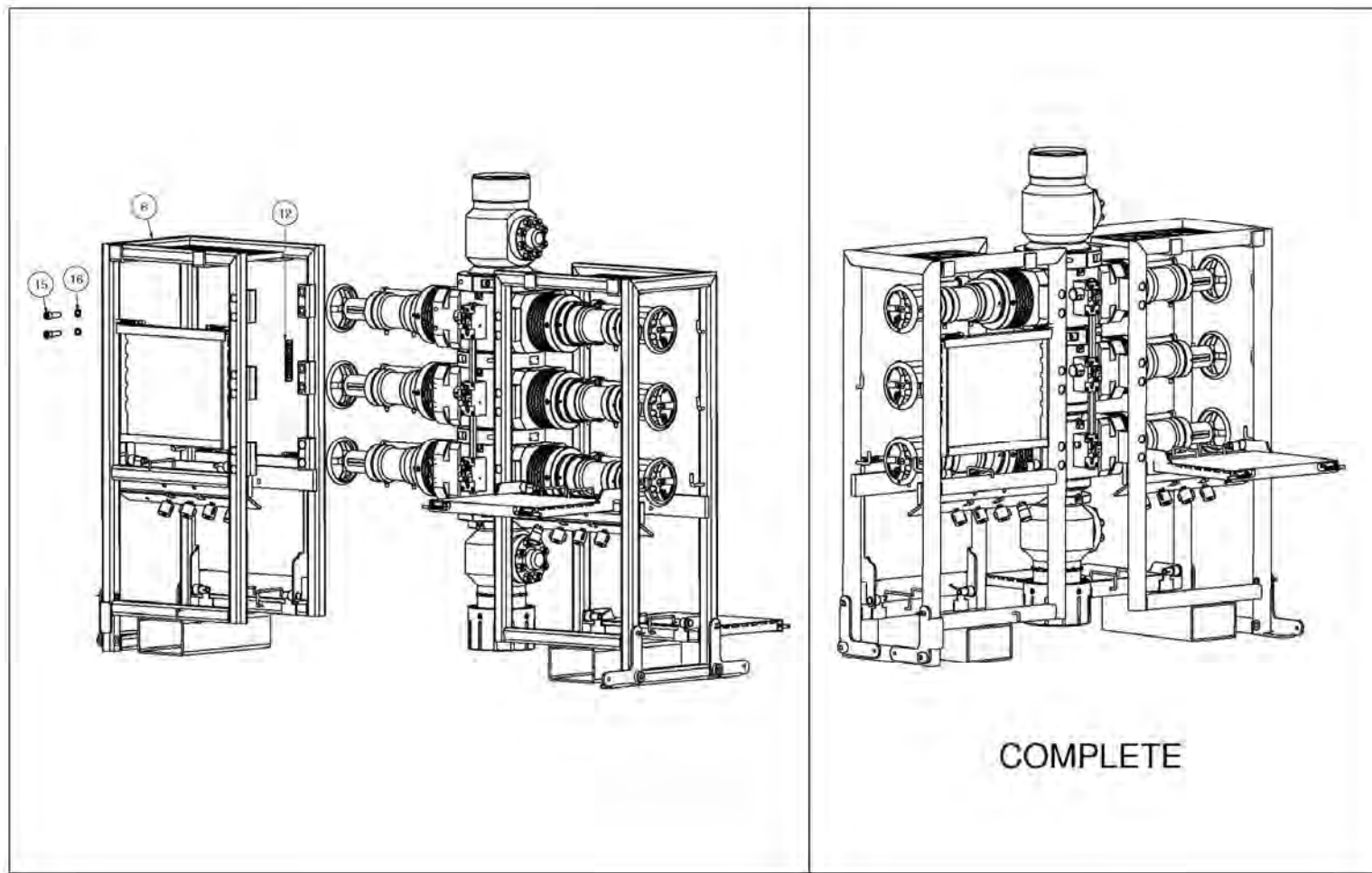
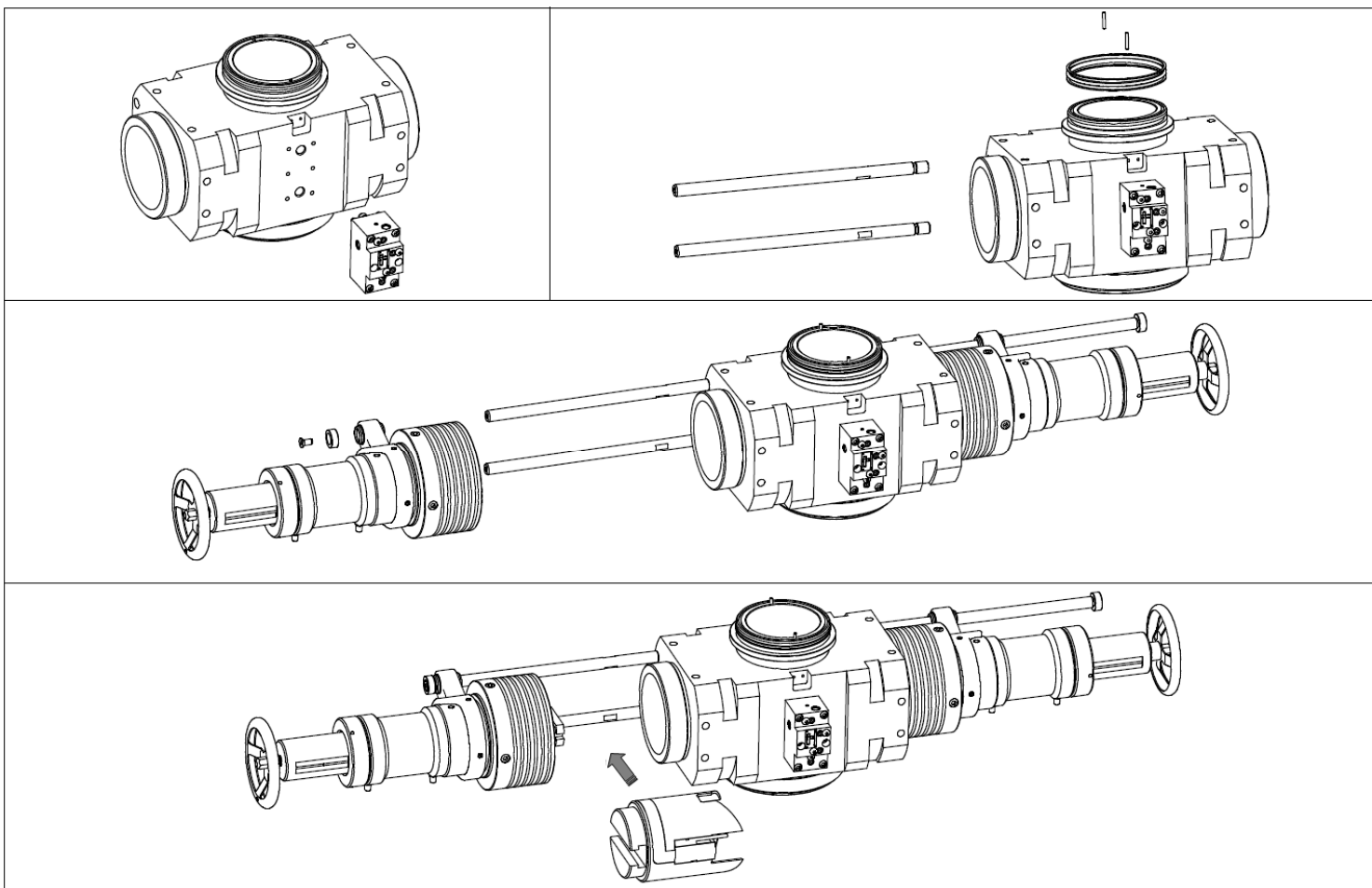
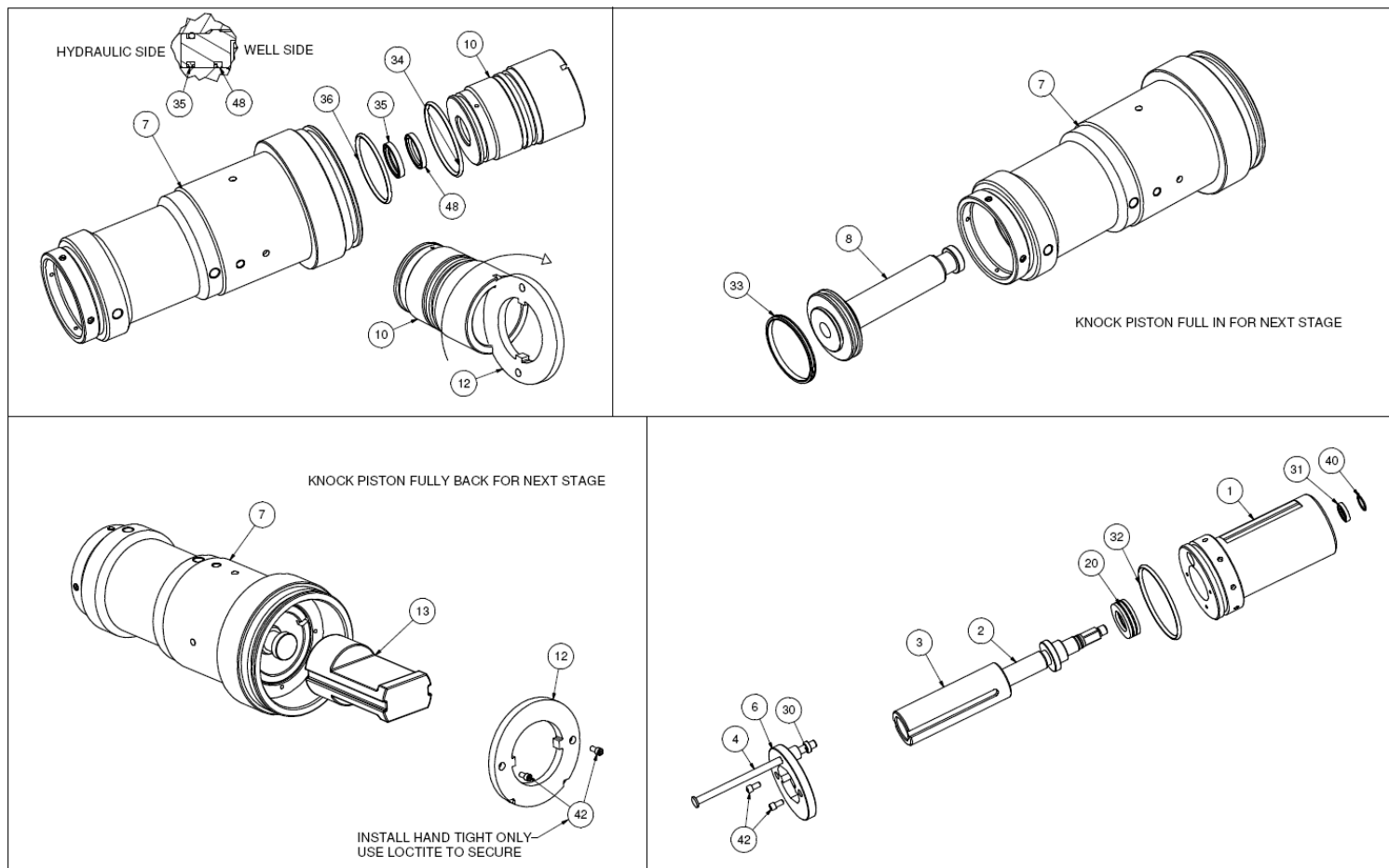


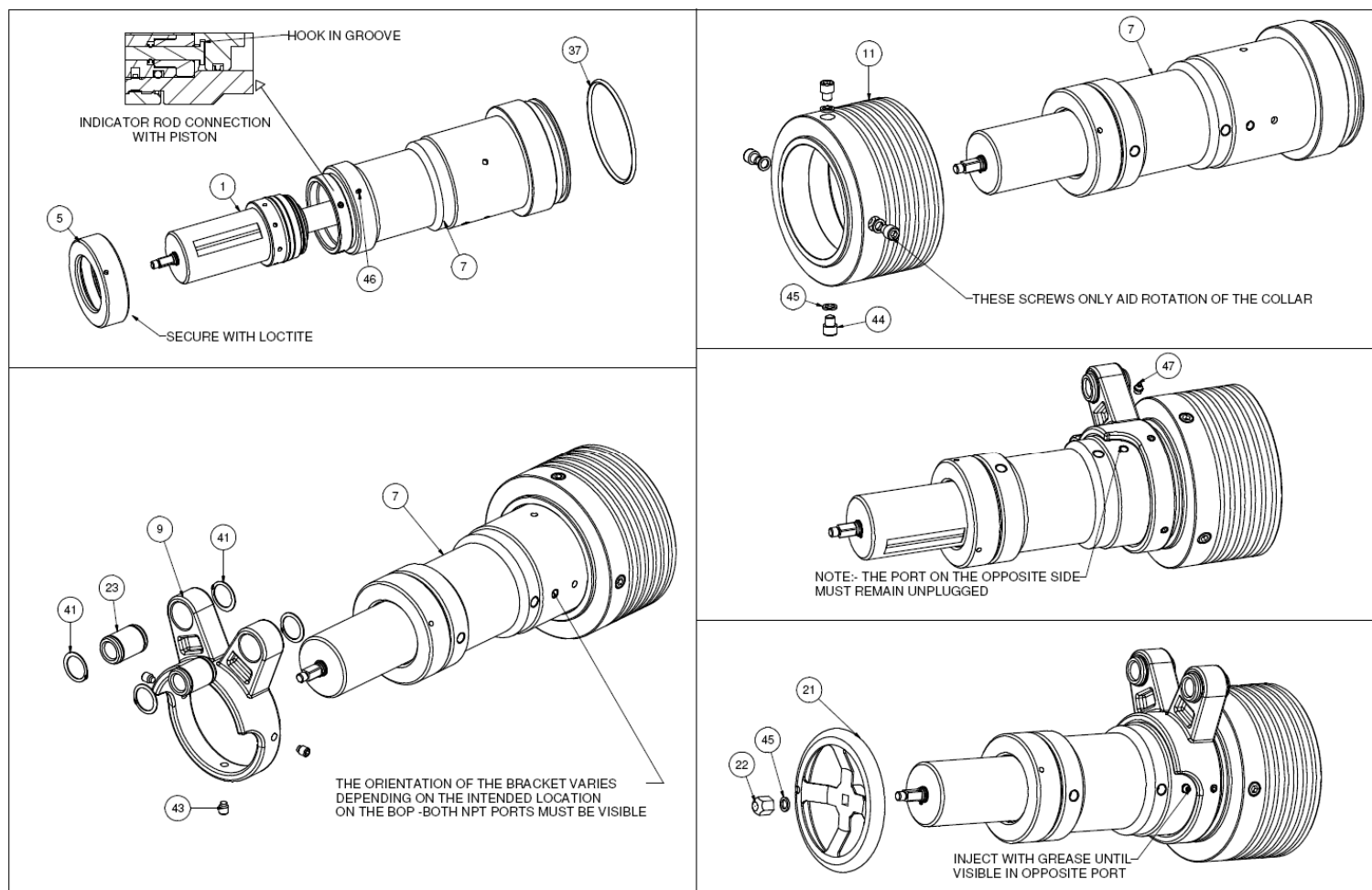
Figure 19: Assembly of the Frame



**Figure 20: Modular Body Assembly**



**Figure 21: Actuator (Part 1)**



**Figure 22: Actuator (Part 2)**

## 6.8 Maintenance Record Sheet

Date Performed	Type of Maintenance	Performed By	Verified By	Comments

Table 4: Maintenance Record

## 7 Testing

**All testing is to be carried out in the designated test area and by suitably qualified and competent personnel.**

**WARNING: Trapped air requires considerable time to compress and when it is compressed is highly dangerous. It has enough stored energy to separate parts with considerable force.**

### 7.1 Prepare BOP for pressure testing

- Check the pressure rating for all test equipment is sufficient to allow testing to be carried out.
- Check / replace o-ring on the pin part of the BOP.
- Ensure BOP is placed in an area suitable for pressure testing.
- Fit the BOP to the test stump.
- Makeup BOP (collar) on test stump by turning the "collar" all the way down, and then back off ¼ turn
- Fill BOP with test fluid.
- Connect the hydraulic hoses from the BCU to BOP to operate the rams.
- Check all connections / hoses that they are secured with safety wire before use
- Vent BOP Rams by hydraulic operation of the Rams.
- On completion of venting the Rams fit test cap, ensuring the valve is in the open position to allow air to vent and top up the BOP with Test Fluid. Once all air is expelled close valve.
- The BOP is now prepared for testing

### 7.2 Body Test

- Ensure that all the rams are in the open position
- Close equalizing valve 1A, all other equalizing valves to be open.
- Disconnect pipe on the grease injection and the chemical injection connector plate to test check valves.
- Fit the pressure test hose with security link
- Put up safety barrier in the workshop.
- Pump slowly up to 300 psi and observe for leaks. Hold Time 5 min
- Bleed the pressure to zero
- Pressurize to MWP of BOP and observe for leaks. Hold Time 15 min
- Bleed of pressure to zero and drain BOP.

### 7.3 Ram test: Shear seal

- With BOP Rams in the open position and fill up the bop with the test medium by using the test pump. Ensure valve on test cap remains open for the duration of this test.
- Close Shear Ram, this is done by activating the BCU Shear seal valve to "close" position, then pressurize up to a maximum of 2700 psi on the ram – Test fluid will be observed coming out of the Test Cap valve.
- Close equalizing valves. (Note - equalizing valve setup to be added to the test chart with number and position)
- Connect pressure test pump to the Test Stump so that pressure testing is done from the underside of rams and up
- Observe Test Cap valve during testing for fluid leaking out under pressure.
- Put up safety barrier in the workshop.
- Pressurize up to 300 psi low pressure test - observe if there are leaks. Hold Time 5 min
- Bleed the pressure to zero
- Press up to the MWP for the bop in accordance documentation - keep pressure in 15 min.
- Bleed the pressure to zero.
- Open rams on bop by enabling BCU Shear seal valve to "open" position.

### 7.4 Wireline Ram Seal Test (Between the ram)

- Ensure Test Cap is not fitted
- Ensure all Rams are in open position
- Open the equalizer valve between the respective rams to be tested.
- Connect the test hose in the 1A on equalizing block (gauge port)
- Close the Middle Ram.
- Open Snaftite connector on the test stump for verification of leakage on the lower ram.
- Fill the BOP with test fluid to above the Upper Ram. Close the Upper Ram by setting Ram to 2700 psi by activating the valves on the BCU to "close position."
- Pump test medium thru the equalizing. Block 1C to see fluid is rising above the upper ram.
- **Close equalizing valve 1C, 2A, 2D, 3A, 3B.**
- **Open equalizing valve : 1A, 1B, 1D**



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- Put up safety barrier in the workshop.
- Pressure up to 300 psi in 5 minutes and observe for leaks
- Bleed off to zero
- Press up to MWP for bop according to documentation for current bop for 15 min
- Bleed pressure to zero.
- Open the rams- open lower first, and then the upper ram.

### **7.5 Post Test Procedure**

- Disconnect All Hoses
- Remove Test Cap
- Drain out test fluid and circulate with water displacing fluid or lubricating oil
- Remove BOP from Test Stump
- Grease end connections and fit oiled thread protectors

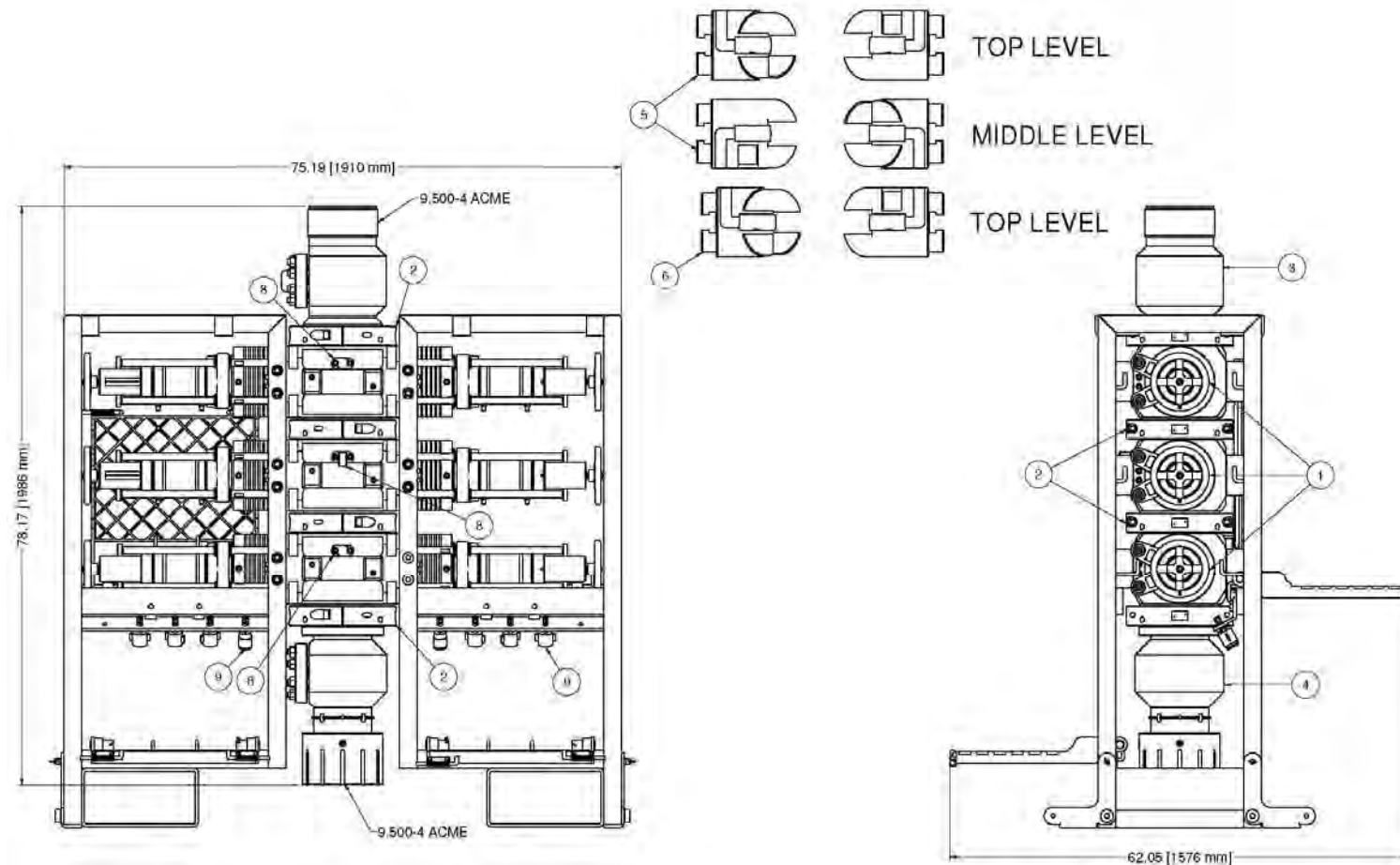


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## 8 Parts List and Drawings

Item Number	Part Number	Quantity	Description
1	196-3145-HV0	3	6-3/8 MULTILINE BODY ASSY
2	196-3497-HS0	4	CONNECTING COLLAR ASSY
3	196-3493-HV0	1	TOP SUB 9.5-4 X 1-13/16 SIDE OUTLET
4	196-3492-HV0	1	BOTTOM SUB 9.5-4 X 2-1/16 SIDE OUTLET
5	190-3863-HH0	2	6 3/8 WIRELINE RAM ASSEMBLY V2
6	190-3862-HH0	1	6-3/8 SHEAR RAM ASSEMBLY V2
7	193-4024-SS0	1	6-3/8" TRIPLE MODULAR CRASH FRAME ASSY (DW STYLE)
8	193-4023-HV1	1	TRIPLE INJECTION MODULE 6.5k
9	193-3591-HS0	1	MODULAR BOP HYDRAULIC FITTING LIST

**Table 5: 193-3568-HV0 Parts List**



**Figure 23: Modular BOP 193-3568-HV0 (Part 1)**

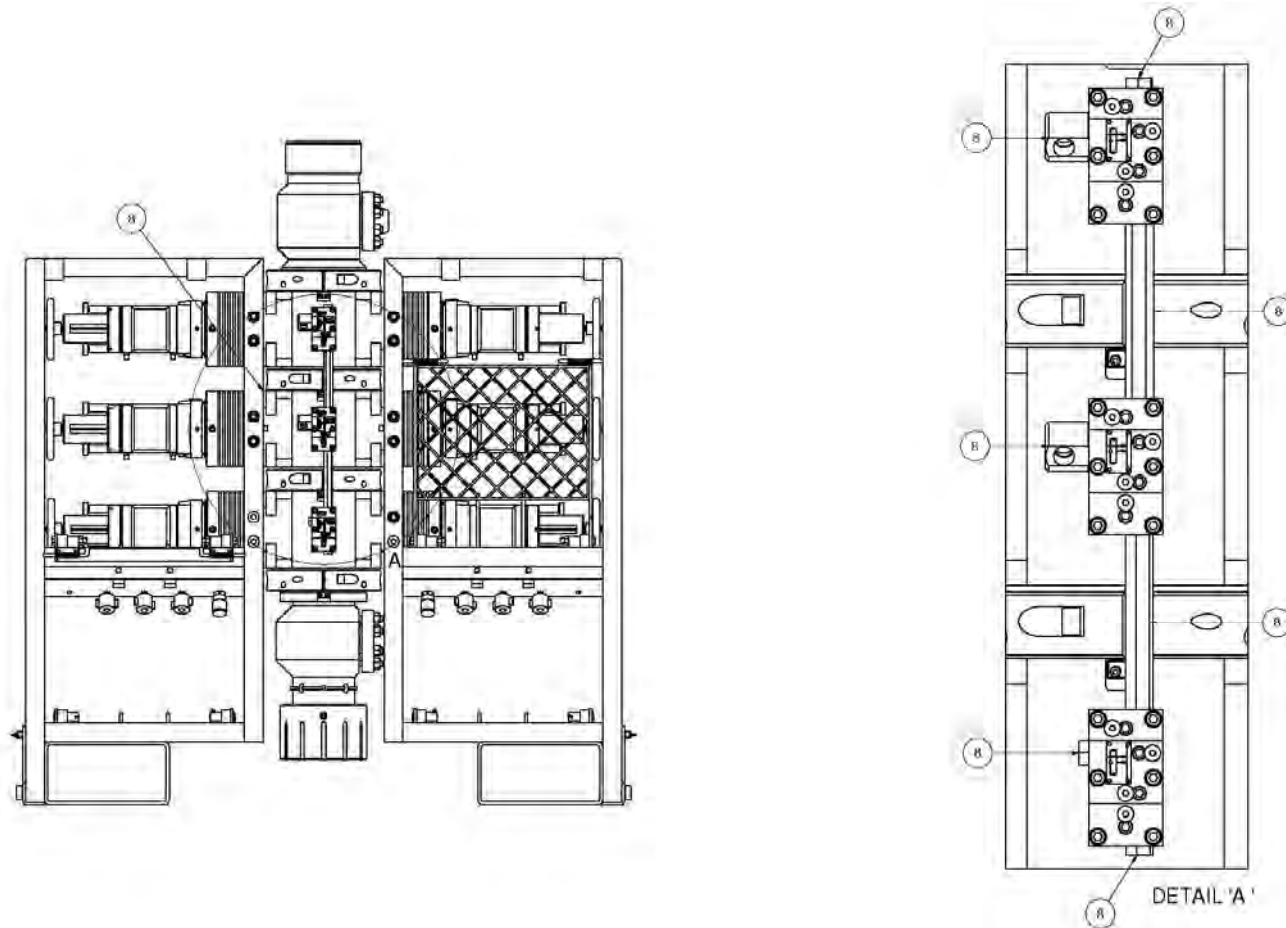
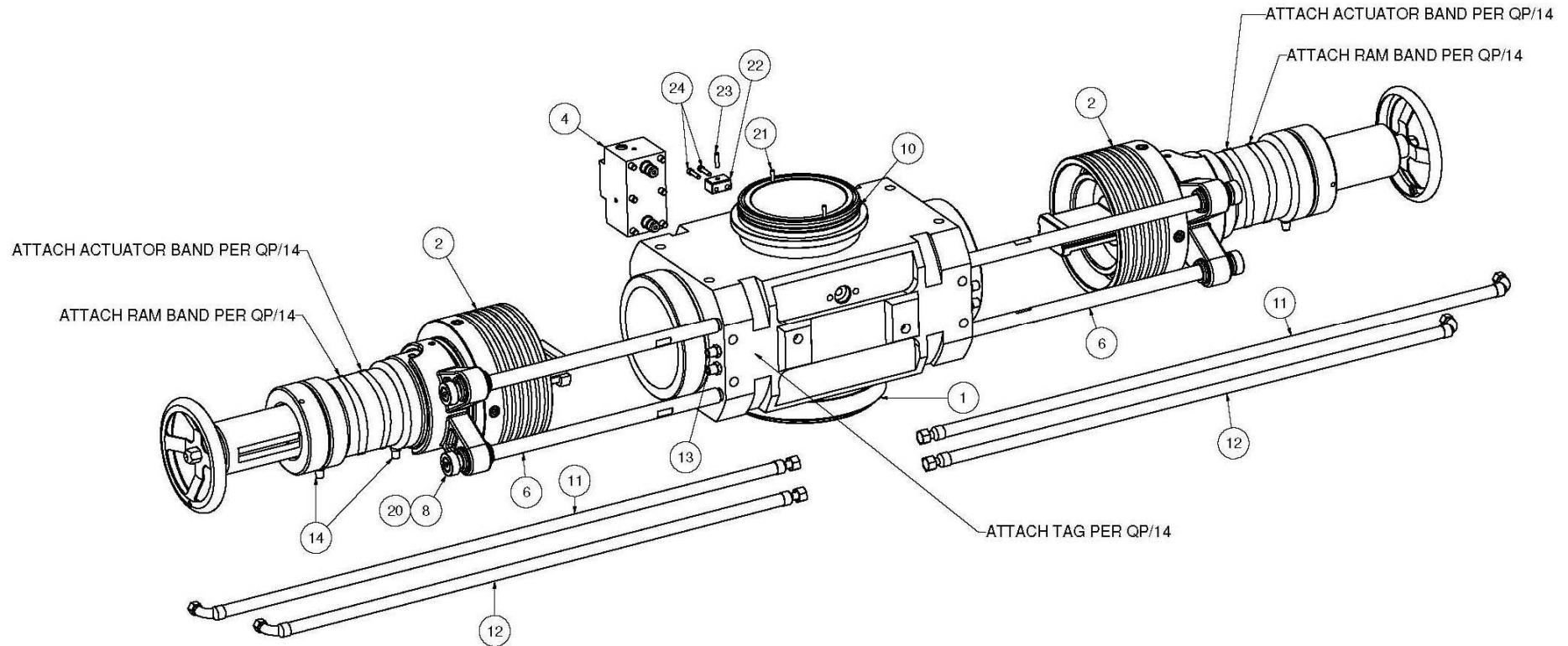


Figure 24: Modular BOP 193-3568-HV0 (Part 2)

Item	Part No	Qty	Description
1	196-3318-480	1	MODULAR BOP BODY - 10K
2	190-2476-HV0	2	ACTUATOR ASSEMBLY V2
4	190-2806-HV0	1	EQUALISATION BLOCK ASSEMBLY
6	190-2413-X90	4	SLIDER ROD 21.5 LONG
8	190-1537-316	4	END STOP
10	802-2921-V80	1	7.642 T-SEAL WITH BACK-UPS
11	196-2919-316	2	BOP HOSE - CLOSE
12	196-2918-316	2	BOP HOSE - OPEN
13	950-3168-316	4	CONNECTOR 3/8 BSPP X 3/8 NPT (1252-06-06)
14	950-3169-316	4	CONNECTOR 1/4 BSPP X 1/4 NPT (1252-04-04S)
20	CSU-0585-3A4	4	CSink Soc Hd Size 1/2 Length 1 in
21	196-3164-304	2	DOWEL PIN 6MM X 32MM LONG
22	190-2791-316	1	LOCK BLOCK
23	190-2804-304	1	SPIROL ROLL PIN 1/4 DIA X 1
24	SHC-0507-HTS	2	Soc Hd Cap Size 1/4 Length 1 in

**Table 6: Modular Body Parts List 196-3145-HV0**



**Figure 25: Modular Body 196-3145-HV0**

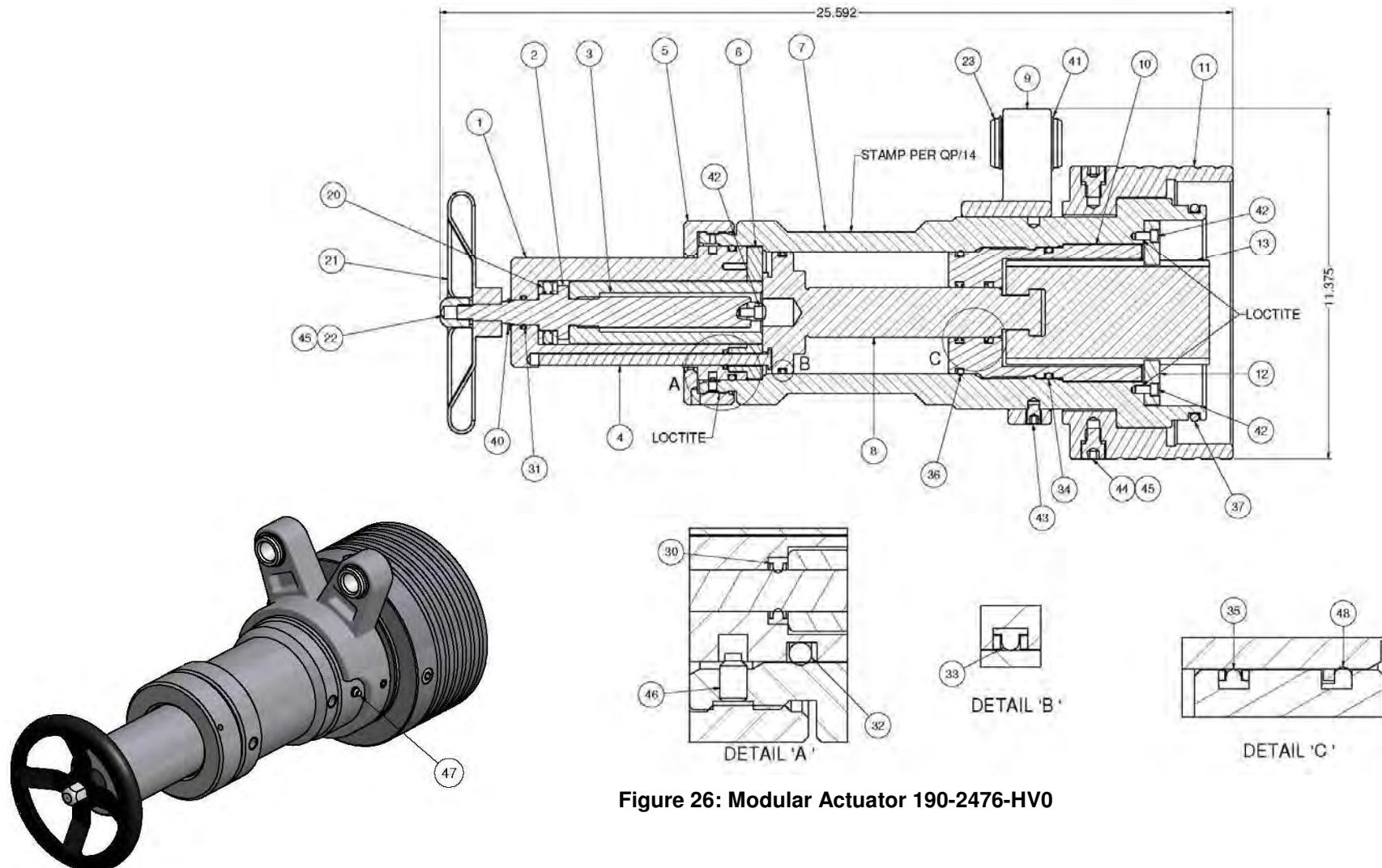


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## Modular BOP System

Item	Part Number	Quantity	Description
1	190-2927-480	1	ROTATE CYLINDER CAP
2	190-2772-480	1	DRIVE ROD
3	190-1726-480	1	DRIVE SLEEVE
4	190-1645-316	1	INDICATOR ROD
5	190-1649-480	1	CAP COLLAR
6	190-1773-STL	1	DRIVE KEY PLATE (CAST)
7	190-2926-480	1	HOUSING
8	190-1929-480	1	PISTON
9	190-3233-STL	1	MODULAR ACTUATOR BRACKET
10	190-1612-480	1	Piston Seal Sub
11	190-2863-480	1	ACTUATOR COLLAR
12	190-2838-480	1	RAM KEY PLATE
13	190-1774-STL	1	RAM TEE
20	190-1696-STL	1	Thrust Bearing (FAG 812 06)
21	190-1702-STL	1	Hand Wheel
22	190-1704-STL	1	Acorn Nut 1/2-13
23	190-1608-STL	2	Ball Slide ( TK-25-UU)
30	802-1699-H85	1	Rod T-Seal Assy (TR004)
31	802-2505-H85	1	ROD T-SEAL 0.825 DIA
32	801-0345-V90	1	O-Ring - B.S Size 345
33	802-2161-H85	1	PISTON T-SEAL 4.000
34	801-0344-V90	1	O-Ring - B.S Size 344
35	802-2162-H85	1	ROD T-SEAL 1.625
36	801-0342-V90	1	O-Ring - B.S Size 342
37	801-0439-V90	1	O-Ring - B.S Size 439
40	190-2491-STL	1	EXTERNAL CIRCLIP (SH-75)- 0.750 DIA
41	190-1756-STL	4	EXTERNAL CIRCLIP (EXT-0400)
42	SHC-0503-B7M	4	Soc Hd Cap Size 1/4 Length 0.5 in
43	SDU-0582-HTS	3	Set Screw Dog Point 1/2 UNC X 0.625 in
44	SHC-0581-HTS	4	Soc Hd Cap Size 1/2 Length 0.5 in
45	WNL-0580-316	5	WASHER NORDLOCK (M12)
46	SDU-0503-HTS	1	Set Screw Dog Point Size 1/4 Length 0.5 in
47	100-2179-STL	1	GREASE NIPPLE 1/8 NPT
48	190-3870-H85	1	ROD SEAL

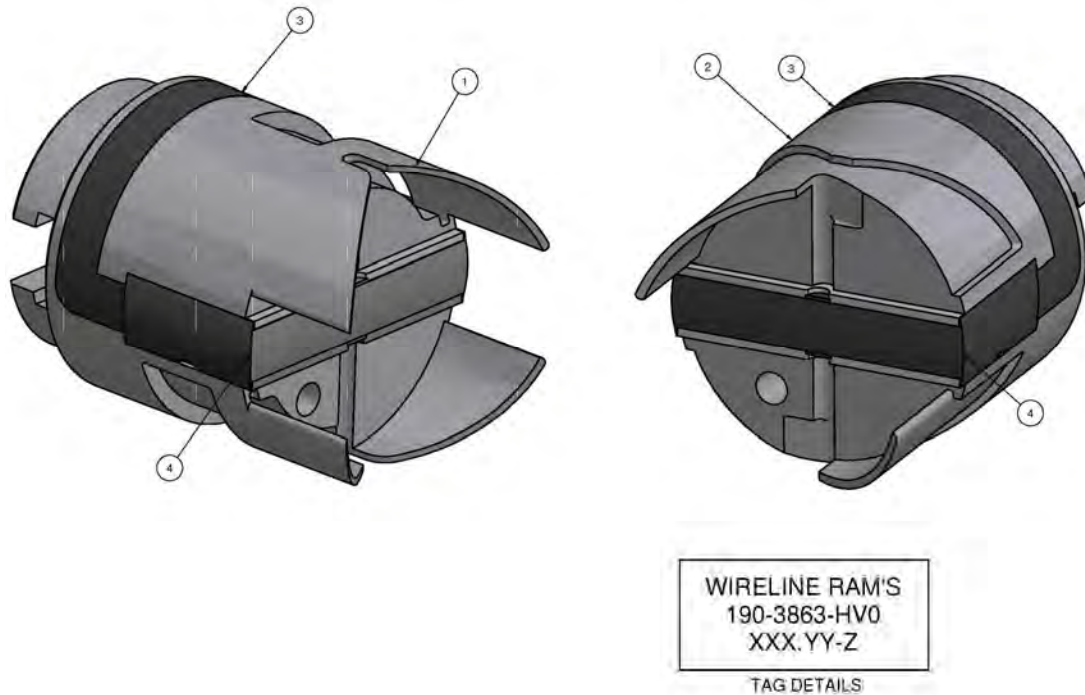
**Table 7: Modular Actuator Assembly 190-2476-HV0**



**Figure 26: Modular Actuator 190-2476-HV0**

Item	Part Number	Quantity	Description
1	190-3705-480	1	GUIDE RAM -6-3/8
2	190-3706-480	1	SINGLE GUIDE RAM 6-3/8
3	190-1715-H70	2	Outer Seal
4	190-5307-H80	2	RAM INNER SEAL - SIZE 7.00

**Table 8: Wireline Ram Assy 190-3863-HH0**

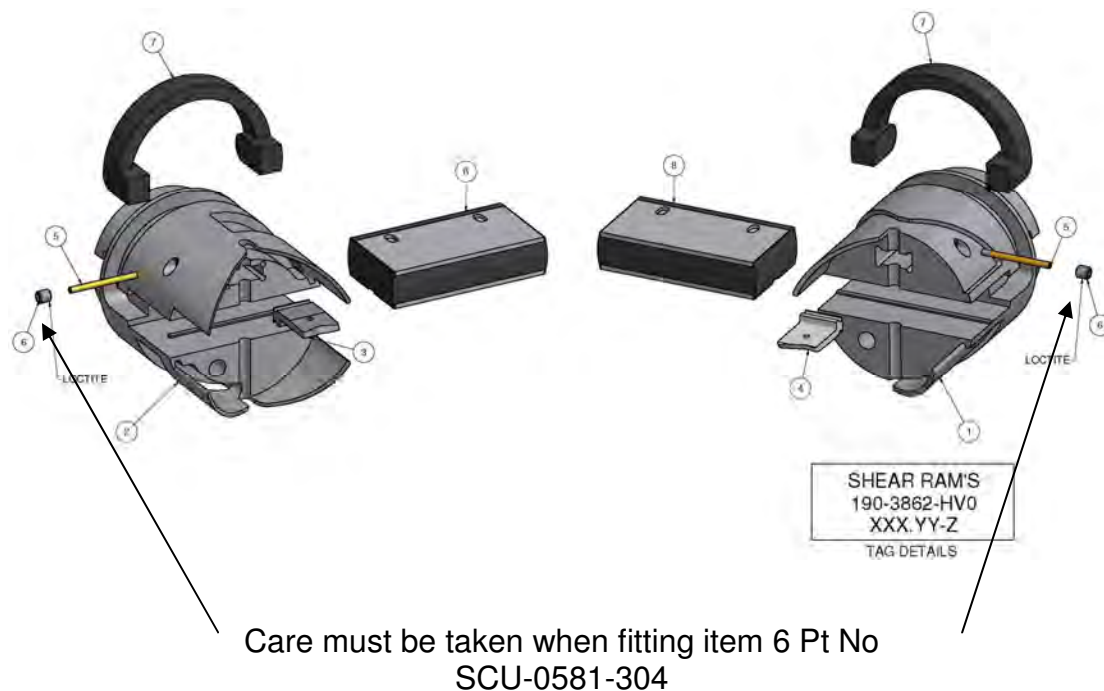


**Figure 27: Wireline Ram Assy 190-3863-HH0**

Item	Part Number	Quantity	Description
1	190-3811-480	1	SINGLE GUIDE SHEAR RAM - 6 3/8
2	190-3812-480	1	SHEAR GUIDE RAM 6 3/8
3	190-5100-411*	1	SHEAR BLADE
4	190-5102-411*	1	SHEAR BLADE SINGLE GUIDE
5	190-3741-B21	2	SHEAR BLADE PIN
6	SCU-0581-304	2	1/2"-13 x 0.500" LONG SET SCREW CUP POINT UNC
7	190-1715-H70	2	Outer Seal
8	190-5306-H80	2	BLIND RAM INNER SEAL - SIZE 7.00

\* *SHEAR BLADE - Was: 190-3740-411 - Now: 190-5100-411, and SHEAR BLADE SINGLE GUIDE - Was: 190-3815-411 - Now: 190-5102-411. Blades altered to improve the shearing capability for heavy duty cables such as 7/16 Dyform. The older shear blade are still fit for purpose but will be phased out.*

**Table 9: Shear Ram Assy 190-3862-HH0**



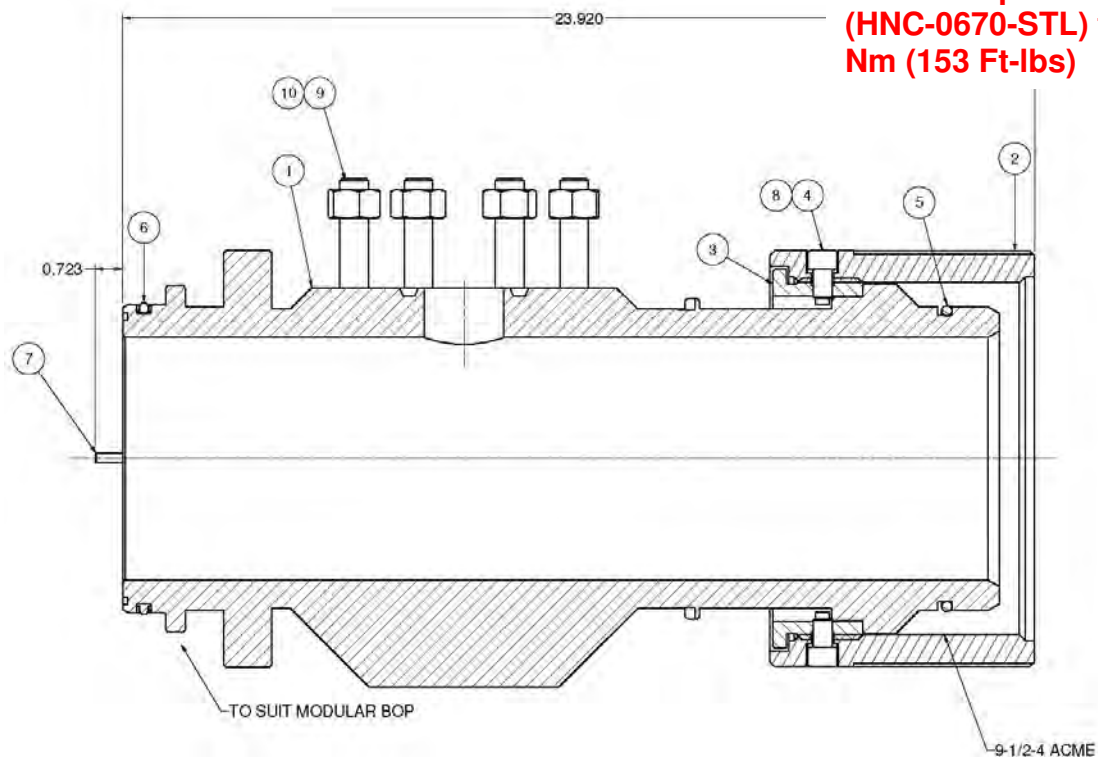
**DO NOT OVERTIGHTEN TORQUE TO 5 – 12 lb ft (7 – 15 Nm)**

**Figure 28: Shear Ram Assy 190-3862-HH0**

Item Number	Part Number	Quantity	Description
1	196-3435-480	1	9.5 BOTTOM SUB X 2-1/16 SIDE OUTLET
2	110-3345-480	1	9-1/2 SPLIT COLLAR (DW STYLE)
3	117-2382-480	1	SPLIT RING (9.5-4)
4	110-3147-3A4	4	STOP PIN FOR 9.5 SPLIT COLLAR
5	801-0443-V90	1	O-Ring - B.S Size 443
6	802-2921-V80	1	7.642 T-SEAL WITH BACK-UPS
7	196-3164-304	2	ROLL PIN 6MM X 40MM LONG
8	WNL-0580-316	4	WASHER NORDLOCK (M12)
9	165-2165-AB7	8	STUD 3/4-10 UN X 3.75" LONG
10	HNC-0670-A2H	8	HEX NUT 3/4 UNC
11	950-2164-STL	1	API SEAL BX 152
100	910-3539-N66	1	DW MALE PROTECTOR 9-1/2

**Table 10: Parts List Bottom Sub**

**Note: Torque 3/4 Hex Nut (HNC-0670-STL) to 206 Nm (153 Ft-lbs)**

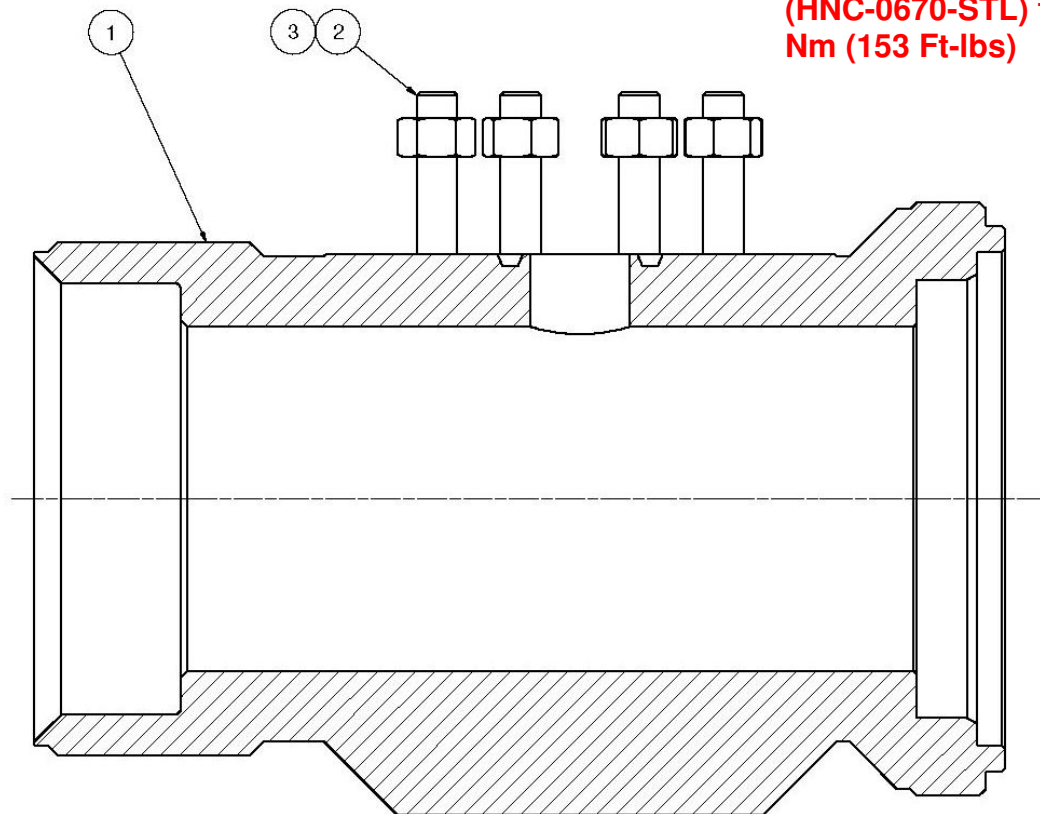


**Figure 29: Bottom Sub Assembly**

Item Number	Part Number	Quantity	Description
1	196-3434-480	1	9.5 TOP SUB WITH 1-13/16 SIDE OUTLET
2	165-2165-AB7	8	STUD 3/4-10 UN X 3.75 LONG
3	HNC-0670-A2H	8	HEX NUT 3/4 UNC
100	910-3540-N66	1	DW FEMALE PROTECTOR 9-1/2 (Not Shown)

**Table 11: Parts List Top Sub**

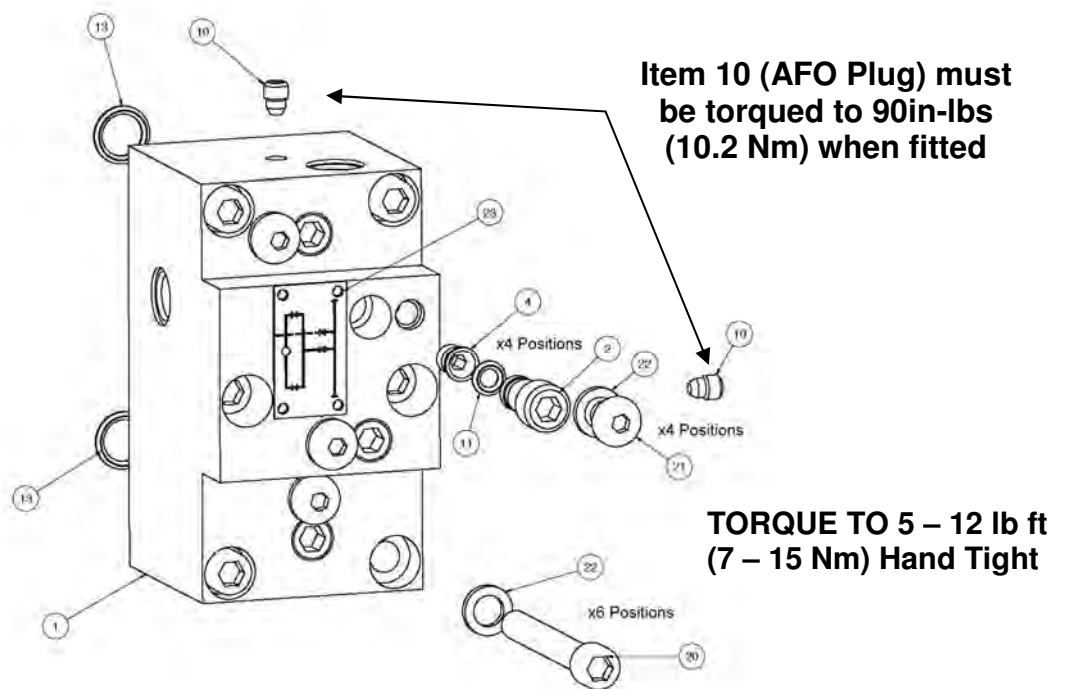
**Note: Torque  $\frac{3}{4}$  Hex Nut (HNC-0670-STL) to 206 Nm (153 Ft-lbs)**



**Figure 30: Top Sub Assembly**

Item	Part Number	Quantity	Description
1	190-2813-480	1	EQUALISATION BLOCK
2	110-2979-316	4	VALVE
4	190-2823-PEK	4	VALVE SEAT
10	190-1758-416	2	AFO Plug (PLAA3124010A)
11	801-0108-V90	4	O-Ring - B.S Size 108
13	801-0113-V90	2	O-Ring - B.S Size 113
20	SHC-0555-AL7	6	SOC HD SCREW 3/8 UNC X 3.0 LONG
21	SBC-0543-304	4	Button Hd Screw Size 3/8 Length 0.625 in
22	WNL-0540-316	10	Nord Lock Washer Size 3/8
23	190-3328-316	1	VALVE PLATE (EQUALISATION BLOCK)

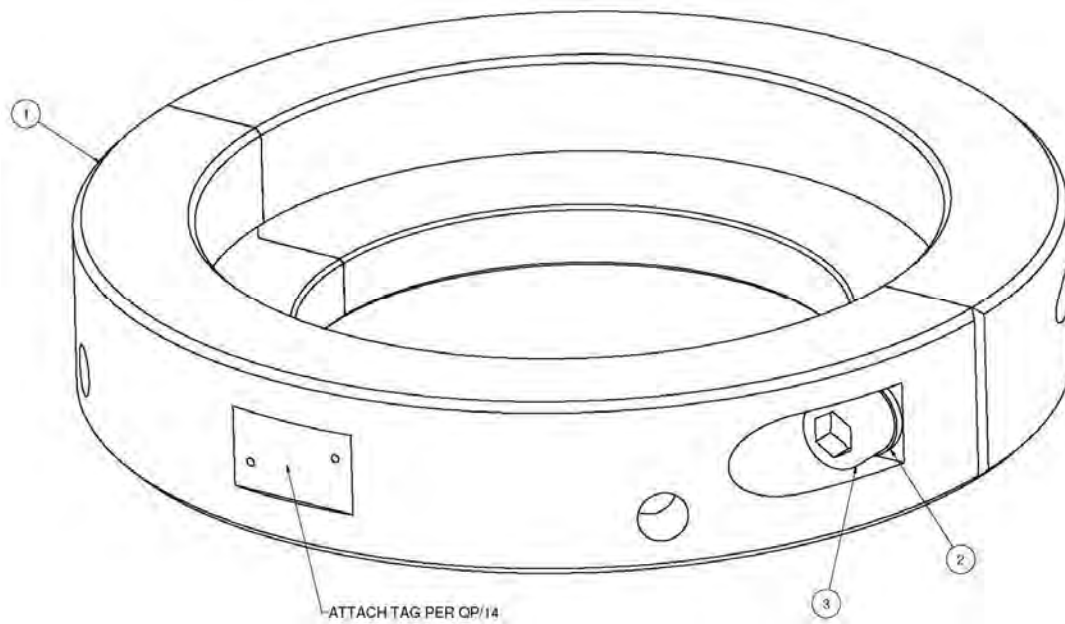
**Table 12: Equalisation Assy 190-2806-HV0**



**Figure 31: Equalisation Assy 190-2806-HV0**

Item Number	Part Number	Quantity	Description
1	196-3496-411	1	BOLTED COLLAR
2	SHC-0673-AL7	2	Soc Hd Cap 3/4-UNC x 3.5" Long
3	WNL-0660-316	2	WASHER NORDLOCK (M12)

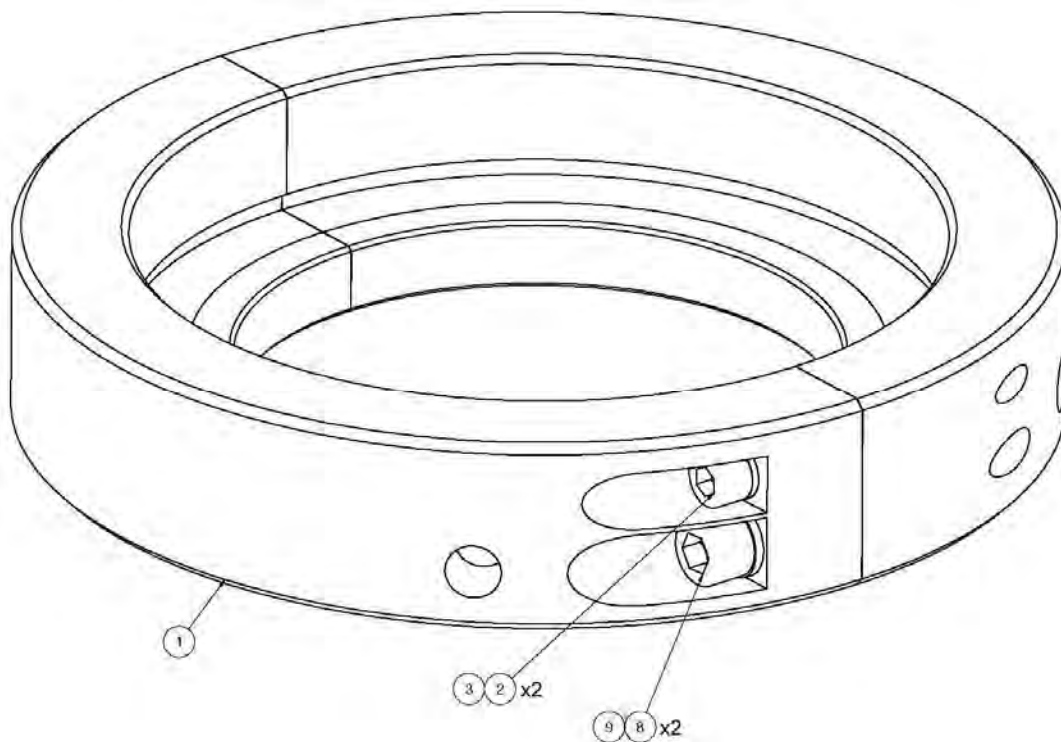
**Table 13: Bolted Collar Parts List 196-3497-HS0**



**Figure 32: Bolted Collar Assembly (Single Bolt) 196-3497-HS0**

Item Number	Part Number	Quantity	Description
1	196-2765-411	1	BOLTED COLLAR
2	SHC-0594-AL7	2	Soc Hd Cap 1/2-UNC x 3.0in Long
3	WNL-0580-316	2	WASHER NORDLOCK (M12)
8	SHC-0632-AL7	2	Soc Hd Cap 5/8 UNC X 3.0in Long
9	WNL-0620-316	2	Nordlock Washer 5/8 (NL16)

**Table 14: Bolted Collar Parts List 196-3150-HS0**



**Figure 33: Bolted Collar Assembly (Dual Bolt) 196-3150-HS0**

**Note – This item is no longer available for purchase – replace with 196-3497-HS0**



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Item	Part Number	Quantity	Description
1	900-3019-480	1	CHECK HOUSING
2	205-2105-480	2	BLANK TEST PORT
3	190-2820-316	2	RIGHT ANGLED PORT 6.5K
4	190-3324-316	2	EXTENSION BAR (12.625 P.C.D)
5	190-2821-316	3	PORT BLANK END
6	100-2114-PEK	1	CHECK VALVE SEAL
7	190-2786-PEK	1	CHECK CONE SEAL
8	145-2185-STL	1	COMP SPRING (D22120)
9	190-1749-STL	1	COMP SPRING (C5515650)
10	190-1703-STL	1	Hollow Lock Screw 3/4-16 (MAC-765)
11	801-0110-V90	9	O-Ring - B.S Size 110
12	801-0119-V90	3	O-Ring - B.S Size 119
13	SHC-0583-3A4	6	Soc Hd Cap 1/2 UNC Length 3/4 in
14	WNL-0580-316	6	WASHER NORDLOCK (M12)

**Table 15: Triple Injection Module 6.5K Parts List 193-4023-HV1**

Item	Part Number	Quantity	Description
1	900-3331-316	8	Bulkhead Connector (6MBC6N)
2	950-3337-316	2	Male Connector (6MSC8N)
3	900-3332-316	6	NPT Elbow (6MSEL6N)
4	900-333-316	3m	3/8 Tube
5	950-3348-PLA	6	Dual Clamp Assy (RBPR1-109 5)
6	190-2746-STL	4	Quick Release Coupling (QR74QC5-06)

**Table 16: Modular BOP Hydraulic Fittings 193-3591-HS0**

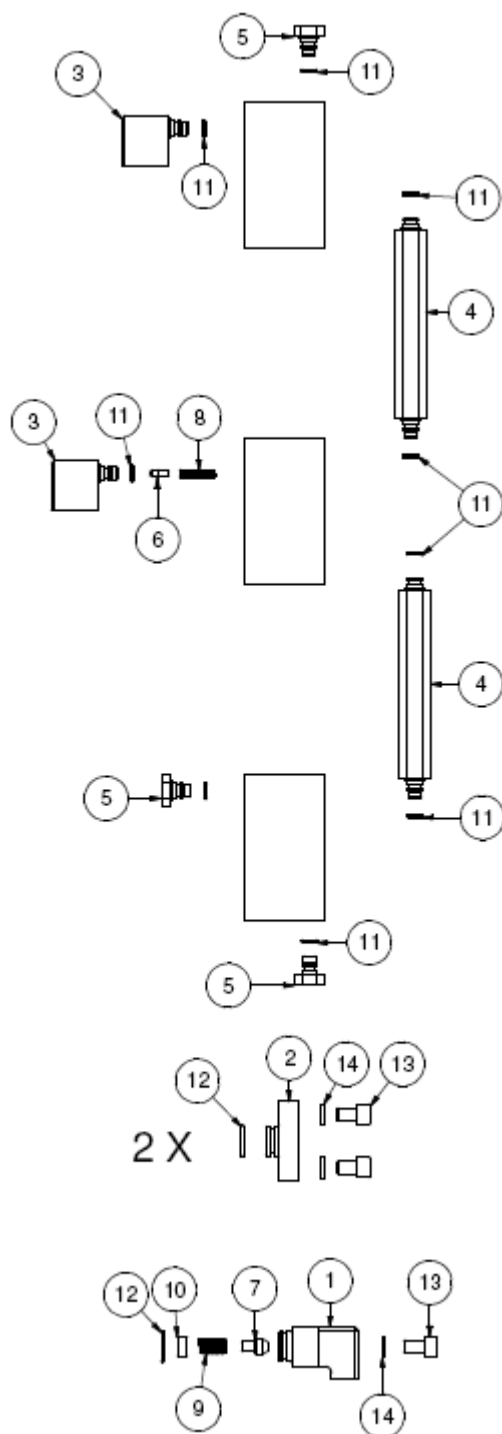


Figure 34: Equalizing Check Valve Assy 193-4023-HV0

## 9 Spares

Use only spares supplied or approved by Phuel Oil Tools Ltd.

It is recommended that sufficient quantities of the following spares be maintained to ensure that the equipment is always available when required.

Elastomeric spares are supplied in Viton material as standard. Other materials are available please specify when ordering.

Part Number	Quantity	Description	Comment
RDK-2476-HV0	6	Actuator Redress Kit	
RDK-4023-HV0	3	Triple Injection Redress Kit	
RDK-3145-HV0	3	Modular Body Redress Kit	
RDK-3156-HV0	1	9-1/2" QU Bottom Sub Redress Kit	

**Table 17: BOP Redress Kit RDK-3568-HV0**

Part Number	Quantity	Description	Comment
RDK-2476-HV0	2	Actuator Redress Kit	
RDK-4023-HV0	1	Equalisation/Isolation Redress kit	
802-2921-V80	1	7.642 T-SEAL WITH BACK-UPS	

**Table 18: Modular Body Redress Kit RDK-3145-HV0**

Part Number	Quantity	Description	Comment
190-2804-304	1	SPIROL ROLL PIN 1/4 DIA X 1	
196-3164-304	2	DOWEL PIN 6MM X 32MM LONG	
802-2921-V80	1	7.642 T-SEAL WITH BACK-UPS	

**Table 19: Redress Kit HV0-3318-HV0**

Part Number	Quantity	Description	Comment
801-0345-V90	1	O-Ring - B.S Size 345	
801-0342-V90	1	O-Ring - B.S Size 342	
801-0344-V90	1	O-Ring - B.S Size 344	
801-0439-V90	1	O-Ring - B.S Size 439	
802-2505-H85	1	ROD T-SEAL 0.825 DIA	
802-2162-H85	1	ROD T-SEAL 1.625	
802-2161-H85	1	PISTON T-SEAL 4.000	
802-1699-H85	1	Rod T-seal Assy (TR004)	
190-3870-H85	1	Rod Seal	
SHC-0503-B7M	4	Soc Hd Cap Size 1/4 x 0.5 in	

**Table 20: Actuator Redress Kit RDK-2476-HH0**

Part Number	Quantity	Description	Comment
190-1715-H70	2	Outer Seal – 6 3/8"	
190-5307-H80	2	Inner Seal – 6 3/8"	

**Table 21: Wireline Ram Redress Kit RDK-2777-HH0**



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Part Number	Quantity	Description	Comment
190-1715-H70	2	Outer Seal – 6 3/8"	
190-5306-H80	2	Blind Inner Seal – 6 3/8"	

**Table 22: Shear Ram Redress Kit RDK-2805-HH0**

Part Number	Quantity	Description	Comment
801-0108-V90	4	O-Ring BS 108	
801-0110-V80	2	O-Ring BS 110	
801-0113-V90	2	O-Ring BS 113	

**Table 23: Equalisation/Isolation Redress Kit RDK-2806-HV0**

Part Number	Quantity	Description	Comment
801-0110-V90	9	O-Ring - B.S Size 110	
801-0119-V90	3	O-Ring - B.S Size 119	

**Table 24: Triple Injection Redress Kit RDK-4023-HV0**

Part Number	Quantity	Description	Comment
801-0108-V90	4	O-Ring - B.S Size 108	
801-0113-V90	2	O-Ring - B.S Size 113	
802-2921-V80	1	7.642 T-SEAL WITH BACK-UPS	

**Table 25: Modular Body Redress Kit RDK-2476-HV0**

Part Number	Quantity	Description	Comment
802-2921-V80	1	7.642 T-SEAL WITH BACK-UPS	
801-0443-V90	1	O-Ring - B.S Size 443	

**Table 26: 9-1/2" Bottom Sub Redress Kit RDK-3156-HV0**

Part Number	Quantity	Description	Comment
802-2921-V80	1	7.642 T-SEAL WITH BACK-UPS	
801-0444-V90	1	O-Ring - B.S Size 444	

**Table 27: 11-1/2" Bottom Sub Redress Kit RDK-3152-HV0**

Part Number	Quantity	Description
196-4559-STL	1	METAL SEAL

**Table 28: Optional Metal to Metal Seal**

Individual seals and parts may be ordered as required. See the parts list in the previous section for part numbers