NATIONAL OILWELL VARCO

# TDS-8SA

## Top Drive System Service Manual

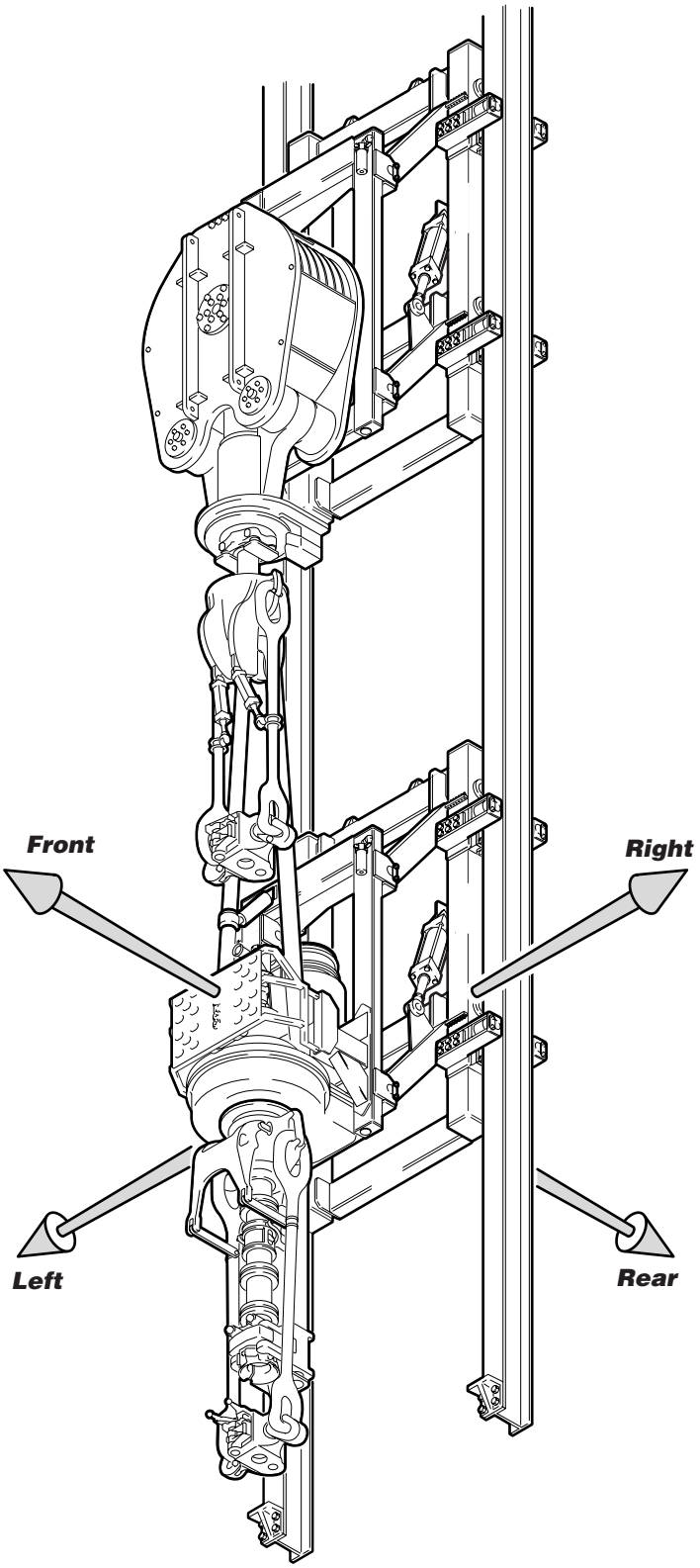
SM00511
Revision C

# General Information



# Tool orientation





# Preface

## Manual conventions



This Preface contains the conventions used throughout this manual. Avoid injury to personnel and/or equipment damage by reading this manual and related documents before operating, inspecting, or servicing the equipment.

Notes, cautions, and warnings

The following examples explain the symbols for notes, cautions, and warnings. Please pay close attention to these important advisories.

### Note

Provides additional information on procedures involving little or no risk of injury to personnel or equipment damage.

### Caution

***Alerts the reader to procedures involving a risk of equipment damage.***

### Warning

***Warns the reader of procedures involving a definite risk of injury to rig personnel.***

## Product bulletins

The Product Bulletin tab, if included in your manual, defines a section of the manual in which you can store Product and Safety bulletins that may be issued by Varco.

## Overall equipment safety requirements

Varco drilling equipment is installed and operated in a controlled drilling rig environment that involves hazardous operations and situations.

To avoid injury to personnel or equipment damage, carefully observe the following safety requirements.

## Personnel training

All personnel installing, operating, repairing, or maintaining equipment, or those in the vicinity of this equipment, should be trained in rig safety, tool operation, and maintenance as applicable. This measure helps ensure the safety of everyone exposed to the equipment for whatever purpose.

During installation, operation, maintenance, or repair of this equipment, personnel should wear protective equipment.

Contact the Varco Service Department to arrange for training for equipment operation and maintenance.

## Systems safety practices

The equipment covered by this manual may require or contain one or more utilities such as electrical, hydraulic, pneumatic, and cooling water.

Before installing or performing maintenance or repairs on the equipment, read the following instructions to avoid endangering exposed persons or damaging equipment.

- ❏ Isolate all energy sources before beginning work.
- ❏ Avoid performing maintenance and repairs while the equipment is in operation.
- ❏ Wear proper protective equipment during the installation, maintenance, or repair of this equipment.

### Electrical systems and components

All electrical wiring, junction boxes, sensors, glands, and related equipment are designed for the specific application, environment and particular zone where the equipment is intended to be used.

- ❏ Before beginning work on this equipment, familiarize yourself with the electrical schematics, as well as the equipment power and voltage requirements.
- ❏ When performing installation, maintenance, or repairs on the equipment, isolate all power. Lock out switches and tag them to prevent injury.
- ❏ Prior to disconnecting wires, verify that all wires and terminals are properly labeled to ensure proper reconnection.

**Hydraulic systems and components**

Hydraulic systems and components are designed for specific use in the drilling industry. The hydraulic pressure for this equipment can be as high as 3,000 psi.

- ❏ Before beginning work on any portion of the hydraulic system, familiarize yourself with the hydraulic and electrical schematics.
- ❏ Isolate, lock out, and tag the hydraulic and electrical power and controls.
- ❏ Take precautions when bleeding down residual system pressure, using bleed valves or equivalent techniques.

***Hydraulic fluids can be extremely hot and under high pressure.***

- ❏ Properly discharge all system accumulators.
- ❏ Collect all residual hydraulic fluid in a container to prevent rig or environmental contamination.
- ❏ Take precautions to prevent hydraulic oil from leaking into other open electrical or mechanical components, such as junction boxes.

**Pneumatic systems and components**

Pneumatic systems and components are designed for specific use in the drilling industry. The pneumatic pressure for this equipment can be as high as 150 psi.

- ❏ Prior to beginning work on any portion of the pneumatic system, familiarize yourself with the pneumatic and electrical schematics.
- ❏ Isolate, lock out, and tag the pneumatic and electrical power and controls.
- ❏ Take precautions when bleeding down residual system pressure using bleed valves or equivalent techniques.
- ❏ Properly discharge all system accumulators.

**Water cooling systems and components**

Water cooling systems and components are designed for specific use in the drilling industry. The water can reach temperatures high enough to cause scalding.

- ❏ Prior to beginning work on any portion of the cooling system familiarize yourself with the plumbing and electrical schematics.

- ❏ Isolate, lock out, and tag the cooling water and electrical power and controls.
- ❏ Take precautions when bleeding down residual system pressure using bleed valves or equivalent techniques.
- ❏ Collect all residual cooling water in a container to prevent rig or environmental contamination if necessary.
- ❏ Take precautions to prevent cooling water from leaking into other open electrical or mechanical components such as junction boxes.

## General safety

**Equipment motion hazards**

Some of the Varco equipment travels either horizontally, vertically on rails, or both.

Avoid placing objects in or near the path of motion for this equipment. Such interference could cause personnel to be trapped or crushed by equipment.

Keep the working envelope/zone of the equipment free from personnel.

**When replacing components**

- ❏ During disassembly and reassembly of any equipment, verify all components such as cables, hoses, etc. are tagged and labeled to ensure reinstalling the components correctly.
- ❏ Replace failed or damaged components with Varco certified parts. Failure to do so could result in a hazard, equipment damage, or personal injury.

**During routine maintenance**

Equipment must be maintained on a regular basis. See the body of the service manual for maintenance recommendations.

Failure to conduct regular maintenance can result in a hazard, equipment damage, or injury to personnel.

**Visibility of equipment operation**

Clear, unobstructed visibility of all equipment functions is critical to safe operation. Do not block or impair the equipment operator's field of view. In cases where this is not possible, the customer must install video cameras to ensure adequate visibility.

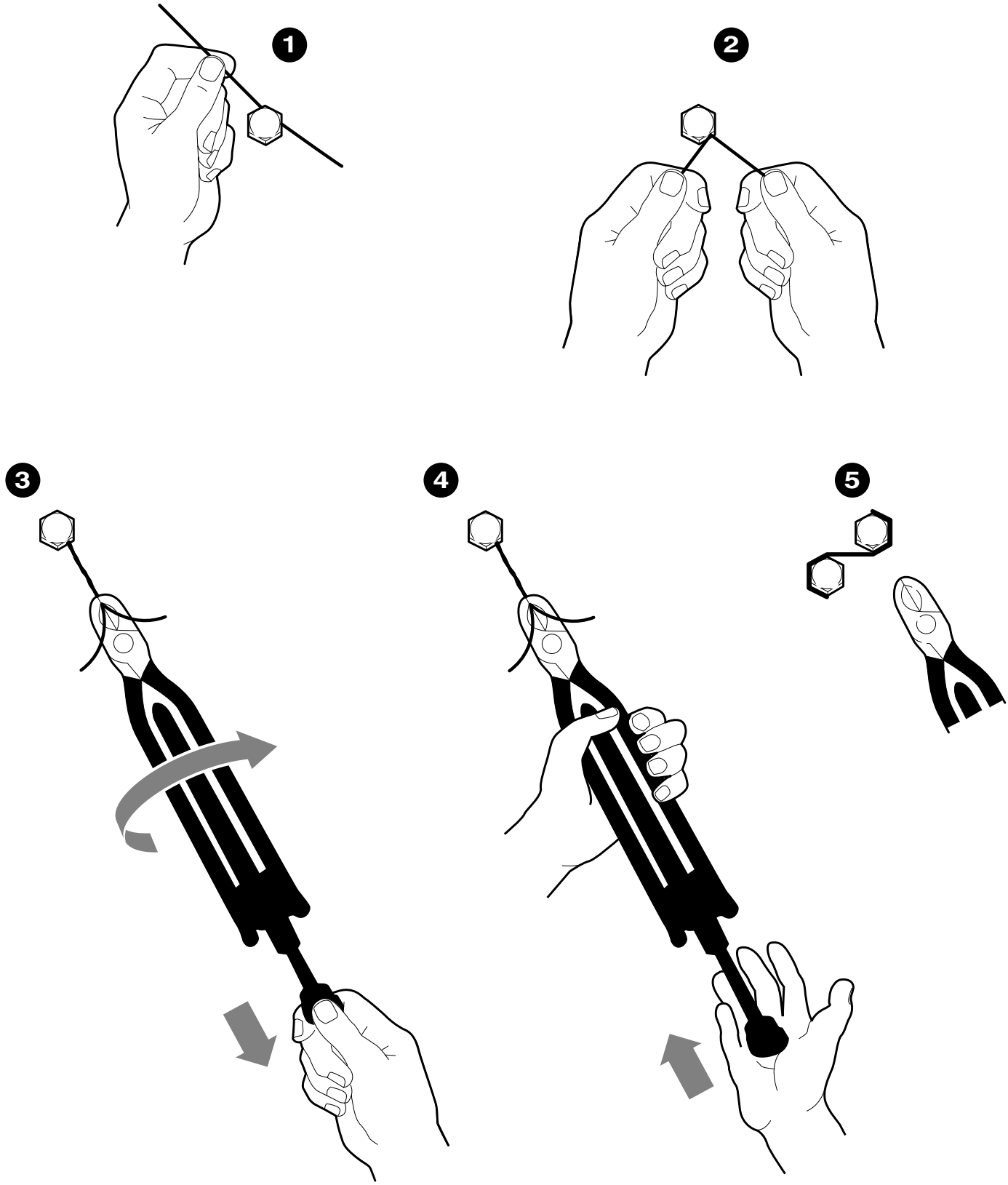
**Proper use of equipment**

Varco equipment is designed for specific functions and applications and should be used only for the intended purpose.

Do not hoist personnel using this equipment.

Contact the Varco service center for questions regarding equipment operation, maintenance, hazards, and designed function.

## Safety wiring



# Torque values

*(Unless otherwise specified)*

| | | Bolts Lubricated with *Light Machine Oil* | | | Bolts Lubricated with *Anti-seize Compound* | | |
|---|---|---|---|---|---|---|---|
| | | *Grade 5* | | | *Grade 5* | | |
| Diameter | Threads per inch | Min. Torque (ft lb) | Max. Torque (ft lb) | Clamp Force (lb) | Min. Torque (ft lb) | Max. Torque (ft lb) | Clamp Force (lb) |
| **Coarse Thread Series, UNC** | | | | | | | |
| 1/4 | 20 | 7.6 | 8.4 | 2020 | 5.7 | 6.3 | 2020 |
| 5/16 | 18 | 16 | 18 | 3340 | 12.1 | 13.4 | 3340 |
| 3/8 | 16 | 29 | 32 | 4940 | 21.4 | 23.6 | 4490 |
| 7/16 | 14 | 48 | 53 | 6800 | 36 | 39 | 6800 |
| 1/2 | 13 | 71 | 79 | 9050 | 53 | 59 | 9050 |
| 9/16 | 12 | 105 | 116 | 11600 | 78 | 87 | 11600 |
| 5/8 | 11 | 143 | 158 | 14400 | 107 | 118 | 14400 |
| 3/4 | 10 | 247 | 273 | 21300 | 185 | 205 | 21300 |
| 7/8 | 9 | 409 | 452 | 29400 | 306 | 339 | 29400 |
| 1 | 8 | 608 | 672 | 38600 | 456 | 504 | 38600 |
| 1 1/8 | 7 | 760 | 840 | 42300 | 570 | 630 | 42300 |
| 1 1/4 | 7 | 1064 | 1176 | 53800 | 798 | 882 | 53800 |
| 1 3/8 | 6 | 1387 | 1533 | 64100 | 1040 | 1150 | 64100 |
| 1 1/2 | 6 | 1843 | 2037 | 78000 | 1382 | 1528 | 78000 |
| **Fine Thread Series, UNF** | | | | | | | |
| 1/4 | 28 | 9.5 | 10.5 | 2320 | 7.1 | 7.9 | 2320 |
| 5/16 | 24 | 18 | 20 | 3700 | 13.5 | 15.0 | 3700 |
| 3/8 | 24 | 33 | 37 | 5600 | 25 | 28 | 5600 |
| 7/16 | 20 | 52 | 58 | 7550 | 39 | 43 | 7550 |
| 1/2 | 20 | 86 | 95 | 10700 | 64 | 71 | 10700 |
| 9/16 | 18 | 114 | 126 | 12950 | 86 | 95 | 12950 |
| 5/8 | 18 | 162 | 179 | 16300 | 121 | 134 | 16300 |
| 3/4 | 16 | 285 | 315 | 23800 | 214 | 236 | 23800 |
| 7/8 | 14 | 447 | 494 | 32400 | 335 | 370 | 32400 |
| 1 | 14 | 665 | 735 | 42200 | 499 | 551 | 42200 |
| 1 1/8 | 12 | 836 | 924 | 47500 | 627 | 693 | 47500 |
| 1 1/4 | 12 | 1178 | 1302 | 59600 | 884 | 977 | 59600 |
| 1 3/8 | 12 | 1596 | 1764 | 73000 | 1197 | 1323 | 73000 |
| 1 1/2 | 12 | 2090 | 2310 | 87700 | 1568 | 1733 | 87700 |

**T.S. = 120,000 psi to 1" dia. Proof Strength = 85,000 psi**
**T.S. = 105,000 psi 1 1/8" to 1 1/2" dia. Proof Strength = 74,000 psi**

# Typical TDS-8SA

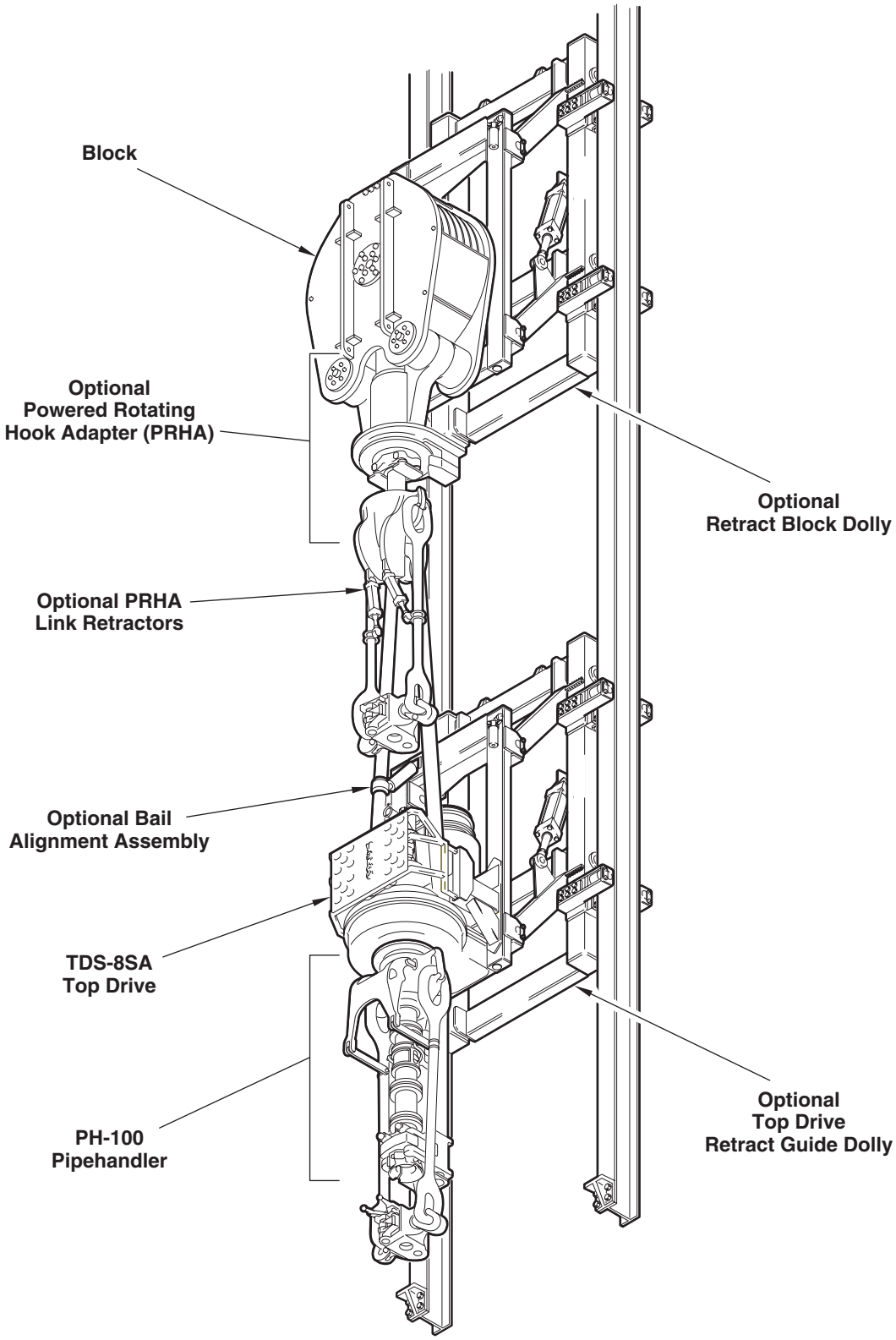


The TDS-8SA AC Top Drive is the AC motor version of the TDS-4S, developed for use in deep water applications. It generates 1,150 horsepower and a continuous drilling torque rating of 62,500 ft lb. The TDS-8SA features a maximum speed of 270 rpm and an intermittent torque of 95,000 ft lb, with a 750-ton hoisting capacity.

The TDS-8SA uses a Variable Frequency Drive (VFD) control system. The TDS-8SA, with its high-capacity helical gears and single-speed gearbox, offers a wide range of torque and speed performance.

# Typical TDS-8SA

(Shown with optional PRHA and optional dual retract guide dolly system for rigs with TDS parking systems.)



# Typical TDS-8SA



Connecting the TDS integrated swivel bail directly to the traveling block or motion compensator frame can eliminate the drilling hook and shorten the TDS working height.

The drive stem functions as the main output shaft driving the drill string. The AC drilling motor, through the gear transmission, rotates the drive stem. The AC motor bolts to the motor support bonnet on the upper gearcase.

The drive stem passes through the rotating link adapter. The rotating link adapter allows the hydraulic lines to remain connected as the pipehandler rotates with the drive stem components while tripping or when positioning the link tilt. The link tilt mechanism and the shot pin assembly are integrated into the rotating link adapter, and the torque arrestor frame hangs from the rotating link adapter.

A hydraulic piston (pressurized chamber) built into the rotating link adapter keeps the rotating link adapter lifted off the load collar during drilling. When hoisting drill pipe, the rotating link adapter is pulled down onto the load collar due to the added weight of the drill string. This directs the load to the integrated swivel bail through the drive stem.

The motor frame/guide dolly attaches to the motor housing assembly. The entire assembly moves vertically on two rails installed in the derrick. The vertical rails react the motor torque during drilling operations.

The pipehandler assembly can make or break drill pipe at any height in the derrick.

Internal blow out preventor (IBOP) valves connect to the end of the drive stem. The driller can close the upper IBOP at any position in the derrick from the Varco Driller's Console (VDC). A second, lower IBOP can be manually closed and sent downhole while controlling a kick (see the *Well control procedures* section).

The torque backup clamp cylinder is located below the lower shoulder of the saver sub, and is an integral part of the torque arrestor assembly. The torque backup clamp cylinder is capable of making up and breaking out saver subs, the upper and lower IBOP valves, as well as the tool joints.

The hydraulic lift cylinder raises and lowers the torque backup clamp cylinder to allow making and breaking various connections. The torque backup clamp cylinder, with its integral torque arrestor, is connected by a wire cable that runs over a pulley to the lift cylinder mounted inside the torque arrestor tube. It is controlled by a manual valve (LIFT VALVE HANDLE) mounted on the torque backup clamp cylinder.

# Typical TDS-8SA

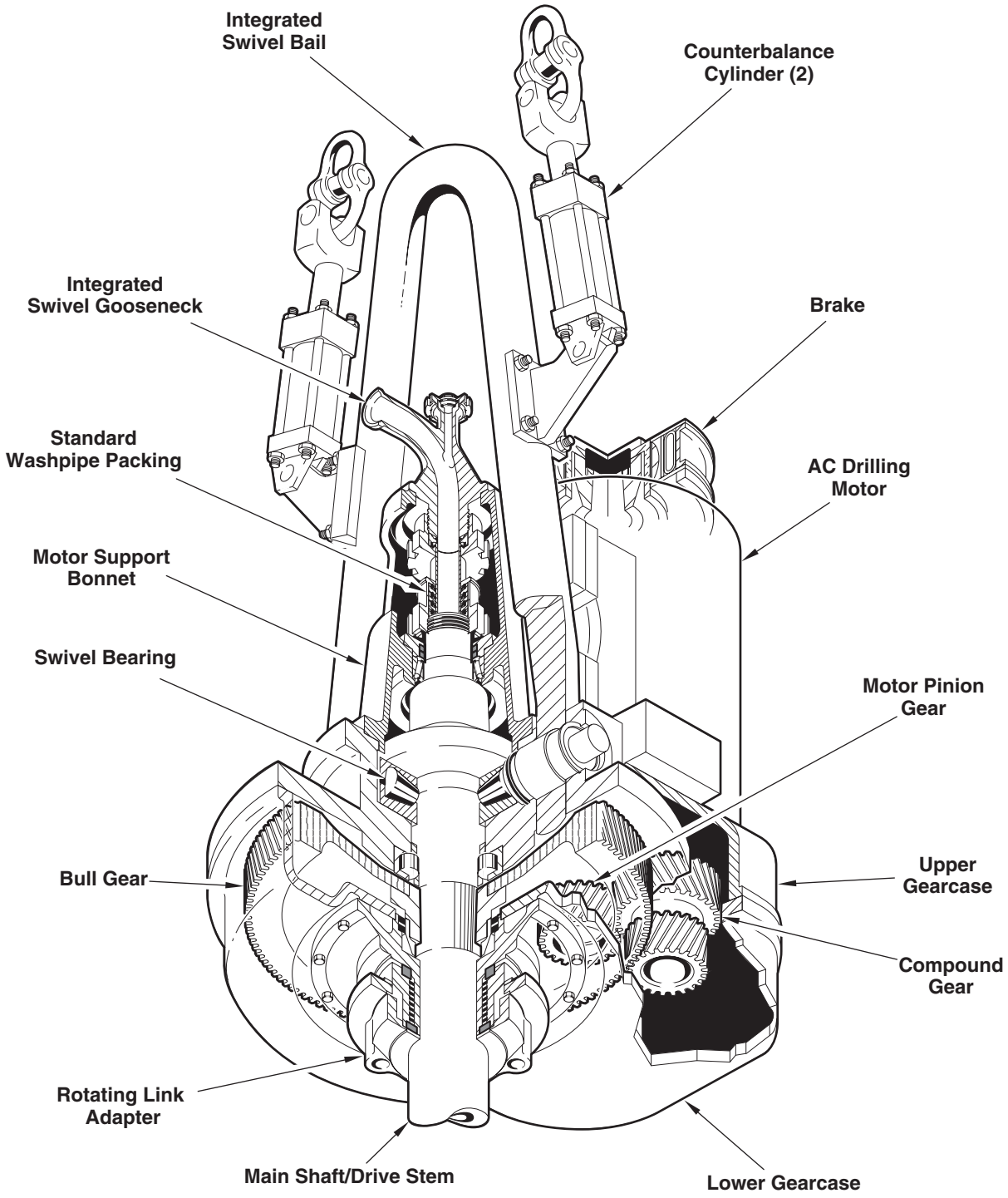


The torque backup clamp cylinder assembly contains a set of jaws, stabilizer liners, and stabbing guides. These components are interchangeable and are used to clamp onto several sizes of tubulars, depending on the size of jaws, stabilizer liners, and stabbing guides installed.

The tool joint locks are installed over the tool joints to prevent inadvertent breakout between the drive stem, upper IBOP valve, lower IBOP valve, and saver sub.

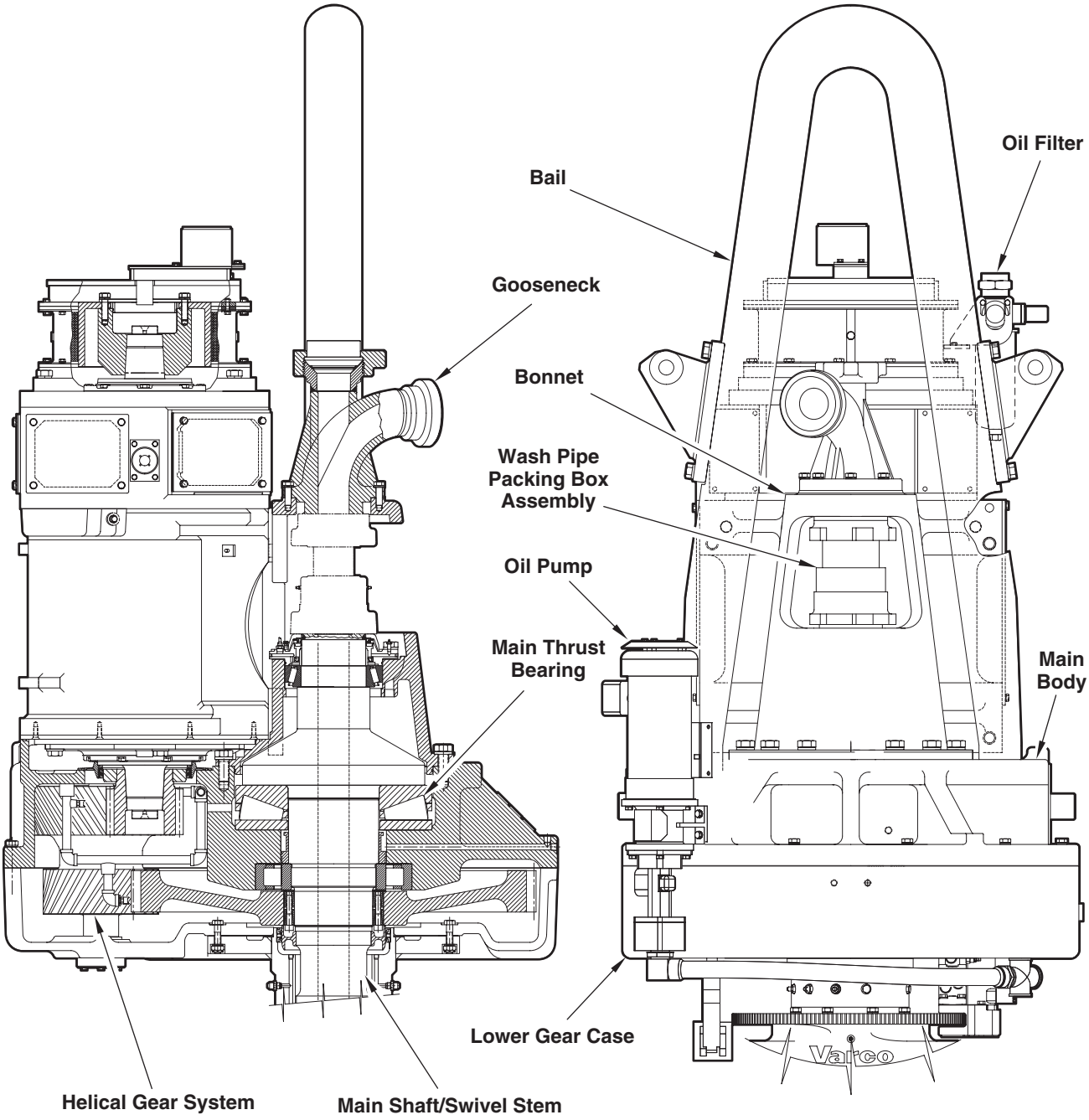
# Typical TDS-8SA

## TDS-8SA motor housing and swivel



# Typical TDS-8SA

## TDS-8SA transmission and motor housing



# Typical TDS-8SA



The transmission, motor housing and swivel assembly transfers the power produced by AC drilling motor to the drill string. Inside the transmission and motor housing main body is a helical gear system that provides an 8.5:1 ratio from the motor to the main shaft.

The main thrust bearing located inside the motor housing supports drilling and hoisting loads from the load stem.

The main body of the motor housing provides a sealed oil lubrication reservoir for the transmission gears and bearings. Bearings and gears are force fed by an externally mounted oil pump that is integral with the main body. The filtered lubrication oil constantly circulates through the main thrust bearing, upper radial bearings and compound gear bearings and over the gear meshes.

An industry standard wash pipe packing box assembly is located between the main shaft/swivel stem and the Gooseneck.

The forged alloy steel bail attaches to standard rotary drilling hooks. The bail is fitted with bronze bushings that are grease lubricated.

The lower gearcase is a heavy duty steel casting, fully ribbed for added heat dissipation.

# Typical TDS-8SA

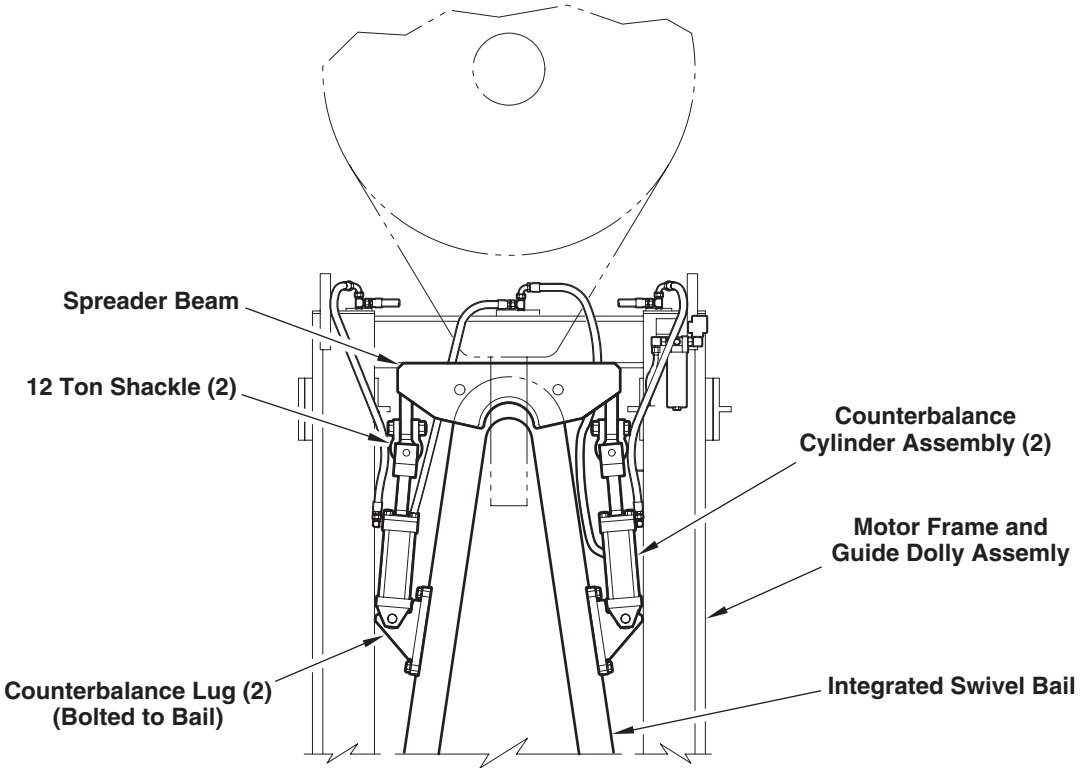
## Counterbalance system



The counterbalance system prevents damage to tool joint threads while making or breaking connections with the TDS. It provides cushioned stroke similar to that provided by the hook.

Counterbalance systems vary widely in configuration. For description purposes, this section describes a counterbalance arrangement illustrated below. The principles are the same regardless of which counterbalance configuration your rig uses.

The counterbalance system prevents damage to the threads of the saver sub and drill pipe by offsetting the weight of the top drive while stabbing into a connection. When properly adjusted, the counterbalance system supports all but about 800 lb of the weight of the top drive over a full 8" to 10" of travel.




The system consists primarily of two hydraulic cylinders, a counterbalance manifold, and two hydraulic accumulators. The hydraulic cylinder assemblies connect the integrated swivel bail and the block, adapter becket, spreader beam or hook, as appropriate.

The two hydraulic cylinders are connected to two hydro-pneumatic accumulators located in the motor frame. A manual valve can extend the cylinders to assist during rig-up. The accumulators are charged with nitrogen and maintained at a predetermined pressure setting.

# Typical TDS-8SA



## Counterbalance system

The system also incorporates a complete backup. The two accumulators, constantly maintained at system pressure, are always able to provide pressure to the counterbalance cylinders if the HPU is “off” or non-operational for any reason. For normal operation, however, the HPU is “on” when using the torque wrench for breaking out the top drive at the floor and is left on while making up the next stand.

When adding a stand to the string during drilling operations, the driller takes a stand into the elevators and stabs it into the box in the rotary. The driller continues to lower the TDS until the saver sub touches the box of the new stand. At this point, only about 800 lb load is on the saver sub/drill pipe connection. The counterbalance cylinders support the remainder of the TDS weight. The driller then spins in and torques up the connections and is ready to drill ahead.

Note that the driller does not have to do anything for the counterbalance system to function properly. It is a pre-adjusted system. Once drilling resumes, the HPU can be turned off and restarted again for breaking out the connection at the floor after drilling the stand down.

Note that TDS-8SA systems using an optional Powered Rotating Hook Adapter (PRHA), use a counterbalance system built into the PRHA. Refer to the *Powered Rotating Hook Adapter* for details on that counterbalance configuration.

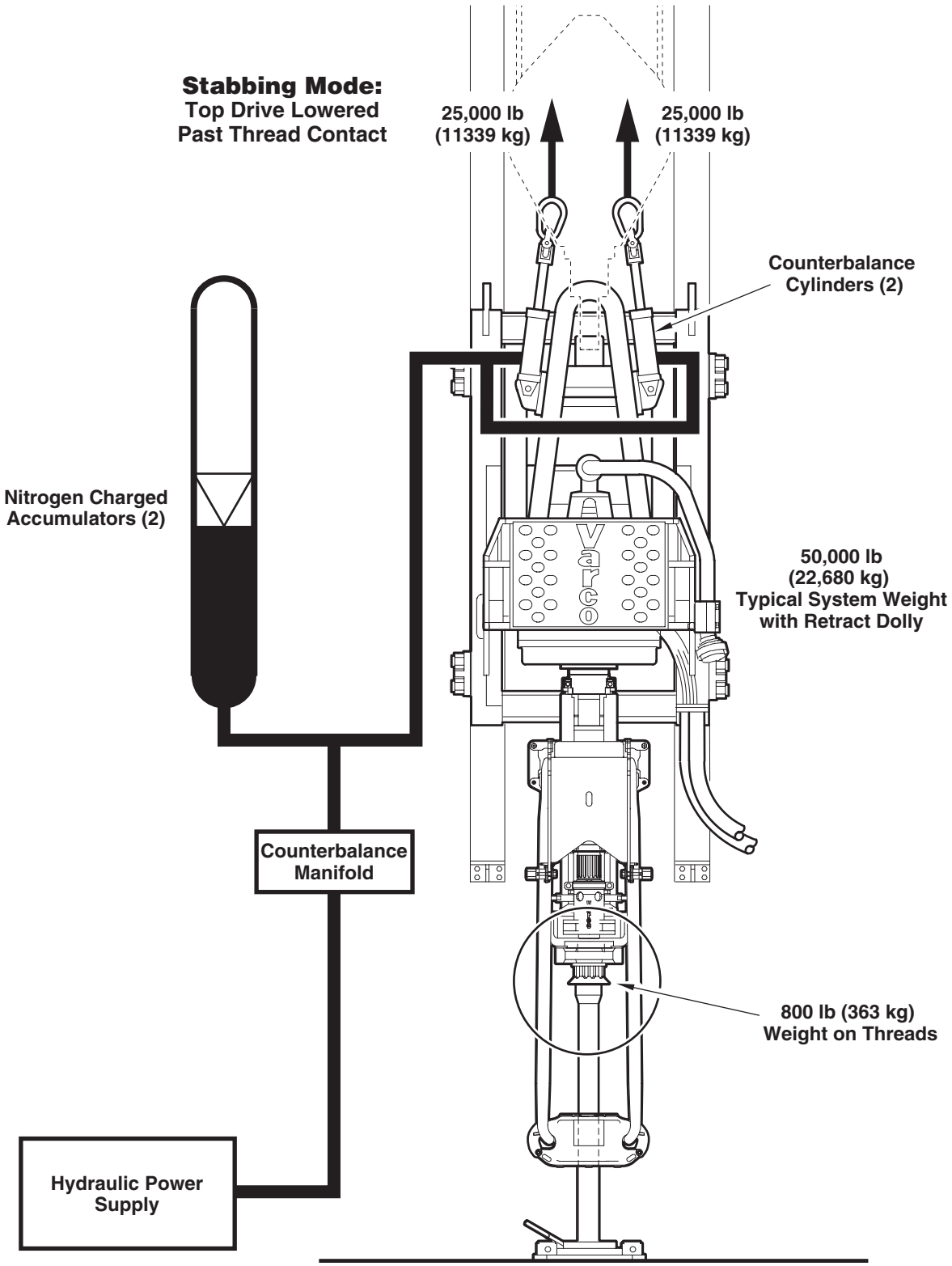
## Optional stand jump

Stand jump is an optional feature for the TDS-8SA. It consists of a switch at the driller’s console allowing you to change the mode of operation of the counterbalance cylinders from DRILL, which is a standard counterbalance condition, to STAND JUMP. The stand jump feature allows the cylinders to lift the weight of the top drive off the drill string while breaking out a connection. This eases the stress on the threads and avoids damage. The cylinders lift the swivel bail off its resting point on the hook.

# Typical TDS-8SA

## Counterbalance system

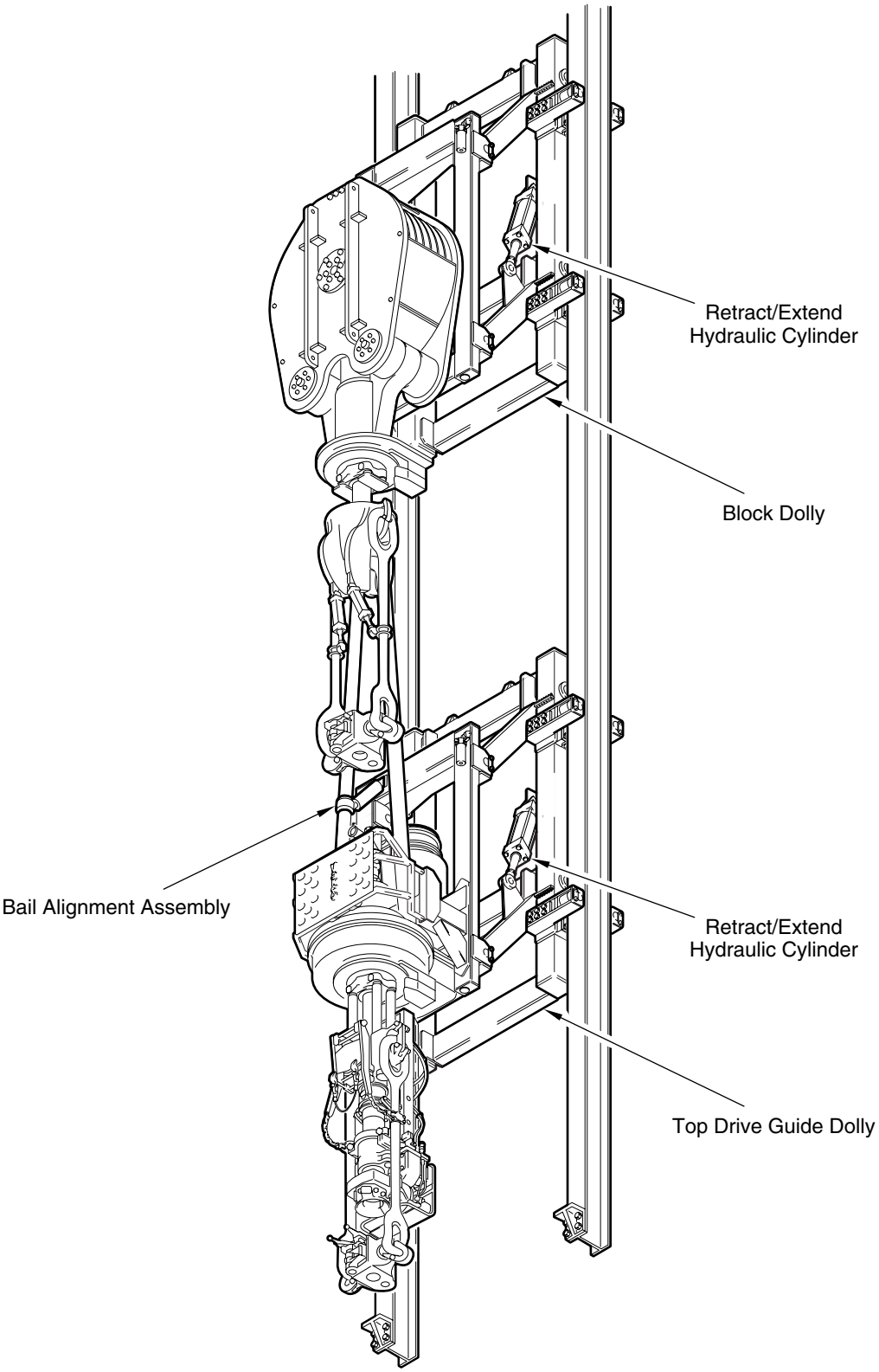




# Typical TDS-8SA

## Typical retract guide dolly





# Typical TDS-8SA



See the *General Arrangement, Derrick Interface* drawing in the top drive technical drawings in reference to the following paragraphs.

The guide dolly assembly transmits the drilling torque reaction to the guide rails and can provide a method for retracting the entire unit to allow for other rig operations.

The standard TDS-8SA guide dolly is a dual retract system with a control plate assembly.

Refer to the engineering drawing and the appropriate *Retract Guide Dolly* service manual supplement for rig-specific information about your retract guide dolly system.

The Dual Retract Dolly System can be part of a well-center pipe handling system, a top drive parking system, or both.

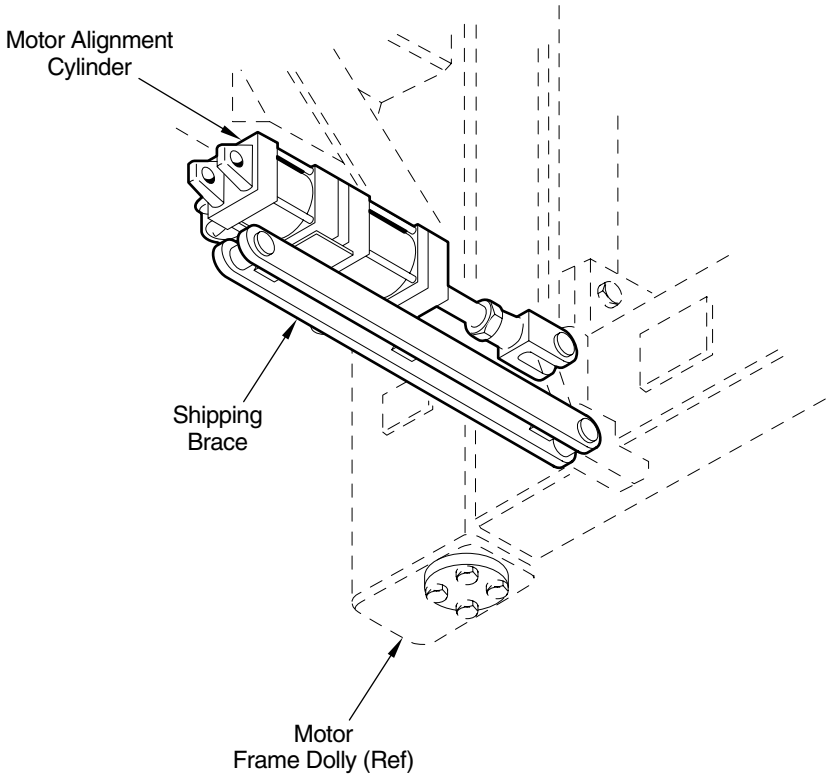
The retract dolly pulls back (retracts) the traveling equipment from well center. Retracting the traveling equipment provides pipe racking systems and other equipment full and immediate access to well center, and it allows parking a top drive in a parking frame system. While a racking system controls the pipe at well center, the retracted traveling equipment can be hoisted, lowered, or parked (using an optional parking system supplied by others), depending on the operation being performed and the rig configuration. These simultaneous operations are impossible without a retract system.

The Dual Retract Dolly System utilizes two dollies to guide and retract the traveling block and the TDS.

# Typical TDS-8SA

## Motor alignment cylinder system





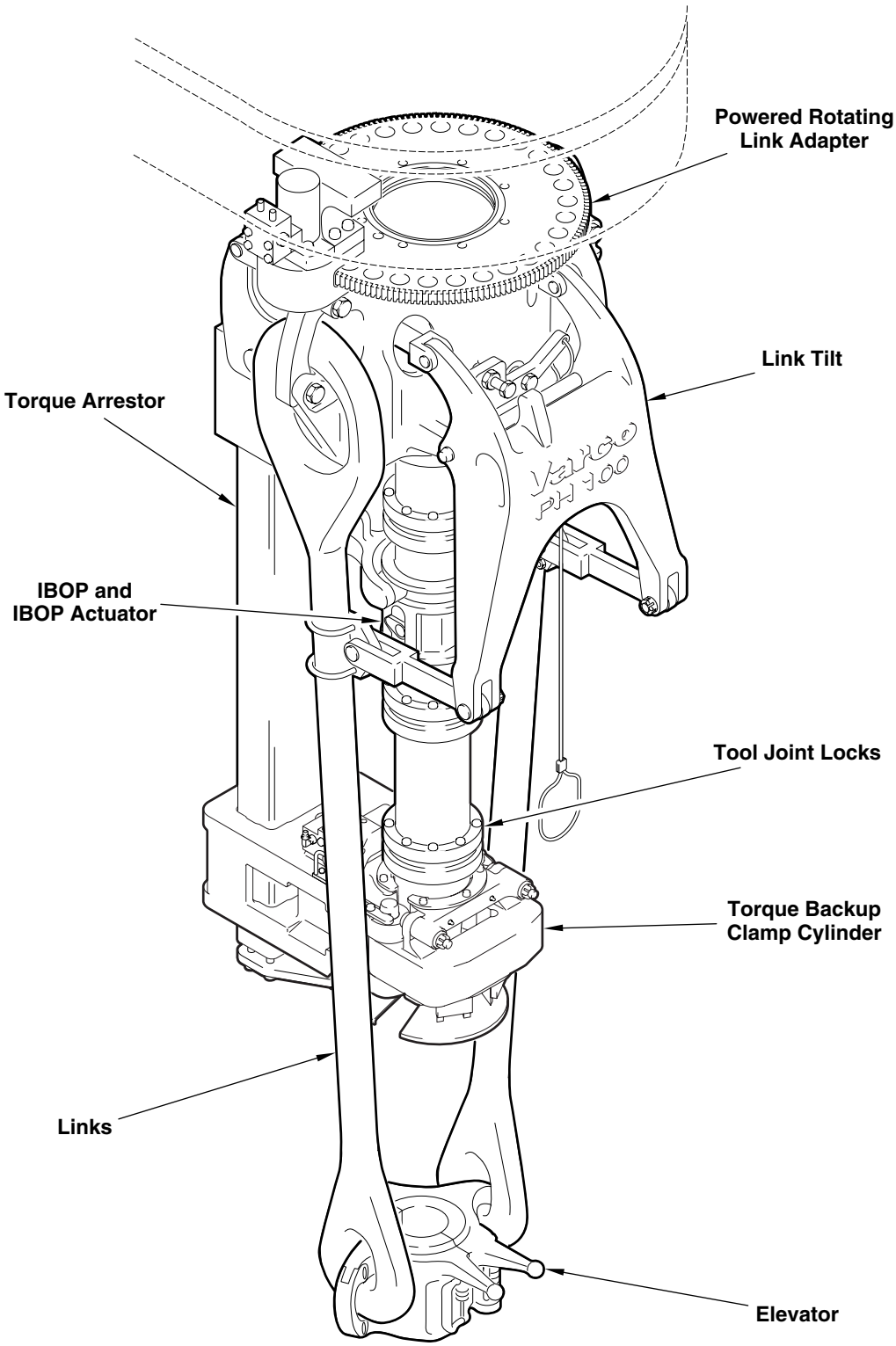

The motor alignment system consists of a duplex cylinder, hydraulic accumulator, pressure reducing valve manifold, and related hardware.

The duplex cylinder attaches between the bottom of the lower gearcase and the motor frame. It connects to an accumulator circuit located on the TDS guide dolly. The accumulator is charged with nitrogen and maintained at a predetermined pressure setting by the alignment cylinder manifold.

The duplex cylinder maintains a vertical orientation for the swivel stem when disconnected from the drill sting, while allowing the motor housing assembly to float slightly about its trunnions, aligning with the drill string while drilling or hoisting.

# Typical TDS-8SA

## PH-100 pipehandler



# Typical TDS-8SA

## PH-100 pipehandler



The PH-100 pipehandler provides two basic functions:

- ❏ Tripping drill pipe stands
- ❏ Providing backup capability of up to 100,000 ft lb torque for making or breaking connections with the top drive at any height in the derrick

The PH-100 pipehandler consists of the following major components:

- ❏ Rotating link adapter assembly
- ❏ Torque arrestor assembly
- ❏ Elevator links and BNC drill pipe elevator

The drive stem passes through the rotating link adapter. The rotating link adapter allows the hydraulic lines to remain connected as the pipehandler rotates with the drive stem components while tripping or when positioning the link tilt. The link tilt mechanism and the shot pin assembly are integrated into the rotating link adapter, and the torque arrestor frame hangs from the rotating link adapter.

A hydraulic piston (pressurized chamber) built into the rotating link adapter keeps the rotating link adapter lifted off the load collar during drilling. When hoisting drill pipe, the rotating link adapter is pulled down onto the load collar due to the added weight of the drill string. This directs the load to the integrated swivel bail through the drive stem.

When not in use, the pipehandler remains stationary and free from the drill string passing through it. When tripping or performing bottom hole operations, the pipehandler is free to rotate 360°.

### Rotating link adapter

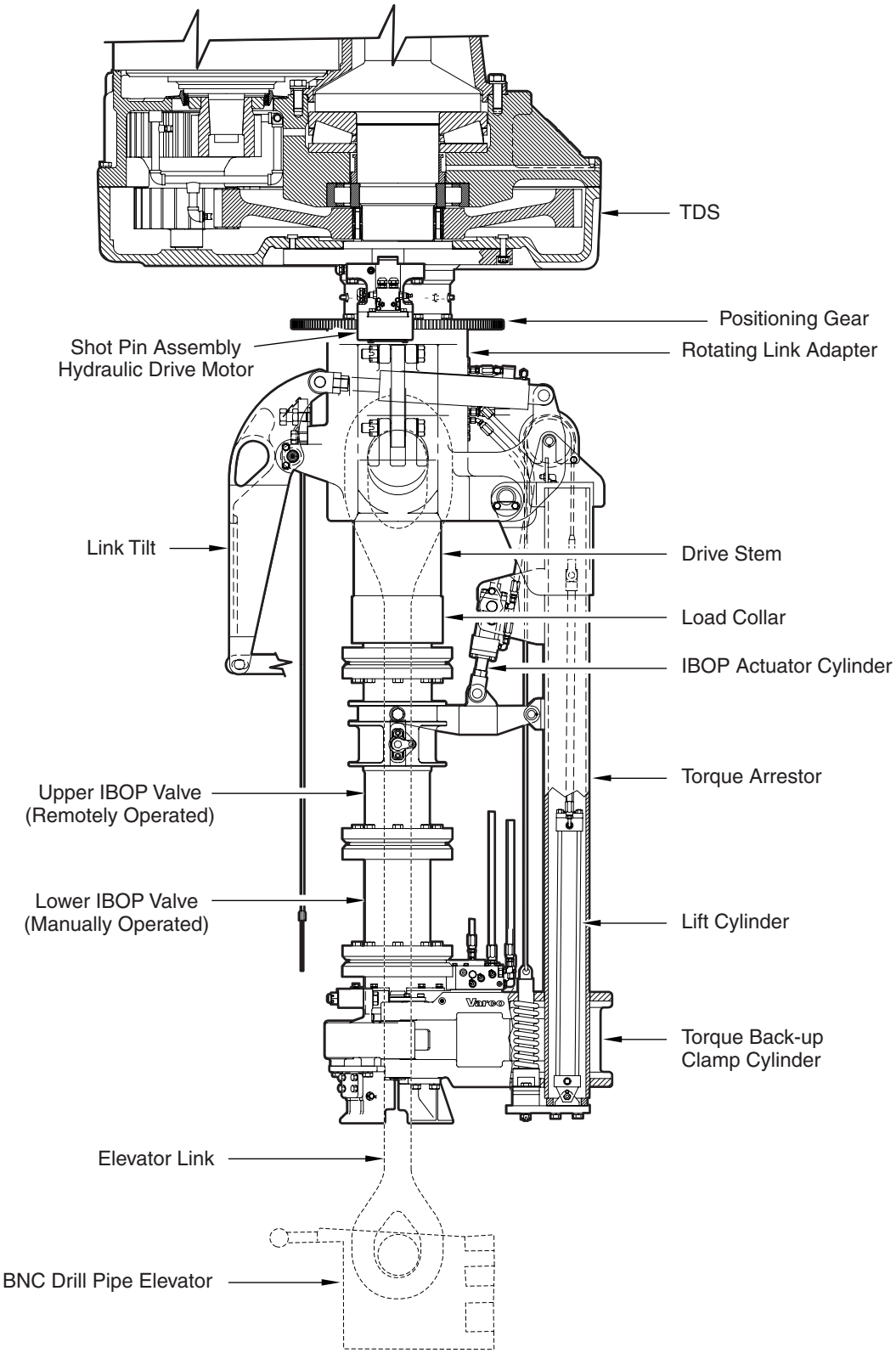
The rotating link adapter hangs from a stem bolted onto the lower gear case. During tripping, when the drill pipe elevator supports the weight of the drill string, the rotating link adapter strokes down to the landing collar seat and, in turn, transfers the load to the main shaft.

The rotating link adapter allows hydraulic lines to remain connected as the pipehandler rotates with the drill stem components while tripping or when positioning the integral link tilt mechanism.

The rotating link adapter has a solenoid-controlled valve-operated hydraulic drive motor. This motor drives the positioning gear, which in turn allows the rotating link adapter to rotate in either direction.

# Typical TDS-8SA

## PH-100 pipehandler



The torque arrestor frame hangs from the rotating link adapter.

Two bushings located toward the top and bottom ends of the rotating link adapter and sandwiched radially against the stem, support the radial loads. The internal hydraulic fluid passages in the stem connect to the respective fluid passages in the rotating link adapter.

Fluid is fed from the main manifold into the stem through the radial passages at the upper end. This fluid is routed from the vertical passages in the stem to grooves in the rotating link adapter, and out to all actuators on the pipe handler. While rotating or in any stationary position, fluid flows between the two components.

## Torque backup clamp cylinder

The torque backup clamp cylinder assembly is normally located below the lower shoulder of the saver sub. It includes two gripping jaws with die inserts and a clamping cylinder for gripping the box end of the drill string when connecting to a saver sub. A torque arrestor frame hanging from the rotating link adapter supports the torque backup clamp cylinder and allows the clamp cylinder to float up or down to allow for making and breaking different connections. With the torque backup clamp cylinder pressurized to clamp on a tool joint, torque is reacted through the torque arrestor frame while making and breaking connections.

The torque backup clamp cylinder position is adjustable. Its position is adjustable vertically by changing the spacers mounted on the spring retainer plate so the top of the dies are 3/8 to 1/2 in. below the top of the box end of the tool joint.

The torque backup clamp cylinder assembly contains a set of jaws, stabilizer liners, and stabbing guides. These components are interchangeable and are used to clamp onto several sizes of tubulars, depending on the size of jaws, stabilizer liners, and stabbing guides installed.

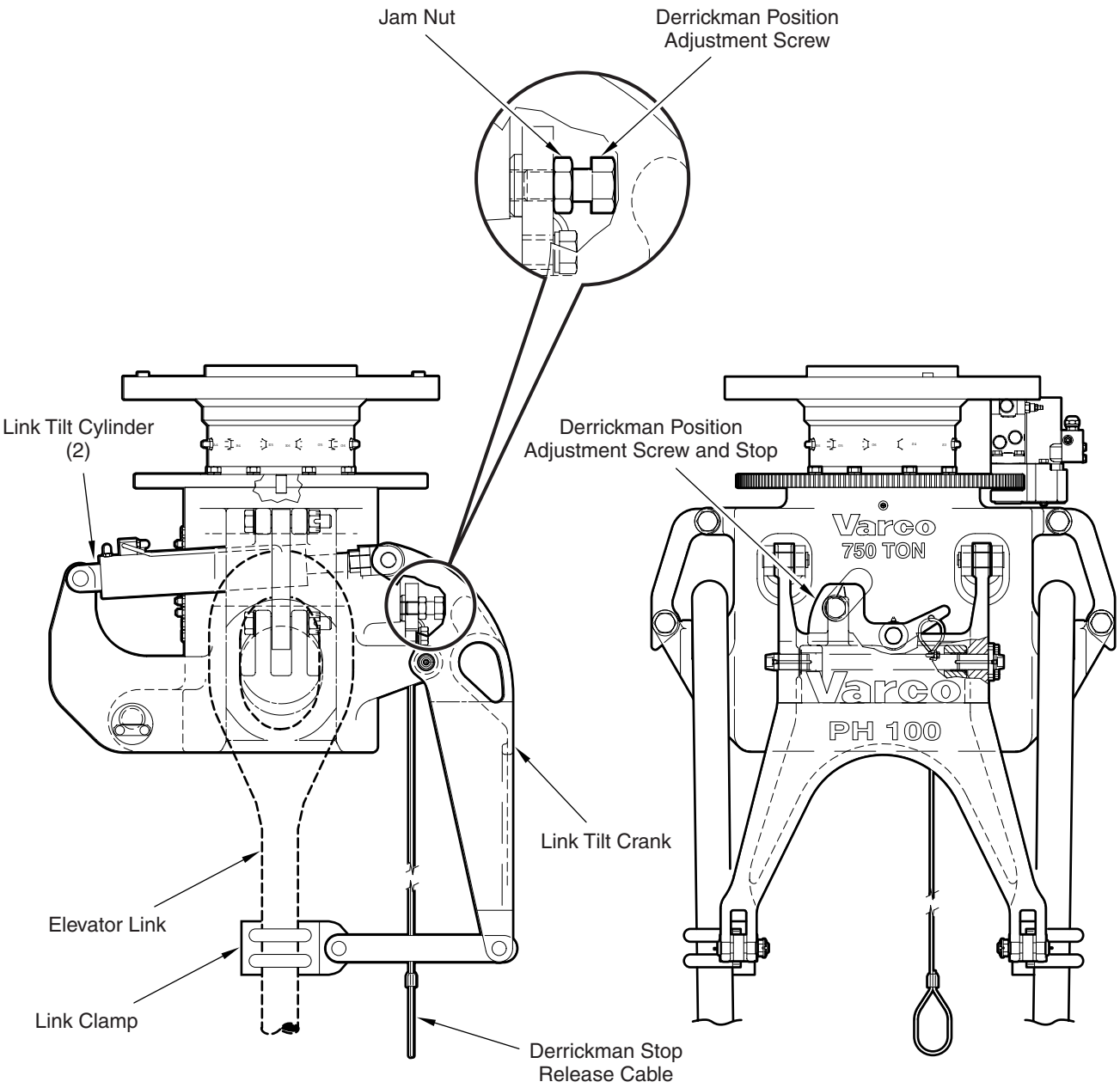
## Tool joint locks

Three tool joint locks are installed over the joints to prevent inadvertent breakout between the main shaft, upper IBOP, lower IBOP and saver sub. Each of these locking assemblies consists of an inner double tapered split sleeve and two external rings. Tightening the bolts draw the two external rings together over the split internal sleeve providing the locking force.

Factory tests demonstrate that a tool joint lock properly installed can resist a torque of up to 30,000 ft lb. A 6 5/8 in. API connection made up to 46,000 ft lb can resist a net torque of 76,000 ft lb with the tool joint locks properly installed.

# Typical TDS-8SA

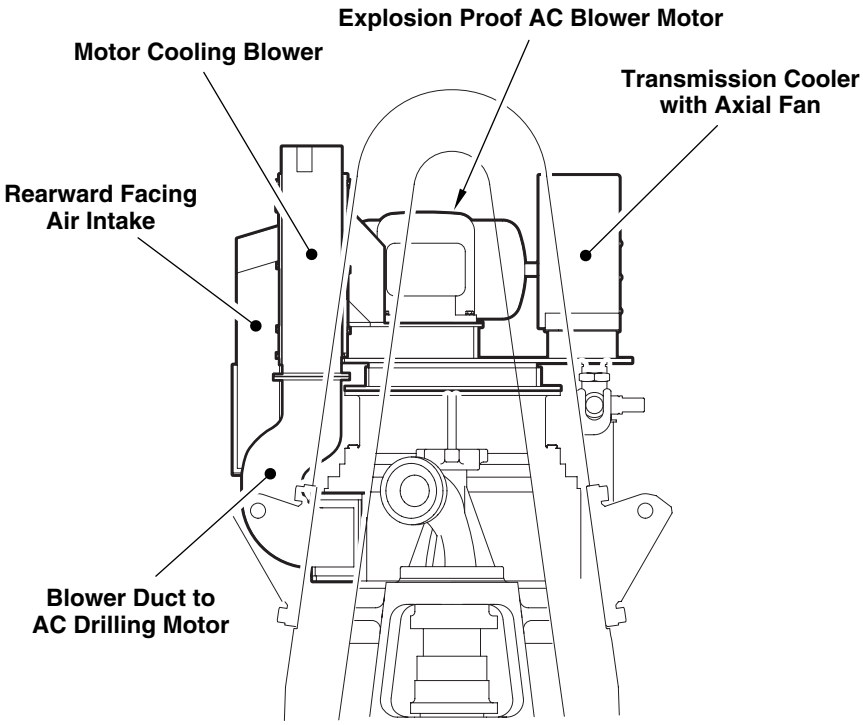
## PH-100 bidirectional hydraulic link tilt



# Typical TDS-8SA

## TDS-8SA cooling system






The local blower cooling system provides local cooling air to the drilling motor. The blower propels local cooling air through the drilling motor and forced convection air to the transmission oil heat exchanger.

The cooling system consists of a heavy-construction pressure motor cooling blower and duct mounted on the drilling motor. An explosion-proof 20 hp, double-shafted 3,450 rpm AC electrical motor directly drives the blower and the axial fan for motor and transmission cooling respectively.

A moisture separator is mounted at the inlet duct to assist with the removal of water from the intake air.

## Elevator links

Varco elevator links attach to the link adapter and support the drill pipe elevator. Elevator link options include:

- ❏ 108 in., 350-ton elevator links
- ❏ 132 in., 350-ton elevator links
- ❏ 180 in., 500-ton elevator links (special long links for running casing, providing 120 in. of clearance for cementing heads)

# Typical TDS-8SA

## Service loops



The service loops transfer the required electric and fluid services between the derrick service standpipes and junction boxes, and the corresponding junction boxes and fluid connections located on the TDS. There are three types of loops: electric power cables, electric control cables, and hydraulic (fluids) lines.

The TDS-8SA requires two electrical service loops, two control service loops and a fluids service loop.

The electric loops contain three 646 MCM power cables and three 2/0 ground cables; a composite cable that contains all of the conductors for the auxiliary AC motors, sensors, and actuator (solenoid) control consisting of:

- ❑ 26 14 AWG conductors
- ❑ 4 8 AWG conductors
- ❑ 2 14 AWG triads
- ❑ 3 14 AWG shielded pairs

The power, ground and composite cables are spiral wound and potted inside a protective cover with 7 1/2 in. mounting flanges at each end.

The TDS can use optional dual electrical service loops in order to meet certain regulatory agency requirements for power cable current carrying capacity.

The control loops consist of 14 TSP cable.

The fluids loop configuration depends on the type of guide dolly and frame the top drive uses. A basic TDS-8SA fluids loop consists of (as a minimum):

- ❑ 3 3/4 in. SAE 100-R9 for hydraulic supplies (one is a spare)
- ❑ 1 1/2 in. SAE 100-R2 for air supply

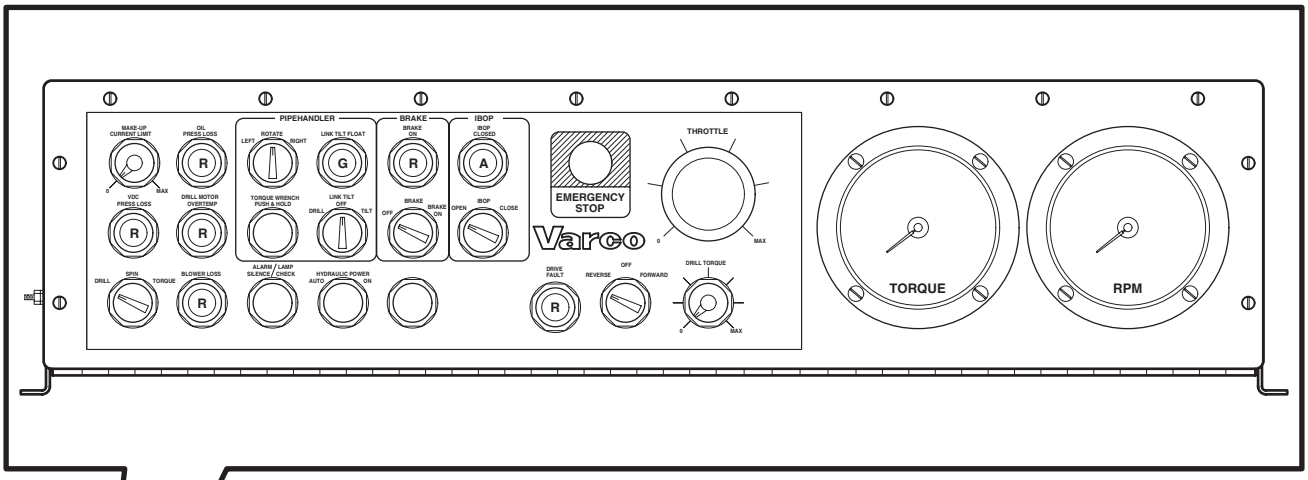
Additional components may include some, or all of the following, depending on your top drive configuration:

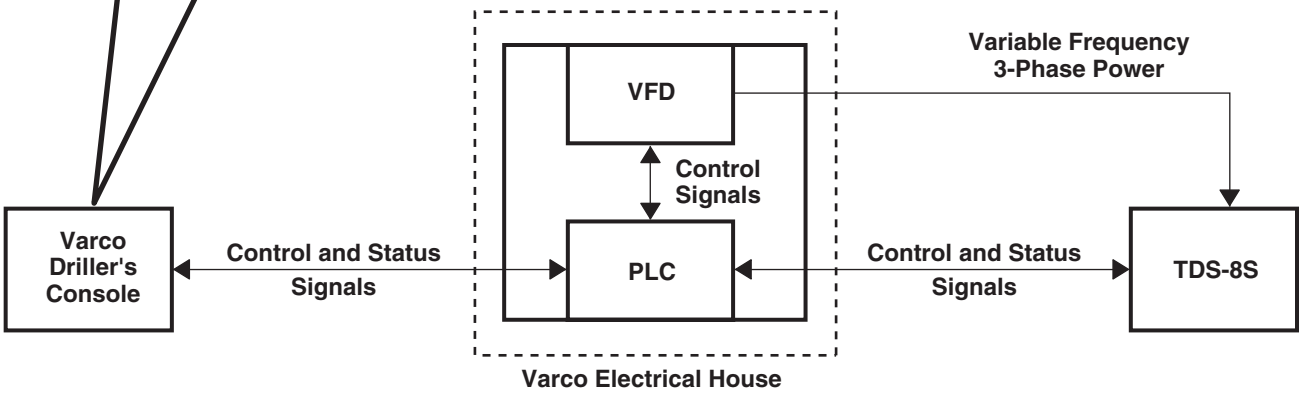
- ❑ 1 1 in. SAE 100-R2 for purge supply
- ❑ Additional 7-conductor, 20 AWG cables as required

# Typical TDS-8SA

## Typical Varco driller's console (VDC)





# Typical TDS-8SA



A typical Varco-supplied driller's console is equipped with the following items to directly interface with the AC frequency drives:

- ❏ The throttle uses a design similar to a standard throttle control supplied with SCR systems. The handle includes integral stops to prevent damage.
- ❏ The drill torque limit potentiometer is very similar to the designs used on SCR systems. The maximum torque output of the drive is limited to the continuous torque rating of the drive and motor.
- ❏ The makeup torque limit potentiometer controls the makeup torque when the top drive is used to makeup connections using the drilling motor. This control allows the top drive to operate at the intermittent rating to make up drill pipe connections.
- ❏ Switches control the link tilt, AC drilling motor brakes, torque wrench, small auxiliary AC motor (i.e., blowers and pumps), rotating link adapter, remote IBOP valve, and drill pipe forward/reverse selection.
- ❏ Seven illuminated indicators show conditions:
  - ⇨ IBOP CLOSED
  - ⇨ BRAKE ON
  - ⇨ OIL PRES. LOSS
  - ⇨ BLOWER LOSS
  - ⇨ MOTOR OVERTEMP
  - ⇨ DRIVE FAULT
  - ⇨ AUTO POSITION

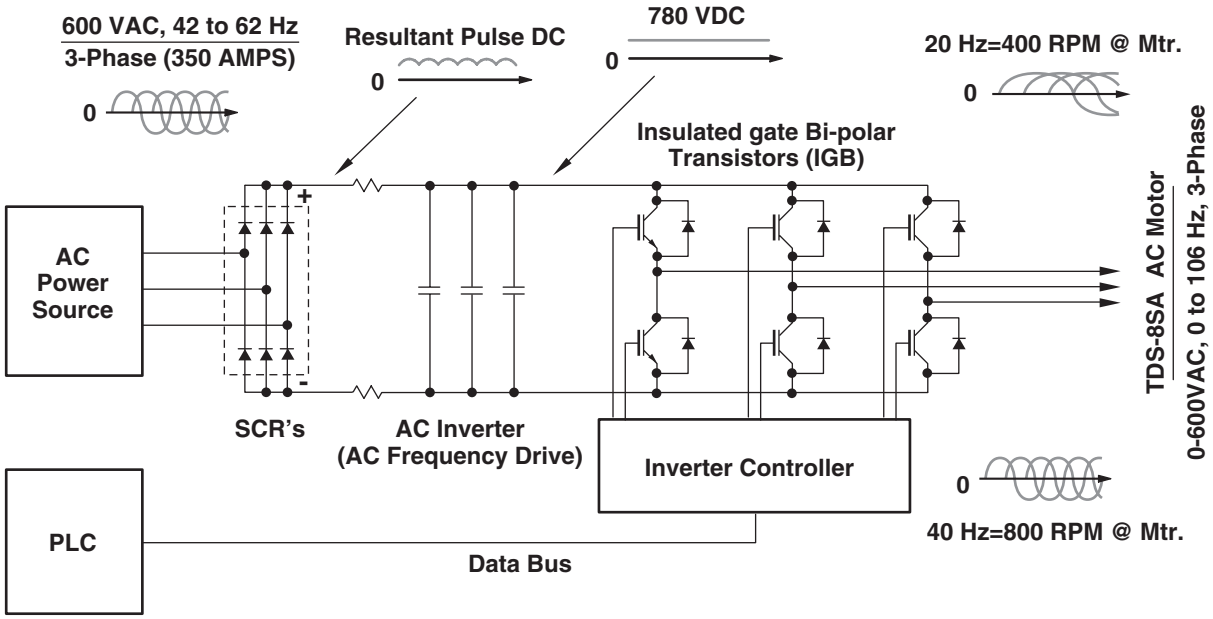
The driller's console also includes a horn to warn of an alarm condition.

The driller's console, made from 300-series stainless steel, uses full size oil tight switches and indicators, and is designed for purging to meet hazardous area requirements. The console can be supplied with Pyle-National explosion-proof connectors, if requested.

1

# Typical TDS-8SA

## Variable frequency AC drive




The frequency drive used to operate the TDS-8SA AC drilling motor consists of three major parts:

- ❏ Rectifier/capacitor
- ❏ Power modules
- ❏ Control sections

The rectifier/capacitor section converts incoming 3-phase AC power to DC and stores the DC power in capacitors for use by the power devices.

The power modules or inverters convert the DC power into a simulated AC signal using pulse-width-modulation (PWM).

The control section monitors the performance of the drilling motor, accepts throttle and torque limit signals from the driller, and controls the firing circuits of the power modules.

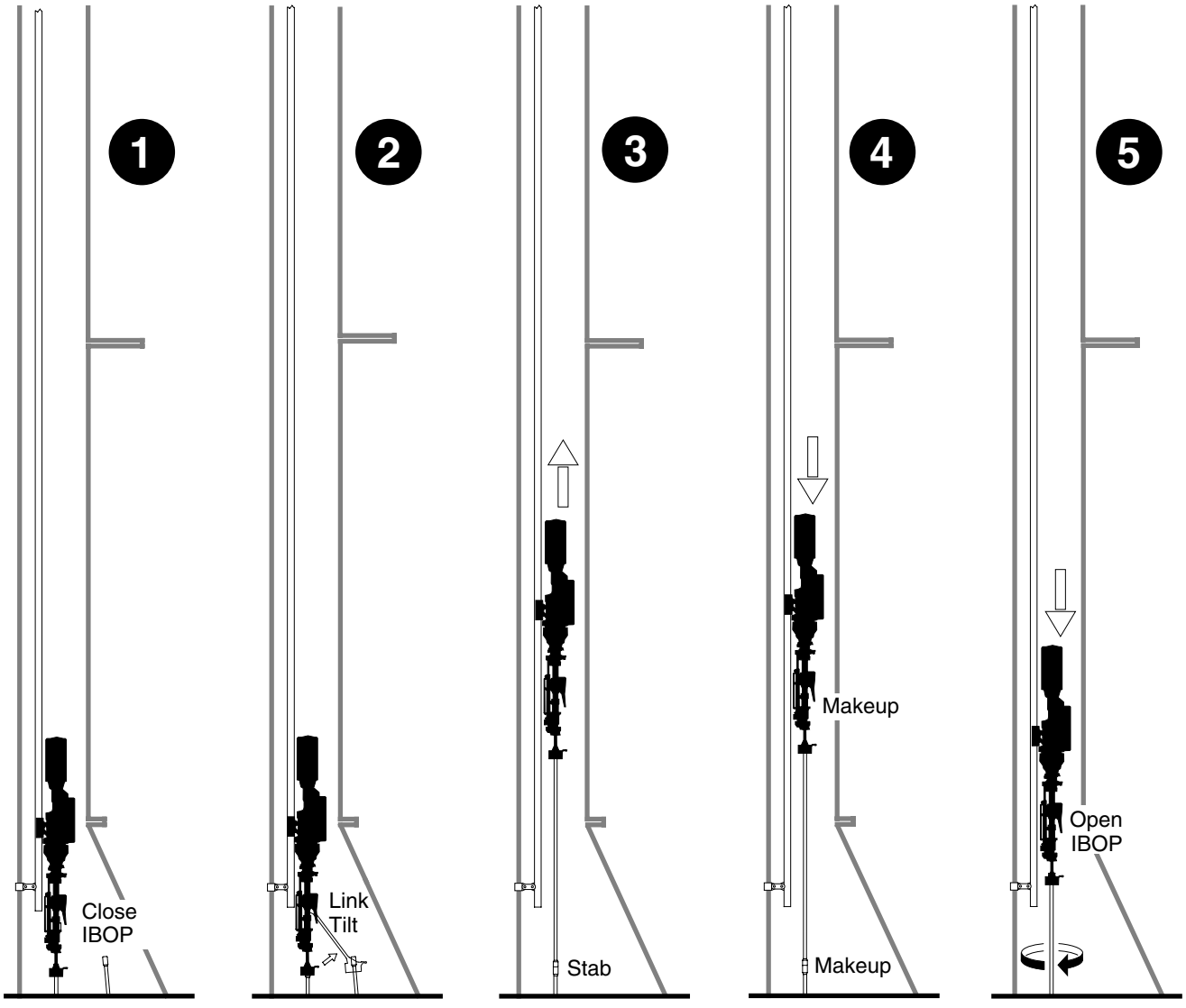
The driller controls the speed of the AC drilling motor with a hand throttle. The throttle varies the frequency and voltage to the motor. Since the drilling motor is frequency synchronous, the speed of the motor is proportional to the frequency (i.e., 20 Hz is 400 motor RPM, 40 Hz is 800 motor RPM). Because of the nature of AC motors, the voltage supplied to the motor varies with the frequency, and is stated as volts per Hertz.

The drive accepts DC voltage by bypassing the input rectifier circuit. The drive requires a DC voltage of 740 VDC +/- 10%, 750 amperes continuous, and 1110 amperes intermittent.

# Basic useage

## Drilling ahead with singles

- Set slips on string
- Stop circulation
- Close IBOP
- Breakout connection using pipehandler and drilling motor (in reverse)
- Tilt links to mousehole
- Latch drill pipe elevator around single
- Pickup single with elevator
- Release link tilt
- Stab bottom of single onto string
- Lower block to stab motor into top of single
- Spin in motor and single
- Makeup both connections with motor in torque mode
- Pull slips
- Open IBOP
- Start circulation
- Begin drilling

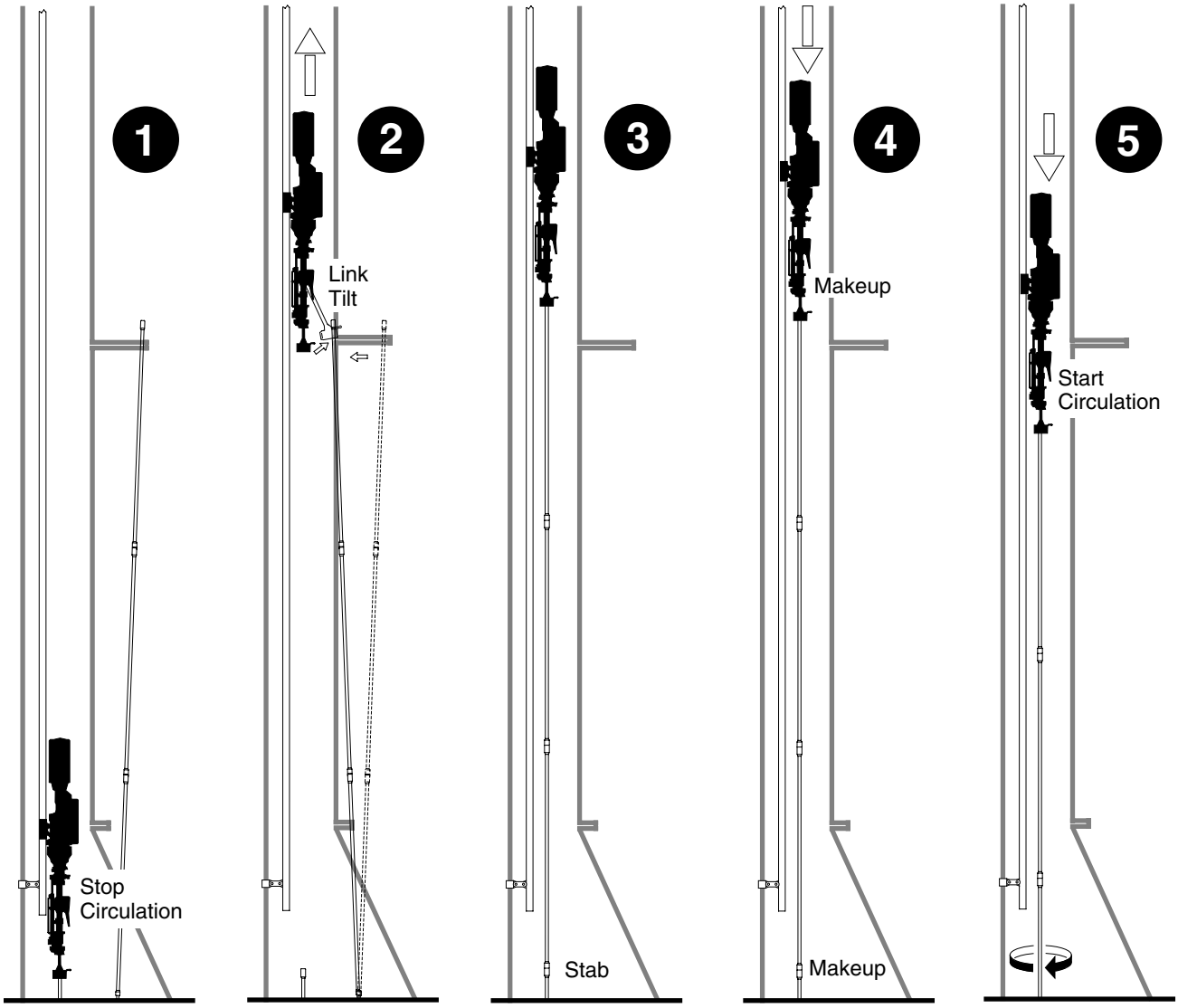


# Basic useage

## Drilling ahead with triples



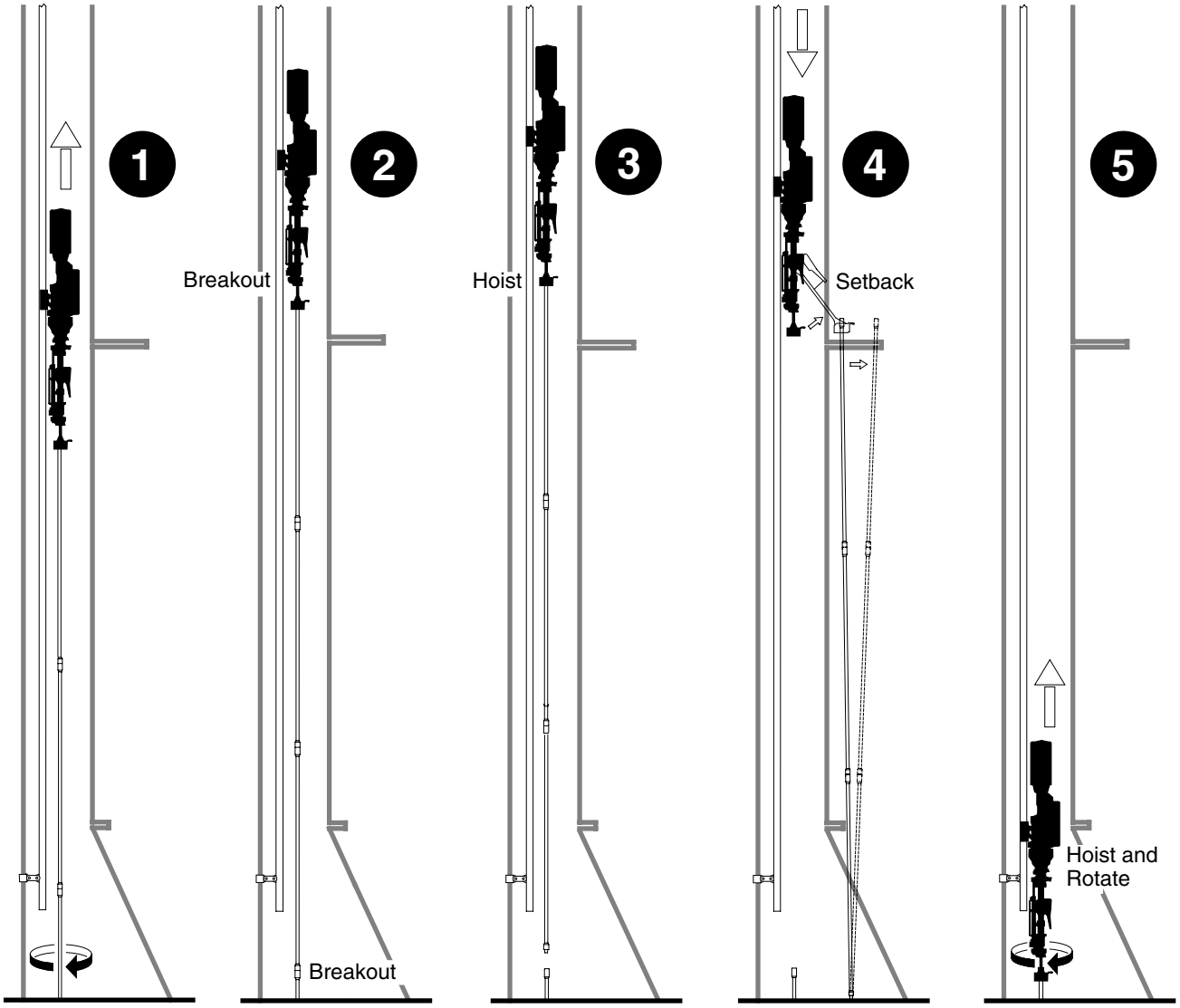
- Set slips on string
- Stop circulation
- Breakout connection using pipehandler and drilling motor (in reverse)
- Raise block
- Tilt link tilt to derrickman
- Pickup stand with elevator
- Stab bottom of stand onto string
- Lower block to stab motor into top of stand
- Spin in motor and stand
- Makeup both connections with motor
- Pull slips
- Start circulation
- Begin drilling



# Basic useage

## Backreaming

- Hoist while circulating and rotating
- When 3rd connection surfaces, stop rotation and circulation
- Set slips on string
- Breakout connection using pipehandler and drilling motor (reverse)
- Breakout and spinout stand at floor
- Hoist free stand with elevator
- Setback stand using link tilt
- Lower block, stab motor into string
- Spin in motor and makeup connection with motor
- Start circulation, pull slips, hoist and rotate



# Specifications







# General specifications

## AC motor

Refer to the original manufacturer's documentation.

## Variable frequency AC drive

Refer to the original manufacturer's documentation.



## Motor cooling system

| | |
|---|---|
| Type | Local intake blower |
| Flow | 2,800 cfm |
| Blower motor | 20 hp |
| Voltage | 220/460 VAC,<br>3-phase, 60 Hz |
| Speed | 3,450 rpm |

## Service loops

| | |
|---|---|
| Power Cables | Three 646 MCM and three<br>2/0 conductor grounds |
| Auxiliary Composite Cable | Conductors (Qty/type/size):<br>26 SGL/14 AWG<br>4 SGL/8 AWG<br>2 triads, not shielded/14 AWG<br>3 TSP/14 AWG |
| Control Cable | 14 TSP |

## Gearcase

| | |
|---|---|
| Type | Helical (double reduction) |
| Gear Ratio | 8.5:1 |

## Gearcase lubrication

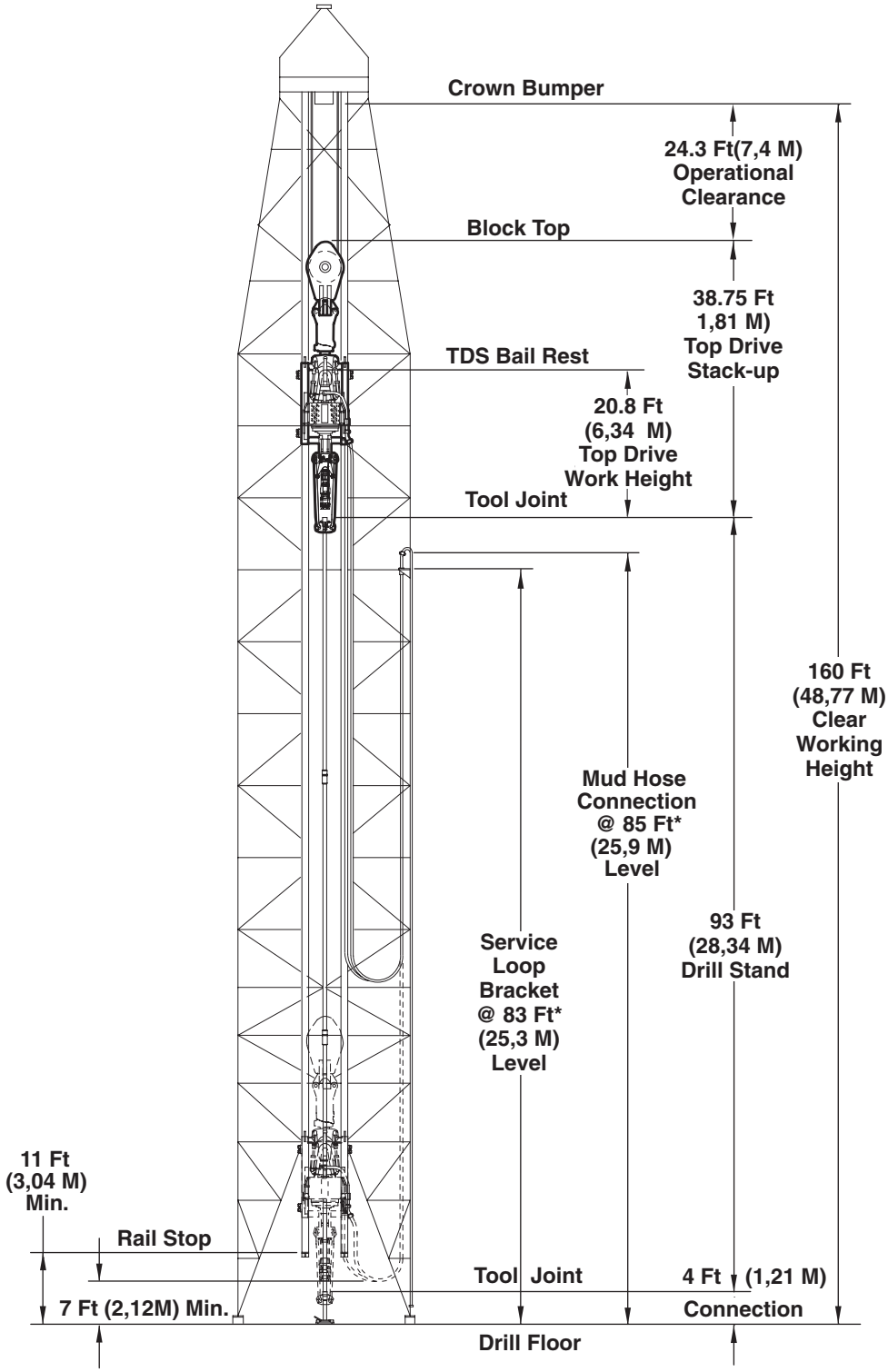
| | |
|---|---|
| Type | Pressure feed |
| Reservoir Capacity | 10-20 gal. |

## Pipehandler

| | |
|---|---|
| Backup torque | 100,000 ft lb |
| Hydraulic pressure | 2,000 psi maximum |
| Hydraulic flow | 30 to 35 gpm |

# Typical derrick interface

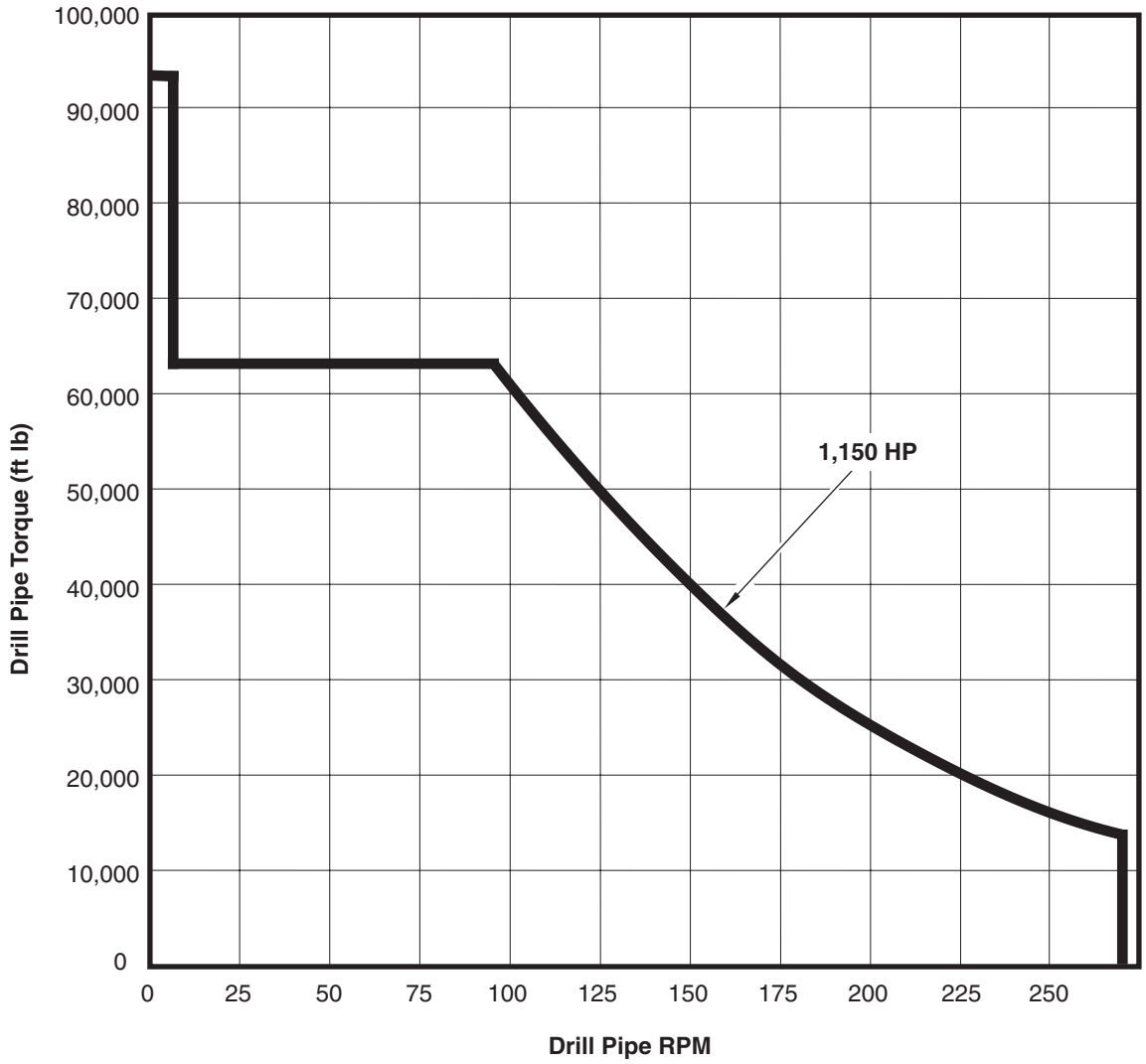
Refer to the General Arrangement engineering drawings for rig-specific information



# Performance curve

**TDS-8S Top Drive Drilling System**

GEB-20 AC Motor 1,150 HP — 8.5:1 Transmission



# Installation, Commissioning and Decommissioning

# Pre-installation checklist

The following assumes that all pre-installation planning and rig-up has been accomplished prior to installation of the TDS. This includes:

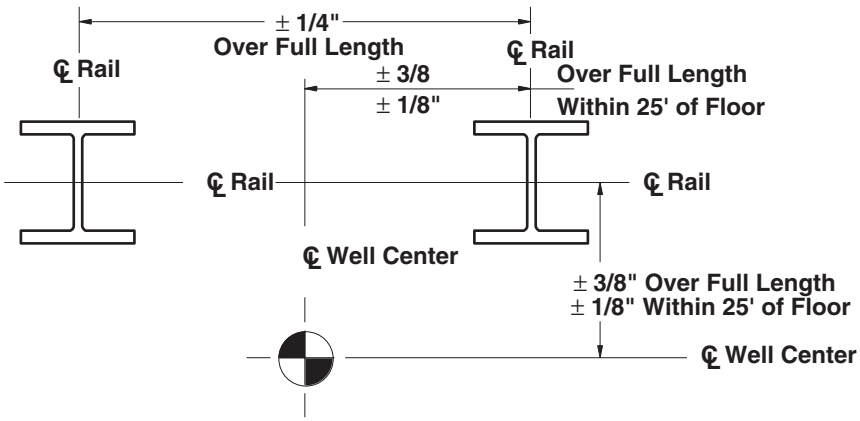
1. Guide rails and bracing are installed and inspected to conform to Varco specification and installation tolerances.
2. Stops are ready for installation.
3. Hydraulic standpipes are installed in the derrick, flushed clean and pressure tested.
4. All electronics are installed up to the derrick junction box.
5. Rigging of the tong lines, etc. are inspected to ensure that they will not foul with the TDS and other rig equipment.

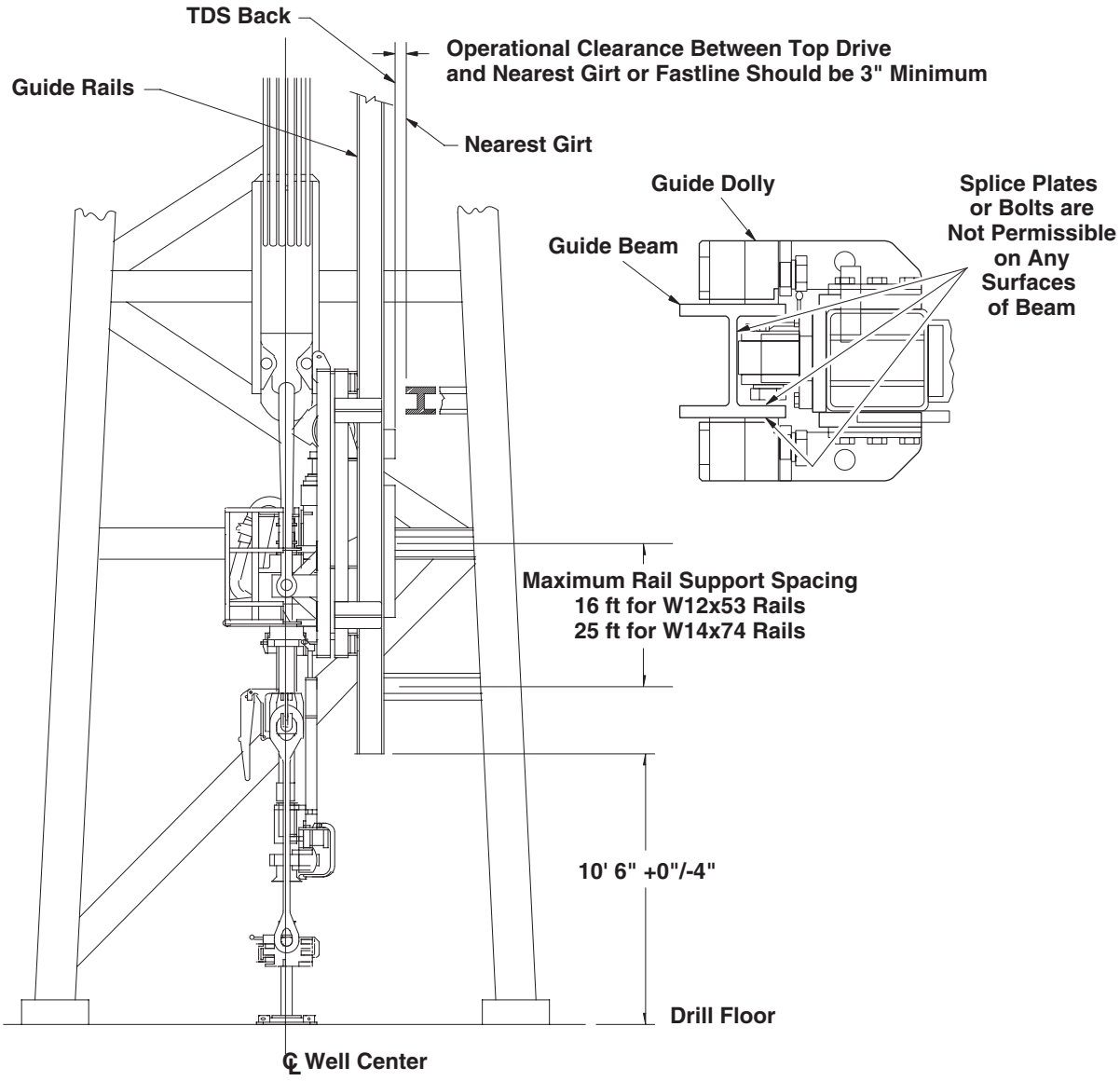
# Installing the derrick electrical termination kit

Refer to the illustrations on the following pages for typical mounting dimensions of the plate assembly and a typical cabling diagram. Mount it at racking board height within 15 feet of the service loop support bracket. Remember to provide convenient access for wiring and maintenance.

Usually, mounting the plate so that the J-box is four to five feet above the walk-around and near the service loop support bracket is adequate. If a walk-around does not exist, then construct a work platform to allow access to the J-boxes. Manufacture appropriate brackets and clamps to attach the plate to the derrick structure.

# General rail installation data

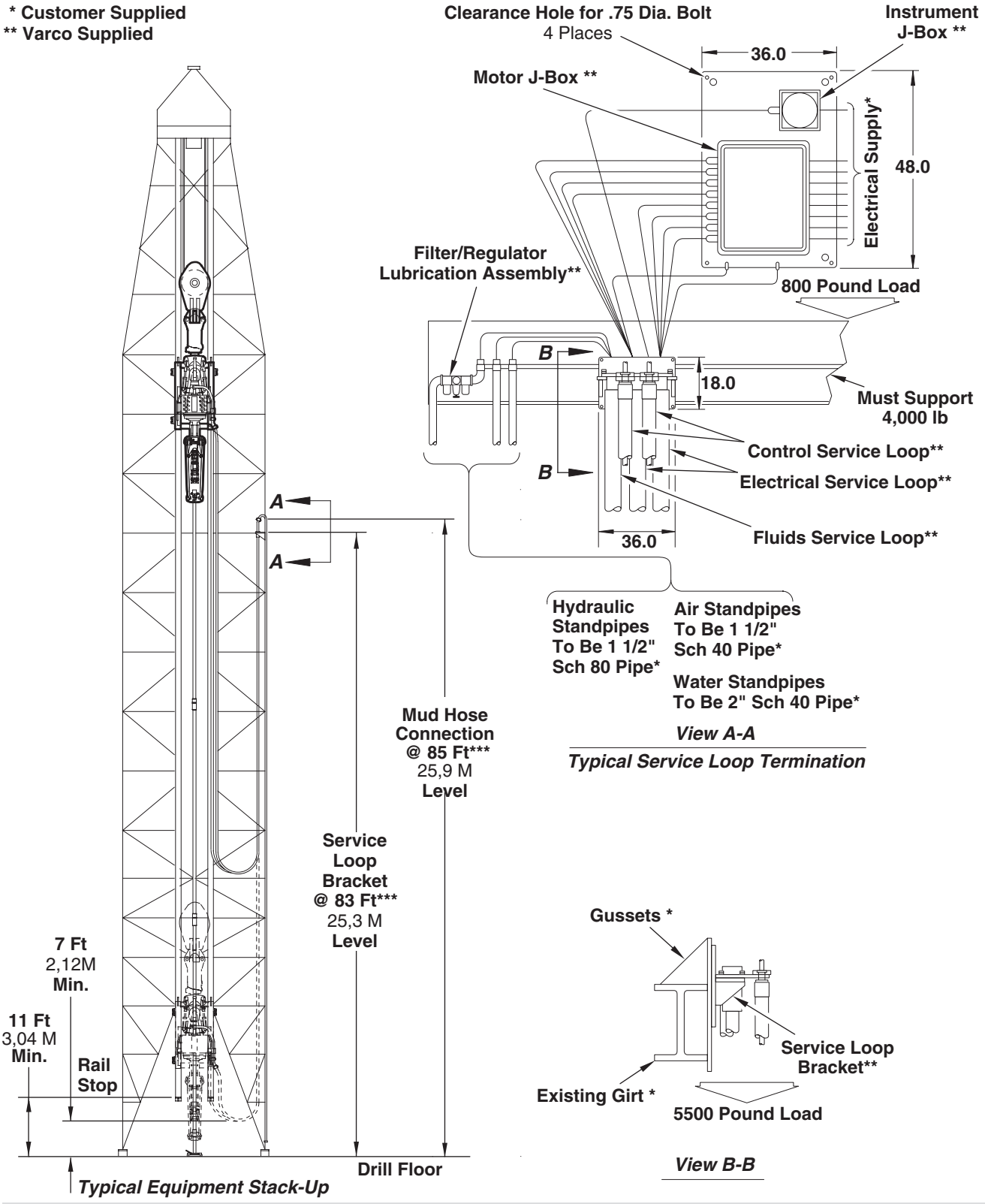


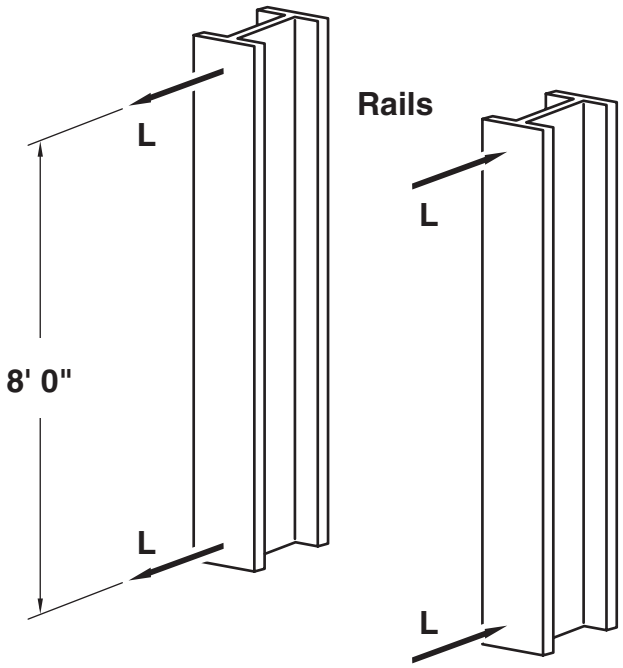
# Derrick services/general installation data

Refer to the General Arrangement engineering drawing for details.





# General installation data




**Rail Loading while Drilling: 62,250 ft lb for TDS-8S**

| Rail Spacing | Load L - lb |
|---|---|
| 39 x 66 | 5450 |
| 48 x 62 | 5800 |
| 30 x 72 | 5000 |
| 91 x 108 | 3330 |
| 101 x 108 | 3330 |

# Installing plumbing for the top drive

The plumbing connections should terminate near the service loop bracket. The mating halves are pre-assembled on the service loop.

## Hydraulic

Hydraulic lines should be cleaned and pickled, black pipe lines (one pressure and one return) 1 1/2 or 2 in. schedule 80 pipe. Install shutoff valves at the drill floor or racking board level. The derrick connections are reduced to 1 in. NPT female pressure and fluid return for connection to the service loop.

# Rig-up procedure

Refer to the engineering drawings to install the top drive.

1. Using four lift slings from the crane, one attached at each corner of the guide dolly, lift the TDS motor and dolly assembly to the V-door.

2. Attach the lifting slings from the hook or block to the motor support bonnet and lift the TDS into the guide rails. The slings must be a minimum of 15 feet long (equal length) and capable of lifting 40,000 lb each. (BOP stack lift slings are usually adequate.)



On some configurations it may be necessary to remove the upper roller brackets from the dolly to allow the unit to engage the guide rails.

3. Once the TDS is fully engaged on the guide rails, install the stop in the guide rails and lower the TDS onto the stops.

4. Use the pipehandler to tighten the connection between the lower IBOP/saver sub assembly to the upper IBOP.

5. Install the elevator links and drill pipe elevator. Attach the link tilt clamps to the links (U-bolts on the inside).

6. Attach the service loops to the bracket on the TDS dolly frame.

   Use the electrical schematic (refer to the engineering drawings) to make the connections. Be certain that the cables are securely tied or clamped to the structure along their length. Route the hoses to the bulkhead and plug in the quick disconnects. Follow the stamped code numbers to confirm each type, and identify spares.

7. Attach the S-tube to the swivel gooseneck and the side of the motor frame as follows (if applicable):
   a. Make up the upper union just before clamping the S-tube to the side of the motor frame, if applicable.
   b. Install the drill pipe rubber onto the S-tube aligned with the mounting saddle on the frame (if applicable).
   c. Attach the mud hose to the bottom connection of the S-tube.

## Rig-up procedure

8. Remove the exhaust duct shipping cover from the air exhaust duct on the top drive. Save the covers for use during future shipping or storage.

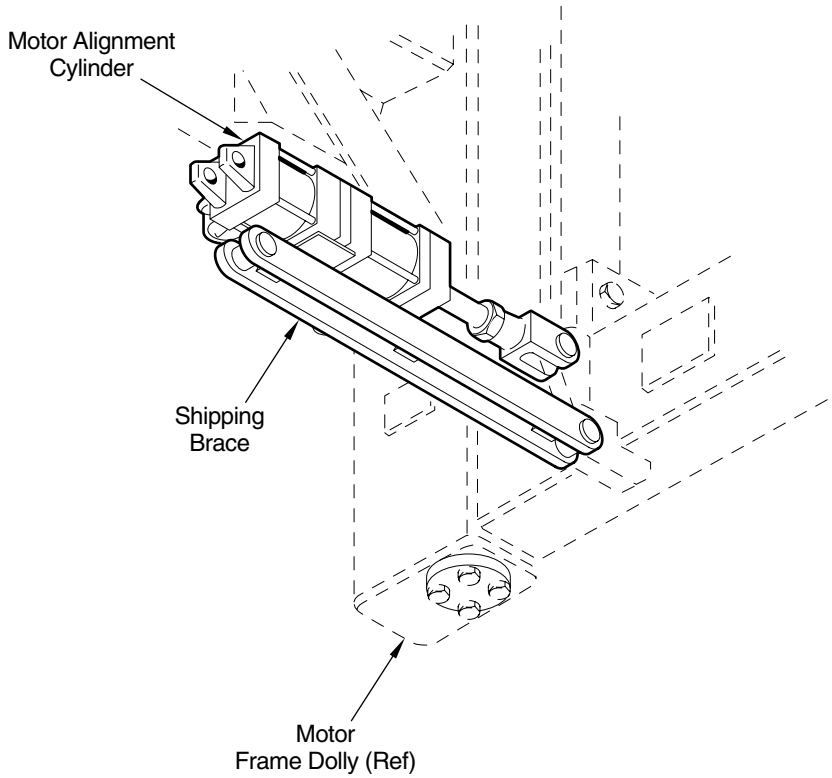
***Never operate the top drive with the exhaust duct covers attached to the air exhaust ducts. Doing so severely restricts air flow through the motor, causing overheating and potential damage. They can also fall off during operation and injure personnel working below. Attach the covers only during shipping and storage.***

# Motor alignment cylinder system

The shipping brace, shown exploded from the cylinder rod, is only removed after unit is fully installed. If the brace is removed before the hydraulic system is powered, the motor tends to rotate on its trunnions.

If the cylinder is removed for service, use the three bleed holes (located along the top of the cylinder barrel) to remove trapped air from the cylinder before operating the unit. Refer to the *Maintenance and Troubleshooting* book for the adjustment procedure, as this dimension can vary.





# Installing the driller's controls and instrumentation

The following sections describe the controls and instrumentation necessary to operate the TDS system.

## Driller's console

Mount the driller's console within easy reach and in plain view of the driller while he is operating the drawworks brake and clutches. The gauges must be easily seen by the driller during drilling operations. Appropriate cable glands are provided for the electric cables.



## Throttle and torque limit controls

The throttle and torque limit controls are the standard controls used for the independent rotary drive table.

## Wiring

Refer to the electrical schematics in the engineering drawings.

***Customers who choose to use control systems not manufactured by Varco should be aware that Varco systems are specifically designed with operational interlocks and safety devices to prevent possible injury to personnel or damage to the system. Other systems must meet Varco requirements. Varco highly recommends the use of its system as it is specifically made for use with the TDS system.***

# Installing the service loops

Install the service loops as follows:

1. Fabricate the appropriate brackets and clamps to attach the service loop mounting bracket to the derrick structure.
2. Place the service loop derrick mounting bracket at the height specified on the derrick interface or general arrangement drawing provided with the engineering drawings. The bracket must be located far enough from the corner to insure the loops do not catch under the guide rails during operations, but far enough back to provide clearance for tong lines, the stabbing board, tugger lines, etc.
3. Do not unpack the service loops from the protective shipping tub until ready to hang them in the derrick. Lift the service loops onto the rig floor (still in the crates) and then remove them from the crates *with the lifting eyes provided*.



***Use care in lifting gear rigging so as not to damage electrical conductors. Use lifting eyes only. Do not bend the service loops tighter than a three foot bend radius. Tighter bends damage the loops.***

4. Attach a sling to the top drive end of the service loop and lift *using the lifting eyes only.* Allow enough room for the 86 ft. service loop to hang and untwist.
5. Attach the derrick end of the service loop to the tugger line. Hoist this end of the loop into the derrick while slacking off at the other end. *Do not drag the loop on any sharp areas on the derrick.* Disconnect the crane from the sling and continue hoisting the loop into the derrick.
6. Check that the derrick end of the loop is hanging toward the crown. Attach the derrick end to the derrick service loop bracket and hold in place with flange clamps.
7. Pick up the TDS end of the loops and attach them to the service loop bracket on the motor frame.
8. Complete the terminations of the loops as outlined in the following sections.

# Installing the service loops

## Electrical loop

1. Terminate and connect the wire ends at the motor J-boxes using the appropriate glands. Refer to the electrical schematic provided to ensure proper terminal block assignments.

2 Cut wires and cables to length and terminate them at the derrick end to attach them to the derrick J-boxes.

Terminal ends and lugs are supplied, but proper assembly equipment (crimping pliers, wire strippers, and hydraulic crimper for the power lugs with the correct dies for the cable) must be provided by the installer. Installation practices should comply with applicable electrical codes (i.e., NEC, etc.).



## Fluids loop

1. Before connecting the hoses from the service loop, be certain that the service stand pipes have been flushed free of any contamination.

***Use only 10 wt. hydraulic oil or non-detergent motor oil as a lubricant in the air system. Use of any other type of oil (i.e., Marvel Mystery Oil, etc.) or synthetic additive will cause the seals in the air valves to swell and cease to function.***

2. Plug the quick disconnects into the appropriate mating end on the TDS. The quick disconnects are arranged to connect only one way so that the hoses cannot be mixed up. The hydraulic and air lines are identification stamped at both ends so they can be verified and connected properly.

   An assortment of pipe fittings are supplied with the termination kit to attach the fluid service loop hoses to the top of the standpipes in the derrick.

3. Connect the service loop to the standpipes, noting the codes (i.e., H for hydraulic, etc.) to separate the hoses.

The hoses in the fluid loop may not extend far enough from the mounting bracket. It may be necessary to make jumper hoses to reach the standpipes.

# Commissioning

## Commissioning checkout procedures

1. Turn on the hydraulic and air power and check for leaks. Repair as required.
2. Turn on the electric power (driller's controls only).
3. Check the function of switches and solenoids. There is an audible click when each solenoid is actuated.
4. Actuate the link tilt. Be sure that it operates smoothly and the elevator reaches a joint in the mousehole, if applicable.
5. Adjust the link tilt so that the elevator clears the monkey board when actuated. Refer to the *Maintenance and Troubleshooting* book if a problem occurs.
6. Actuate the motor brake.
7. Torque the connection between the upper and lower safety valves.
8. Push and hold the control button on the driller's console a sufficient number of times to make up the connection.
9. Make up the lower IBOP to the saver sub.
10. Reset pressure to the appropriate setting for drill pipe connections.
11. Actuate the safety valve. Verify that the stroke adjustment is correct and that no binding occurs.

***It is extremely important to verify that the stroke adjustment is correct and that no binding occurs as the valve will fail prematurely (wash out) if it does not open and close fully.***

12. Verify that the indicator light on the driller's console lights up when the safety valve is closed.
13. Assign the TDS at the driller's console and check that the cooling system operates.
14. Advance the throttle and be sure that the motor is operating properly in both directions.
15. Check the torque gauge and RPM meter calibration.
16. With the hydraulic power unit off, bleed down the TDS accumulators (HYD SIDE, not gas side).

17. Remove the split shipping brace from the motor alignment cylinder.

18. Open the two flow control valves 1-1/2 turns off their seats.

19. Set a joint of drill pipe in the slips.

20. Bring the TDS down as if stabbing the saver sub into the box. The pin and box should be in alignment. If adjustment is necessary, use the following procedure:

    a. Measure how far and in what direction (toward or away from the rails) the pin must move to line up with the drill pipe box.

    b. Turn off the hydraulic power unit and bleed down the cylinder accumulator (open the needle valve on the back of the manifold). This allows the motor alignment cylinder to relax and the motor to rotate on its trunnions until the integrated swivel bail contacts the motor support bonnet.

    c. Loosen the lock tab and jam nut on the cylinder clevis.

    d. With a wrench tightened on the cylinder rod flats, screw the rod into or out of the clevis, in the same direction the saver sub pin is to be moved.

    e. Secure the jam nut and lock tab.

    f. The nominal position of the two cylinder flow control valves is 1-1/2 turn off their seats. If you experience heavy drill pipe vibration, first attempt to control it with non-rotating stabilizers if the casing shoe is close to the surface. If motor movement becomes excessive due to continued vibration, (more than 1/2 in. of total cylinder stroke) close the flow controls to 3/4 turn off their seats.

# Operating the PH-100 pipehandler

## Rotating link adapter

The rotating link adapter supports the weight of the drill string through a set of links that hang from the adapter. The positioning gear is an integral part of the rotating link adapter. The positioning gear, meshed with a hydraulic motor driven pinion gear, rotates the pipehandler. The rotating link adapter also functions as a hydraulic slip ring providing all the necessary hydraulic passages between the stationary load stem and the rotating link adapter.

## Torque backup clamp cylinder



The pipehandler clamp cylinder has two jaw assemblies that clamp on the box section of a tool joint when the shot pin is fully engaged in the rotating link adapter positioning gear. Pushing the torque wrench clamp switch rotates the link adapter slowly until the shot pin engages. With the shot pin fully engaged, the torque backup clamp jaws clamp onto the tool joint. With the tool joint held in place by the clamp cylinder, the AC drilling motors make or break connections.

***Failing to apply the correct amount of torque when using the top drive to makeup connections can result in equipment damage and injury to rig personnel.***

***Stop and verify correct operation whenever the operator observes unsteady or inconsistent hydraulic pressure readings, or finds it difficult to adjust set points.***

A spring assembly hanging from a wire cable supports the torque backup clamp cylinder. The wire cable runs over a pulley, mounted at the top of the torque arrestor, and down to the hydraulic cylinder. Actuation of the hydraulic cylinder raises and lowers the torque backup clamp cylinder. Shifting the valve handle up raises the torque backup clamp cylinder, and shifting it down lowers the torque backup clamp cylinder.

Raising the torque backup clamp cylinder is powered by tapping hydraulic pressure from the return side of the torque backup clamp cylinder. Lowering takes place due to gravity when the fluid passages in the lift cylinder are directed to the tank. Therefore, lowering is somewhat slower than raising.

When any valve connection is broken out and separated (i.e., with the torque backup clamp cylinder jaws clamped), the torque backup clamp cylinder, holding on to the valve, moves into a floating position and, due to gravity, sinks until the spring assembly bottoms out on the spring retainer plate.

# Operating the PH-100 pipehandler

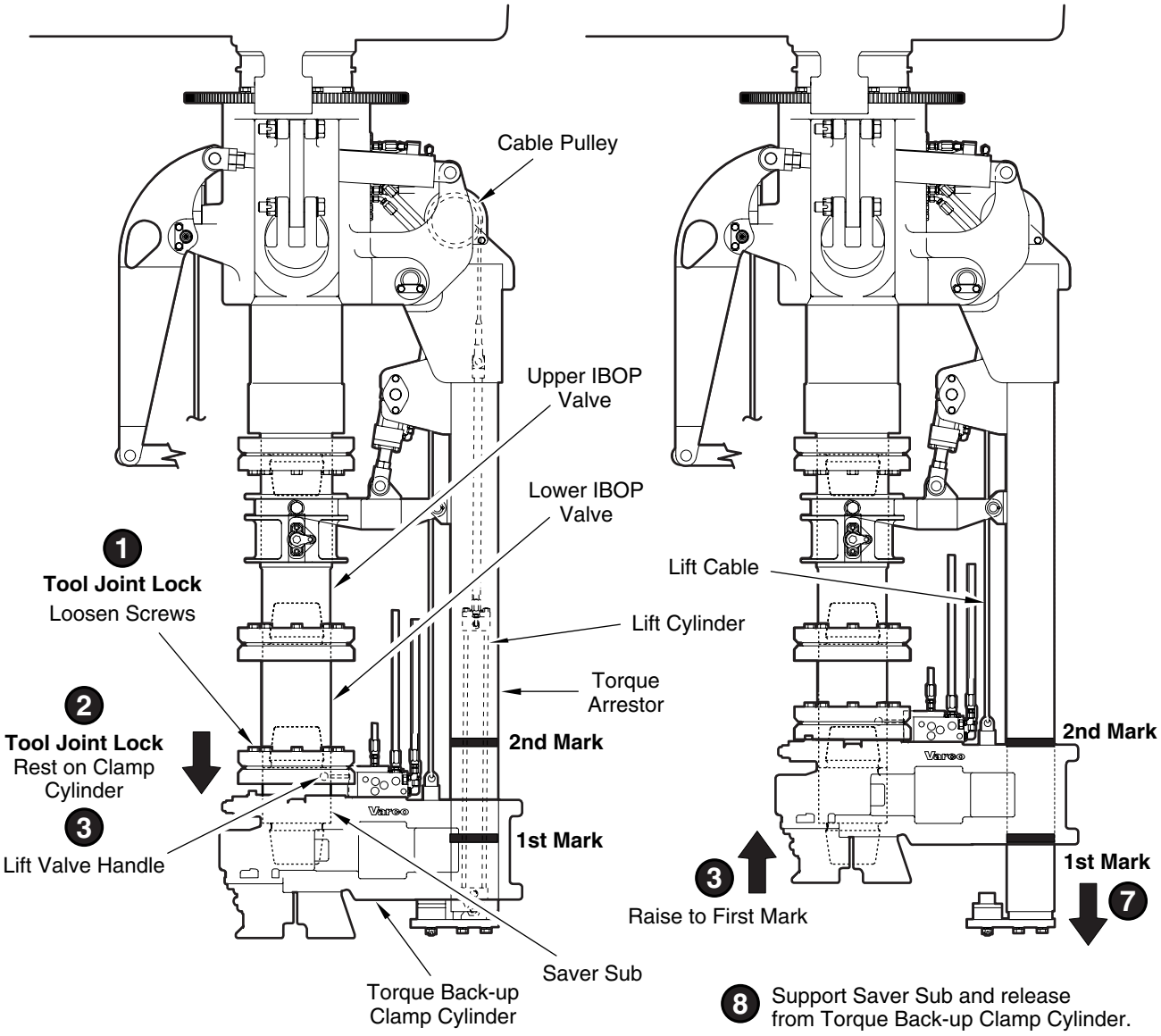
During normal operation, the torque backup clamp cylinder is sitting on the spring, which is supported by the spring retainer plate of the torque arrestor and lined up with the box end of the tool joint.

## Breaking out the saver sub

1. Loosen the tool joint lock between the saver sub and the lower IBOP valve by unscrewing the eight bolts.
2. Slide the tool joint lock down until it rests on the torque backup clamp cylinder body.
3. Raise the torque backup clamp cylinder by pushing the valve handle up and holding until the torque backup clamp cylinder lines up with the first mark on the torque arrestor and the jaws are lined up with the saver sub.
4. Select TORQUE mode on the VDC.
5. Pressurize the torque backup clamp cylinder to clamp on the saver sub by pressing and holding the TORQUE WRENCH PRESS AND HOLD button on the VDC. (The lift cylinder moves into a floating position.)
6. Switch the drilling motor to REVERSE on the VDC to breakout the connection.
7. Once the connection is broken, switch to SPIN on the VDC and allow the motor to spin until the saver sub and lower IBOP valve separate. (The torque backup clamp cylinder with the broken out saver sub gradually sinks all the way down because of gravity.)
8. Unclamp the saver sub by releasing the TORQUE WRENCH PRESS AND HOLD button on the VDC.

***Stand clear. The saver sub must be supported before unclamping it. It will fall through the bottom of the stabbing guide if not supported.***

# Operating the PH-100 pipehandler




**At VDC:**

4. Select **TORQUE** mode.
5. **TORQUE WRENCH** PRESS AND HOLD.
6. Drilling Motor **REVERSE.**
7. Drilling Motor **SPIN.**

# Operating the PH-100 pipehandler

## Making up the saver sub

1. Manually screw in the replacement saver sub into the lower IBOP valve.

To manually screw in the replacement saver sub to the lower IBOP valve, raise the torque backup clamp cylinder until the lower IBOP valve is exposed below the stabbing guide (a pup joint may be used). Lower the torque backup clamp cylinder by pulling the valve handle down and holding until it lines up with the first mark on the torque arrestor.



2. Select TORQUE mode on the VDC.
3. Pressurize the torque backup clamp cylinder to clamp on the saver sub by pressing and holding the TORQUE WRENCH PRESS AND HOLD button on the VDC.
4. Switch the drilling motor to FORWARD on the VDC.
5. Select SPIN mode and rotate the drilling motor until the saver sub shoulders against the lower IBOP valve.
6. Select TORQUE mode and apply the desired torque.
7. Release the TORQUE WRENCH PRESS AND HOLD button to unclamp.
8. Lower the torque backup clamp cylinder all the way down by shifting the handle down.
9. Position the two tool joint locks correctly and follow the proper assembly procedure described in the *Tool joint locks* section.

## Breaking out the lower IBOP valve

1. Loosen the tool joint lock between the saver sub and lower IBOP valve by unscrewing the bolts.
2. Slide it down and rest it on the torque backup clamp cylinder body.
3. Raise the torque backup clamp cylinder by pushing the valve handle up and holding until the torque backup clamp cylinder lines up with the first mark on the torque arrestor.
4. Select TORQUE mode on the VDC.
5. Pressurize the torque backup clamp cylinder to clamp on the saver sub by pressing and holding the TORQUE WRENCH PRESS AND HOLD button on the VDC.

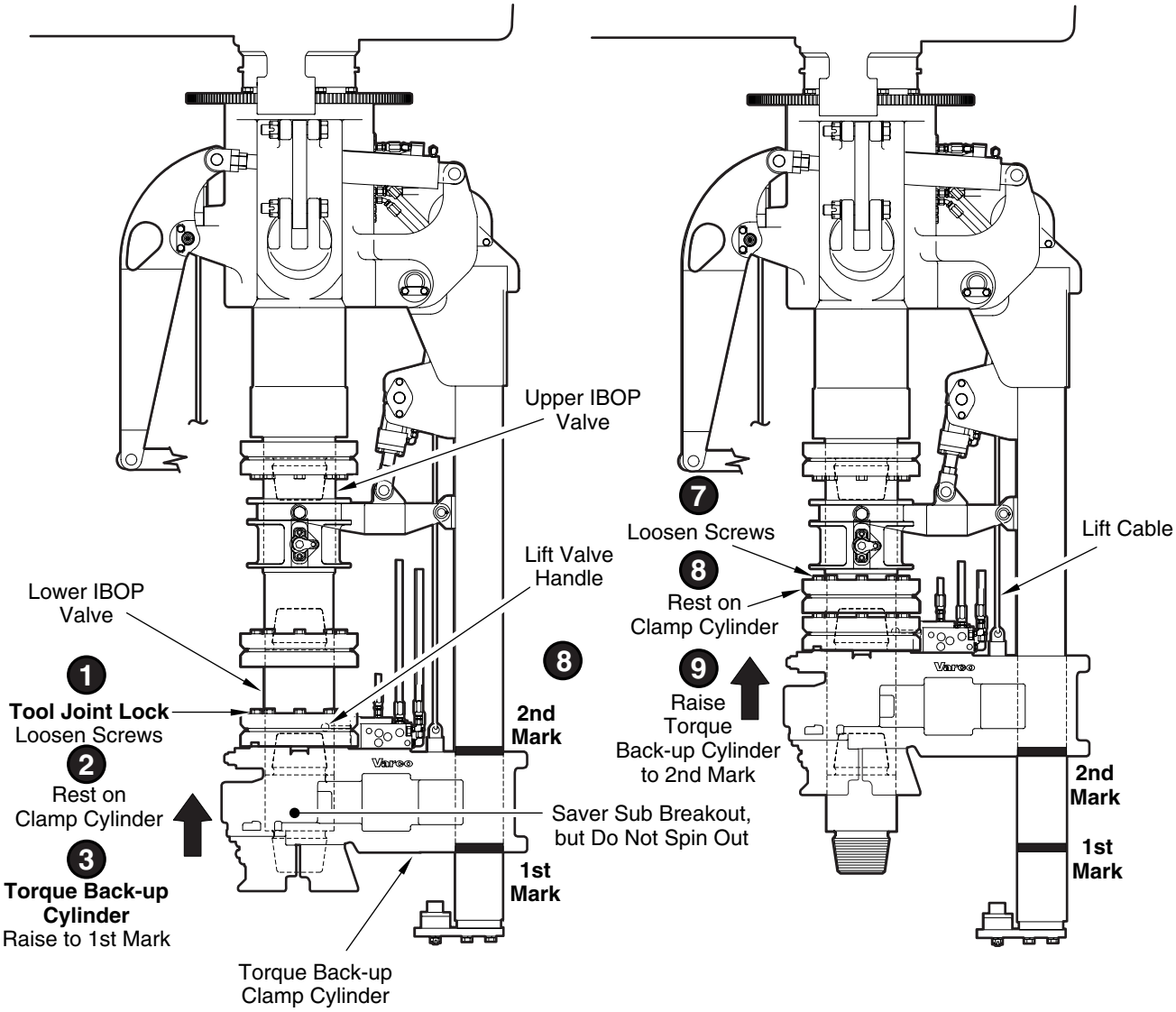
# Operating the PH-100 pipehandler

6. Switch the drilling motor to REVERSE on the VDC and apply torque to break out the connection. Make sure the saver sub is loose. Do not spin it out.
7. Loosen the tool joint lock between the lower IBOP valve and the upper IBOP valve by unscrewing the bolts.
8. Slide it down and rest it on the tool joint lock sitting on the torque backup clamp cylinder.
9. Raise the torque backup clamp cylinder by pushing the valve handle up and holding until the torque backup clamp cylinder lines up with the second mark on the torque arrestor.
10. Select TORQUE mode on the VDC.
11. Pressurize the torque backup clamp cylinder to clamp on the lower IBOP valve by pressing and holding the TORQUE WRENCH PRESS AND HOLD button on the VDC. (The lift cylinder moves into a floating position.)
12. Verify that the drilling motor is in REVERSE and apply torque to break the connection.
13. Once the connection is broken, switch to SPIN on the VDC and allow the motor to spin until the upper IBOP valve and the lower IBOP valve separate.
14. The torque backup clamp cylinder with the broken out lower IBOP valve and saver sub gradually sink because of gravity. When it is all the way down, unclamp the lower IBOP valve by releasing the TORQUE WRENCH PRESS AND HOLD button on the VDC.

***Stand clear. The lower IBOP valve and saver sub must be supported before unclamping them. They will fall through the bottom of the stabbing guide if not supported.***

# Operating the PH-100 pipehandler






**At VDC:** (Saver Stub Breakout)

4. Select **TORQUE** mode.
5. **TORQUE WRENCH** PRESS AND HOLD.
6. Drilling Motor **REVERSE.**

**At VDC:**

10. Select **TORQUE** mode.
11. **TORQUE WRENCH** PRESS AND HOLD.
12. Drilling Motor **REVERSE.**
13. Drilling Motor **SPIN.**
14. Support Sub and Valve and Release From Torque Back-up Clamp Cylinder

# Operating the PH-100 pipehandler

## Making up the lower IBOP valve

1. Screw in the replacement saver sub and the lower IBOP valve together manually and stand it under the torque backup clamp cylinder.
2. Position the torque backup clamp cylinder by stabbing over the lower IBOP valve. Make sure the lower IBOP valve comes up through both tool joint locks sitting on the torque backup clamp cylinder body.
3. Tighten four alternate screws on the top tool joint lock to secure it to the lower IBOP valve to provide a temporary shoulder to support the weight of the lower IBOP valve and the saver sub.



The clamp cylinder cannot raise if it is clamped on the saver sub or the lower IBOP.

***Make sure all four screws are tightened sufficiently so that the tool joint cannot slide through when the torque backup clamp cylinder is raised.***

4. Select SPIN and FORWARD modes on the VDC.
5. Raise the torque backup clamp cylinder with the lower IBOP valve and saver sub while rotating the drive stem to engage the threads. Once the upper IBOP valve and the lower IBOP valve start to spin together, stop the drilling motor.
6. Lower the torque backup clamp cylinder and line it up with the first mark on the torque arrestor, to line it up with the saver sub.
7. Select TORQUE mode on the VDC.
8. Pressurize the torque backup clamp cylinder to clamp on the saver sub by pressing and holding the TORQUE WRENCH PRESS AND HOLD button on the VDC.
9. Switch the drilling motor to FORWARD on the VDC.
10. Select SPIN mode and rotate the drilling motor until the saver sub shoulders against the lower IBOP.
11. Select TORQUE mode and apply desired torque and makeup both connections.
12. Release the TORQUE WRENCH PRESS AND HOLD button to unclamp.

# Operating the PH-100 pipehandler

13. Lower the torque backup clamp cylinder all the way by shifting the handle down.

14. Loosen the temporarily made up tool joint lock. Position both tool joint locks correctly and follow the proper assembly procedure described in the *Tool joint locks* section.

## Breaking out the upper IBOP valve

1. Loosen the tool joint lock between the saver sub and lower IBOP valve by unscrewing the bolts.

2. Slide it down and rest it on the torque backup clamp cylinder body.

3. Raise the torque backup clamp cylinder by pushing the valve handle up and holding until the torque backup clamp cylinder lines up with the first mark on the torque arrestor.

4. Select TORQUE mode on the VDC.

5. Pressurize the torque backup clamp cylinder to clamp on the saver sub by pressing and holding the TORQUE WRENCH PRESS AND HOLD button on the VDC.

6. Switch the drilling motor to REVERSE on the VDC and apply torque to break out the connection. Make sure the saver sub is loose. Do not spin it out.

7. Loosen the tool joint lock between the lower IBOP valve and the upper IBOP valve by unscrewing the bolts.

8. Slide it down and rest it on the tool joint lock sitting on the torque backup clamp cylinder.

9. Raise the torque backup clamp cylinder by pushing the valve handle up and holding until the torque backup clamp cylinder lines up with the second mark on the torque arrestor.

10. Select TORQUE mode on the VDC.

11. Pressurize the torque backup clamp cylinder to clamp on the lower IBOP valve by pressing and holding the TORQUE WRENCH PRESS AND HOLD button on the VDC. (The lift cylinder moves into a floating position.)

12. Verify that the drilling motor is in REVERSE and apply torque to break the connection.

# Operating the PH-100 pipehandler

13. Once the connection is broken, switch to SPIN on the VDC and allow the motor to spin until the upper IBOP valve and the lower IBOP valve separate.

14. The torque backup clamp cylinder with the broken out lower IBOP valve and saver sub gradually sink because of gravity. When it is all the way down, unclamp the lower IBOP valve by releasing the TORQUE WRENCH PRESS AND HOLD button on the VDC.

***Stand clear. The lower IBOP valve and saver sub must be supported before unclamping them. They will fall through the bottom of the stabbing guide if not supported.***



15. Remove the IBOP actuator yoke by unpinning it at three places.

16. The IBOP actuator shell stays on the upper IBOP valve assembly.

17. Loosen the top tool joint lock by unscrewing the bolts.

18. Slide the tool joint lock down and rest it on the actuator shell.

19. Raise the torque backup clamp cylinder all the way up until it stops.

20. To breakout the upper IBOP valve, pressurize the torque backup clamp cylinder to clamp on the upper IBOP valve by pressing and holding the TORQUE WRENCH PRESS AND HOLD button and switch to REVERSE on the VDC.

21. Verify that the drilling motor is in REVERSE and then apply torque to break the connection.

22. Once the connection is broken, switch to SPIN on the VDC and allow the motor to spin until the upper IBOP valve and drive stem separate. The torque backup clamp cylinder with the broken out upper IBOP valve gradually sinks all the way down because of gravity.

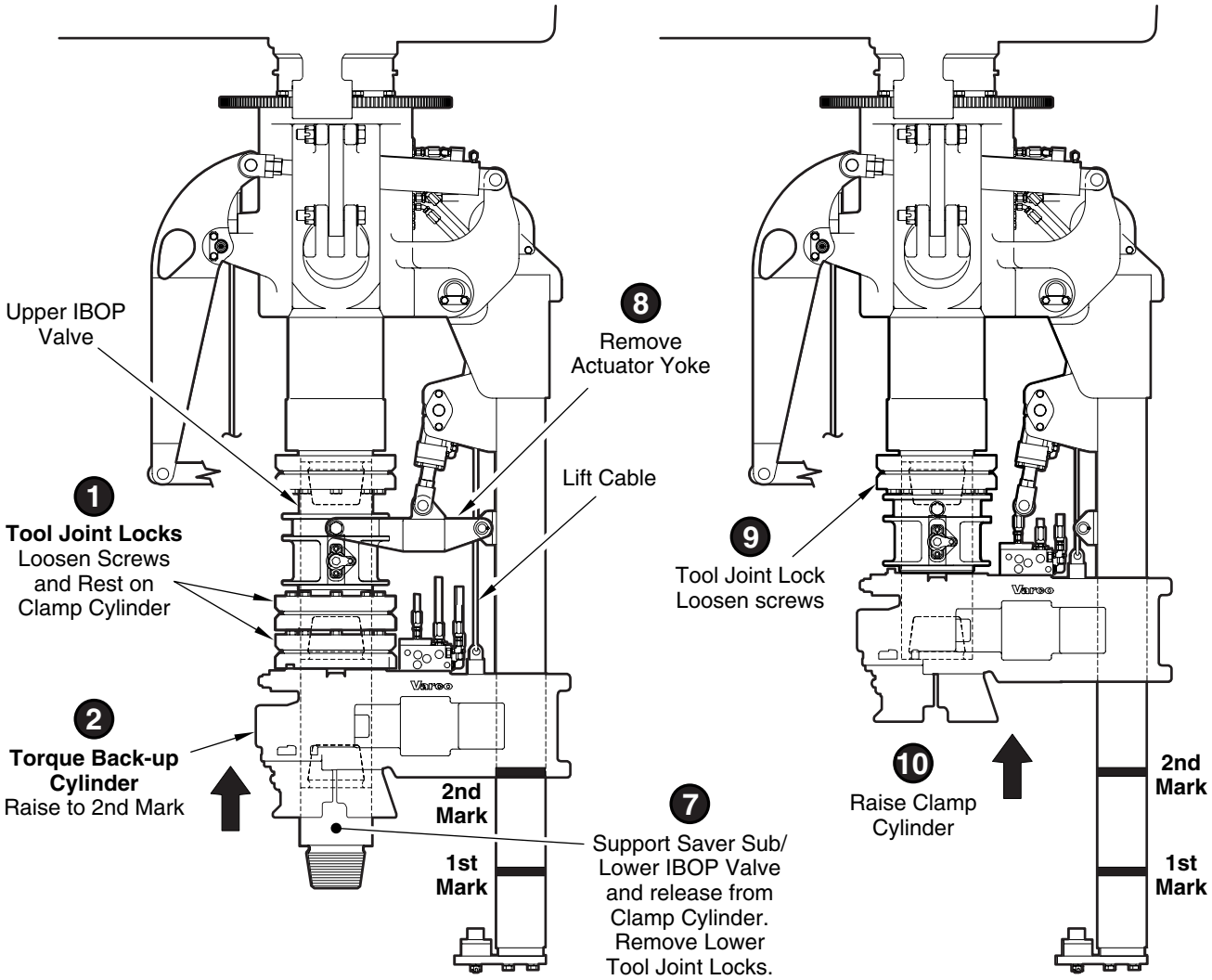
23. Unclamp the upper IBOP valve by releasing the TORQUE WRENCH PRESS AND HOLD button on the VDC.

The upper IBOP valve cannot fall through as it is supported at the shoulder by the torque backup clamp cylinder.

24. Remove the upper IBOP valve with the actuator shell by lifting it from the top.

# Operating the PH-100 pipehandler






**At VDC:**

3. Select **TORQUE** mode.
4. **TORQUE WRENCH** PRESS AND HOLD.
5. Drilling Motor **REVERSE.**
6. Drilling Motor **SPIN.**

**At VDC:**

11. Select **TORQUE** mode.
12. **TORQUE WRENCH** PRESS AND HOLD.
13. Drilling Motor **REVERSE.**
14. Drilling Motor **SPIN.**

# Operating the PH-100 pipehandler

## Breaking out the upper IBOP valve

1. Place the replacement upper IBOP valve (with actuator shell assembled) in the torque backup clamp cylinder.
2. Raise the torque backup clamp cylinder until it picks up the upper IBOP valve with its shoulder. This sets it at the correct elevation.
3. Place the tool joint lock over the upper IBOP valve and let it rest on the actuator shell.
4. Switch the drilling motor to FORWARD on the VDC.
5. Select SPIN mode and rotate the drilling motor until the IBOP shoulders against the drive stem.
6. Raise the torque backup clamp cylinder with the upper IBOP valve while rotating the drive stem clockwise to engage the threads.
7. Once the drive stem and upper IBOP valve shoulder together, stop the motor, and press and hold the TORQUE WRENCH PRESS AND HOLD button to tighten the connection to the desired torque.
8. Release the TORQUE WRENCH PRESS AND HOLD button to unclamp.
9. Lower the torque backup clamp cylinder until it lines up with the first mark. (Now the torque backup clamp cylinder is lined up with the saver sub.)
10. Select TORQUE mode on the VDC.
11. Pressurize the torque backup clamp cylinder to clamp on the saver sub by pressing and holding the TORQUE WRENCH PRESS AND HOLD button on the VDC and apply desired torque to makeup all three connections.
12. Place the three tool joint locks at their respective joints. Install the three tool joint locks by using the proper assembly procedure described in the *Tool joint locks* section.
13. Install the IBOP actuator yoke and secure it.

# Operating the PH-100 pipehandler

## Link tilt

Turning the link tilt switch on the VDC to the right extends the drill pipe elevator to the derrickman position.

The latch on the cylinder assembly limits the elevator travel to the derrickman position. Pulling the latch cable releases the latch, allowing the elevator to travel to the mousehole position.

Turning the link tilt switch to the left retracts the drill pipe elevator to the drill down position.

Pushing the link tilt float button allows the elevator to return to well center.

Elevator travel is adjustable to the derrickman and mousehole positions.

To adjust the derrickman position, adjust the shims and/or flip stop as required at the end of the cylinders.

## IBOP safety valves

Turning the IBOP switch on the VDC to the CLOSE position moves the yoke and the actuator shell body upward. This upward movement rotates the crank assemblies 90°, closing the IBOP ball valve.

Turning the switch to the OPEN position pushes the IBOP actuator shell downward, opening the IBOP. Full hydraulic pressure is applied to fully open the valve, then a hydraulic timing circuit reduces the pressure maintaining the shell position.

***If the upper IBOP loses hydraulic pressure for any reason, the valve gradually opens.***

# Torque values for load carrying components

Proper makeup torque is critical to the function of drill stem components. Table 1 only includes components within the TDS. Refer to the API charts for other components.

***Table 1. Torque values for load carrying components***

| Components | ID | Connection | OD | Min. torque | Max. torque |
|---|---|---|---|---|---|
| Upper safety valve to main stem/main shaft | 3 in. | 7 5/8 in. API Reg. | 9 in. | 60,000 ft lb | 91,000 ft lb |
| Lower safety valve to upper safety valve | 3 in. | 7 5/8 in. API Reg. | 9 in. | 60,000 ft lb | 84,000 ft lb |
| Saver sub to lower upper safety valve | 3 in. | 7 5/8 in. API Reg. | 7 5/8 in. | 60,000 ft lb | 85,000 ft lb |
| Crossover sub to lower safety valve | 3 in. | 7 5/8 in. API Reg. | 9 in. | 60,000 ft lb | 91,000 ft lb |

# Operating the PH-100 pipehandler

## Well control procedures

The TDS can stab into the drill string in any position in the derrick.

While drilling, the remotely controlled upper IBOP valve is always in the string for immediate use.

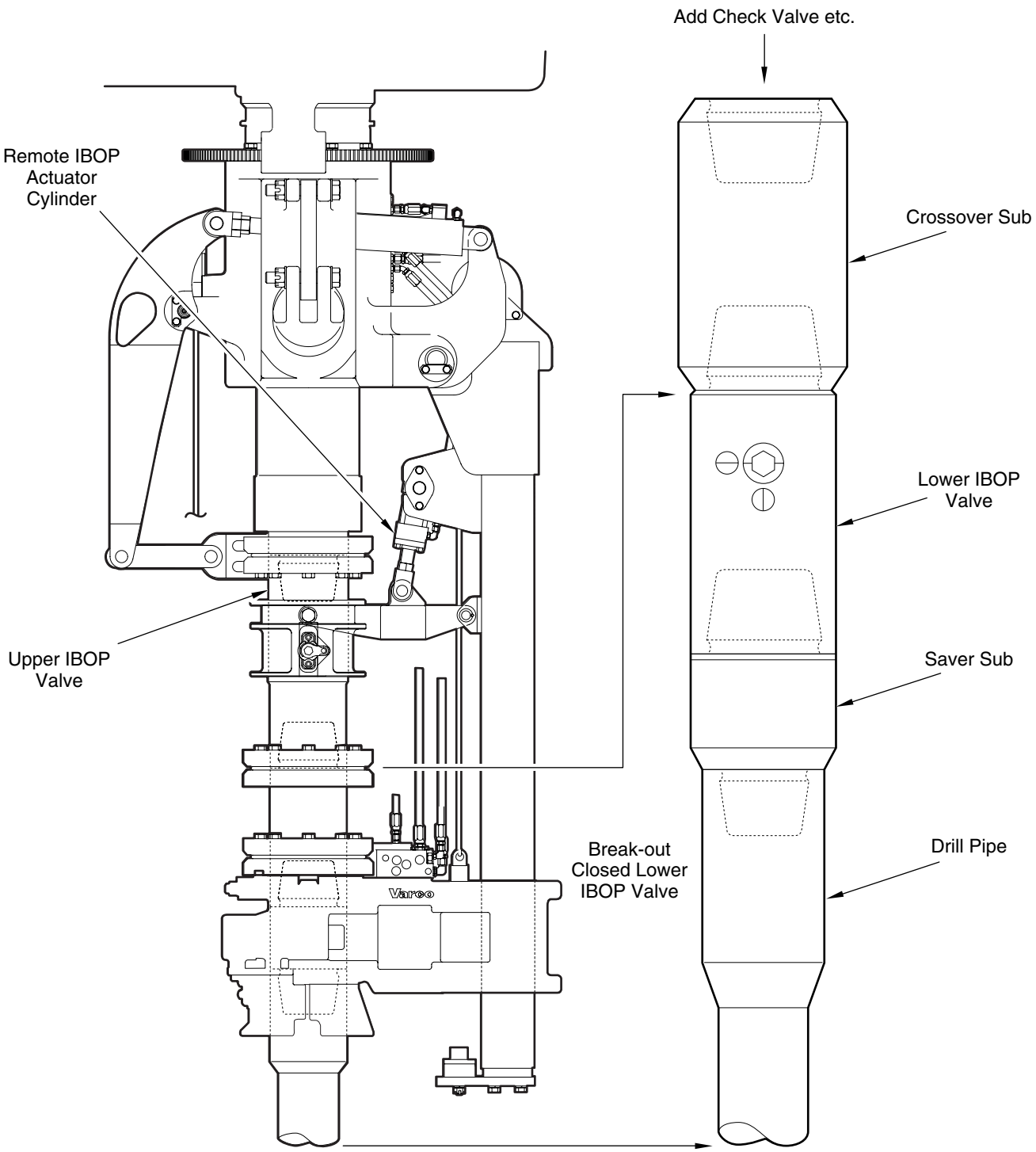
Use the following well control procedure in conjunction with standard IBOP well control procedures:

1. On indication of a kick, set the slips at the nearest connection and stab the top drive into the drill string.
2. After setting the torque backup clamp cylinder, spin in and torque the connection using the SPIN/TORQUE control on the VDC.
3. Remotely close the upper IBOP valve. (Operation of the IBOP valves is the same as any standard valve.)

A 7/8 in. hex wrench is included with the system to operate the upper IBOP valve if the remote actuator fails.

4. Lower the string to the floor and reset the slips.
5. Manually close the lower IBOP valve.
6. Remove the two lower tool joint locks (see the *Tool joint locks* section).
7. Breakout the lower IBOP valve from the upper IBOP valve (see the *Lower IBOP valve breakout/makeup procedure* section).
8. Engage the drive motors in reverse to spin out the connection.
9. Install the appropriate crossover sub, check valve, or circulation sub on top of the lower IBOP valve.

# Operating the PH-100 pipehandler



# Operating the PH-100 pipehandler

## Running casing

Use longer elevator links (180") to allow clearance for cementing head under the backup clamp in the pipehandler.

Attach a short piece of hose to the saver sub in the pipehandler to fill the casing while lowering. Use the remotely controlled upper IBOP valve to start and stop the fluid flow.

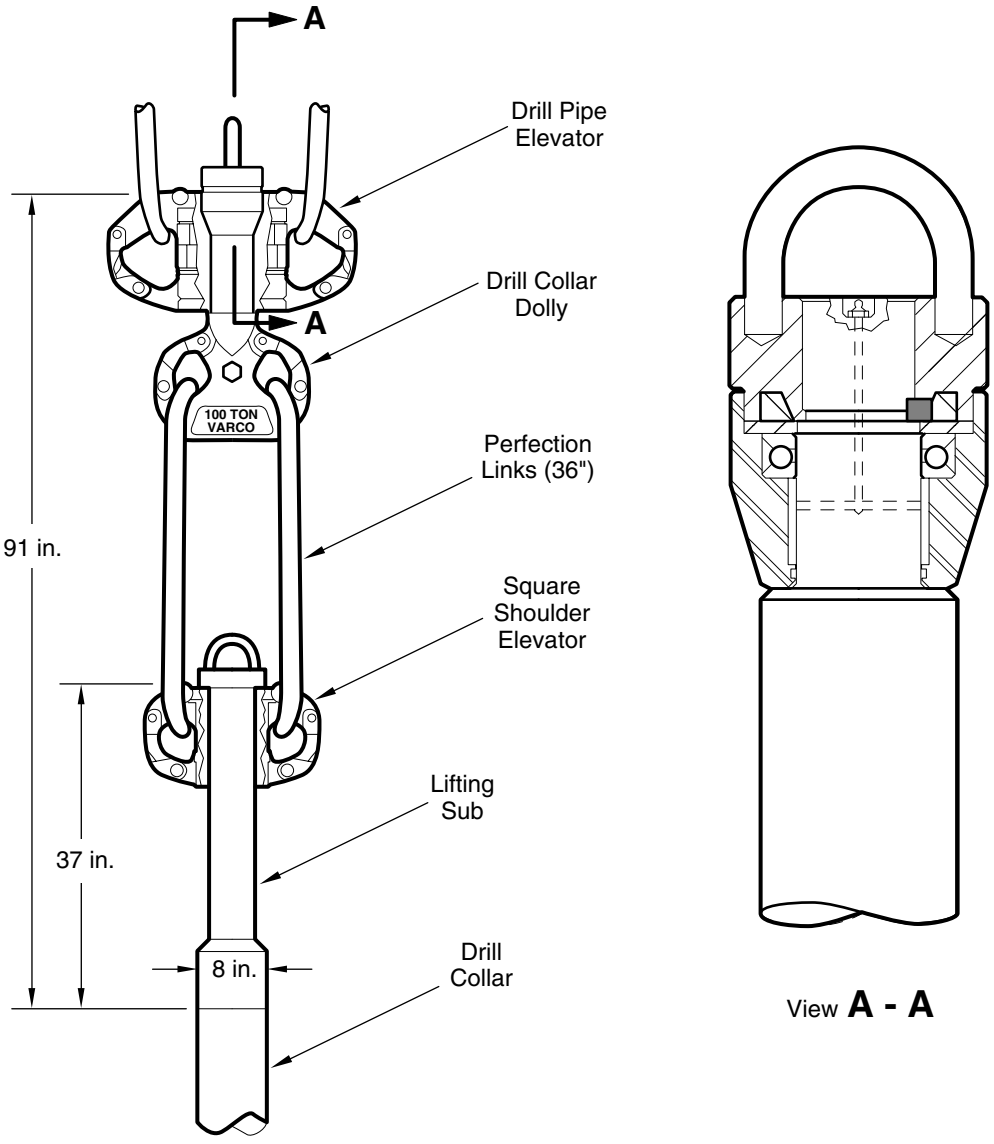
If desired, run casing conventionally using the block and hook and swinging the TDS aside. Use longer bails (180") to prevent the block dolly (if used) from contacting the TDS dolly.

# Operating the PH-100 pipehandler

## Handling bottom hole assemblies

For handling bottom hole assemblies, use the swiveling drill collar dolly to allow the elevators to turn freely. The drill collar dolly's upset, which latches in the standard drill pipe elevator, is mounted on a bearing allowing it to swivel even while it is under load. A shoulder elevator is suspended from the perfection links (or a second drill pipe elevator if lifting subs are used.) The collars can be walked in or out with the elevator turning on the drill collar dolly.





# Post jarring operations

***Jarring occurs on all drilling rigs. It is not practical to recommend removing the top drive from the drill string during all jarring operations. But the possibility of damage to a top drive during a jarring operation is considerable. Consider removing the top drive from the drill string before performing prolonged jarring. It is imperative to exercise caution when using a top drive after a jarring operation.***

***Safe operation of the top drive is the responsibility of the user and rig crew. Use the Post Jarring Checklist and Design Specification DS00008 (Design Torque Standards) to help ensure safe top drive operation. Note that the checklist includes recommended procedures. Do not limit inspections to items on the checklist.***

***The checklist draws attention to specific parts on major subassemblies. Inspection should be rigorous, looking for any wear that could cause a safety or operational risk.***

***Use the checklist and Design Torque Standard (DS00008), after performing any jarring operation while the top drive is in the drill string.***

# Decommissioning

## Long term TDS storage procedures

1. Palletize the main unit for indoor storage. A cargo container is appropriate for indoor/outdoor storage.

2. Avoid wide variations in temperature and high humidity. The preferred environment is clean and dry at 60°F ambient. If high humidity is unavoidable, 70°F is recommended.

3. All exposed unpainted metal surfaces are coated with a rust preventive at the factory prior to shipment, however, check these surfaces periodically to be sure that no corrosion is taking place. The recommended rust preventive (slushing compound) for bare metal surfaces is Kendall Grade 5
(GE-D6C6A1) or equivalent.

4. Cover all openings to prevent water or dust from entering. Leave enough space around the drilling motor to allow the machine to breathe. Do not use silica gel or a dehydrating agent.

5. During storage, lubricant drains from the top half of the roller bearings in the motor, allowing corrosion to take place on the exposed areas. In order to counteract this, run the oil pump, i.e., rotate the motor and gear train, periodically to distribute lubricant over the top of the bearings. Perform this at three month intervals if stored indoors, and at one month intervals if stored outdoors.

6. The drilling motor is equipped with AC space heaters or provisions to excite the stator coil in order to keep the internal motor temperature above ambient, preventing condensation. Connect power to the space heaters as indicated (see electrical schematic in the back of this section for proper voltage). Be sure to reseal the protective covering after connection.

7. Megger the drilling motor when placed into storage and at three month intervals thereafter (one month if stored outside). Keep a record of the readings, as a drop between readings indicates an increase in moisture in the windings created by inadequate storage protection. If megger readings drop, bake the motor as soon as possible to restore proper resistance and avoid further damage.

8. Varco recommends adding one gallon of Mobilarma 524 Rust Preventive to the transmission case prior to shutdown. Or drain the oil and mix with a rust preventive, then replace the oil, run the oil pump and rotate motor to insure 100% coverage.

# Returning the TDS to service after storage

Before placing the TDS back into service, verify the following items:

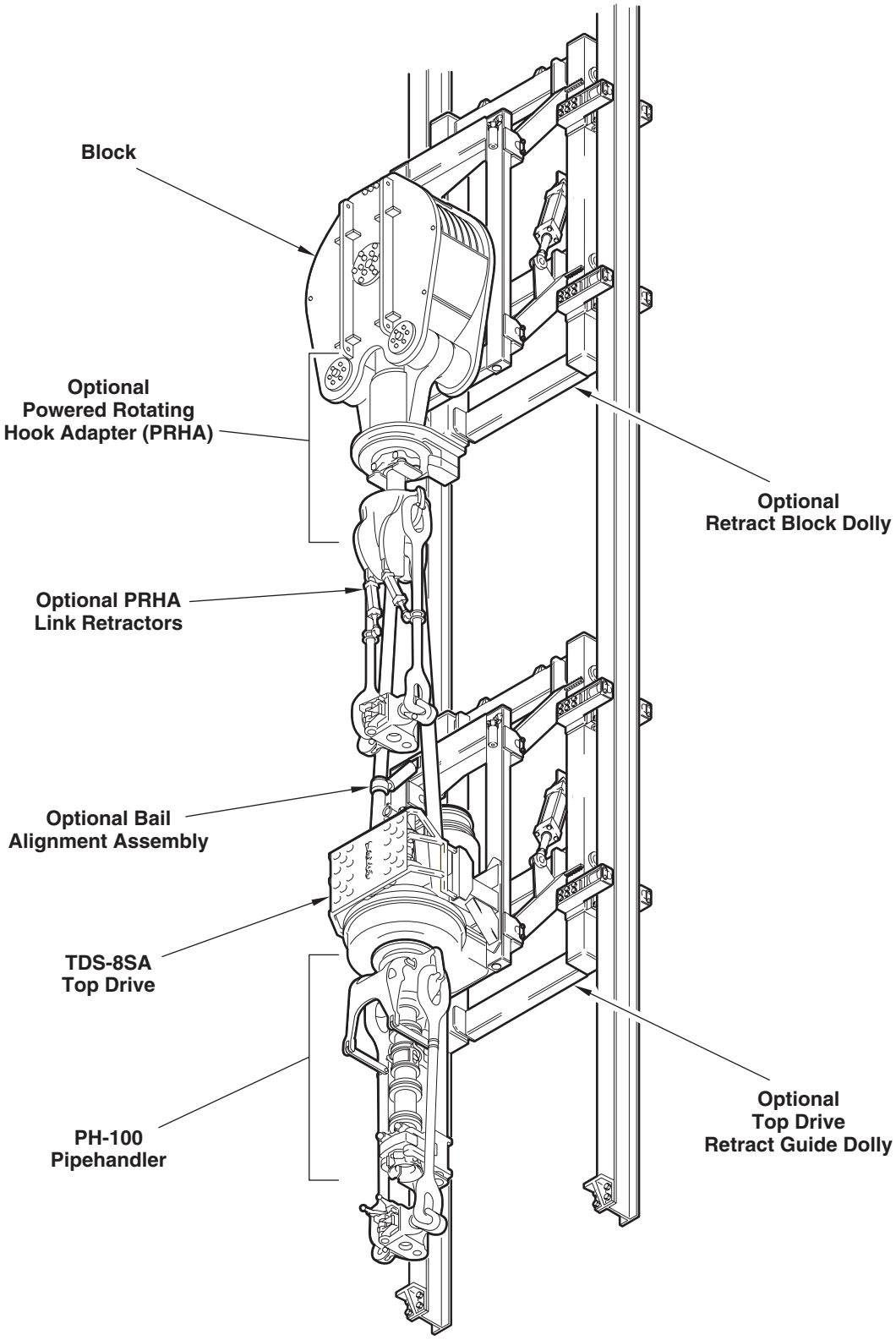
1. Remove all rust preventive and any corrosion that may have taken place, taking special care with all load carrying components.
2. Follow the procedure in the drilling motor service manual included in this manual. To verify the condition of the motor, take note of the following:
   a. Blow out all dust and dirt that may have accumulated in the windings with clean, dry air.
   b. Check the winding insulation continuity to ground with a 1,000 volt megger. If the reading is less than two MOhms, bake the winding until the moisture content is sufficiently reduced to produce an acceptable reading.
3. Perform a complete system test and adjustment.

# TDS-8SA installation and commissioning checklists

The installation and commissioning checklists (FIPs) are included with the TDS-8SA Product Documentation Package. Refer to the installation and commissioning FIPs for details specific to each rig.

# Maintenance

# Maintenance


Block
Optional
Powered Rotating
Hook Adapter (PRHA)
Optional PRHA
Link Retractors
Optional Bail
Alignment Assembly
TDS-8SA
Top Drive
PH-100
Pipehandler
Optional
Retract Block Dolly
Optional
Top Drive
Retract Guide Dolly

# Maintenance schedules

## Inspection schedule

*The service intervals listed in the table on the following pages are based on average operating conditions. Use the schedule as a guide. Some conditions (excessive loadings, dusty or corrosive atmosphere, temperature extremes, etc.) may warrant more frequent service intervals.*

| Inspection | Frequency |
|---|---|
| *Inspect* gearbox oil level | Daily |
| *Inspect* entire unit for loose hardware and fittings | Daily |
| *Inspect* wash pipe assembly for leaks | Daily |
| *Inspect* link tilt clamps position and tightness | Daily |
| *Inspect* link tilt hydraulics and pin connections for leaks and wear | Daily |
| *Inspect* IBOP actuator cylinder for leaks | Daily |
| *Inspect* tool joint lock screws for proper torque | Daily |
| *Inspect* torque back-up clamp cylinder for leaks | Daily |
| *Inspect* torque back-up clamp cylinder hose fittings (tightness) | Daily |
| *Inspect* motor alignment cylinder | Weekly |
| *Inspect* lubrication oil spray and flow | Weekly |
| *Inspect* AC drilling motor louvers | Weekly |
| *Inspect* guide dolly components | Weekly |
| *Inspect* torque back-up clamp cylinder tong die for wear | Weekly |
| *Inspect* stabbing guides for damage | Weekly |
| *Inspect* stabbing arm guides for wear | Weekly |
| *Inspect* upper stem liner for corrosion | Monthly or whenever wash pipe packing is serviced |
| *Inspect* elevator link eye diameter | Monthly |
| *Inspect* AC drilling motor brake for wear and leaks | Monthly |
| *Inspect* shot pin for wear | Monthly |
| *Inspect* IBOP actuator yoke bushings and pins for excessive play | Monthly |
| *Inspect* IBOP actuator rollers for wear and free movement | Monthly |
| *Inspect* torque back-up clamp cylinder gate hinge pins for wear | Monthly |
| *Inspect* stabilizer liners for wear | Monthly |

# Maintenance schedules

## Inspection schedule (cont.)

| Inspection | Frequency |
|---|---|
| *Inspect* main shaft for axial movement (end play) and bore wear | 3 Months |
| *Inspect* charge on accumulators | 3 Months |
| *Inspect* gears for backlash | 6 Months |
| *Inspect* load collar for wear, damage, or corrosion | 6 months |
| *Inspect* S-pipe internal surfaces for wear | 6 Months |
| *Inspect* BNC drill pipe elevator inside bore wear | 6 months |
| *Inspect* pump adapter plate components for wear | 12 Months |
| *Inspect* drive stem diameter for wear | *API Recommended Practice 8B, Section 2* |
| *Inspect* IBOPs for damage | Whenever connections are broken |
| *Inspect* load bearing components | Magnetic Particle Inspection (MPI) @ 3 Months or 1,500 hours on exposed surfaces; MPI @ 5 Years over entire surface; Ultrasonic Inspection to be performed along with MPI |

# Maintenance schedules

## Lubrication schedule

| Lubrication job | Frequency |
|---|---|
| *Lubricate* rotating link adapter gear teeth (entire gear) | Daily (General purpose grease) |
| *Lubricate* shot pin assembly gear teeth (entire gear) | Daily (General purpose grease) |
| *Lubricate* torque backup clamp | Daily (General Purpose Grease) |
| *Lubricate* wash pipe assembly (1 fitting) | Daily (General Purpose Grease) |
| *Lubricate* upper main body oil seal grease fittings (2 fittings) | Daily (General Purpose Grease) |
| *Lubricate* torque back-up clamp cylinder | Daily (General purpose grease) |
| *Lubricate* torque back-up clamp cylinder gate hinge pin grease fittings (2) | Daily (General purpose grease) |
| *Lubricate* stabilizer bushing | Daily (General Purpose Grease) |
| *Lubricate* stabilizer liner (4 pts.) | Daily (General purpose grease) |
| *Lubricate* rotating link adapter grease fittings (2) | Weekly (General Purpose Grease) |
| *Lubricate* torque arrestor tube, unpainted surfaces (4 pts.) | Weekly (General purpose grease) |
| *Lubricate* IBOP actuator rollers (2 pts.) | Weekly (General purpose grease) |
| *Lubricate* IBOP crank (2 pts.) | Weekly (General purpose grease) |
| *Lubricate* IBOP valves | Weekly (See *IBOP Service Manual*) |
| *Lubricate* BNC drill pipe elevator (7 fittings) | Weekly (General Purpose Grease) |
| *Lubricate* guide dolly (24 fittings) | Weekly (General Purpose Grease) |
| *Lubricate* bail pins (2 fittings) | Weekly (General Purpose Grease) |
| *Lubricate* RBS | Weekly (General Purpose Grease) |
| *Lubricate* link tilt crank pivot pin grease fittings (2 pts.) | Weekly (General purpose grease) |
| *Lubricate* link tilt crank stop grease fitting (1 pt.) | Weekly (General purpose grease) |
| *Lubricate* elevator link eyes (4 pts.) | Weekly (Pipe dope) |
| *Lubricate* elevator support and master bushing wear guide (7 fittings) | Weekly (General Purpose Grease) |
| *Lubricate* the wireline adapter | Weekly (General Purpose Grease) |
| *Lubricate* AC drilling motor bearings (2 fittings) | 3 Months (Motor Grease) |
| *Lubricate* AC blower motor | 3 Months (Motor Grease) |
| *Replace* gearbox oil | 3 Months (Gear Oil) |
| *Replace* gearbox oil filter | 3 Months |

# Lubricant specifications

## Selecting a gear oil

Varco Top Drives operate under a wide variety of temperatures and conditions. The oil viscosity varies from quite thick at start-up in cold climates to very thin in hot climates during difficult drilling conditions.

Select gearbox lubrication based on the minimum ambient temperature to be expected before the next oil change. Introducing an oil viscosity greater than required by the ambient temperature could damage the gearbox due to reduced oil flow, or damage the oil pump with an excessive load.

Use the following table to select the proper gearbox lubricant:

| Minimum ambient temperature ˚F (˚C) | Oil type required | Varco part number |
|---|---|---|
| Below 20°F (-6°C) | See note below | See note below |
| 20–60°F (-6–16°C) | 2EP, ISO 68 | 56004-1 |
| 45–85°F (7–30°C) | 4EP, ISO 150 | 56004-BSC |
| Above 70°F (21°C) | 6EP, ISO 320 | 56004-2 |

*For minimum temperatures below 20° F, warm the TDS-8SA up by rotating at a very light load and very slow speeds until the oil temperature is above 20° F. Contact your local Varco service center for specific instructions.*

# Lubricant specifications

## Selecting a lubricant

Use the following two tables to select the appropriate lubricant for your specific application. Motor grease and hydraulic fluid specifications appear in the following tables.

### Recomended general lubricants

| | Ambient Temperature Range | |
|---|---|---|
| | **Below -20˚ C (Below -4˚ F)** | **Above -20˚ C (Above -4˚ F)** |
| **Manufacturer** | | |
| **Castrol** | N/R | MP Grease |
| **Chevron** | Avi-Motive W | Avi-Motive |
| **Exxon** | Lidok EP1 | Lidok EP2 |
| **Gulf** | Gulf Crown EP31 | Gulf Crown EP32 |
| **Mobil** | Mobilux EP1 | Mobilux EP2 |
| **Shell** | Alvania EP1 | Alvania EP2 |
| **Statoil** | Uniway EP1N | Uniway EP2N |
| **Texaco** | Multifak EP1 | Multifak EP2 |
| **Total** | Multis EP1 | Multis EP2 |
| **Union** | Unoba EP1 | Unoba EP2 |
| **Viscosity Index** | | |
| **NGLI** | 1 | 2 |

# Lubricant specifications

## Recommended hydraulic lubricants

| | Oil Temperature Range | |
|---|---|---|
| | **-15˚ to 75˚ C (5˚ to 167˚ F)** | **-10˚ to 85˚ C (14˚ to 185˚ F)** |
| **Manufacturer** | | |
| **Castrol** | Hyspin AWS-32 | Hyspin AWS-46 |
| **Chevron** | AW Hyd oil 32 | AW Hyd oil 46 |
| **Exxon** | Nuto H32 | Nuto H46 |
| **Gulf** | Harmony 32AW | Harmony 46AW |
| **Mobil** | DTE 24 | DTE 25 |
| **Shell** | Tellus 32 | Tellus 46 |
| **Statoil** | Hydraway HMA 32 | Hydraway HMA 46 |
| **Texaco** | Rando oil HD32 | Rando oil HD46 |
| **Total** | Azolla ZS 32 | Azolla ZS 46 |
| **Union** | Unax AW32 | Unax AW46 |
| **Viscosity Index** | | |
| **ISO Viscosity Grade** | 32 | 46 |

## Recommended motor lubricants

| | Motor Grease |
|---|---|
| **Manufacturer** | |
| **Chevron** | Black Pearl EP2 ***(Do Not Substitute)*** |

# Lubricant specifications

## Recommended transmission lubricants

| | Ambient Temperature Range | | |
|---|---|---|---|
| | **-6˚ to 16˚ C (20˚ to 60˚ F)** | **7˚ to 30˚ C (45˚ to 85˚ F)** | **Above 21˚ C (Above 70˚ F)** |
| **Manufacturer** | | | |
| **Castrol** | Alpha LS-68 | Alpha LS-150 | Alpha LS-320 |
| **Chevron** | NL Gear 68 | NL Gear 150 | NL Gear 320 |
| **Exxon** | Spartan EP68 | Spartan EP150 | Spartan EP320 |
| **Gulf** | EP Lube HD68 | EP Lube HD150 | EP Lube HD320 |
| **Mobil** | MobilGear 626 | MobilGear 629 | MobilGear 632 |
| **Shell** | Omala 68 | Omala 150 | Omala 320 |
| **Statoil** | Loadway EP68 | Loadway EP150 | Loadway EP320 |
| **Texaco** | Meropa 68 | Meropa 150 | Meropa 320 |
| **Total** | Carter EP 68 | Carter EP 150 | Carter EP 320 |
| **Union** | Extra Duty NL2EP | Extra Duty NL4EP | Extra Duty NL6EP |
| **Viscosity Index** | | | |
| **AGMA** | 2EP | 4EP | 6EP |
| **ISO Viscosity Grade** | 68 | 150 | 320 |

# Inspection

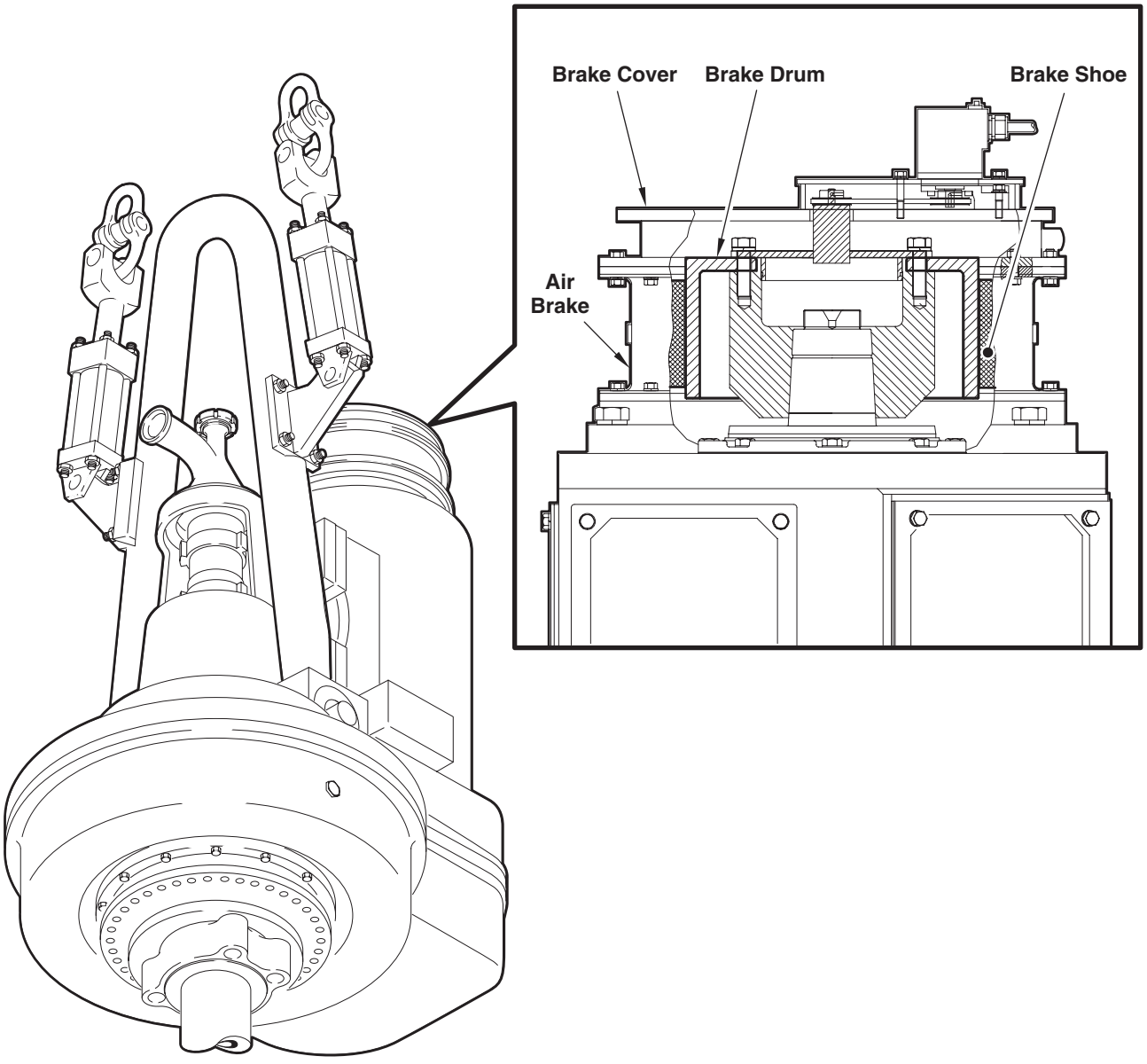
## Inspecting hardware and fittings

Visually inspect the TDS-8SA for loose or missing hardware and fittings daily. Make sure all safety wire is undamaged.

## Inspecting the drilling motor brakes

Remove the brake cover to access the drilling motor brake.

Inspect the brake shoes for wear, and replace the shoes if worn below the allowable lining wear limit given by the manufacturer. See the brake manual included in the *Vendor Documentation Package*.



# Inspection

## Mud course inspection

A complete inspection of includes performing thorough inspections of the following components in the order listed (inspection information appears in the sections below):

1. Visually inspect the washpipe assembly.
2. Inspect the S-pipe
3. Inspect the upper stem liner
4. Check for shaft end play (optional)

### Inspecting the washpipe assembly

Visually inspect the washpipe assembly daily for leaks. Satisfactory packing life depends on good washpipe alignment. Use the following procedure every six months to check sleeve-to-gooseneck support alignment:

1. Attach and indicator base to the gooseneck support and place the indicator at the top of the sleeve.
2. Raise and lower the sleeve and record the total indicator reading.
3. Attach a magnetic indicator base or improvised holding fixture to the sleeve or packing box.
4. Rotate the sleeve 360° and record the total indicator reading.

# Inspection

**Recommended washpipe tolerances**

Shim the gooseneck support to obtain a required bearing clearance of .001" to .003". Check the clearance by raising and lowering the sleeve. The maximum allowable misalignment at the gooseneck support bore is .008" T.I.R.

The maximum allowable misalignment at the gooseneck pilot is .010" T.I.R.

The maximum allowable misalignment after complete assembly is .010" T.I.R.

*Inspection may indicate misalignment exceeding recommended limits. The packing box assemblies are designed to accommodate misalignment of the sleeve to the gooseneck and can operate with some excessive misalignment. However, to achieve maximum packing life, maintain the misalignment at the washpipe within the recommended limits.*

*Clean the bore of the S-pipe and inspect for visible signs of pitting, corrosion, or erosion.*

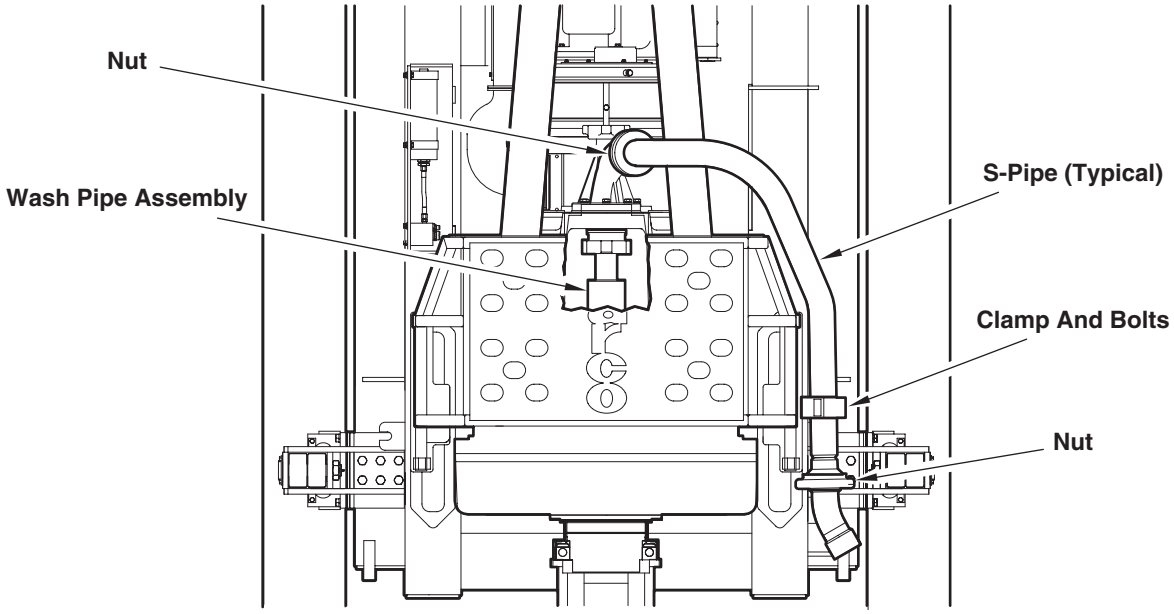
*Use a flashlight and mirror to visually inspect the bore of the S-pipe. A Bore-o-Scope is best for inspection, if available.*

Remove and perform an ultrasonic inspection on the S-pipe if inspection indicates erosion or corrosion.

# Inspection

## Inspecting the S-pipe

Unscrew the two nuts that hold the S-pipe in place along with the six bolts that secure the clamp to remove and inspect the S-pipe.



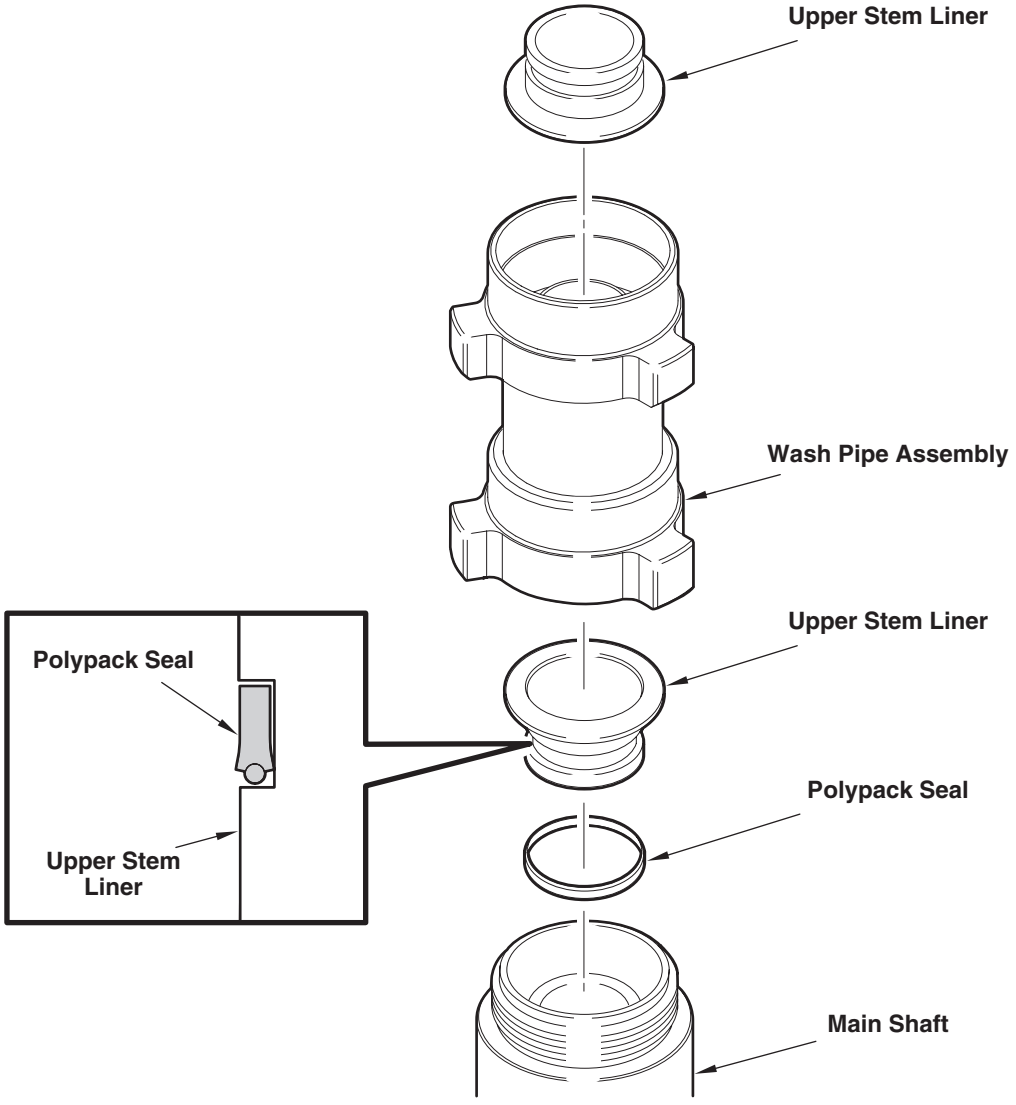
# Inspection

## Inspecting the upper stem liner

Use the following procedure to inspect the upper stem liner.

1. Remove the washpipe assembly.
2. Check the upper stem liner for erosion caused by leaking washpipe packing and replace the liner if erosion is found.

*The 4.625 in. OD polypack seal must also be replaced whenever the upper stem liner is replaced. Make sure the O-ring of the seal is facing down when the seal is installed on the liner).*



# Inspection

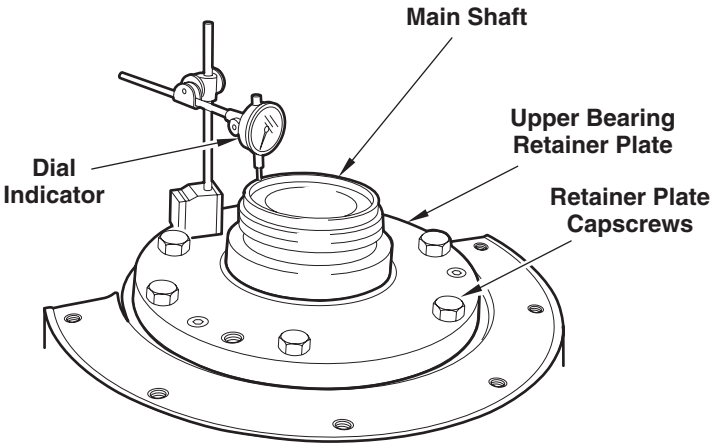
## Inspecting main shaft end play

Use the following procedure to check for main shaft end play:

1. Remove the washpipe assembly.
2. Mount the dial indicator.
3. Check the main shaft axial movement by applying an upward force to the main shaft and measuring the amount of axial movement with a dial indicator.
4. If axial shaft movement is greater than .003 in., remove the upper bearing retainer plate and adjust the number of shims under the bearing retainer plate as required to allow .001 to .003 in. of axial shaft movement (end play) with the retainer plate capscrews tightened to 250-270 ft lb.

*Refer to Installing the upper bearing retainer plate in the Disassembly and assembly section of this book for further details on this adjustment.*





# Inspection

## Inspecting gear backlash

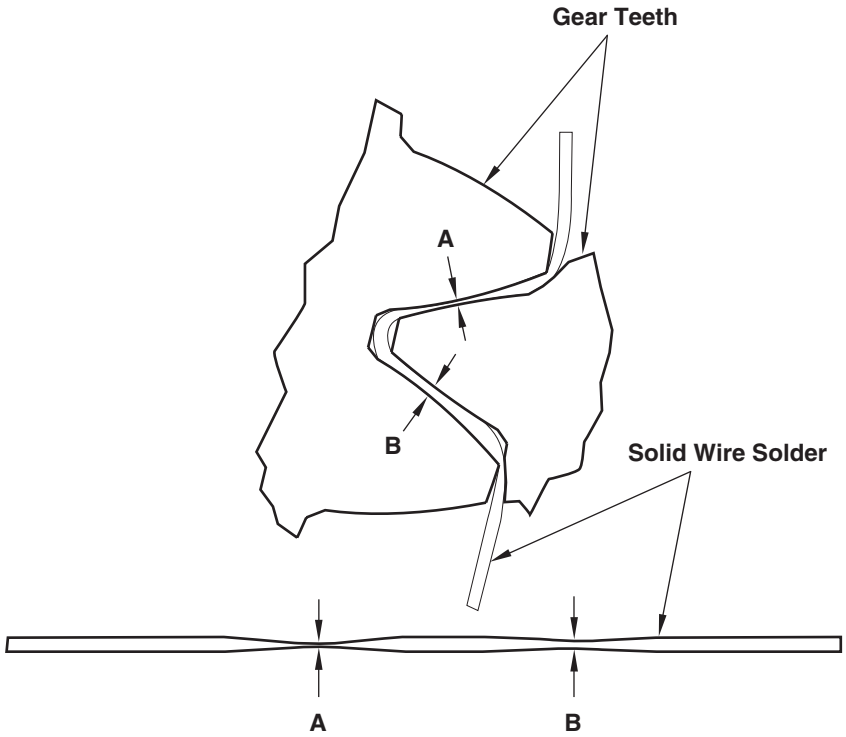
*This procedure is only necessary if you are rebuilding the TDS. It is not required under normal inspection or maintenance.*

Use the following procedure to check for gear backlash:

1. Drain the gearbox oil.
2. Remove the lower gear case to check gear set backlash.
3. Run a piece of solid wire solder through the gear meshes and measure the thickness of the two flat spots made by the gear teeth surfaces with a micrometer. If the gear mesh backlash exceeds .050 in., excessive gear wear or bearing failure is indicated.



*Check the gear teeth for pitting or corrosive wear at the same time the gear set backlash is checked.*



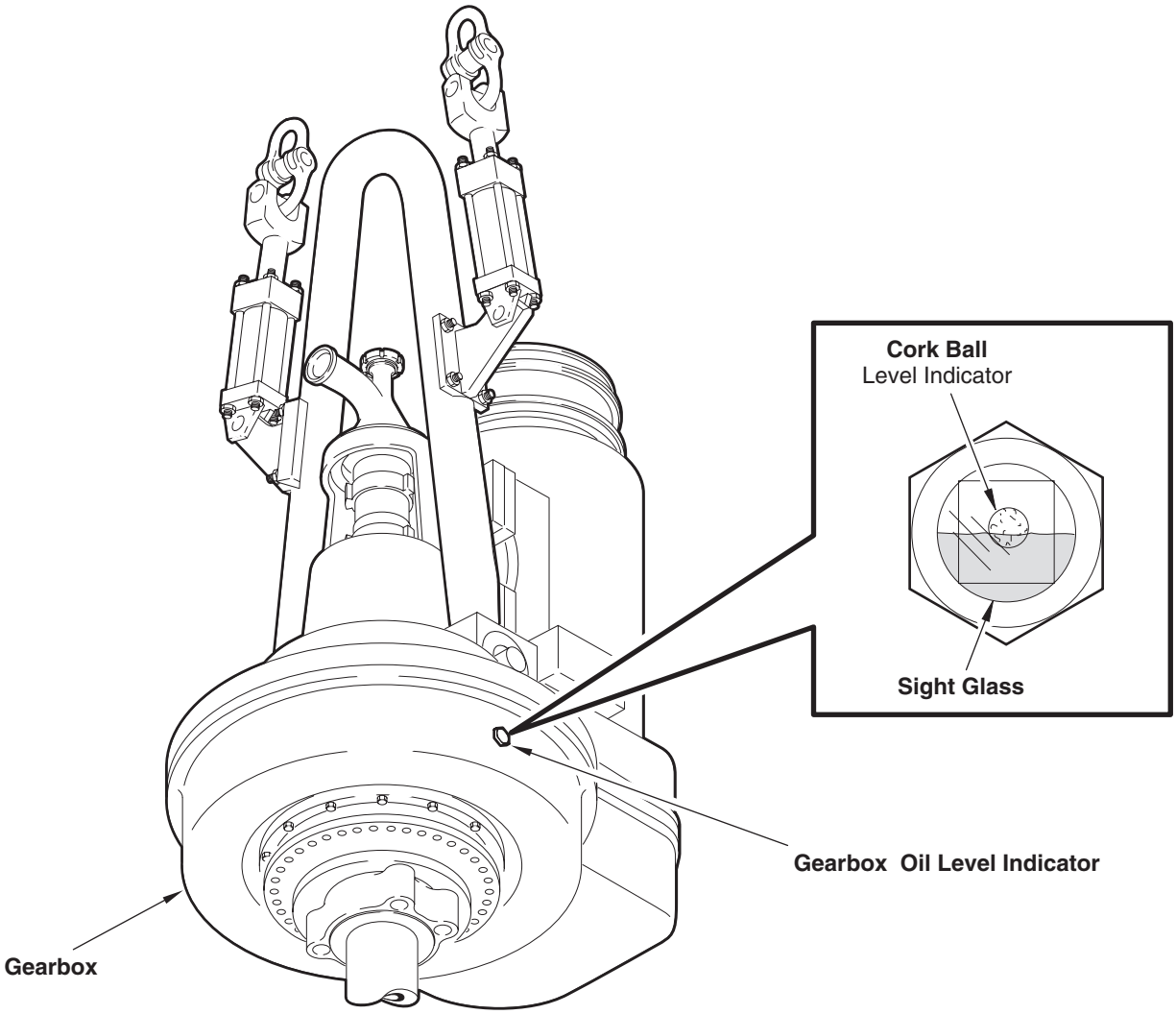

**Dim. A + Dim. B = Backlash**

# Inspection

## Inspecting the gearbox oil level

Check oil *daily*. With the motor off, check to see that the oil level is at the middle of the sight glass located on the side of the main body. Drain and refill the gearbox every 1,500 operating hours or three months, whichever occurs first. (Refer to *Oil capacity*.)

*Always check the oil level after the unit has been running and the transmission oil is warm. Look for oil level (oil is dark brown); not foam level (foam is tan).*



# Inspection

## Inspecting the motor alignment cylinder

***The alignment cylinder is not intended to be used to align the pin with the box at the well bore. It is a device to counterbalance the offset weight of the drilling motor and allow the system to accommodate external forces. It is adjustable to ensure that the mainshaft is straight at well center–to compensate for design tolerances in the guide rails and dolly. To work properly, the guide rails must be properly located, and the dolly must fit within design tolerances.***

***Check alignment cylinder operation weekly. Also, inspect all moving parts and check accumulator pressures on a weekly basis.***



## Inspecting the air exhaust muffler

Varco installs air exhaust mufflers on the exhaust ports of the multi-gang solenoid valve manifold for noise abatement. All such mufflers reduce noise *and* collect contaminants that can eventually restrict the air passage. Air passage constriction results in back pressure on all of the solenoid valves and erratic valve operation. It also holds pressure on the air brake.

Periodically remove the mufflers and clean or replace them.

If noise abatement is not an issue on the rig, replace the mufflers with simple pipe elbows.

## Inspecting the pipehandler

Thoroughly inspect the pipehandler for loose bolts and fittings daily. If any safety wire or cotter pins were removed during repairs, replace them immediately.

Inspect the hinge pins and retainer bolts daily to make sure they are not separating from the pipehandler. Make sure the hinge pins are not separating from the pipehandler, or are loose due to excessive wear in the bores of the gate or clamp body.

### Inspecting the shot pin assembly

Inspect the shot pin for wear monthly and replace it if it exceeds .06" wear on the diameter.

# Inspection

## Inspecting the link tilt assembly

Inspect the hydraulics and the pin connections daily for leaks and wear, replace components as needed. Inspect the link clamps daily for position and tightness.

**Wear allowances**

Pins: Replace pins that exceed .06 in. wear on diameter.

Bushings: Replace bushings when

a. the metal backing is visible through the lining

b. the end cap of the metal backing exceeds .04 in. wear

*Bushings should be pressed in using the mating pin as an installation mandrel.*



## Inspecting the load collar

Inspect all load collar parts for wear, damage, or corrosion every six months. Check for the following:

- ❏ Radial grooves on the inside diameter of the retainer ring.
- ❏ Wear or corrosion induced pitting on the load collar shoulder halves.
- ❏ Wear, corrosion, or fatigue cracks on the inside or outside diameter of the load collar halves.

Replace the appropriate part(s) if any of the above conditions exist.

## Inspecting the IBOP actuator cylinder and yoke

Check for leaks around the IBOP actuator cylinder daily. Tighten fittings and replace damaged or worn hoses as needed. If the leak is detected from the cylinder, remove the cylinder and replace seals as needed. Monthly, check the actuator and yoke bushings and pins for wear and excessive play by removing the two pins between the torque arrestor and the yoke.

**Wear allowances**

Pins: Replace pins that exceed .03 in. wear on diameter.

Bushings: Replace bushings when

a. the metal backing is visible through the lining

b. the end cap of the metal backing exceeds .04 in. wear

# Inspection

*Bushings should be pressed in using the mating pin as an installation mandrel.*

*See the IBOP Service Manual for proper IBOP actuator adjustment procedures.*

## Inspecting the IBOP actuator rollers

Inspect the IBOP actuator rollers monthly for wear and free movement. If excessive wear or frozen rollers are found, replace the rollers.

## Inspecting the IBOP valves and saver subs

Inspect the IBOP valves for damage whenever connections are broken. See the *IBOP Service Manual* for proper inspection and maintenance procedures.



*Upper and lower safety valves, because of their internal grooves and shoulders, are particularly susceptible to corrosion fatigue cracking. These internal diameter changes act as stress risers for bending and tensile loads. It is especially important to properly inspect the safety valves on a frequent basis. Read and use the safety valve inspection procedures described in the Varco IBOP Service Manual.*

*The saver subs are load bearing components and should be inspected along with other load bearing components using Magnetic Particle Inspection (MPI) and Ultrasonic Inspection. Saver sub threads can be recut to a minimum shoulder-to-shoulder length of 5" before the saver sub must be discarded and replaced.*

## Inspecting the tool joint locks

The three tool joint locks should be inspected daily for loose bolts and repaired or replaced as necessary. The torque on all locking screws should be 362 ± 5 ft lb.

# Inspection

## Inspecting the torque backup clamp cylinder, gate, and jaws

Check for hinge pin wear monthly and replace the pins as necessary. Inspect daily for loose hose fittings, torque backup clamp cylinder leaks, and replace the seals as needed (see the *Disassembly/assembly* procedure). Check weekly for tong die wear. If excessive wear is found, replace the dies.

**Jaw and stabbing guide types**

| Tool joint connection type | Tool joint diameter range |
|---|---|
| NC 38 – NC 46 | 4.75" – 6.00" |
| NC 50 – 5 1/2 FH | 6.25" – 7.25" |
| NC 56 – 6 5/8 FH | 7.50" – 8.625" |

## Inspecting the stabilizer

Inspect the front and rear stabilizer liners monthly for wear. Replace the stabilizer liner if the wear exceeds 1/8" Remove the two bolts (with slotted nuts and cotter pins) that hold the front stabilizer. Check the springs for damage and replace if needed. To adjust the spring tension, add (increase tension) or remove (reduce tension) the flat washers between the slotted nuts and mating surfaces. Pack spring cavities with grease and reassemble. Be sure all safety wire, cotter pins, and capscrews are tight, and tighten or replace as necessary.

## Inspecting the stabbing guide

Inspect the stabbing guides weekly for damage, and replace parts as needed. Inspect the arm guides weekly for damage and excessive wear, and replace the arms if wear exceeds 1/8 in.

# Inspection

## Inspecting the electrical system

Periodically, depending on severity of service, check all electrical lines, connectors, and related electrical hardware for loose connections and damage, and replace components and tighten connections as necessary.

Also, inspect electrical sensors for exterior damage and replace components as required.

## Nondestructive Examination (NDE)

Yearly (or after approximately 3,000 operating hours), perform a Nondestructive Examination (NDE) of all critical load path items.

*NDE inspection includes visual examination, dye penetrant examination, magnetic particle inspection, ultrasonic inspection, x-ray examination, and other methods of nondestructive testing for metallurgical integrity.*



### Inspecting the elevator link eyes

Use calipers on a regular basis to measure the amount of wear on the elevator link eyes. Compare the measurements with the *Wear Chart* to determine the current strength of the elevator links. The capacity of the links equals the capacity of the weakest link.

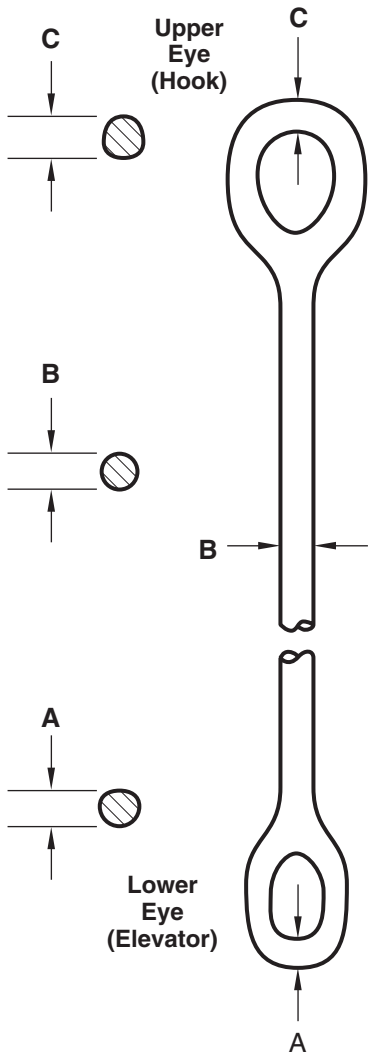
### Inspecting the BNC drill pipe elevator

Inspect the BNC drill pipe elevator every six months along with the load collar inspection. Inspect for evidence of inside bore wear on the BNC drill pipe elevator, indicating contact with the drill pipe while drilling. Wear on the inside shoulder of the elevator should not exceed 1/8 in.

# Inspection

## Wear Chart - Forged Links

| Upper Eye Dimension (C) | Lower Eye Dimension (A) | Capacity (per set) in Tons |
|---|---|---|
| ***B = 2 7/8 in., 250-Ton*** | | |
| 5 inches | 2 1/4 inches | 250 |
| 4 7/8 inches | 2 1/8 inches | 210 |
| 4 5/8 inches | 2 1/16 inches | 188 |
| 4 3/8 inches | 1 3/4 inches | 137 |
| ***B = 3 1/2 in., 350-Ton*** | | |
| 5 inches | 2 3/4 inches | 350 |
| 4 13/16 inches | 2 9/16 inches | 300 |
| 4 5/8 inches | 2 3/8 inches | 225 |
| 7 7/16 inches | 2 3/16 inches | 175 |
| ***B = 4 1/2 in., 500-Ton*** | | |
| 6 inches | 3 1/2 inches | 500 |
| 5 3/4 inches | 3 1/4 inches | 420 |
| 5 1/2 inches | 3 inches | 325 |
| 5 1/4 inches | 2 3/4 inches | 250 |
| ***B = 6 1/4 in., 750-Ton*** | | |
| 7 1/2 inches | 7 1/2 inches | 350 |
| 7 1/4 inches | 7 1/4 inches | 300 |
| 7 inches | 7 inches | 225 |
| 6 3/4 inches | 7 3/4 inches | 175 |




To determine the strength of worn links, measure (with calipers) the amount of eye wear and compare the measurements with the above Wear Chart to find the current capacity. The capacity of the set of links is determined by the weakest link.

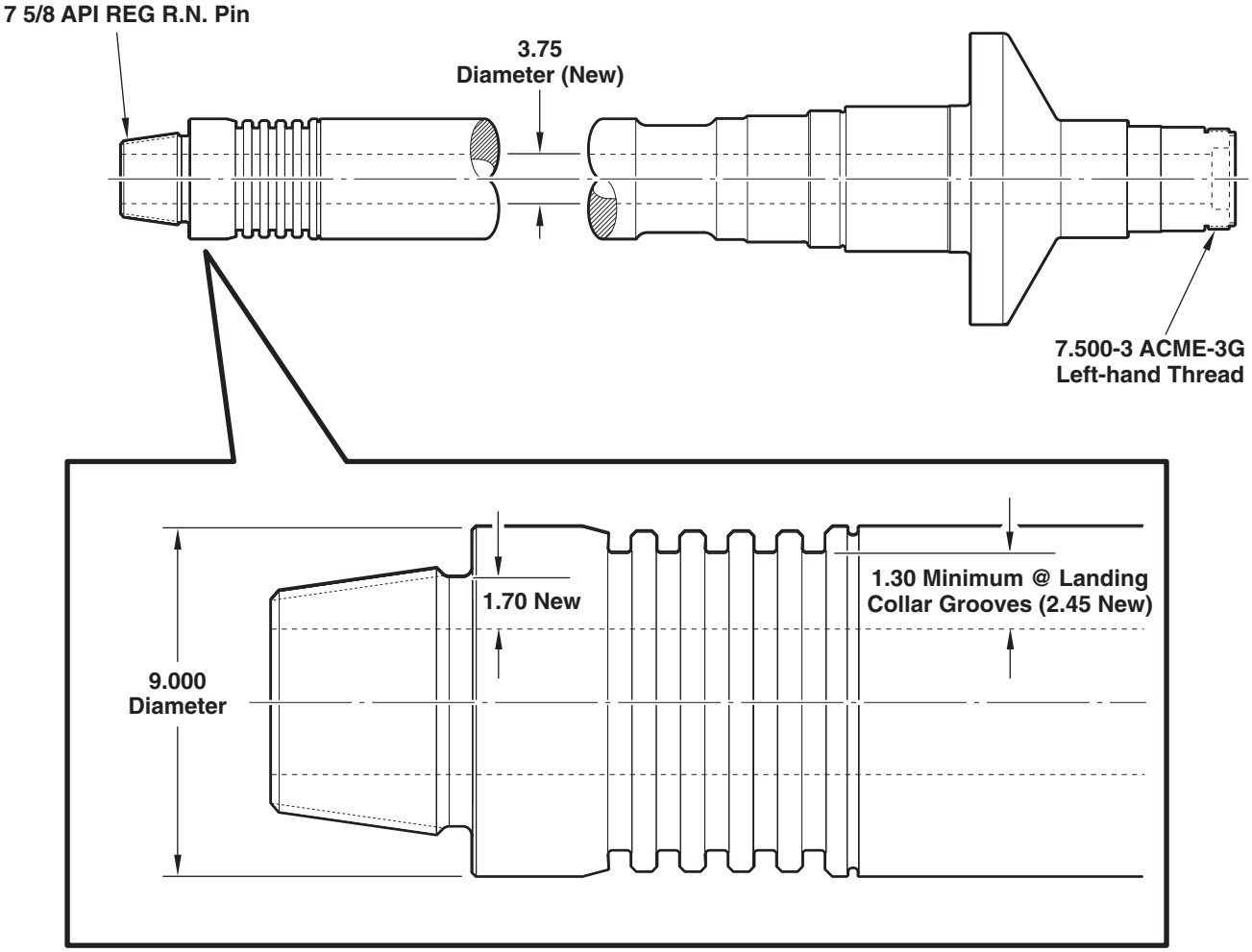
# Inspection

## Inspecting the drive stem

Regularly inspect and measure the drive stem/main shaft for wear.

Determine inspection frequency according to *API Recommended Practice 8B, Section 2* for power swivels and power subs.

Varco recommends the use of *API RP 7G* and *API RP 8B* as guidelines for interpreting and performing inspections. Measurement techniques are specified in *API RP 7G, Section 10. Use API Bulletin 5T1* to identify and define imperfections found during inspections.




(Refer to the engineering drawings for exact dimensions)

# Inspection

## Magnetic particle inspection

Once a year, or every 3,000 operating hours, Varco recommends performing a Magnetic Particle Inspection of the exposed surfaces of all load bearing components and load collar grooves to reveal any fatigue or crack indications. Any indications found are a potential cause for replacing the  suspect component. Round bottom pits and erosion are acceptable as long as the defect is less than 1/16 in. deep. Larger defects or any crack indications are a cause for replacing the suspect component.

After approximately five years or 15,000 operating hours, depending on the severity of operating conditions, Varco recommends performing a Magnetic Particle Inspection of all load bearing components over the entire surface (including internal bores) to reveal any fatigue or crack indications.

Any indications found are a potential cause for replacing the suspect component. Round bottom pits and erosion are acceptable as long as the defect is less than 1/16 in. deep. Larger defects or any crack indications are a cause for replacing the suspect component.



The load bearing components are:

- ❏ Drive stem/main shaft (lower portion)
- ❏ Load collar
- ❏ Upper and lower IBOP
- ❏ 350-ton BNC drill pipe elevator
- ❏ Link adapter
- ❏ Saver and spacer subs
- ❏ Power subs
- ❏ Power swivels
- ❏ Elevator links

Details on MPI Inspection procedures are in the following publications:

- ❏ ASTM A-275, *Standard Method for Magnetic Particle Inspection of Steel Forgings*
- ❏ ASTM E-709, *Standard Recommended Practice for Magnetic Particle Inspection*
- ❏ I.A.D.C., *Drilling Manual, 9th Edition*

# Inspection

## Ultrasonic inspection

In addition to Magnetic Particle Inspection, Varco also recommends performing an Ultrasonic Inspection of the above components to detect any erosion of the inside diameter. Any erosion reduces the load-carrying capacity of the part. Any subsurface irregularity can also compromise a component's integrity.

Details on Ultrasonic Inspection procedures are in the following publications:

- I.A.D.C., *Drilling Manual, 9th Edition*
- ASTM A-388, *Standard Practice for Ultrasonic Examination of Heavy Steel Forgings*

*Upper and lower safety valves, because of their internal grooves and shoulders, are particularly susceptible to corrosion fatigue cracking. These internal diameter changes act as stress risers for bending and tensile loads. It is especially important to properly inspect the safety valves on a frequent basis. Read and use the safety valve inspection procedures described in the IBOP Service Manual included in the Supplemental Material book.*

# Lubrication

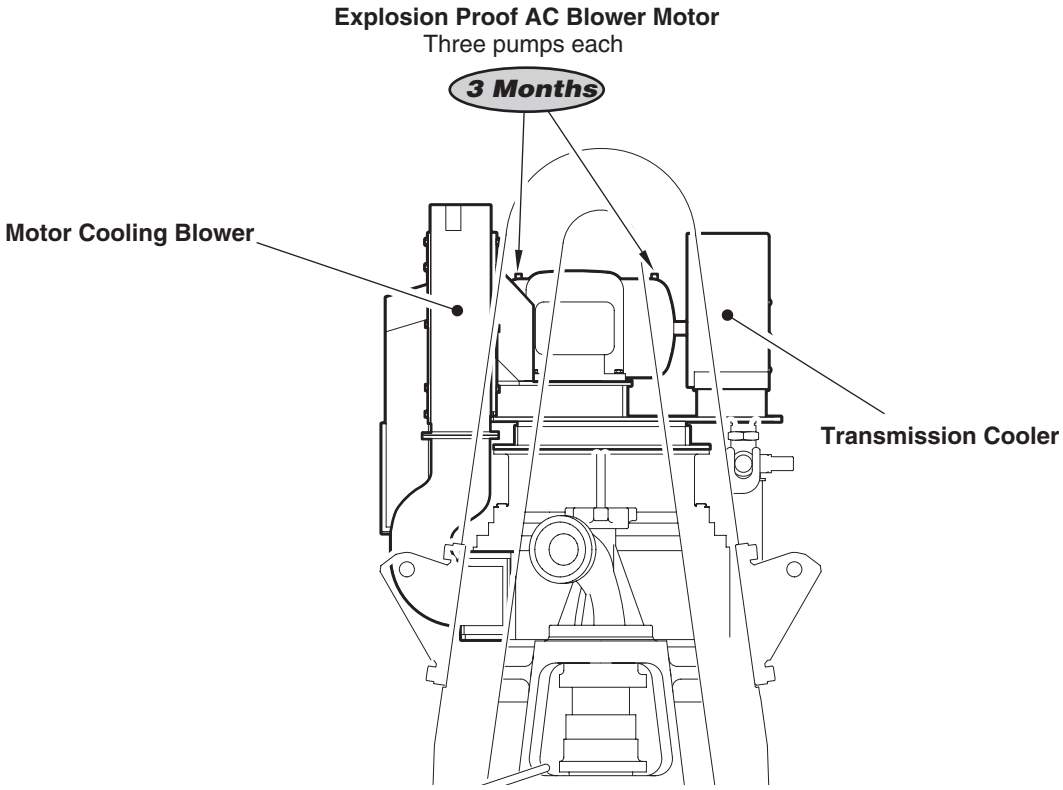
The lubrication intervals described in this manual are based on lubricant supplier recommendations. Severe conditions such as extreme loads or temperature, corrosive atmosphere, etc., may require more frequent lubrication.

Worn bushings, binding parts, rust accumulations, and other abnormal conditions indicate more frequent lubrication is necessary. Be careful not to over lubricate parts. For example, too much grease forced into a fitting can pop out a bearing seal. Over lubrication can also affect safety since over lubricated parts can drip, creating a potential slipping hazard for personnel.

# Lubrication

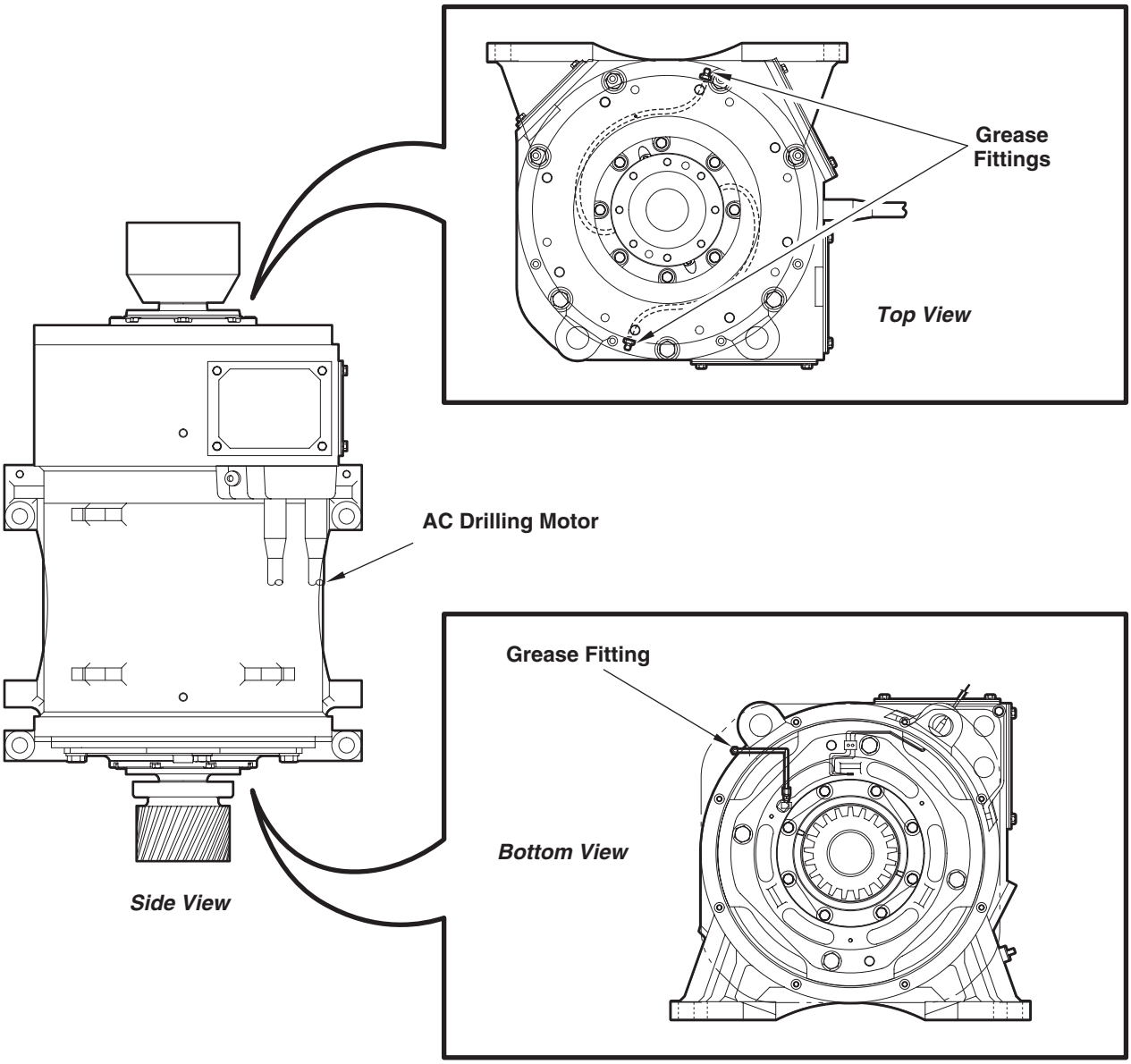
## Lubricating the cooling system AC blower motor

Lubricate the AC blower motor every three months (two fittings).



# Lubrication

## Lubricating the AC drilling motor bearings




Use the following procedure to lubricate the AC drilling motor bearings at the locations indicated every three months with the shaft stationary and the motor warm.

1. Locate the grease inlet at the top of the motor frame .
2. Clean the area and replace the 1/8 in. pipe plug with a grease fitting and remove the grease drain plug located opposite the grease inlet.
3. Repeat steps 1 and 2 for the bottom of the motor frame

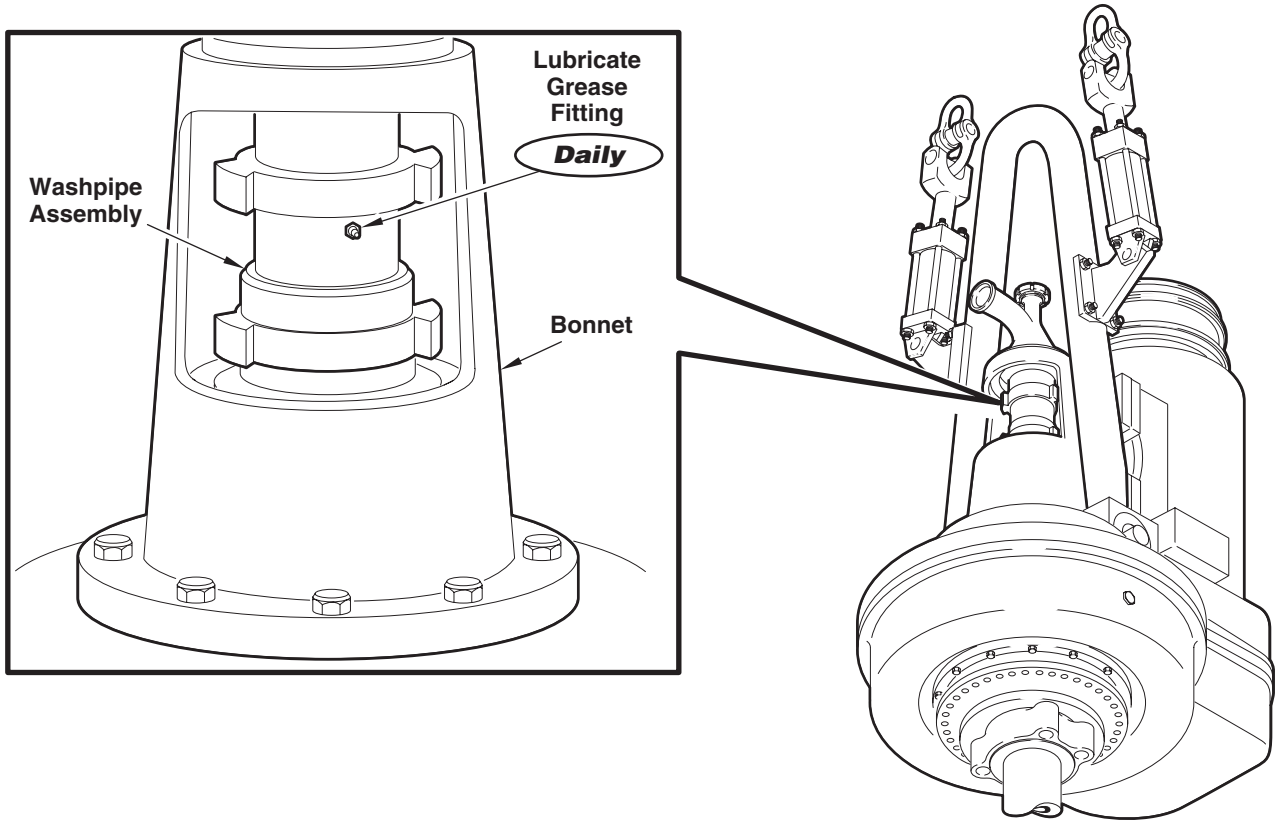
# Lubrication

4. Add grease to the bearing with a manual grease gun. The motor manufacturer's manual, located in the *Vendor Documentation Package*, contains information on the proper amount and type of grease to use.

5. Clean any excess grease from the grease drain and replace the pipe plugs at the inlet and the drain.

## Lubricating the washpipe assembly

Apply grease daily to the washpipe assembly grease fitting with the mud pump shut off.

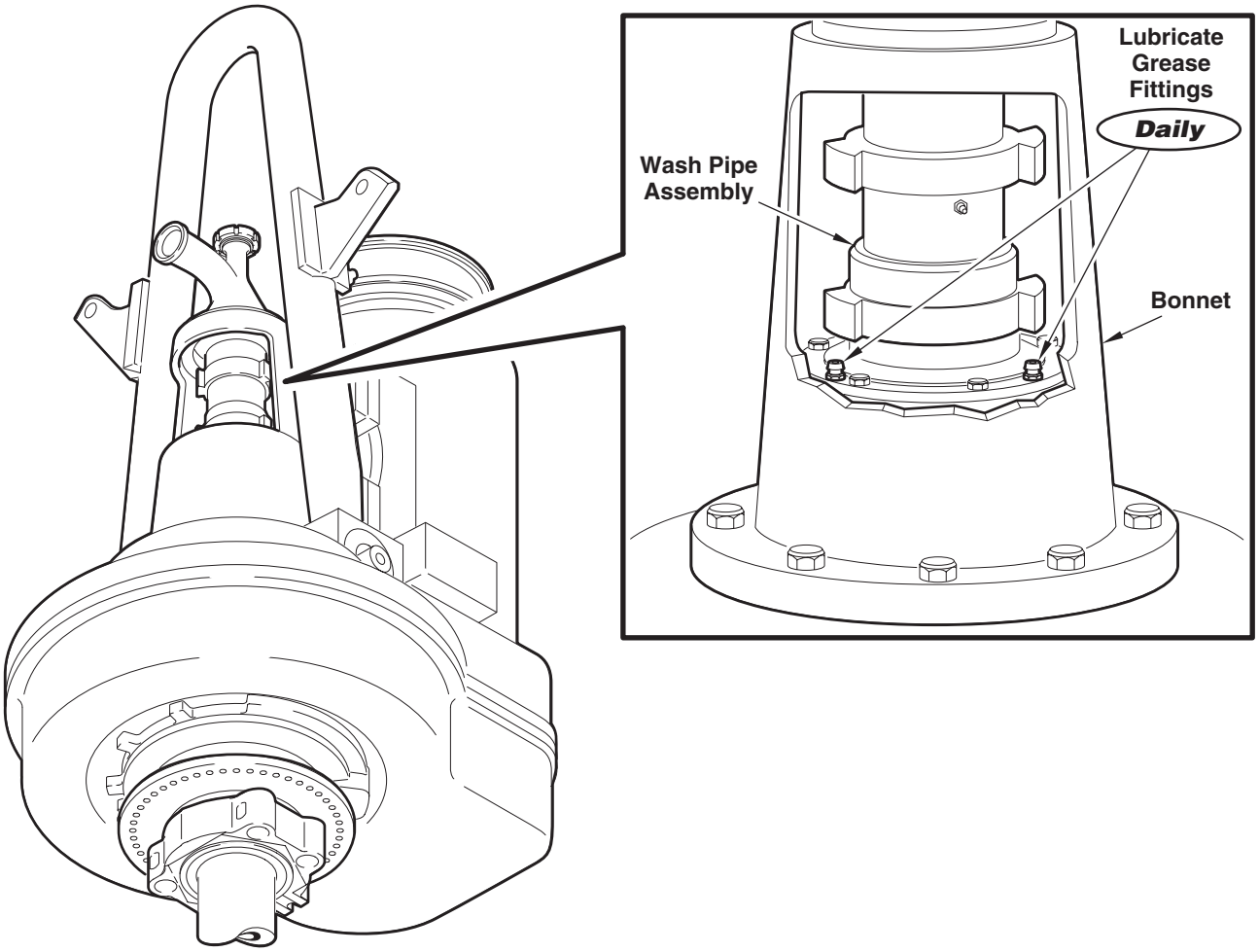


# Lubrication

## Lubricating the upper main body oil seals

Apply grease daily to the two grease fittings for the main body upper oil seals located inside the bonnet.

*Grease the main body oil seals daily to prevent abrasive drilling mud from leaking into the main body.*



# Lubrication

## Replacing the gearbox oil

### Initial oil change

Drain and refill the gearbox after the first four weeks, or 500 hours of operation, whichever comes first (Figure 14). Replace the oil filter when changing the oil.

*After every oil change, check for proper lubrication oil flow. Always check the oil level after the unit has been running and the transmission oil is warm. Look for oil level (oil is dark brown); not foam level (foam is tan).*

### Oil capacity

The TDS-8SA main body holds approximately 10-20 gallons of oil. *Always* fill the transmission to the middle of the sight glass. Use the following procedure to fill the transmission for the first time on a new top drive:

1. Use a hand pump to fill the gearbox to the top of the sight glass (*approximately* 10-20 gallons).
2. Operate the top drive 10-15 minutes and check the sight glass.
3. If the oil level is below the middle of the sight glass, add more oil until the level reaches the middle of the sight glass.

When draining oil from the drain plug at the bottom of the gearcase, only the 5-6 gallons of oil at the bottom of the gearcase actually drains. Oil still remains in the rotating head cavity (approximately 1-2 gallons), the oil lube/pump/cooler system (approximately 1-2 gallons), and the wetted surfaces inside the motor housing assembly (approximately 2-3 gallons). Removing the suction hose from the cover plate below the pinion shaft allows more oil to drain and also removes sediment that collects there.

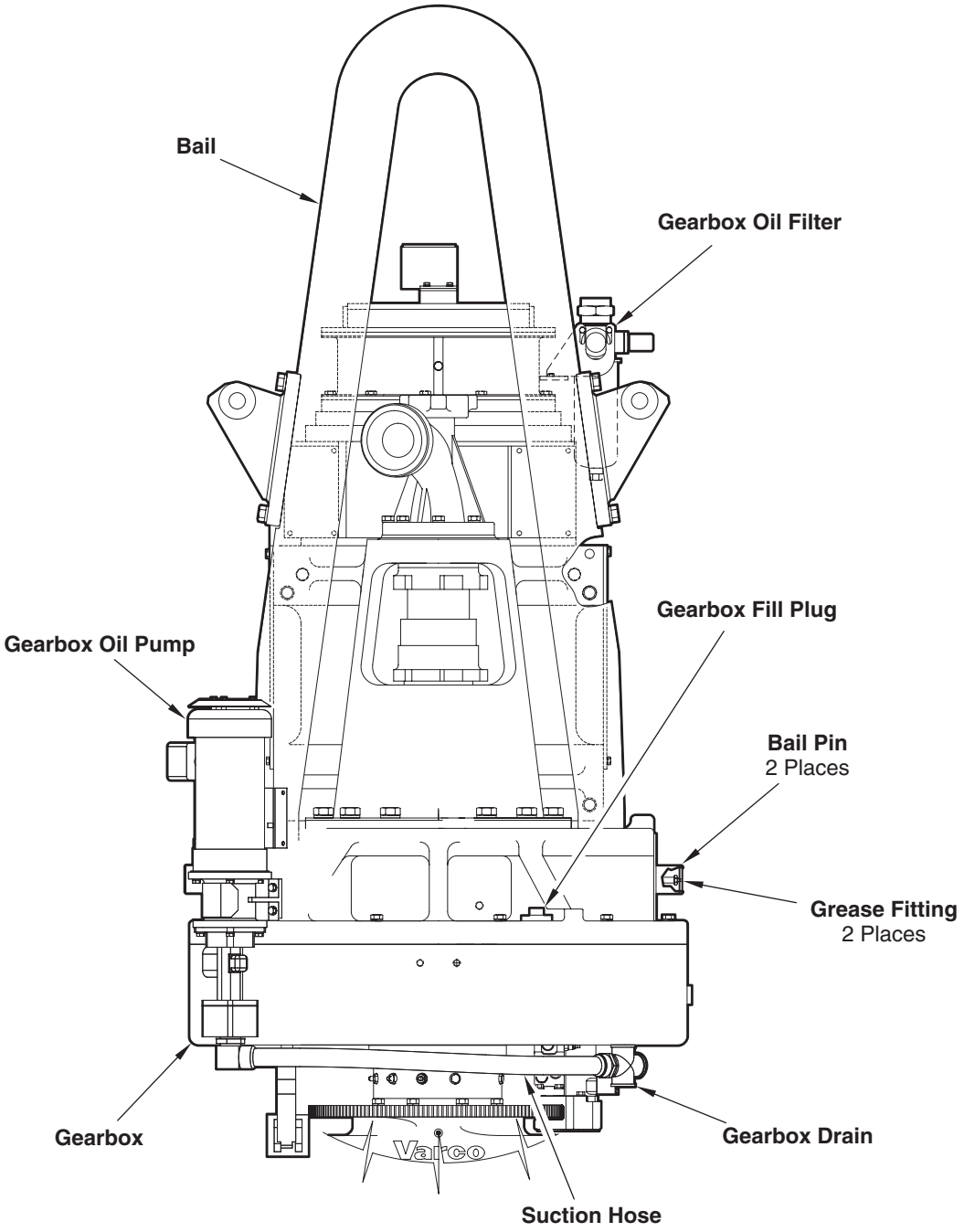
## Lubricating the bail pins

Apply grease weekly to the grease fittings for the bail pins located on the end of each pin.

# Lubrication

## Replacing the gearbox oil filter

Replace the gearbox oil filter at the same time the oil is changed (every three months). The filter is located on the gear case.



# Lubrication

## Lubricating the guide dolly assembly

Lubricate the guide rollers at the grease fitting manifolds located on the guide dolly. Check guide rollers weekly for cracks or excessive axial or radial play and replace as necessary. Lubricate the hinges (one place on each hinge) once each tripping operation, if applicable.

It is possible to over-grease (too much pressure, not volume) the guide rollers. This can push the plugs out. Visually inspect all of the guide rollers for evidence of grease extruding from the end(s) of the shaft. If you discover over-greasing, perform the following procedure:

1. Remove and disassemble the roller assembly.
2. Thoroughly clean and inspect all parts.
3. If the component parts are still serviceable, drill and tap the shaft end(s) for 1/8 in. NPT threads and install internal wrenching pipe plugs after thoroughly cleaning metal chips from the grease ports in the roller shaft.
4. Pre-grease roller bearings before reassembling and installing the rollers and shaft.
5. Re-grease roller bearings through grease lines to make sure lubricant is pumping through the roller bearings. Some grease should extrude between the rollers and roller shaft.
6. Replace unserviceable assemblies.
7. Improve plug retention on roller assemblies with intact sheet metal plugs by staking the edges of the port(s). To do this:
   a. Remove the roller or roller bracket assembly to improve accessibility.
   b. Use a hammer and chisel to stake the port edges.

A preferred method is to rework the roller assembly for drill and tap operation, but the staking method is also effective.

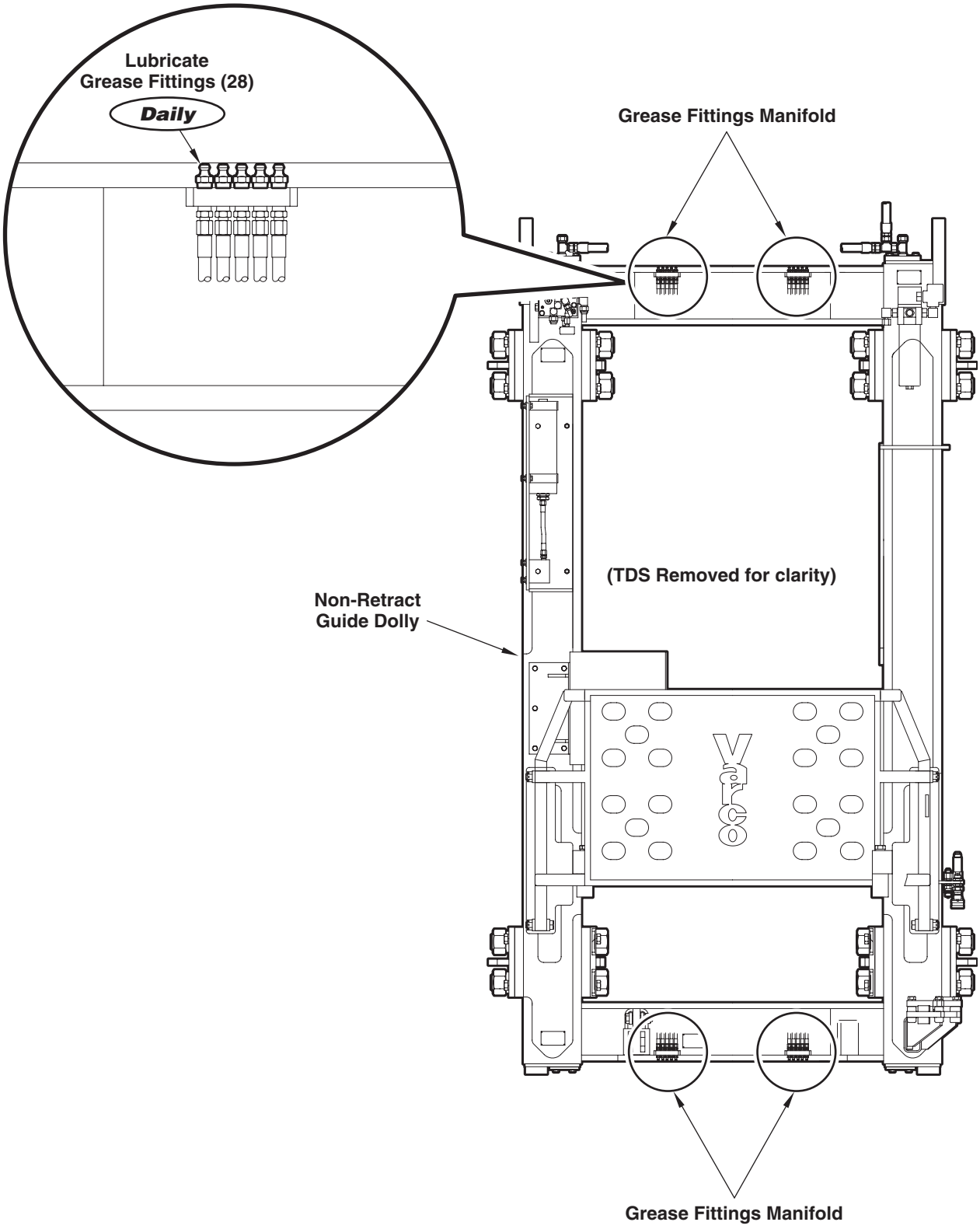
At each bottom corner of the motor frame are the grease points for the motor trunnions. Lubricate these weekly.

Daily, with the hydraulic power on, check the filter gauge on the pressure filter to determine the condition of the filter element. Replace the element when a bypass condition is indicated.

***Do not weld or torch cut on or near the motor frame without removing hydraulic accumulators.***

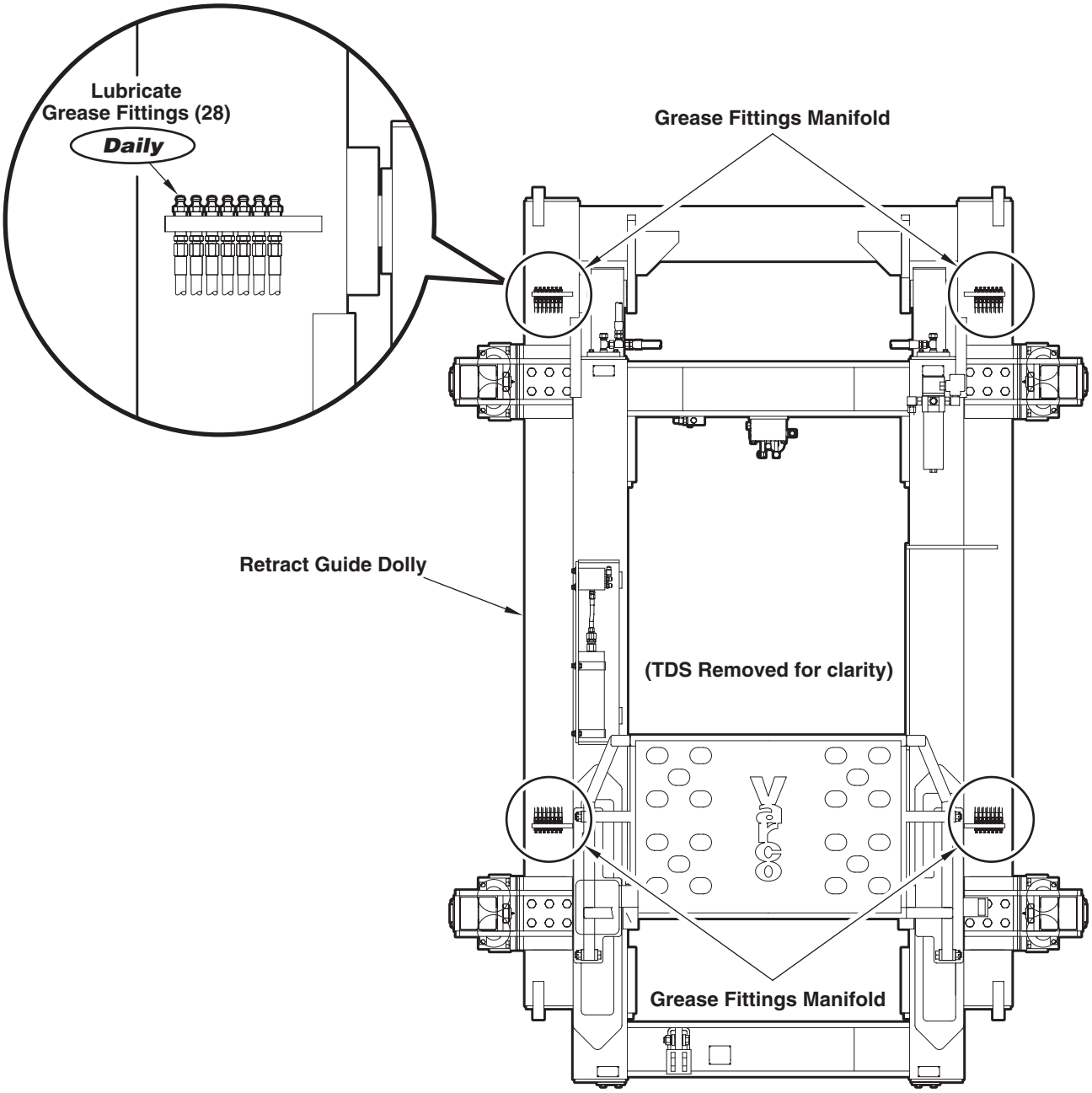
# Lubrication

## Lubricating typcal non-retract guide dolly assembly



# Lubrication

## Lubricating typcal retract guide dolly assembly



# Lubrication

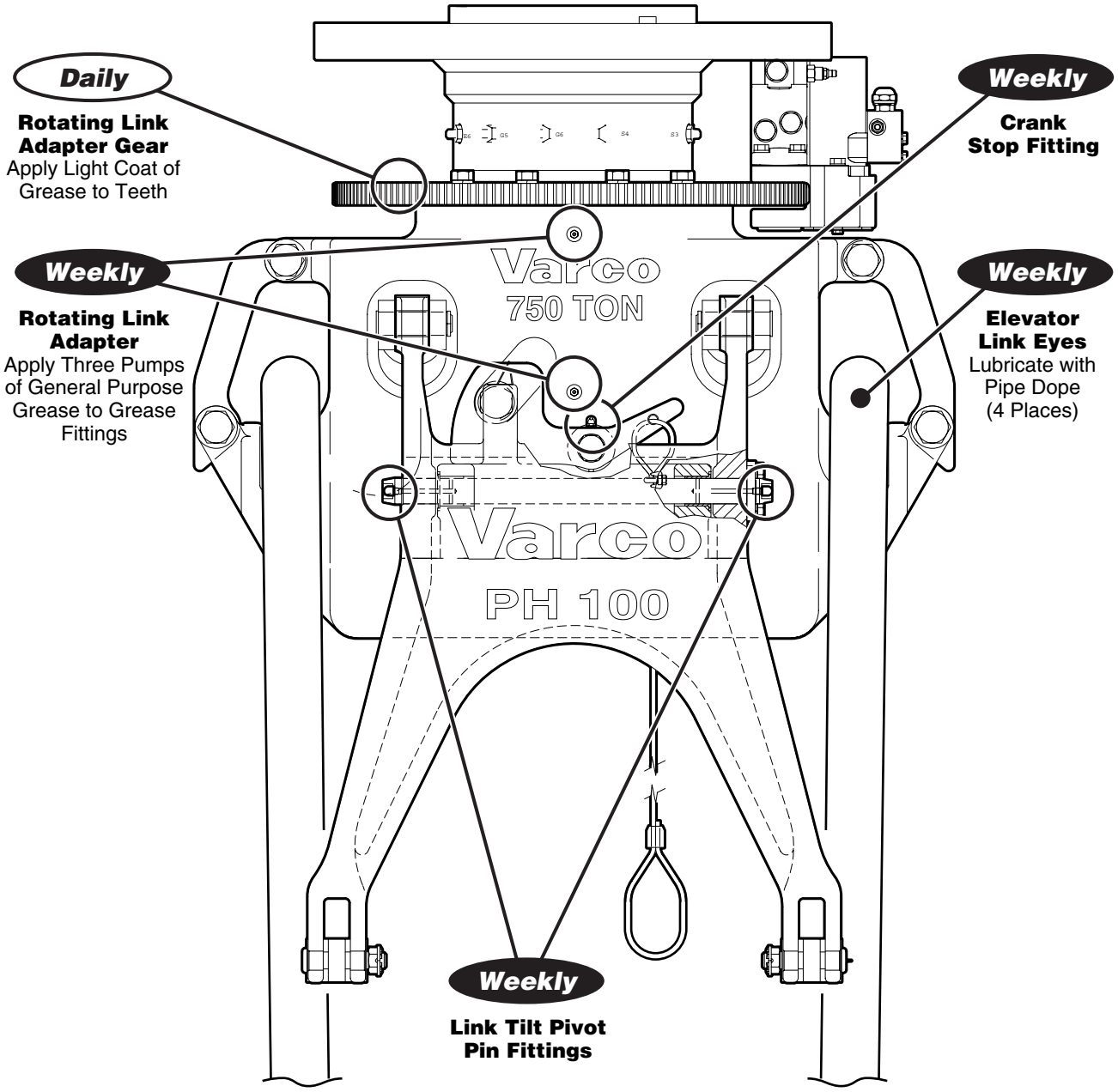
## Lubricating the PH-100 pipehandler

### Lubricating the rotating link adapter

Apply a light coat of grease to gear teeth daily. Apply three pumps of general purpose grease to the two rotating link adapter grease fittings weekly.

Lubricating the link tilt assembly

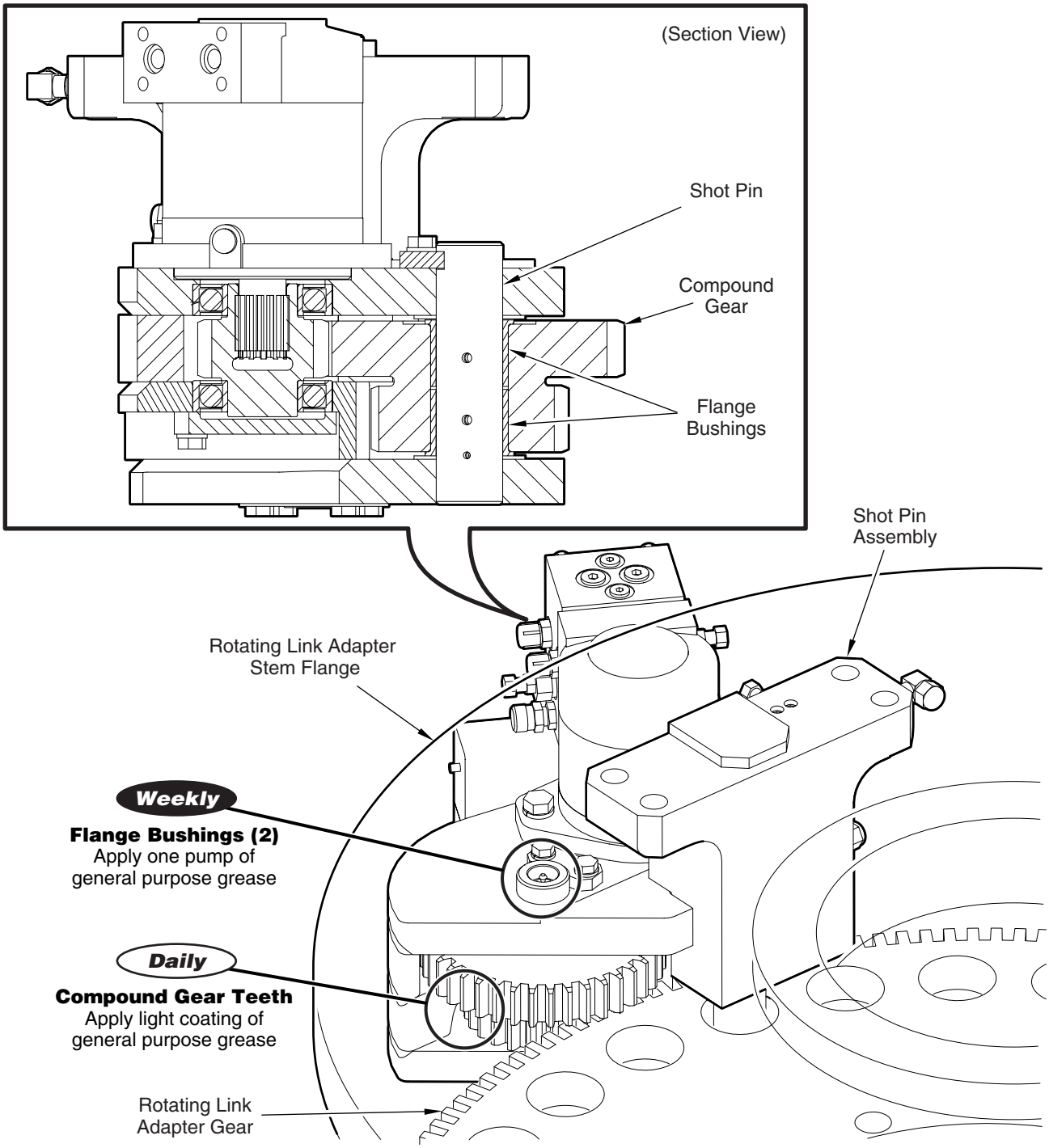
Apply general purpose grease weekly to the two crank pivot pin grease fittings and the crank stop grease fitting.



# Lubrication

## Lubricating the shot pin assembly

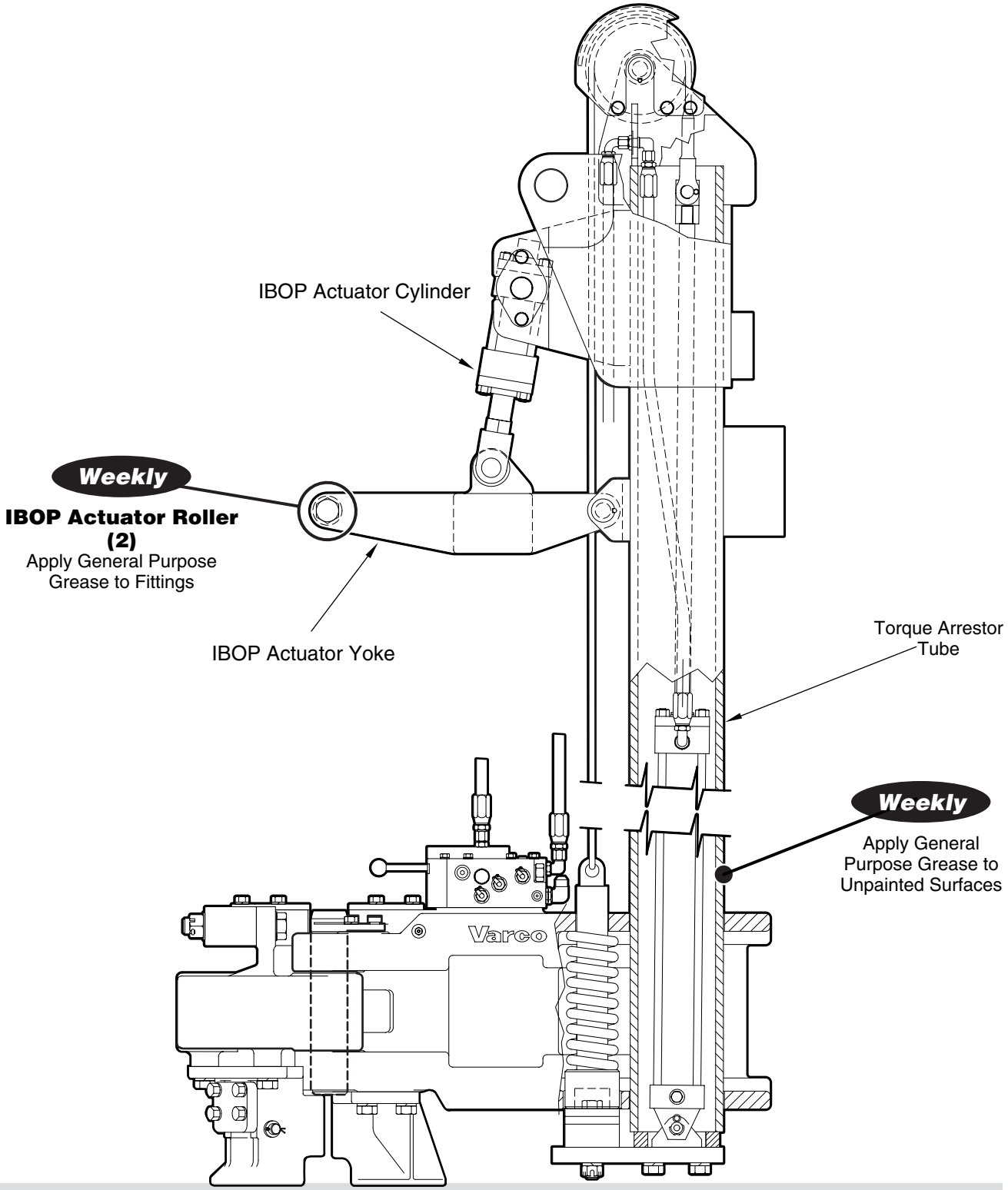
Apply a light coat of grease daily to the shot pin assembly pinion gear teeth.



# Lubrication

## Lubricating the torque arrestor and the IBOP actuator rollers

Apply grease to the five grease fittings on the IBOP actuator weekly.



# Lubrication

## Lubricating the IBOP valve, cranks and torque backup clamp cylinder

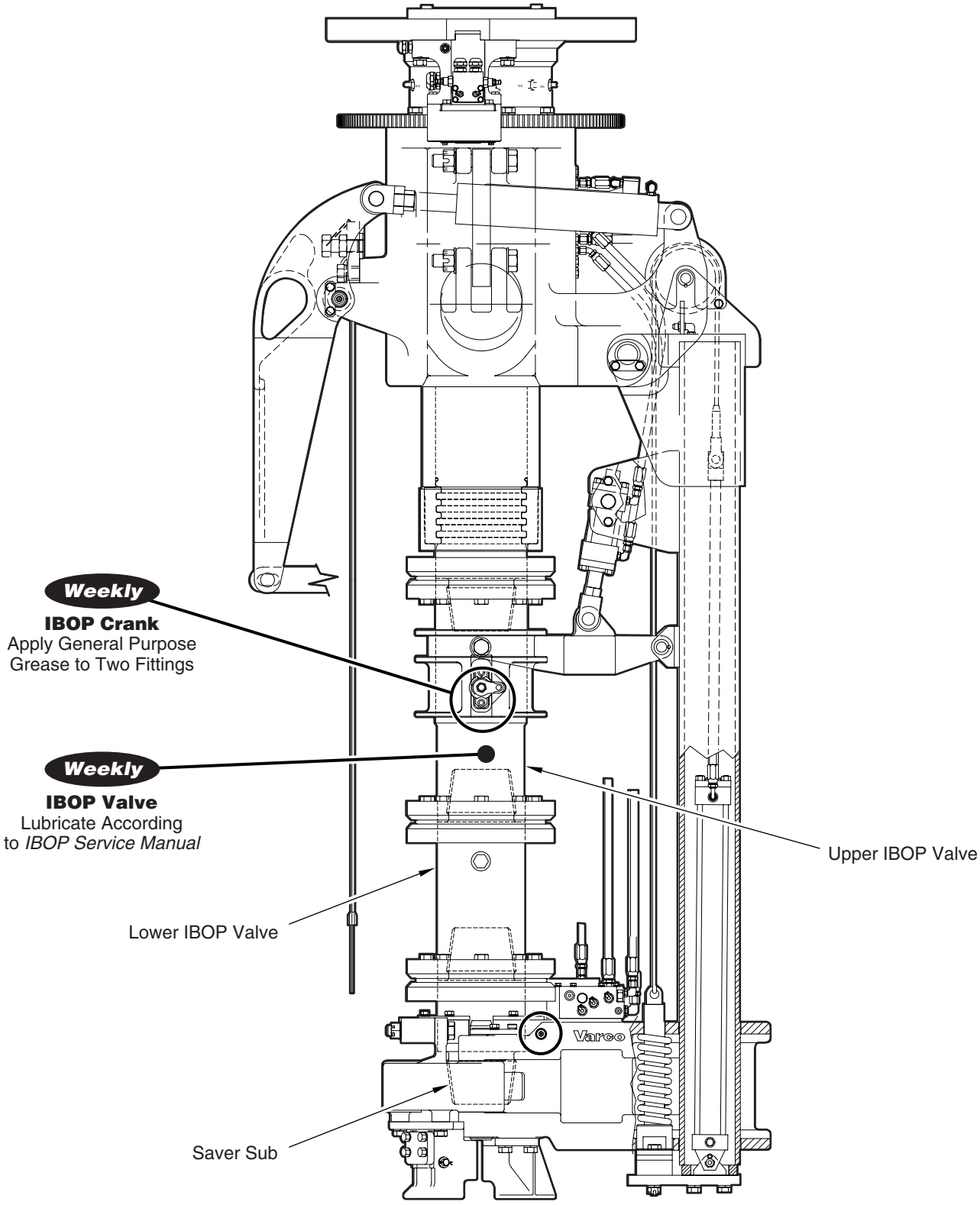
Apply grease with a brush to the torque arrestor tubes.

Apply grease to the two IBOP actuator rollers weekly.

Apply grease weekly to the IBOP actuator crank grease fittings.

Lubricate the IBOP valves weekly (refer to the *IBOP Service Manual* supplement, included with this manual, for details.

# Lubrication



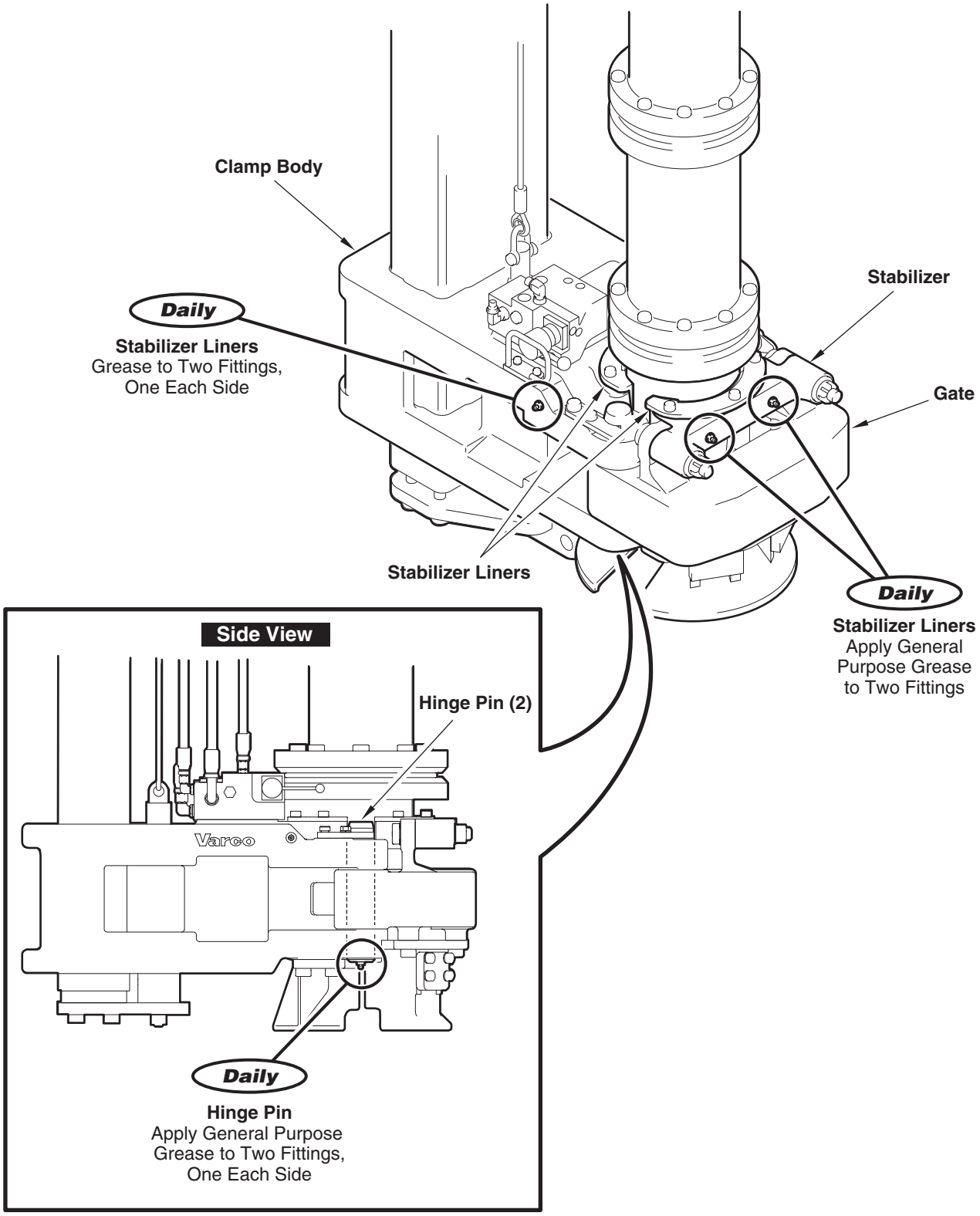
# Lubrication

## Lubricating the torque backup clamp cylinder gate hinge pin and the stabilizer liners

Apply one pump of general purpose grease daily to the torque backup clamp cylinder gate hinge pin grease fittings.

Apply one pump of general purpose grease daily to the stabilizer liner grease fittings.

# Lubrication



# Lubrication

## Lubricating the elevator links and BNC drill pipe elevator

Lubricate the elevator link eyes (four places) weekly with pipe dope.

Apply one pump of general purpose grease weekly to the seven BNC drill pipe elevator grease fittings.

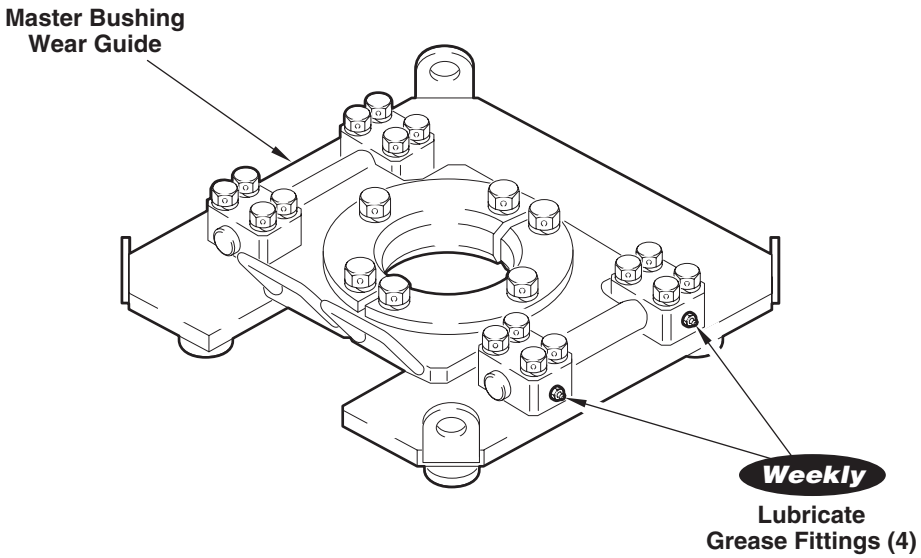
## Lubricating optional Varco top drive equipment

The following sections describe lubricating assemblies and components that may or may not be present on your rig, depending on its configuration. Some optional components have separate service manuals. Be sure to check the *Vendor Documentation Package* and *Supplemental Material* book of this manual. The information in the following sections is presented here as a convenience.



### Lubricating the elevator support and master bushing wear guide

Apply grease to the seven fittings on the elevator support weekly. The master bushing wear guide has four fittings. Lubricate weekly. Inspect the guide ring periodically for wear or damage and replace it as necessary.



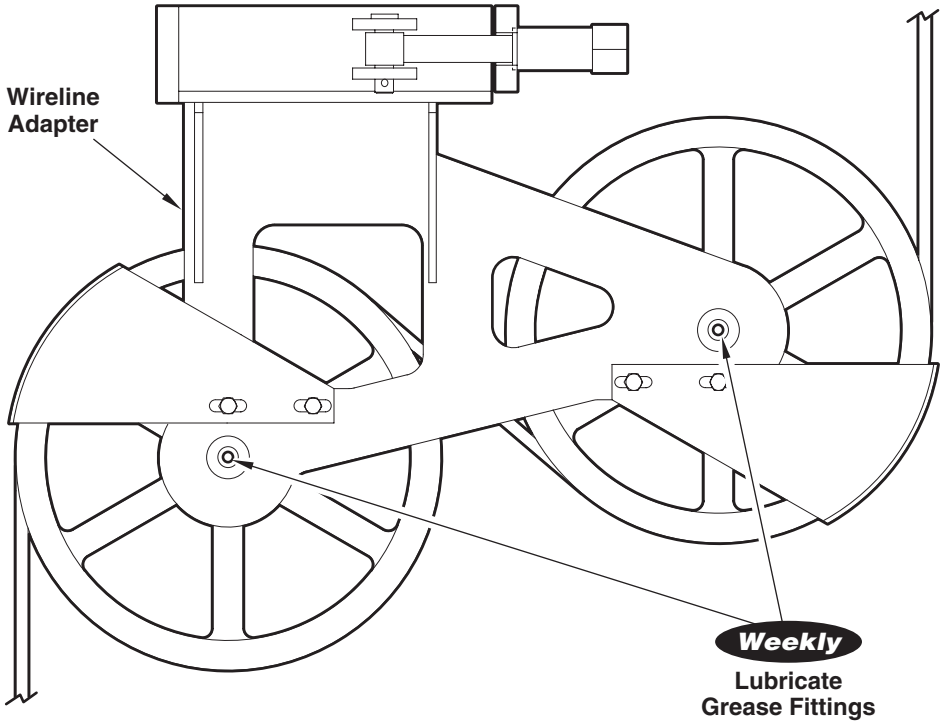
# Lubrication

## Lubricating the RBS

Refer to the *RBS* service manual for lubrication information.

## Lubricating the wireline adapter

Apply grease to the wireline adapter weekly. The wireline adapter has one fitting. Inspect the sheaves periodically for wear or damage and replace as necessary.



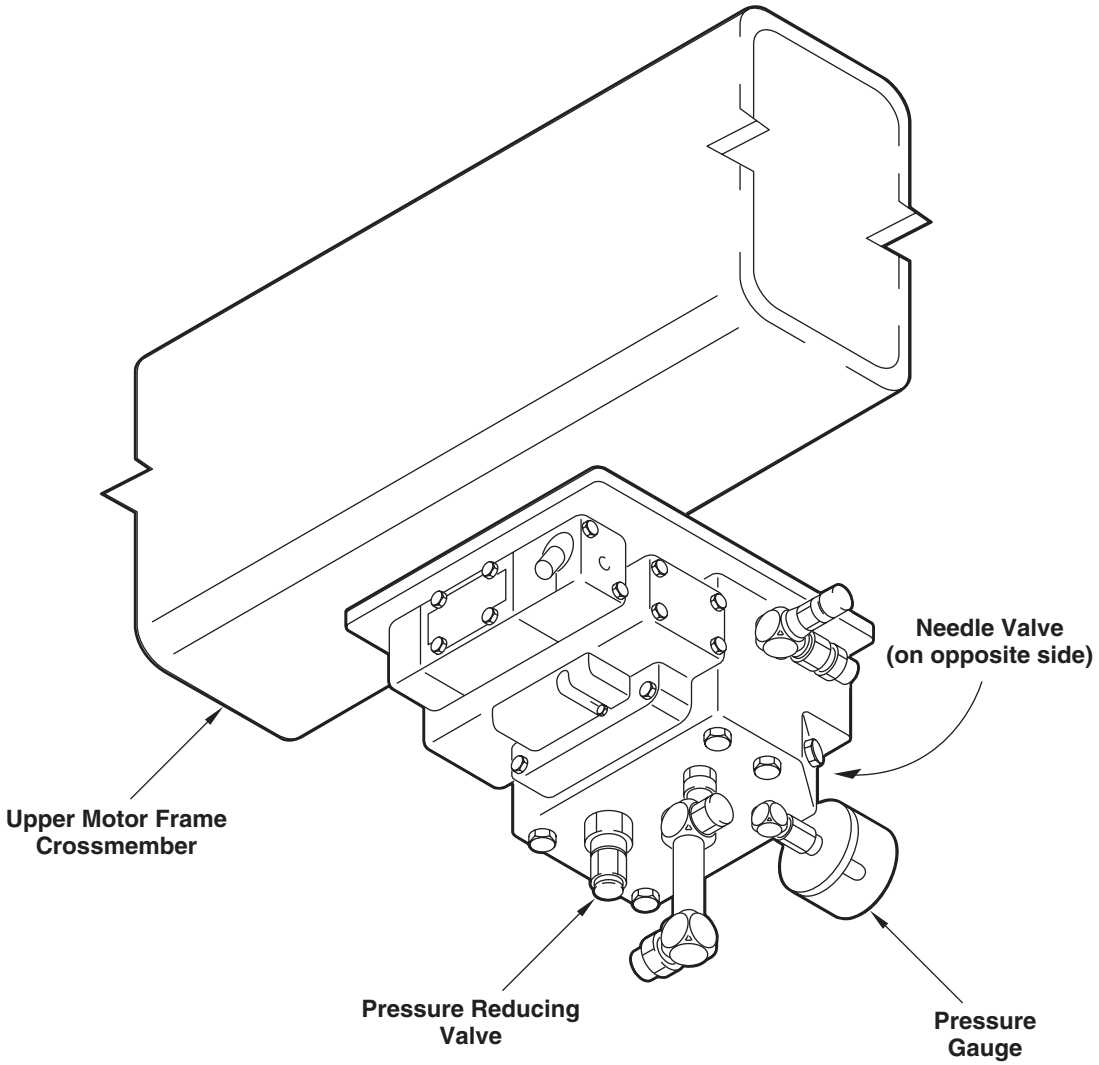
# Adjustment procedures

## Adjusting the counterbalance system

Leave the hydraulic power unit on during the entire adjustment procedure, and disconnect the TDS from the drill string near the bottom of the rails, but well off the stops.

1. Remove the caps and loosen the lock nuts on the needle valve and pressure reducing valve located on the counterbalance manifold. It is not necessary to remove the front guard for access to the manifold. A small amount of oil will leak around the adjusting stems after removing the caps.
2. Open the needle valve and let the stem circulate for two minutes. Crack both upper cylinder fittings and bleed air from system. Tighten the fittings. Close the needle valve.
3. Using a hex wrench, screw in the pressure reducing valve until the cylinder retracts, raising the TDS.
4. Slowly back out the pressure reducing valve. The pressure decreases and the cylinder rods begin extending. When the integrated swivel bail contacts the hook, note the pressure on the gauge. Allow the pressure to decrease an additional 25 psi and tighten the locknut. Replace the caps on the valve adjustment stem.

# Adjustment procedures



# Adjustment procedures

## Adjusting the motor alignment cylinder system

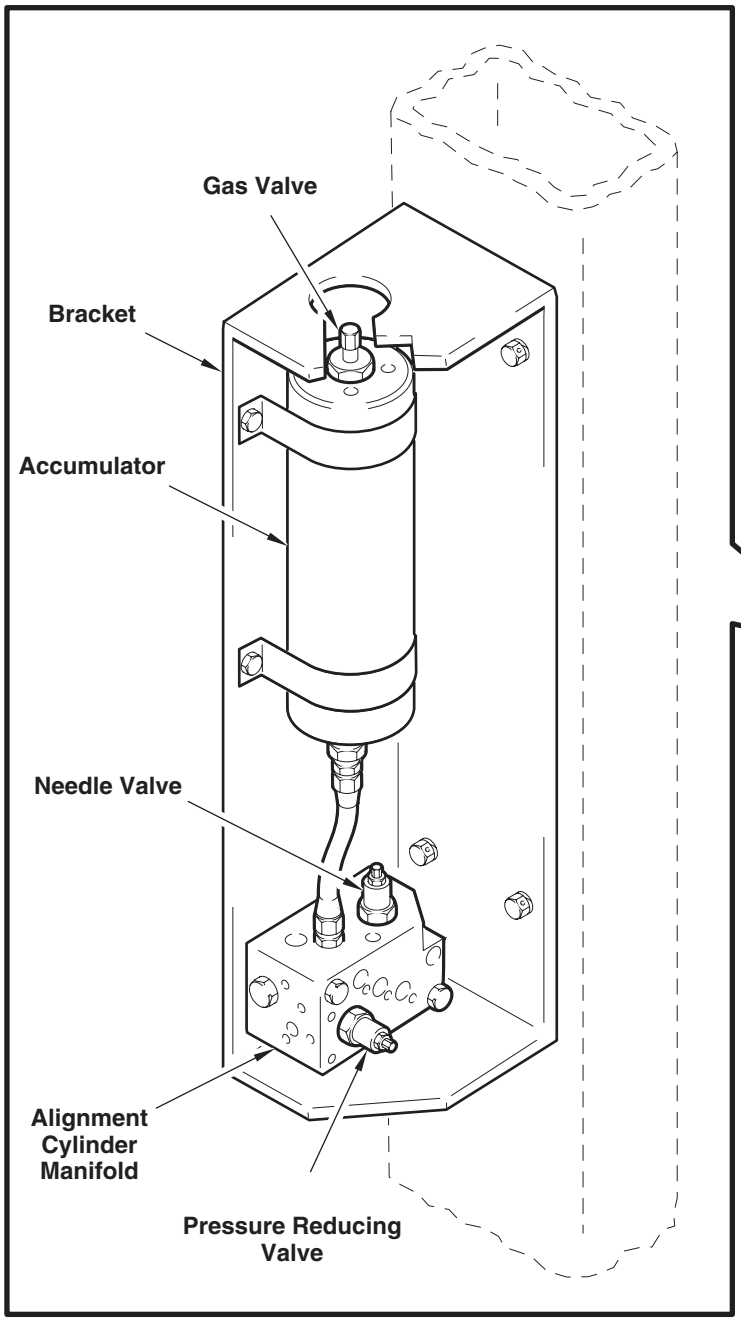
Once the alignment cylinder is installed, use the following procedure to properly adjust the motor alignment before operating TDS.

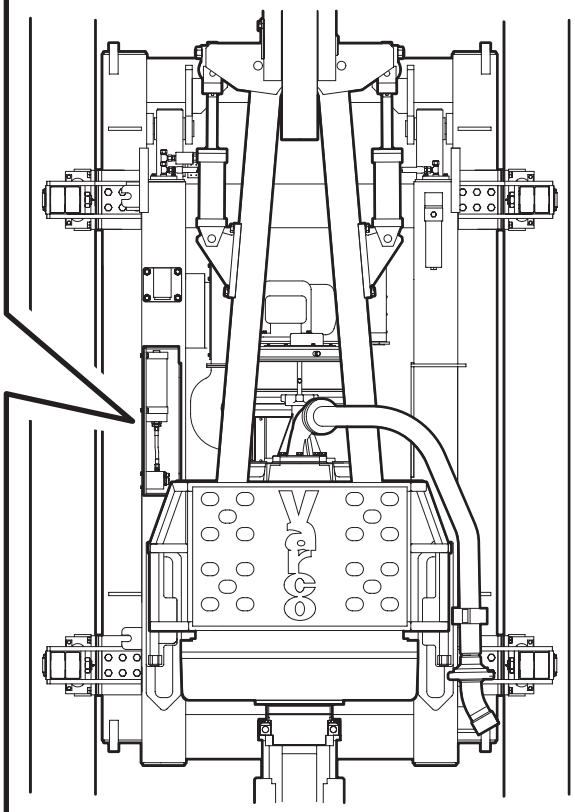
***Warning: accumulators are pressure devices. Bleed down system pressure before performing maintenance to these types of components. Failure to do so can cause serious injury.***

1. With the hydraulic power unit turned off, bleed down the alignment cylinder accumulator by opening the needle valve located at the alignment cylinder valve manifold.
2. Remove the shipping brace from the motor alignment cylinder (Figure 26).
3. Turn on the power unit and allow the system to circulate for approximately two minutes.
4. Close the needle valve.
5. Open the two flow control valves located at the alignment cylinder supply return lines 1-1/2 turns off their seats.

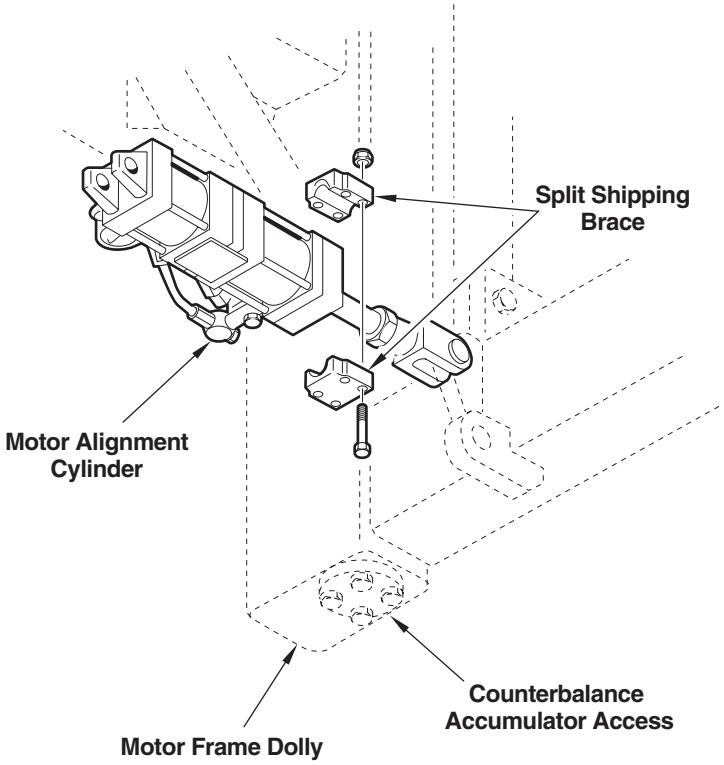
*The pressure setting is adjusted by screwing the pressure reducing valve in or out with a hex wrench. Screwing in the valve increases pressure and moves the saver sub toward the rails. Backing out the pressure reducing valve reduces pressure and moves the saver sub away from the rails (see additional notes at the end of this procedure).*

# Adjustment procedures



# Adjustment procedures




6. Verify the correct pressure setting using the following procedure:
   a. With the power unit on, back down the pressure using the pressure reducing valve (PRV) until the saver sub begins to pivot away from the rails. Record this pressure.
   b. Slowly increase the pressure until the saver sub no longer moves closer to the rails as pressure increases. At this time, the cylinder should be in a “dead band” area.
   c. Slowly increase the pressure until the saver sub begins to move toward the rails again. Record the pressure reading when this occurs.
   d. To determine the correct pressure setting, add the average pressure readings from steps a and c above and divide by two. The resulting pressure “dead band” provides equal pre-load in each direction – both toward and away from the rails.
   e. Record the pressure setting for future reference.
7. Set a joint of drill pipe in the slips.

8. Bring the top drive down as if stabbing the saver sub into the box. The pin and the box should be in alignment so that the OD of the pin clears the shoulder of the box. If adjustment is necessary, use the following procedure:
   a. Measure how far and in what direction (toward or away from the rails) the pin must move to line up with drill pipe box.
   b. Turn off the hydraulic power unit and bleed down the alignment cylinder accumulator. This allows the motor alignment cylinder to relax and the motor to rotate on its trunnions, until the swivel contacts the motor frame.
   c. Loosen the lock tab and jam nut on the cylinder clevis.
   d. Use a wrench on the cylinder rod flats to screw the rod into or out of the clevis, in the same direction the saver sub pin is to be moved. A 1/4 in. of pin movement results from a 3/4 turn of the rod. The alignment cylinder rod extension should be 2 3/8 ± 1/8 in. gland to rod threads when the system is properly aligned.
   e. Secure the jam nut and lock tab.
   f. The nominal position of the two flow control valves is 1-1/2 turns off their seats. Should heavy drill pipe vibration be encountered, first attempt to control it with non-rotating stabilizers in the casing close to the surface. If motor movement becomes excessive due to continued vibration (more than 1/2 in. of cylinder stroke), the flow control valves may be closed to 3/4 turn off their seats.
   g. Tighten the lock nuts and replace the caps on all valve stems.

*If the alignment cylinder is removed for service, install the alignment cylinder replacement brace to support the motor housing assembly while continuing to operate the TDS. After reinstalling the alignment cylinder, use the three bleed holes (located along top of cylinder barrel) to remove air trapped in the cylinder.*

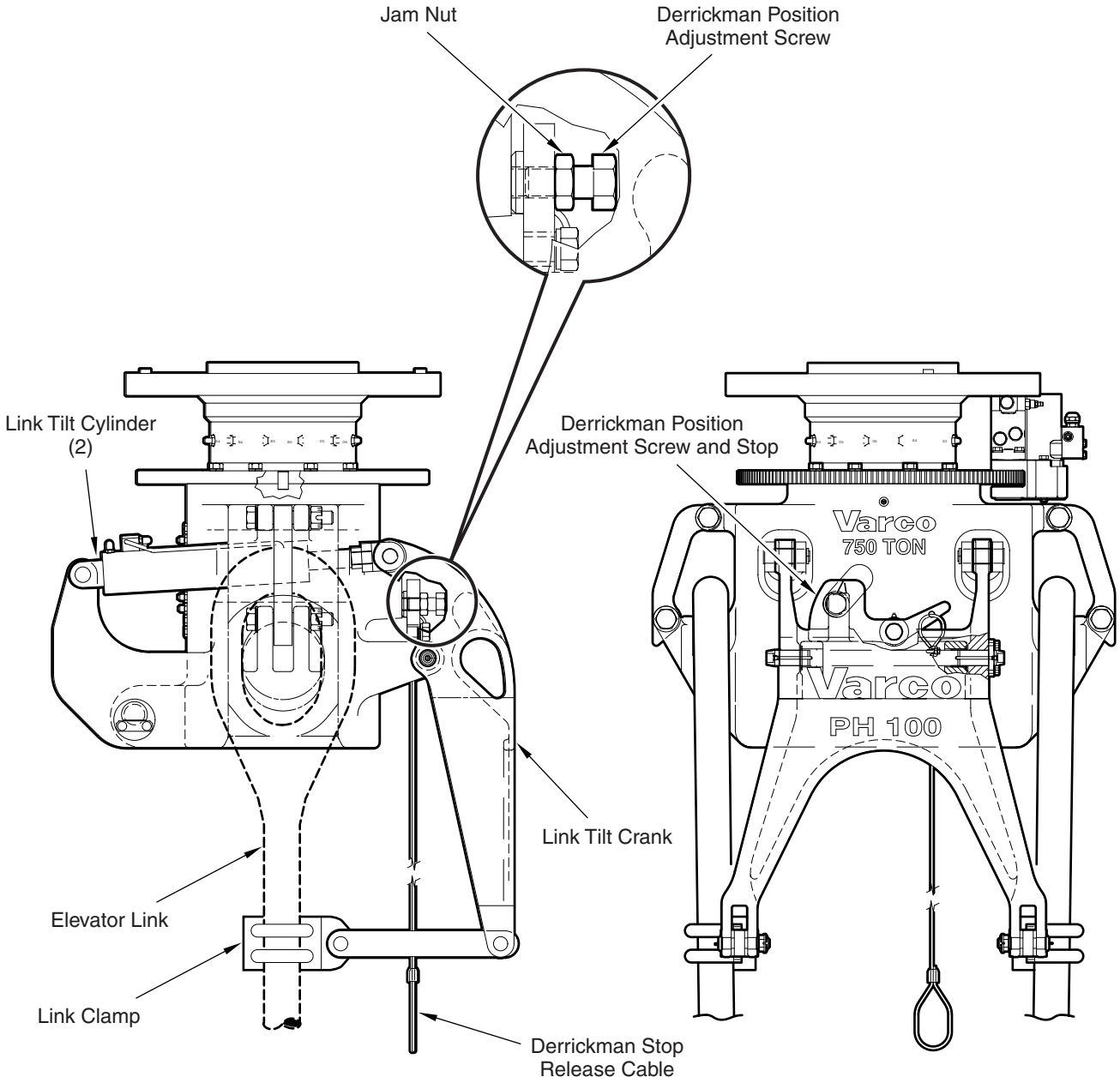
*Rail spacing and setback from the centerline of the well must be held within recommended tolerances in order to maintain vertical alignment of the TDS.*

# Adjustment procedures

## Adjusting the PH-100 link tilt

The derrickman position adjustment screw and stop limit the link travel to the mousehole position. When the top drive is at the finger board level and the links are tilted out toward the monkeyboard, the elevator must not interfere with the monkeyboard.

To adjust the link tilt to the above position, adjust the derrickman position adjustment screw. Screwing it in (CW) increases the elevator travel, and screwing it out (CCW) decreases the elevator travel. After making the adjustment — when the links are at the proper derrickman's position — tighten the jam nut.



# Adjustment procedures

## Precharging the counterbalance system

Please read these instructions completely before precharging, making note of the special cautions at the end of the section.

1. Use an inert gas such as Nitrogen for precharging accumulators. If oil-pumped is not available, use dry, water-pumped Nitrogen gas.

2. Before precharging, make certain:

   a. The accumulator end caps are screwed flush into the accumulator body.

   b. The gas valve is screwed in tight.

   c. No oil remains trapped the top end of the accumulator.

   3. Remove the gas valve protector and the gas valve cap.

   4. Attach the charging hose to the nitrogen bottle and to the gas valve using the following procedure:

   a. Use thread sealing and lubricating compound on the pipe threads of the gauge.

   b. Back the gas chuck stem completely out of the way before attaching the assembly to the accumulator gas valve.

   c. Use a wrench to tighten the gas chuck swivel nut onto the gas valve. Close the bleeder valve.

   d. Turn the gas chuck stem all of the way down, depressing the core in the accumulator gas valve.

   e. Only crack open the nitrogen bottle valve to slowly fill the accumulator. Shut it off when the gauge indicates 900 psi.

   f. If the 900 psi precharge pressure is exceeded, make sure the nitrogen bottle valve is closed, then open the bleeder valve (opposite the gas valve below the gauge) slightly, but only momentarily, to reduce pressure.

   g. Before loosening the swivel nut, turn the gas chuck stem out all of the way, then open the bleeder valve.

   h. Prevent the gas valve from turning, loosen swivel nut, and remove the assembly.

5. When precharging is complete, replace the cap on the gas valve and install the gas valve protector.

***Do not loop or twist hose as it stiffens when gas pressure is released from nitrogen bottles.***

***Never loosen the swivel nut attached to the gas valve in the accumulator without first backing the gas chuck stem all of the way out.***

***Do not reduce accumulator precharge by depressing valve core (high pressure may rupture rubber valve seat). Instead, slowly turn gas valve out until gas begins to escape through bleed hole drilled through threads of valve. This hole is a safety feature, it warns of stored pressure whenever gas valve is being removed. Install new gas valve O-ring each time gas valve is removed.***

# Disassembly and assembly

## Precautions

***Only authorized Varco repair technicians should perform the following major disassembly and assembly procedures.***

***Transport hydraulic components to a clean, dust-free service area before disassembling for service.***

*Disassembly procedures are usually performed when replacing damaged components that are causing a tool function to fail. Whenever performing a disassembly, practice preventive maintenance by:*

- ❏ Cleaning and inspecting all disassembled parts.
- ❏ Replacing all worn and damaged parts before they can cause another failure.
- ❏ Installing thread protectors on exposed threads.

*Torque all fasteners to the limits given in DS 00008 (Design Specification Design Torque Standard) unless an alternative torque value is given in the procedure.*

# Disassembly and assembly

## PH-100 Pipehandler

### Removing the PH-100 Pipehandler

Remove the PH-100 Pipehandler to service the following components:

- ❑ Stem
- ❑ Stem seals
- ❑ Rotating link adapter

***Release all hydraulic oil pressure before disconnecting hydraulic lines. Hydraulic oil under pressure can penetrate skin and cause serious injury.***



***Before opening the hydraulic system, thoroughly clean the work area, and maintain system cleanliness by promptly capping all disconnected lines. Dirt is extremely harmful to hydraulic system components and can cause equipment failure and subsequent injury to personnel.***

*To protect the rotating link adapter seals and inner surfaces, remove the stem along with the rotating link adapter.*

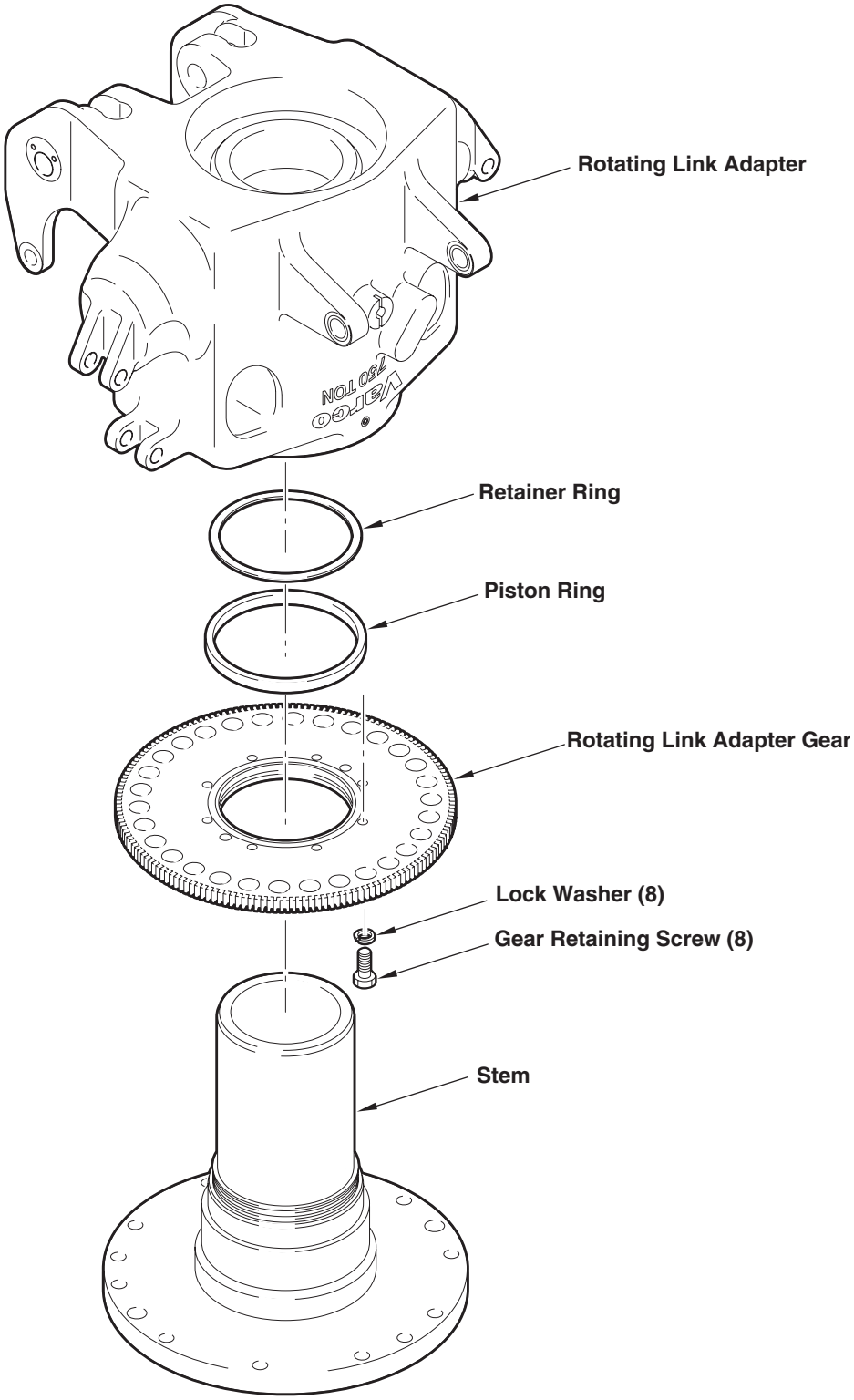
*Contact the nearest Varco Service Center for details about building an appropriate stand for removing the rotating link adapter.*

### Disassembling the rotating link adapter

Use the following procedures to disassemble the rotating link adapter:

1. Remove the elevator links and the BNC drill pipe elevator.
2. Disengage and remove the shot pin (see *Shot pin assembly*).
3. Disconnect the hydraulic lines and cap all connections.
4. Remove one of the torque backup clamp cylinder gate hinge pins and open the gate.

# Disassembly and assembly



# Disassembly and assembly

5. Remove the hose assemblies, link tilt crank, and the two link tilt cylinders.
6. Rotate the rotating link adapter 180° from well center.
7. Remove the pin attaching the torque arrestor to the rotating link adapter and pull back the torque arrestor assembly using a tugger line.
8. Remove the upper IBOP crank assembly.
9. Remove the two lower tool joint locks (see *Tool joint locks*).
10. Remove the IBOP actuator shell.
11. Remove the upper tool joint lock (see *Tool joint locks*).
12. Drain the transmission oil from the housing.
13. Lower the top drive until the bottom of the rotating link adapter just rests on a stand or blocks.
14. Remove the load collar from the drive stem (see *Load collar*).
15. Remove the screws holding the rotating link adapter to the main housing.
16. Raise the top drive slowly.
17. Transport the rotating link adapter to a suitable work area.
18. Support the rotating link adapter assembly on a work table with the link tilt crank side up.
19. Remove the safety wire and screws that hold the gear and stem assembly to the rotating link adapter body.
20. Attach two lifting slings to the bottom of the rotating link adapter body (at the link attachment points) and slowly raise the rotating link adapter body to separate it from the stem and gear assembly.
21. Set the rotating link adapter body on a suitably protected surface.

*Protect the internal surfaces of the rotating link adapter body and the surfaces of the stem when separating the two components. When removing the rotating link adapter from the stem, carefully tap it with a mallet. There can be misalignment between the two bores when raising the stem and gear assembly.*

# Disassembly and assembly

22. Prepare a work area to stand up the stem and gear assembly on the bottom surface of the stem.
23. Remove the retainer ring under the piston ring from the stem and gear assembly.
24. Remove the piston ring and the gear. This may require light tapping on the top of the rotating link adapter gear, with the gear sitting on the piston ring.
25. Check for wear on the stem sealing diameter.

The piston ring is assembled with a light press fit. Provide a support under the gear so that it does not drop when it breaks loose.

26. Remove and discard all rotary seals, O-rings, thrust ring, and wear bushings from inside the rotating link adapter and gear inside diameter.
27. Remove and discard the stem flange O-rings and stem bore shaft seals.

## Assembling the rotating link adapter

1. Orient the stem so the stem flange is down on a suitably protected surface.
2. Install the gear with its rotating seal and wiper in place.
3. Install the O-ring for the piston ring.
4. Heat the piston ring to 175-200°F and install the ring.
5. Install the retainer ring.
6. Install all of the rotary seals on the rotating link adapter, and an O-ring on the top surface.
7. Install the two wear bushings and the thrust ring in the rotating link adapter.
8. Clean and then lubricate (with hydraulic oil) the sealing surface of the stem and the inside diameter of the rotating link adapter.
9. Attach two lifting slings through the link attachment points on the bottom of the rotating link adapter body and slowly lower it onto the stem and gear assembly.

Make sure the seals do not twist in the grooves.

# Disassembly and assembly

10. Line up the dowel pin holes, replace all of the screws and safety wire.
11. Install the link tilt cylinders, pin, and secure in place.
12. Install the link tilt crank, pin, and secure in place.
13. Install all hose assemblies
14. Invert the rotating link adapter assembly so that the stem flange is up.
15. If the oil seal is damaged, install a new seal inside the stem bore with the seal lip facing up.
16. Use care not to damage the seal or the case.
17. Install new O-rings on the stem flange.
18. Install the load collar onto the drive stem (see *Load collar*).
19. Grease the walls of the bore in the main body, the stem seals, and the rotating link adapter O-rings.
20. Position the rotating link adapter using the stand or blocks from the assembly procedure.
21. A light coating of grease applied to the lip seals will help in installing the rotating link adapter assembly into the top drive main body.
22. Using three 5/8-11 UNC bolts, pull the rotating link adapter to the main body and completely seat the rotating link adapter into the bore.
23. Install screws to secure the rotating link adapter to the main body.
24. Install the upper tool joint lock (see *Tool joint locks*).
25. Install the IBOP actuator shell.
26. Install the two lower tool joint locks (see *Tool joint locks*).
27. Install the upper IBOP crank assembly.
28. Pin the torque arrestor to the rotating link adapter.
29. Position the drill pipe elevator and links, and pin the link tilt levers to the link clamps.
30. Close and pin the torque backup clamp cylinder gate.

# Disassembly and assembly

Always install a new stem flange O-ring and use care not to damage the O-ring or the case.

*A light coating of grease applied to the lip seals will help in installing the rotating link adapter assembly into the top drive main body.*

## Shot pin disassembly/assembly

Use the following procedure to disassemble the shot pin assembly:

1. Disconnect the hydraulic lines and cap all connections.
2. Remove the four 3/4 in. capscrews that attach the shot pin assembly to the rotating link adapter.
3. Remove the shot pin assembly from the rotating link adapter gear.
4. Remove the four 1/2 in. capscrews and lockwashers that hold the end cap in place.
5. Separate the shot pin housing from the end cap and hydraulic motor.
6. Using air through the end port on the shot pin housing, remove the shot pin.
7. Replace all seals and O-rings.
8. Lubricate the shot pin, shot pin sleeve, and all new seals with hydraulic oil prior to assembly.

Assembly is performed in reverse order of disassembly.

# Disassembly and assembly

## Link tilt disassembly/assembly

Use the following procedure to disassemble the link tilt assembly:

1. Shutdown power and bleed the system.
2. Remove the two U-bolts from the link clamp.
3. Unclamp the links and remove them.
4. Disconnect the hydraulic lines from the link tilt cylinders and cap all connections.
5. Unpin and remove the link tilt cylinders.
6. Unpin and remove the link tilt crank.

Assembly is performed in reverse order of disassembly.



## Load collar disassembly/assembly

### Disassembly

Use the following procedure to disassemble the load collar:

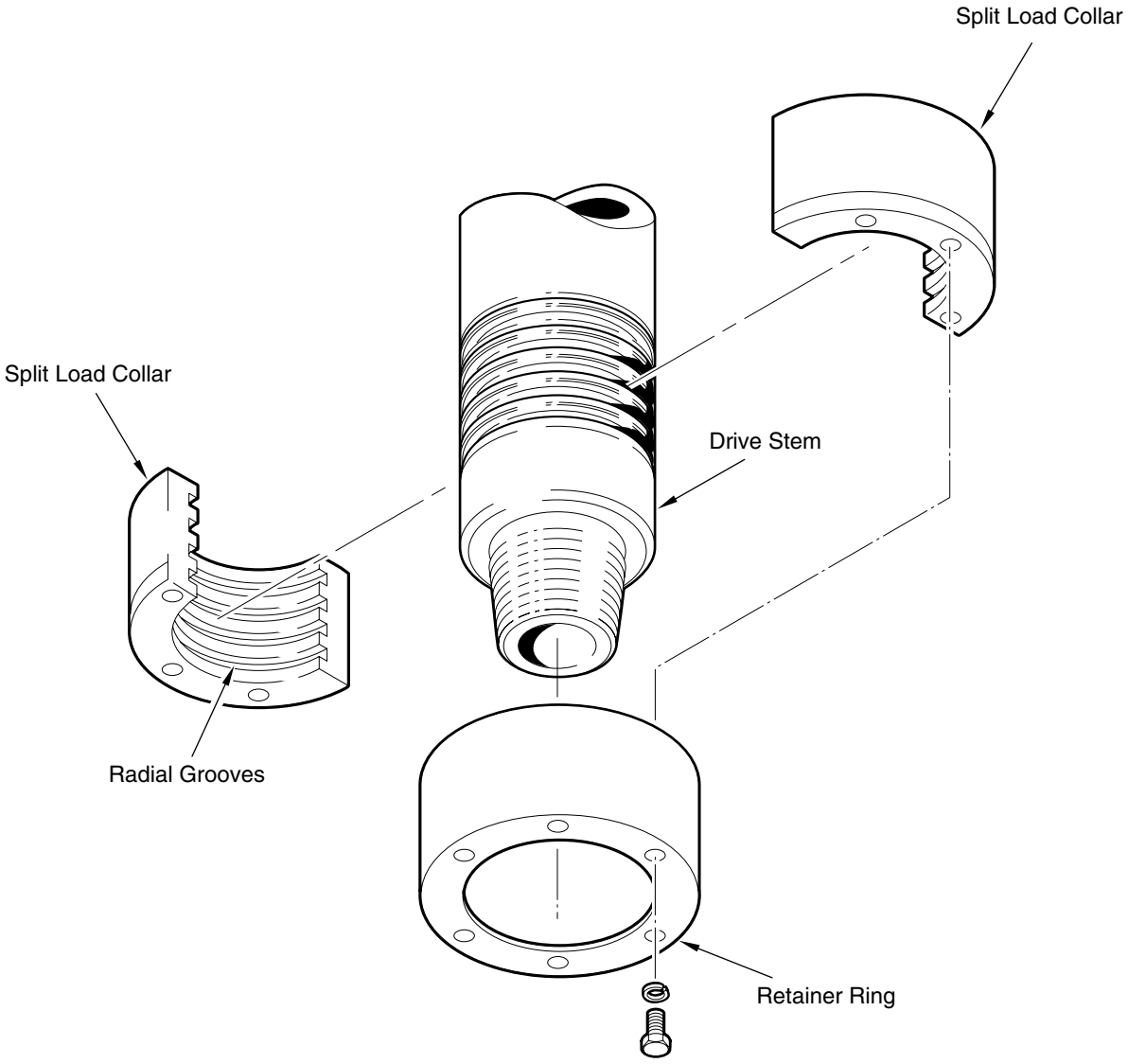
1. Remove the tool joint lock between the drive stem and the upper IBOP valve (see the *Tool joint locks* section).
2. Remove the IBOP valves.
3. Remove the safety wire and screws from the retainer.
4. Slide the retainer ring down and off the drive stem.
5. Remove the load collar halves.
6. Slide the retainer off the drive stem.

### Assembly

Use the following procedure to assemble the load collar:

1. Coat the load collar halves with a generous amount of water resistant grease.
2. Place the load collar halves on the drive stem so that the tapped holes are on the bottom.
3. Grease the inside diameter of the retainer ring.
4. Slide the retainer ring over the load collar halves.
5. Replace the screws and lockwashers, tighten them in accordance with *Design Specification, Design Torque Standard* (DS00008), and safety wire the screws.

# Disassembly and assembly



# Disassembly and assembly

## IBOP actuator cylinder and yoke disassembly/assembly

Use the following procedure to disassemble the IBOP actuator cylinder and yoke:

1. Shutdown the power and bleed the system.
2. Remove one gate hinge pin, open the gate, and pull back the torque arrestor assembly, using a tugger line.
3. Disconnect the hydraulic lines from the IBOP actuator cylinder and cap all connections.
4. Unpin and remove the IBOP actuator cylinder and yoke.
5. Replace hydraulic lines as necessary.
6. Disassemble the cylinder and replace seals as necessary.



*Use the recommended spanner wrench to remove the rod gland seal.*

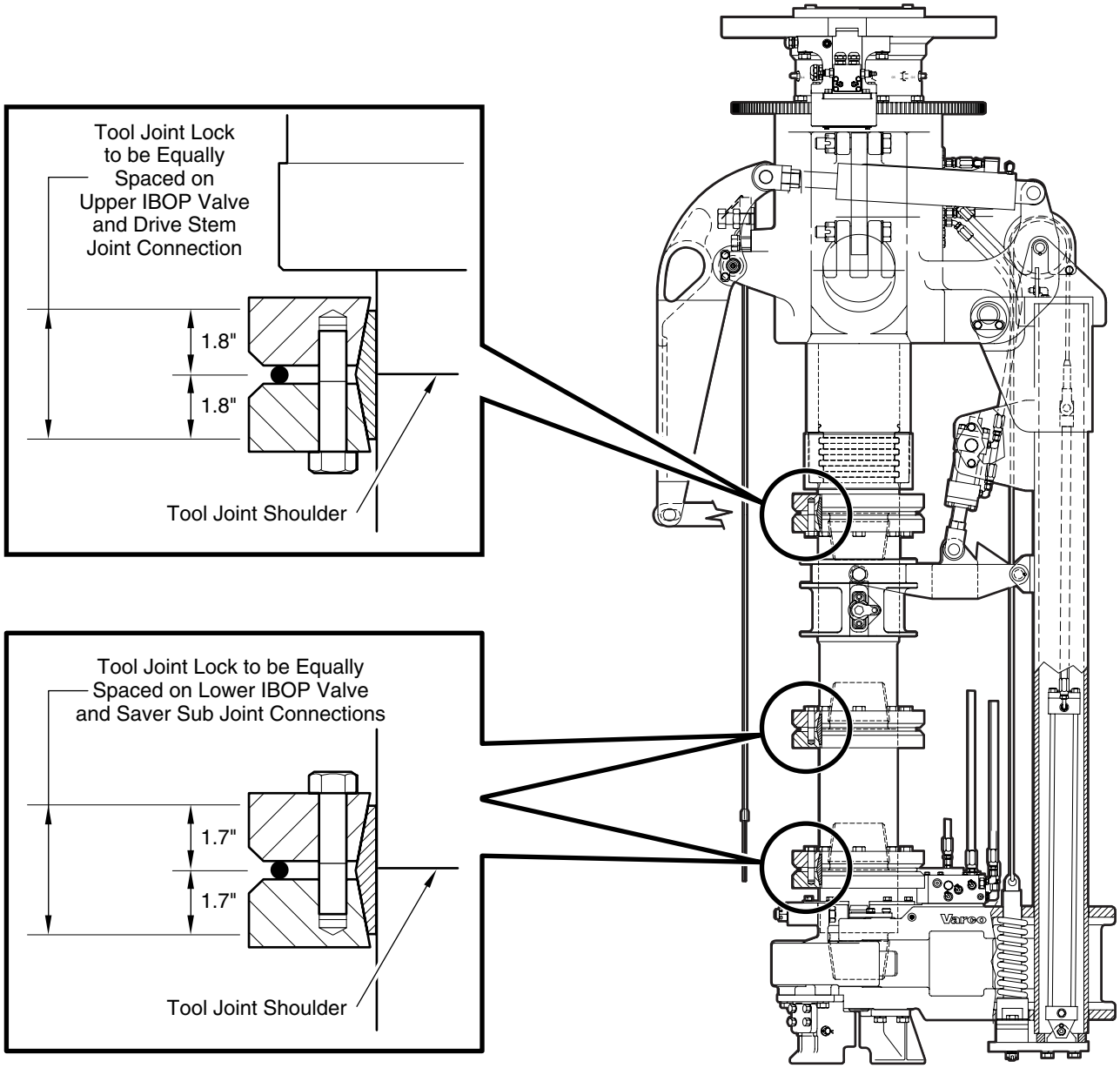
Assembly is performed in reverse order of disassembly.

## Tool joint lock disassembly/assembly

Use the following procedures to disassemble/assemble tool joint locks:

**Disassembly**

1. Gradually release the locking screws all the way around. Initially release each screw about a quarter of a turn, avoiding tilting and jamming the collars. Do not remove the screws completely at this time, otherwise the collars may spring off.
2. Remove any rust formed or dirt collected adjacent to the tool joint lock. Once the screws are loose, remove the tool joint lock from the saver sub, IBOP valves, and drive stem.


Tool Joint Lock
to be Equally
Spaced on
Upper IBOP Valve
and Drive Stem
Joint Connection
1.8"
1.8"
Tool Joint Shoulder
Tool Joint Lock to be Equally
Spaced on Lower IBOP Valve
and Saver Sub Joint Connections
1.7"
1.7"
Tool Joint Shoulder
Varco

# Disassembly and assembly

**Assembly**

1. Lubricate the locking screw threads, screw head bearing area, and the tapers of the inner rings with molybdenum disulfide grease such as Molykote Gn paste.
2. Clean the IBOP valves, drive stem, and saver sub surfaces thoroughly. Make sure these surfaces are smooth and free of grease and oil. If high spots exist, remove them with a file or light grinding.
3. Slide the tool joint lock over the drive stem, IBOP valves, and saver sub.
4. Locate the tool joint lock symmetrically at each joint.

***Never tighten locking screws before the tool joint lock is at the correct location, otherwise it will not slide freely.***

5. Take any four locking screws equally spaced and tighten them to establish parallel or perpendicular position of the tool joint lock collars relative to the drive stem, IBOP valves, and saver sub respectively. This properly seats the collars on the taper of the inner ring and aligns the collars.
6. Using a torque wrench, tighten all locking screws gradually in either a clockwise or counterclockwise sequence (not in a diametrically opposite sequence). Continue tightening all of the screws until they reach 362 ±5 ft lb.

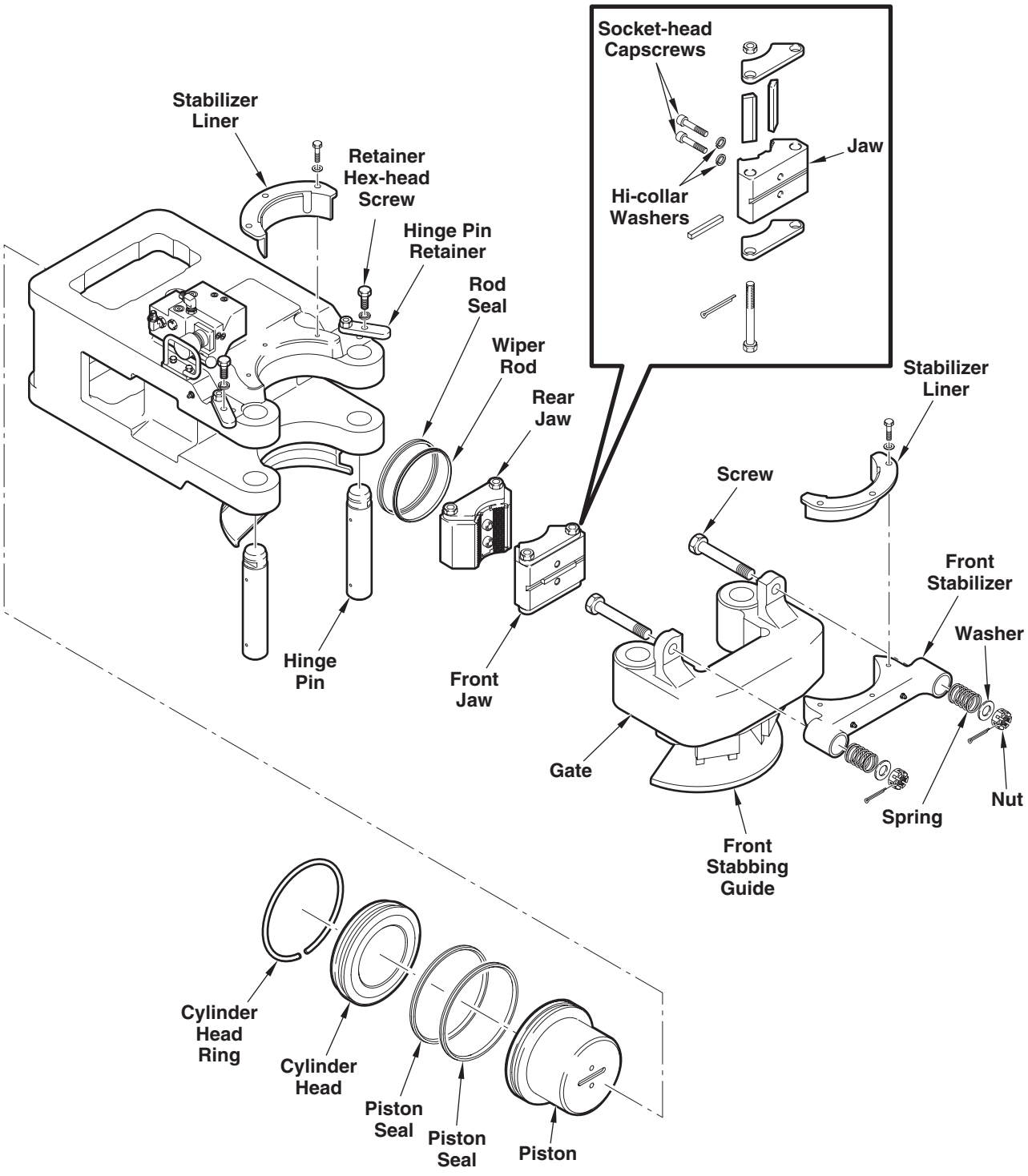
# Disassembly and assembly

## Torque backup clamp cylinder, gate, and jaws disassembly/assembly

Use the following procedures to disassemble/assemble the torque backup clamp cylinder, gate, and jaws:

1. Shutdown the power and bleed the system.
2. Disconnect the hydraulic lines on the torque backup clamp cylinder body and cap all connections.
3. Support the torque backup clamp cylinder body with the torque arrestor.
4. Remove the two wire rope clips and the sheave guard.
5. Remove the four hex-head capscrews and lockwashers that hold the spring retainer plate in place.
6. Remove the spring retainer plate with the lift cylinder.
7. Slowly raise the torque arrestor off the torque backup clamp cylinder and move the torque backup clamp cylinder to a suitable work area.
8. Remove the two stabilizer liners.
9. Remove the two hinge pin retainer hex-head screws.
10. Swing out the two hinge pin retainers.
11. Remove the two hinge pins.
12. Remove the gate, front jaw, front stabilizer, and front stabbing guide.
13. Remove the two socket-head capscrews and hi-collar washers from the front jaw.
14. Remove the front jaw from the gate.
15. Repeat steps 13 and 14 for the rear jaw.
16. Remove the two screws, springs, and the stabilizer from the gate.
17. Push the cylinder head in enough to relieve the load on the cylinder head ring. Remove the cylinder head ring.

# Disassembly and assembly



# Disassembly and assembly

***When removing the cylinder head ring use caution. The split ring must be pried out and can spring out if not careful.***

18. Slowly pull out the cylinder head using the threaded holes. Remove and discard the piston seal.
19. Carefully push the piston out of the body. Remove and discard the piston seal.
20. Remove the wiper rod and rod seal from the body. Discard the seals.
21. Clean the piston, cylinder head, and the body. Clean and lightly lubricate the new seals and seal surfaces prior to reassembly.

*Use the recommended spanner wrench to remove the rod gland seal.*

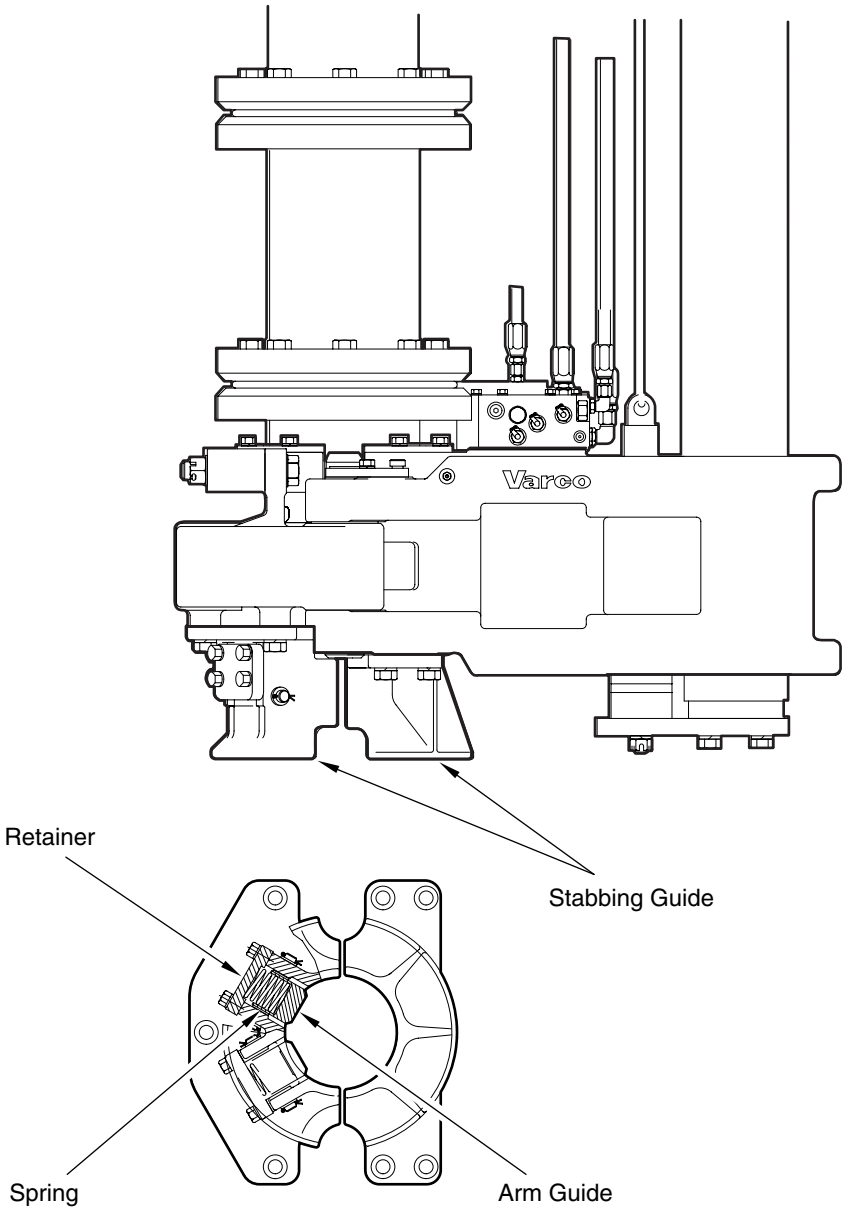
Assembly is performed in reverse order of disassembly.

# Disassembly and assembly

## Stabbing guide disassembly/assembly

To disassemble the stabbing guide, remove the four screws and safety wire from the gate stabbing guide spring retainer.

Assembly is performed in reverse order of disassembly.



# Disassembly and assembly

## Removing the motor assembly from the guide dolly

You can perform some service procedures on top drives (i.e. upper drive stem bearing and seal, brake or locally mounted cooling system) without removing the drilling motor assembly from the dolly. If service is required on the lower end (i.e. gear set, lower bearings or seals), the drilling motor must be removed from the dolly.

1. Set TDS down horizontally on a good flat surface.
2. Make sure that none of the components protrude past the guide dolly roller brackets before setting the TDS down. If so, block up the guide dolly accordingly.
3. Disconnect all wiring and hoses between transmission and guide dolly frame.
4. Remove any cooling ducts (heat exchanger, spark arrestor, etc.) that interfere with removing the transmission from guide dolly frame.
5. Use a suitable sling to support the weight of the TDS and motor support bonnet (approximately 10,000 lb).
6. Take up the slack and remove the trunnion blocks that hold the transmission to the guide dolly frame.
7. Hoist the transmission out of the guide dolly frame.
8. Set the TDS and motor support bonnet down on wooden chocks, being careful not to damage components.
9. Disconnect the wiring between the motor and motor support bonnet.
10. Remove the dowel pins in the motor feet.
11. Remove the four large motor bolts.
12. Lift the transmission off of the motor, angling the upper end slightly to clear the motor support bonnet, and sliding housing off of the motor toward the gearcase
13. Remove the blower and brake assemblies.
14. Reverse this procedure for reassembly.

# Disassembly and assembly

## Transmission/motor housing

### Removing the transmission/motor housing

Remove the transmission/motor housing to service the following components:

- ❑ Gears and bearings
- ❑ Main shaft
- ❑ Main thrust bearing
- ❑ Bull gear

The AC drive motor can be removed with the TDS-8SA left in place. To remove these components, skip to the applicable removal section below.



To remove the transmission/motor housing:

1. Remove the pipehandler components as described above.
2. Remove the saver sub and the lower and upper IBOPs. See the *IBOP Service Manual.*
3. Disconnect the service loop, rig down the tool, and transport the transmission/motor housing to a suitable work area. See the *Installation* chapter of the service manual for rig down procedures.

### Installing the transmission/motor housing

Perform the rig up procedures in the *Installation* chapter of the service manual.

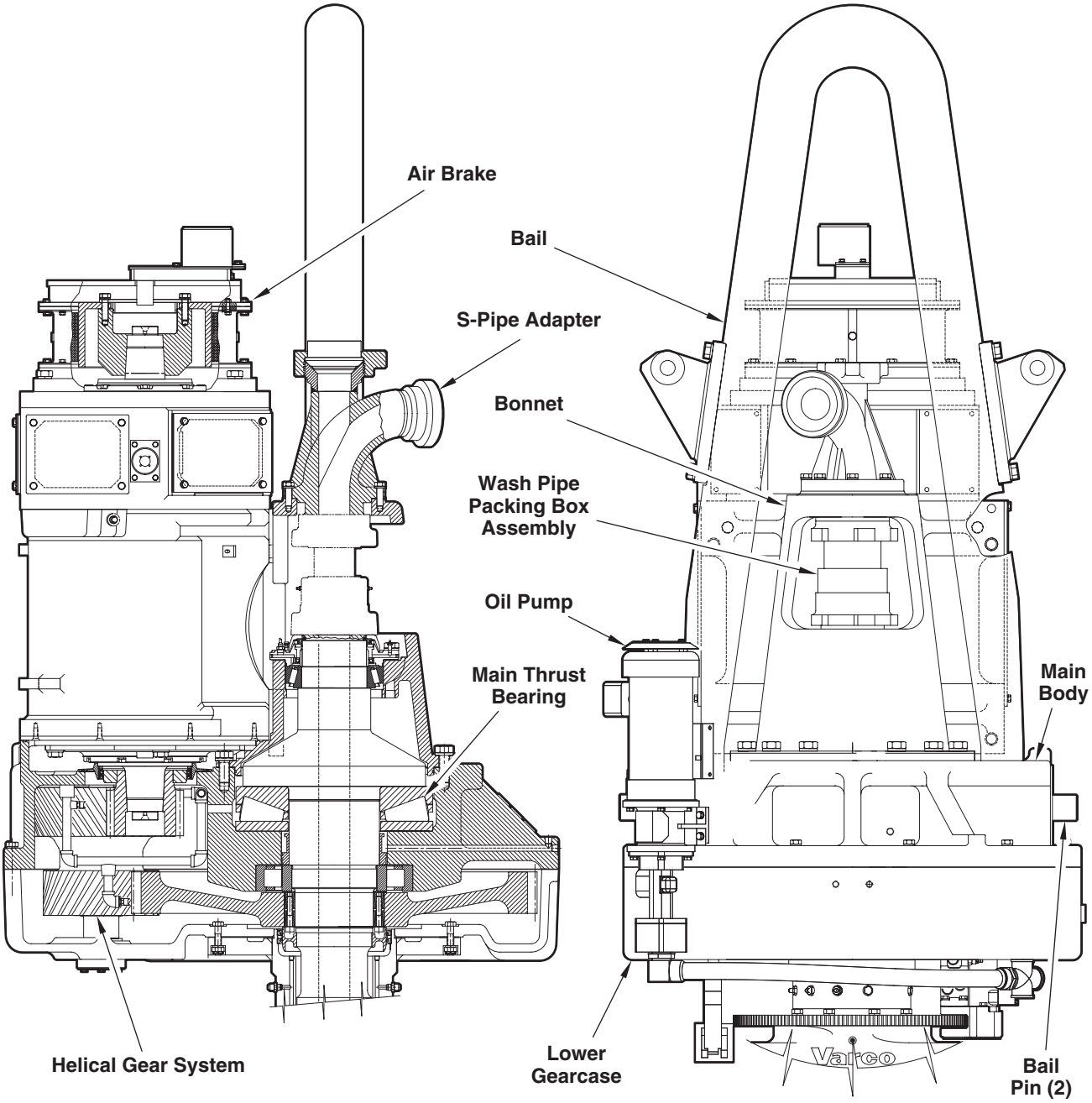
### Disassembling the transmission/motor housing

*Drain the oil from the transmission/motor housing before disassembling components.*

#### Removing the bonnet and washpipe

1. Remove bail pins and bail.
2. Remove the S-pipe and the washpipe packing.
3. Remove the capscrews and lockwashers that hold the S-pipe adapter in place and remove the adapter.

# Disassembly and assembly




4. Remove the safety wired capscrews and lockwashers that attach the bonnet to the main body cover and remove the bonnet.

5. Remove the upper stem liner on top of the main shaft using the two pry points, and remove and discard the liner seal.

6. Remove the bearing shield from the top of the main shaft.

# Disassembly and assembly

Once the unit has been disassembled, inspect the following assemblies for any wear or damage that may be critical:

1. Gear set: Check the teeth and splines for chips or heavy wear. The wear pattern should be even and symmetrical. If not, replace it. Expect some small surface pitting. It is not cause for replacing the gear set.
2. Bearings: Clean thoroughly in solvent, then rotate and listen for any roughness during rotation.
3. Main shaft: Check splines and tool joints for wear. Replace the shaft if spline wear exceeds 0.090 in.
4. Main shaft: Check fit to bull gear, wear sleeve surfaces and retaining threads.
5. Seals: Always replace seals and gaskets when removed.
6. Main shaft housing: The bore for the upper bearing and the pilot diameter for the lower gearcase are critical. Clean up any nicks or gouges prior to reassembly.
7. Brake: Check the brake for leakage and the pads for wear.
8. Wear sleeves: These should be free of any imperfections on the sealing surface.
9. Blower: Clean any accumulation of dust from the ducting, then operate the unit and correct any interference between the impeller and housing.



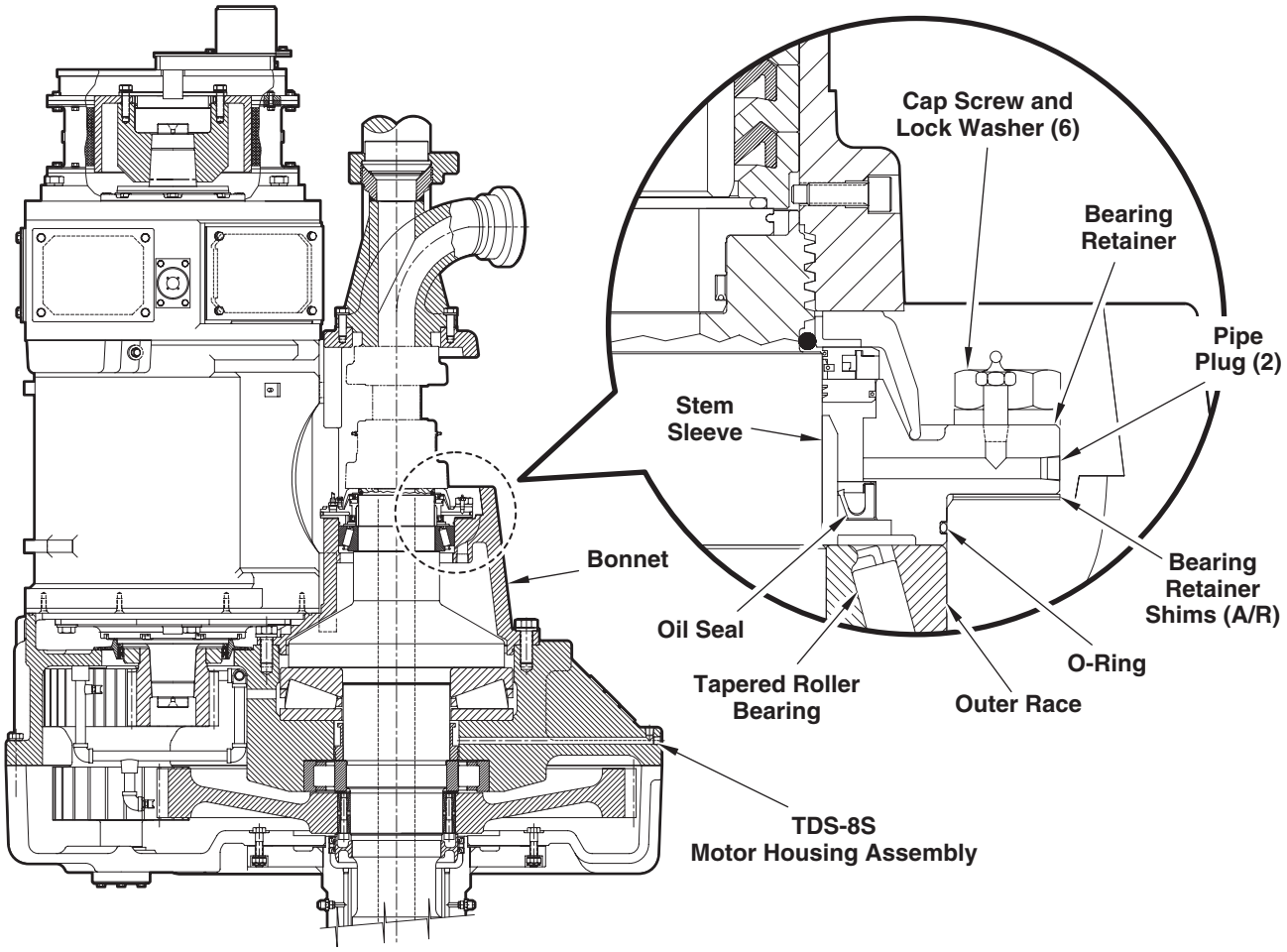
## Removing the upper bearing retainer plate

1. Remove the six capscrews and lockwashers that attach the bearing retainer plate to the main body cover and remove the plate.

*Use the two jacking holes in the upper bearing retainer plate as required to help remove the plate.*

2. Remove the lube tube from the lube tube bore of the cover, and remove the lube tube O-rings.
3. Remove and discard the two lip seals in the bearing retainer plate.
4. Remove the bearing retainer plate shims.
5. Remove the taper roller bearing outer race from the cover bore.

# Disassembly and assembly



# Disassembly and assembly

## Removing the AC drilling motor

1. Remove the capscrews and lockwashers that hold the AC drilling motor to the main body. Remove the motor by attaching handling gear to the brake end of the motor and lifting the motor off the main body cover.
2. Remove the O-rings that seal the AC drilling motor to the main body.

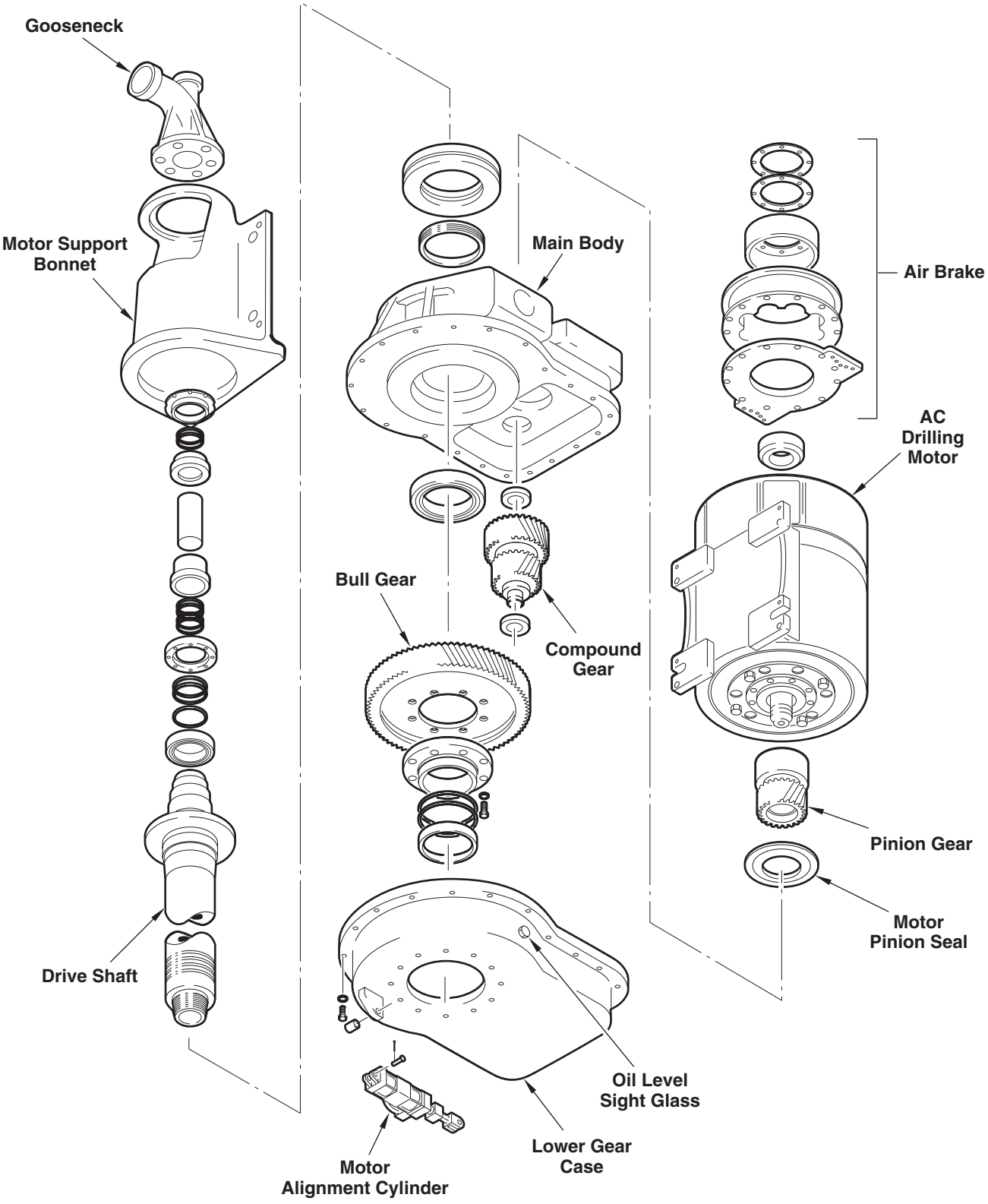
## Removing transmission components

***Facilitate bearing removal by heating bearings with an induction heater. Because this method heats quickly, and could possibly damage bearings, always use a Tempilstik or pyrometer to monitor bearing temperature.***



1. Remove the upper bearing cover and grease seal.
2. Pressurize the air brake to hold the drive mechanism in place.
3. Remove cotter pins, slotted nuts and the rotating head.
4. Remove the lower gearcase, carefully avoiding damage to the lower gearcase locator dowel pins.
5. Carefully remove the bull gear, avoiding damage to the bearing surfaces or wear sleeves. Do not remove the gear from the shaft unless you are replacing it.
6. Remove the pinion seal and retaining ring.
7. Remove the main body.
8. On the opposite end of the motor, remove the magnetic pickup and brake cover.
9. Remove the brake for service.

# Disassembly and assembly



# Disassembly and assembly

### Assembling the transmission/motor housing

***Keep the transmission bearings, shafts, and housing free of chips, burrs, and dirt during the following assembly process to prevent damage to transmission parts.***

*Varco strongly recommends replacing any bearing or gear where even the slightest wear is indicated. It is usually less expensive to replace any questionable parts found during disassembly than risk having to rebuilt the gearbox later.*

## Installing the top drive motor pinion



***Installing a pinion gear can be dangerous to personnel installing it as well as anyone witnessing the procedure. Exercise caution at all times.***

Use the following procedure to install a TDS motor pinion:

1. Clean the motor shaft by hand and cover with a thin layer of Engineer's Blue.
2. Firmly install the pinion on the motor shaft by hand. Mark reference lines on the pinion and the shaft to ensure identical angular orientation each time.
3. There must be a minimum of 75% surface contact between the pinion and motor shaft. Dress the motor shaft/pinion very lightly with a fine emery cloth and repeat the "blueing" procedure if necessary until there is at least 75% surface contact between the pinion and motor shaft.
4. After thoroughly cleaning all blueing, oil, and/or grease from the pinion bore and shaft, trial mount the cold pinion gear on the motor shaft, lining up the reference marks.
5. Make sure the fixture is clean and the "horse shoe" face and bar are parallel.
6. Place the fixture on the motor shaft with the "horse shoe" end against the inner face of the gear and the bar against the outer face of the gear, sandwiching the pinion gear in the fixture.

7. Adjust the adjusting screw to butt against the end of the motor shaft.
8. Attach a calibrated dial indicator gauge to the fixture and set to zero.
9. Back off the adjusting screw until the gauge reads 0.072 - 0.074 in. Then lock the screw in place with a locknut.
10. Remove the fixture from the pinion gear assembly.

***Do not put the fixture in the oven.***

11. Heat the pinion gear to 360° - 385°F (182° - 196°C) for three hours in an oven. After heating for three hours, remove the pinion gear assembly and immediately attach the fixture.
12. Place the pinion gear assembly and fixture on the motor shaft, lining up the reference marks.
13. Gently tap the pinion gear assembly and fixture into place until the adjusting screw butts against the motor shaft.
14. Wait 2-3 minutes and back off the nuts holding the fixture in place. There may be some noise as the pinion gear cools.
15. The pinion creeps up the shaft as it cools to the required position of 0.085 ± 0.005 in. advancement.
16. When the pinion is fully cooled, fit the fixture and check final advancement.
17. Complete the required documentation recording pinion advancement.

# Disassembly and assembly

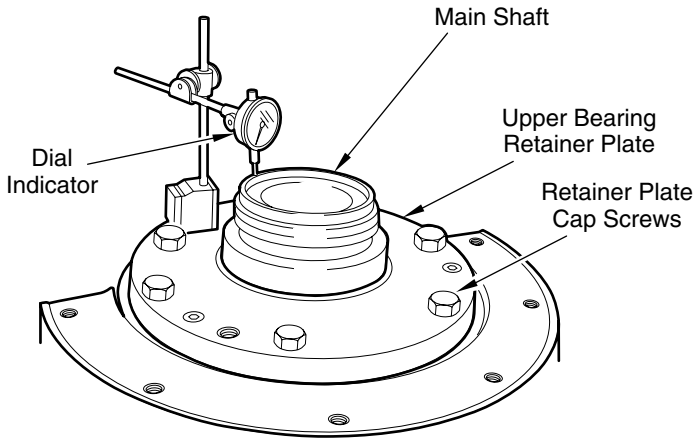
## Installing the upper bearing retainer plate

1. Grease the taper roller bearing on top of the main shaft. Chill the taper roller bearing outer race to at least 0°F (-18°C), then install the race into the cover bore.
2. Clean the retainer plate pipe plugs, apply thread sealer (not Teflon tape) to the pipe plug threads, and install the plugs into the retainer plate.
3. Determine the proper number of shims required under the bearing retainer plate by installing shims, installing the retainer plate, and checking the main shaft axial movement. Check main shaft axial movement by applying a force to the end of the main shaft and measuring the amount of axial movement at the other end with a dial indicator. Add or delete shims as necessary to obtain .001 to .002 in. of axial shaft movement (end play) with the retainer plate capscrews tightened to 250-270 ft lb.



*Align the shims so that the upper bearing lube tube bore is not blocked.*

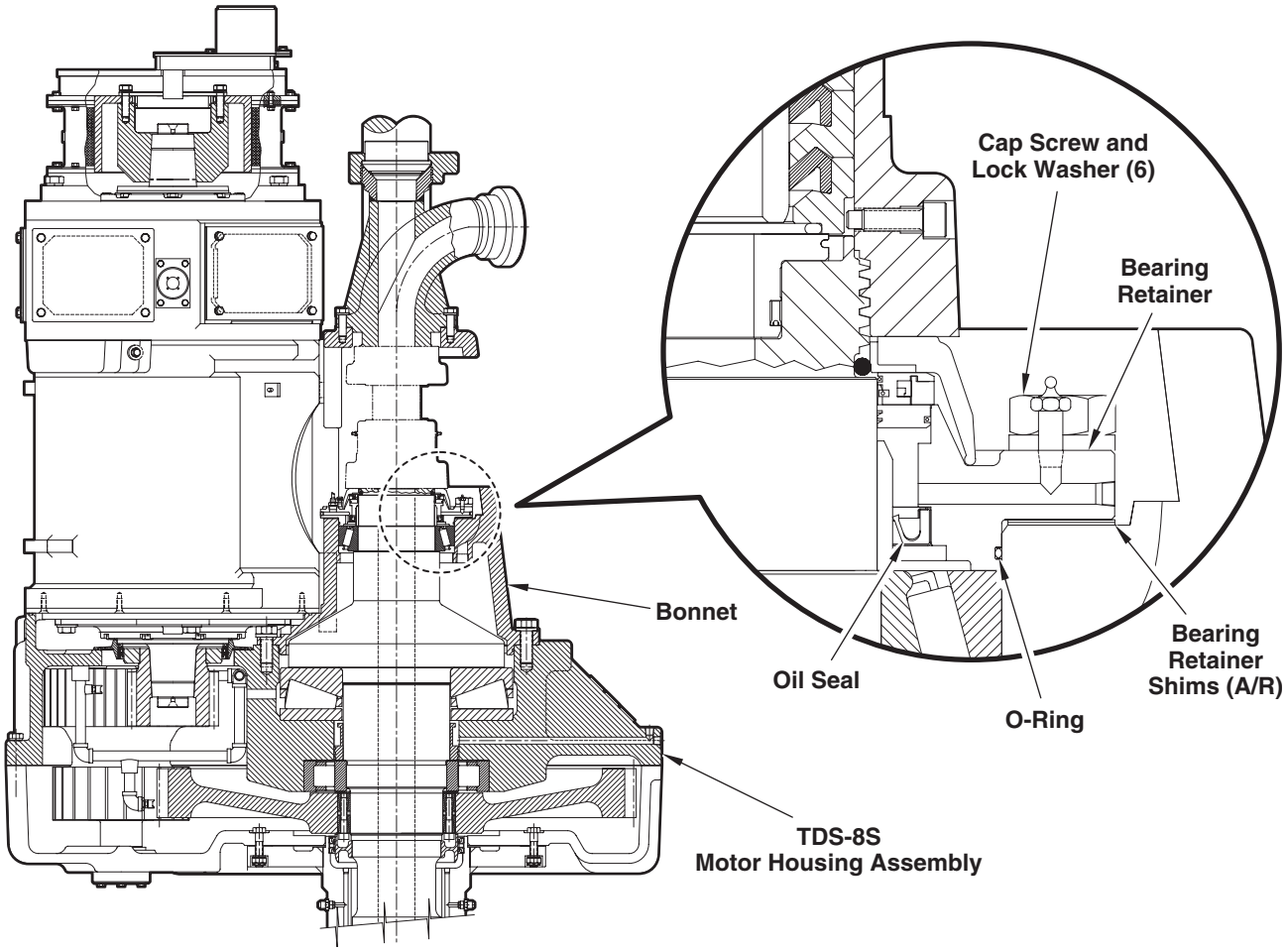
3. Remove the bearing retainer plate capscrews and the bearing retainer plate.




4. Install the two new upper bonnet oil seals in the bearing retainer plate with the lips facing up.

***Use care not to damage the seals. Be careful to install the seals with the lips facing up since these seals function to keep mud from entering the main body.***

# Disassembly and assembly




5. Using a center punch, stake the last seal in place on eight points.
6. Install the O-ring on the bearing retainer plate and coat the O-ring with grease.
7. Install two O-rings on the upper bearing lube tube and coat the O-rings with grease.
8. Install the lube tube into the lube tube bore in the cover with the .060 in. diameter hole facing up.
9. Install the bearing retainer plate, being careful to align the lube tube bore in the retainer with the lube tube protruding from the cover.
10. Carefully tap the bearing retainer plate to seat the plate on top of the cover.

# Disassembly and assembly

11. Apply an anti-seize compound to the threads of the bearing retainer plate capscrews, install the capscrews and lockwashers, and tighten to 250-270 ft lb. Safety wire the capscrews.

12. Recheck the main shaft axial movement by applying a force to the main shaft and measuring the amount of axial movement with a dial indicator. The main shaft movement must be between .001 and .002 in. If the movement falls outside of this specification, readjust the number of shims under the bearing retainer plate.

13. Install two new grease fittings into the bearing retainer plate.

## Installing the bonnet and washpipe

1. Install the new bearing shield on top of the main shaft. Hold the shield in place with the worm clamp.

2. Install the 3.875 in. OD polypack seal onto the upper stem liner with the O-ring facing away from the flange of the stem liner.

3. Lubricate the upper stem liner with grease and tap the liner in place on top of the main shaft.

4. Install the bonnet onto the pilot bore in the cover. Install 3/4 in. capscrews and lockwashers. Tighten the capscrews to 250-270 ft lb and safety wire the capscrews with .051 in. diameter safety wire.

5. Using a dial indicator, measure the run out of the main shaft to the S-pipe adapter bore in the bonnet. The TIR should not exceed .010 in.

6. Install the S-pipe adapter with 5/8 in. capscrews and lock washers. Tighten the capscrews to 145-155 ft lb. Safety wire the capscrews.

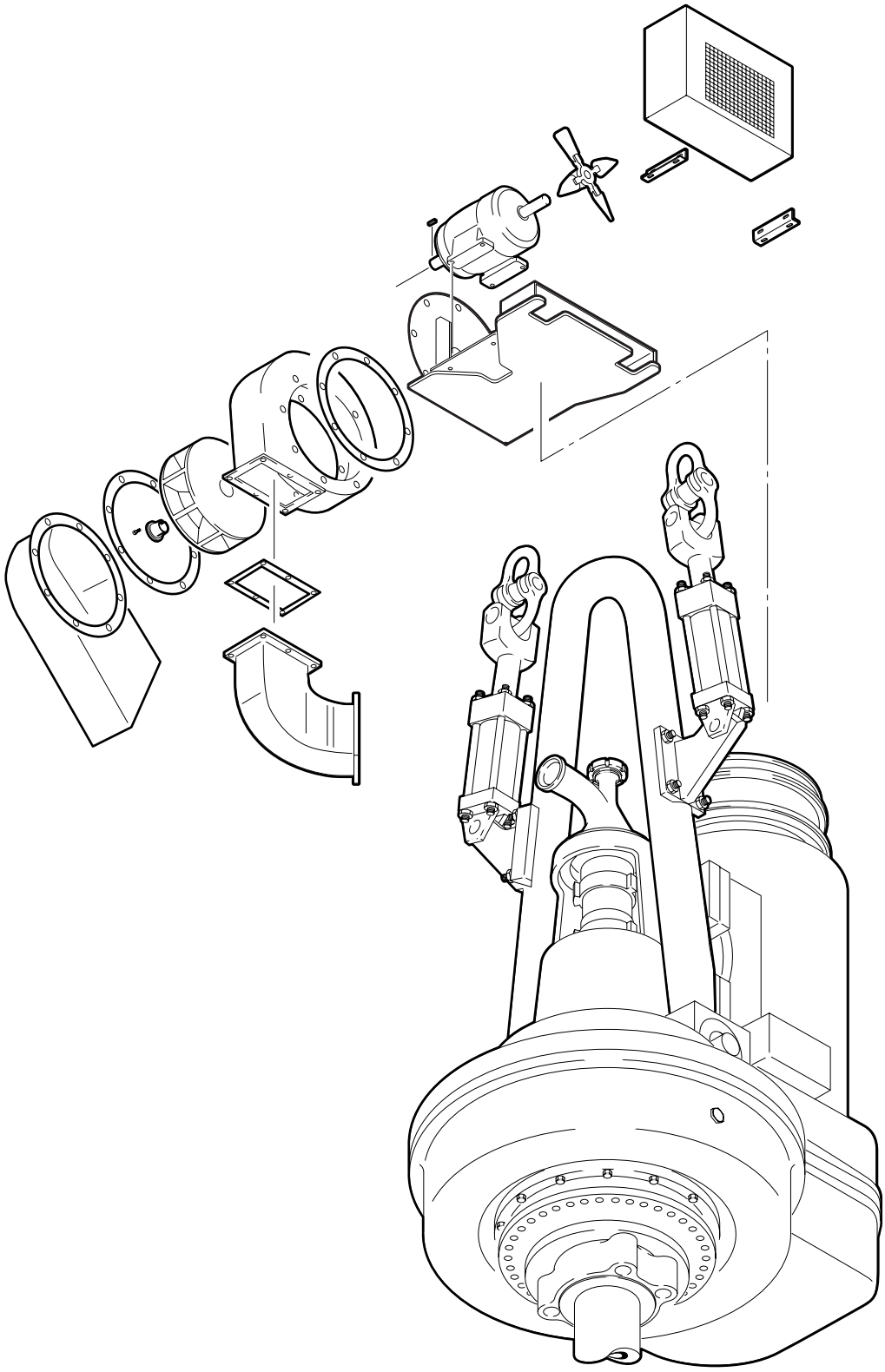
7. Using a dial indicator, measure the main shaft to adapter washpipe pilot on the S-pipe adapter. The TIR should not exceed .010 in.

8. Install the washpipe packing and tighten.

9. Grease the washpipe packing and the bearing retainer plate seals.

# Disassembly and assembly

## Local blower cooling system assembly/disassembly



# Disassembly and assembly

Use the following procedure to remove the blower motor in the local blower cooling system:

1. Remove the electrical wires from the blower motor.
2. Drain the oil from the transmission cooler and disconnect the oil hoses.
3. Remove the blower inlet duct and gasket from the end of the blower housing.
4. Remove the blower duct which leads from the blower housing and the AC drilling motor cooling inlet.
5. Remove the bolts connecting the blower mounting plate to the brake cover.
6. Hoist the blower assembly off of the TDS and move it to a clean work space.
7. Remove the blower housing and gasket from the mounting plate.
8. Remove the taper lock bushing.
9. Remove the blower impeller and locking key from the Cooling Blower motor shaft.
10. Remove the transmission cooler mounting brackets and carefully slide the cooler off of the mounting plate. *Store the transmission cooler so that the oil connection fittings are protected from damage.*
11. Remove the axial fan from the cooling motor shaft.
12. Unbolt the four bolts connecting the blower motor feet to the blower mount.
13. Lift the motor out.

# Disassembly and assembly

Use the following procedure to install a new motor in the local cooling system:

1. Bolt the blower motor onto the blower motor mount and safety wire the bolts.
2. Install the blower housing and gasket onto the mounting plate as follows:
   a. Gradually insert and tighten the bolts that connect the blower housing and inner plate assemblies on both sides to the blower motor frame.
   b. Check the alignment holes as you tighten the bolts to make sure both assemblies line up properly on the blower motor frame.
3. Install the locking keg onto the motor shaft.
4. Install the blower impeller and taper lock bushings. Safety wire the bolts.
5. Install the inlet duct and gasket.
6. Install the axial fan.
7. Install the transmission cooler with mounting brackets.
8. Install and safety wire the four bolts connecting the blower mount to the brake cover.
9. Install the blower duct and gaskets between the AC drilling motor and the blower housing. Safety wire the bolts.
10. Connect the oil lines to the transmission cooler.
11. Connect the electrical wires to the blower motor.

# Troubleshooting the AC drilling motors

Refer to the AC motor manufacturer service manual in the *Vendor Documentation Package*.

# Troubleshooting the drilling motor brake

| Symptom | Probable cause | Remedy |
|---|---|---|
| Brake does not hold. | Insufficient air supply. | Check air supply pressure, 90 psi minimum required. |
| | Solenoid valve not shifting. | Check electrical continuity. |
| | | Check lubricator on air supply. |
| | | Check mechanical operation of solenoid valve. |
| | Brake drum contaminated with grease or pads worn or burnt. | Inspect and replace if necessary. |
| Brake does not release. | Solenoid valve sticking. | Lubricate, repair with repair kit or replace valve. |
| | | Check air supply lubricator. |
| | Quick exhaust valve not functioning properly. | Clean or replace. |

# Troubleshooting the AC blower motor

The following chart describes problems, probable causes and remedies.

| Symptom | Probable cause | Remedy |
|---|---|---|
| Mechanical noise in blower. | Loose impeller. | Reinstall impeller and hub with thread-locking compound on screws. |
| | Faulty motor bearings. | Repair or replace as needed. |
| Blower runs intermittently. | Faulty or loose wiring. | Locate and repair as needed. |
| | Faulty motor starter. | Check for dirt or trash between starter coil. Repair or replace as needed. |
| | Broken service loop conductor. | Use spare service loop conductor. |
| Motor overheating, overtemp alarm stays on with blower running. | Incorrect blower rotation. | Verify that blower rotation is correct. |
| | Broken service loop conductor. | Use spare service loop conductor. |

# Troubleshooting the counterbalance system

| Symptom | Probable cause | Remedy |
|---|---|---|
| System does not hold pressure. | Needle valve is not closed. | See adjustment procedure and check needle valve. |
| | Cylinder rod seals leak. | Replace seals. |
| | Fittings or hoses leak. | Tighten or replace as required. |
| | Dirty or defective PRV valve. | See adjustment procedure. Clean or replace. |
| | Dirty or stuck check valve. | Clean or replace. |
| | Counterbalance control valve in rig down position. | Return valve to drilling position. |
| Cylinder rods remain retracted (closed). | Pressure setting too high. | Adjust per adjustment procedure. |

When activating or reactivating the counterbalance system, never start an empty system with the needle valve closed. Always start hydraulic unit first, run for 3-5 minutes, then slowly close needle valve with hydraulic unit running. If an empty system is started up with needle valve closed there is a good potential for damaging counterbalance cylinder seals.

# Troubleshooting the counterbalance system

## Troubleshooting the motor alignment cylinder

| Symptom | Probable cause | Remedy |
|---|---|---|
| Alignment cylinder fails to move transmission at trunnion pivot points with recommended pressure setting. | Transmission trunnion pins will not pivot in dolly support brackets, from lack of lubrication. | Free trunnion pins as needed and lubricate area regularly. |
| Counterbalance system works erratically or does not work at all. | Possible problem with system hydraulic components. | Check *Troubleshooting* the *counterbalance* section of this book. |
| | Loss of nitrogen precharge in accumulators located in motor dolly upright frame. | Recharge accumulators as per the procedure in the *Counterbalance* section of this book. |
| System does not hold pressure. | Needle valve is not closed. | See *Adjustment* procedure. |
| | Cylinder rod seals leak. | Replace seals. |
| | Fittings or hoses leak. | Tighten or replace as required. |
| | Dirty or defective PRV valve. | Clean or replace. |
| Saver sub on TDS does not align with drill pipe. | Alignment cylinder pressure too high or too low. | See *Adjustment* procedure. |
| | Alignment cylinder rod adjustment too long or short. | Adjust according to procedure. |
| | Rails not properly aligned with centerline of well. | Check to make sure that rotary is in center of floor and then check alignment of rails in relation to rotary. |
| Excessive motor movement. | Alignment cylinder fluid flow not adequately throttled. | See *Adjustment* procedure. Normal adjustment is 1 1/2 turns from full closed position on flow control valves. If there is excessive movement close to 3/4 turn from full closed position. |

# Troubleshooting the retract guide dolly

| Symptom | Probable cause | Remedy |
|---|---|---|
| Guide dolly retracts too slow or too fast. | Flow control valves on the guide dolly are not properly set. | Set the flow controls to attain desired retract speed. |

# Troubleshooting the transmission

| Symptom | Probable cause | Remedy |
|---|---|---|
| Oil leaking from lower seal. | Lower gear case seals are dry or damaged. | Apply grease to seal. Grease fitting daily. |
| | | If problem persists replace gearcase seals and bearing. |
| Oil leaking from shaft housing breather. | Oil level too high. | Adjust oil level per recommended specification. |
| | Incorrect lubricant used. | |
| | Oil is foaming. | Replace oil. |
| Gearbox temperature is excessive. | Oil level too low or too high. | Adjust oil level to recommended level in sight glass. |
| | Incorrect lubricant used. | Check recommended lubricants chart and replace as needed. |
| | Clogged oil suction screen. | Remove suction screen for oil pump check discharge or pressure hoses at outlets to confirm circulation. |
| | Clogged or dirty heat exchangers on unit equipped with such. | Check heat exchangers for air flow or water flow to ensure adequate heat transfer and dissipation. |

# Troubleshooting the pipehandler

## Troubleshooting the rotating link adapter motor

### Operation

The three position directional valve controls the direction of the rotating head to the left or right. The pressure is applied to the A or B port of the hydraulic motor, depending on the selected direction.

### System test

To test the system, operate the rotating head switch on the control panel. Verify both directions of rotation. The rotation speed is limited by the nonadjustable orifice. The torque is limited by the two relief valves.

*The 1,600 psi test pressure at ports A and B is maximum load pressure. If the rotating link adapter is free to rotate, the load pressure will be less than maximum. The shot pin must be engaged to achieve full load pressure.*

| Symptom | Probable cause | Remedy |
|---|---|---|
| Tool does not rotate. | Direct control valve or relief valve is sticking. | Inspect, repair or replace the valve. Look for pressure changes when solenoid is energized. If there is no pressure change, try the manual override on the valve.<br>◆ ***When you override a directional valve, you bypass the safety interlock and top drive components move, possible causing serious injury or death.*** |
| | Solenoid valve is not electrically operating. | Check the electrical connections and valve functions. |
| | Motor is worn out or gear teeth are broken. | Replace the motor. |
| | Shot pin is engaged. | Adjust the relief valve. |
| | Mechanical interference. | Inspect and repair. |
| | Directional valve does not shift. | Test pressure left and right. Replace the valve. |
| | Fixed valve orifice is plugged. | Clear orifice or replace the valve. |
| | Hydraulic lines are damaged. | Replace hydraulic lines. |

# Troubleshooting the pipehandler

## Troubleshooting IBOP actuator cylinders

### Operation

The IBOP is in the open position under low hydraulic pressure. When you close the IBOP, high pressure is applied to the cylinder. The time delay is operated by the time delay accumulator.

***Alert all personnel near the shot pin, clamp, and rotating head before overriding a directional valve. When you override a directional valve, you bypass the safety interlock and top drive components move, possibly causing serious injury or death.***

| Symptom | Probable cause | Remedy |
|---|---|---|
| Safety valve leaks. | Internal parts are worn out. | Check for washouts or defective parts and repair or replace as needed. |
| | Actuator is not functioning properly. | Check mechanical operation of actuator. Check reducing valves. |
| Excessive vibration or wobble while rotating. | Yoke bushings or actuator bushings are worn out. | Replace bushings. |
| | Cam rollers are worn. | Repair or replace rollers and roller brackets. |
| Cylinder does not actuate. | Pressure reducing valve plugged orifice. | Test pressure and adjust or replace the pressure reducing valve. |
| | Accumulator not charged. | Test accumulator pressure and charge as required. |
| | No system pressure. | Check hydraulic system operation. |

# Troubleshooting the pipehandler

## Troubleshooting the shot pin cylinder and clamp cylinder

### Operation

The shot pin cylinder and clamp cylinder operation are interrelated and complex. The shot pin cylinder is different in that it has an extra port called the barrel port. The barrel port is back from the end of stroke which creates a valve effect. When the shot pin and clamp cylinders are not activated, the shot pin is fully retracted with full pressure and the clamp cylinder is retracted with 500 psi.

When you energize the clamp cylinder, the shot pin cylinder is actuated against the rotating gear and it may miss one of the 24 holes. The control system starts pulsing the rotating link adapter to move slowly until the shot pin engages a hole on the rotating gear. The shot pin cylinder pressure is limited by the relief valve until the cylinder passes through one of the holes.

When the clamp cylinder is de-energized, the clamp releases and the shot pin pulls out.

# Troubleshooting the pipehandler

| Problem | Probable cause | Remedy |
|---|---|---|
| Shot pin does not engage. | Solenoid valve is not operating or relief valve is not adjusted. | Check electrical actuation and test pressure. Adjust as required. |
| | Abnormal pressure change at B5 and C5 indicates valve problem. | Replace directional control valve. |
| | Normal pressure change indicates plumbing or shot pin cylinder are faulty. | Repair plumbing or shot pin cylinder. |
| Shot pin applies excessive force to rotating head gear. | Relief valve is not operating or out of adjustment. | Test pressures and adjust as required. |
| Clamp cylinder does not actuate. | No pressure or reduced pressure at the cylinder. | Test pressures and adjust and repair as required. |
| | Cylinder is damaged. | Inspect cylinder and repair or replace. |
| 1 | To provide high pressure to the clamp circuit, pressure at C5 must be 2,000 psi and G5 must be less than 100 psi. If this condition is met, pressure at CP should increase from less than 100 psi to higher than 2,000 psi. If not, check the plumbing, rotating link adapter, and clamp cylinder. | Repair plumbing, rotating head, or clamp cylinder. |
| | While clamping, pressure at CR should be 2.7 times the pressure at CP. When the dies contact the pipe, pressure at CR should be less than 100 psi. If the pressure does not fade, check valve CNEC for contamination. | Clean or repair CNEC valve. |
| Shot pin engages but clamp cylinder does not activate. | Control valve not operating. | Check pressure at C5. Replace valve CV5 if required or the regenerate manifold. |

# Troubleshooting the pipehandler

## Troubleshooting the link tilt cylinders

### System test

For the link tilt circuit, there is nothing to adjust on the manifold. The four load-holding valves are adjusted in pairs, two for the rod end and two for the piston end. Adjusting the valves at the same time assures the link tilt operation is synchronized.

***Alert all personnel near rotating head before overriding a directional valve. When you override a directional valve, you bypass the safety interlock and top drive components  move, possibly causing serious injury or death.***

Use the following procedures to test the link tilt cylinder:

1. From the drillers console, set the link tilt to go to mousehole which drives the link tilt cylinder to full extension.
2. The cylinder goes to full extension and the pressure at test port TP is 2000 psi.
3. Set the system to a neutral position and observe the pressure drop. Adjust the pressure at relief valve CBCA to approach 1500 psi.

*This is an iterative process. Continue to set the driller's console control to mousehole and neutral, taking present and delayed pressure readings.*

***Turning the relief valve counterclockwise increases the pressure.***

4. Both system rod and piston relief valve pressures at TP and FL are 1500 psi for balanced hydraulic system operation. Adjust relief control valves CBCA and CWCK for rod and piston pressure at 1500 psi. The piston relief valves are set at the pistons fully extended and the rod relief valves are set at the pistons fully retracted.

# Troubleshooting the pipehandler

## Troubleshooting the link tilt cylinders

| Symptom | Probable cause | Remedy |
|---|---|---|
| Drill pipe elevator does not reach mousehole/ derrickman position. | Link clamp incorrectly adjusted. | Readjust. |
| Links drift when valve is released. | Pressure at B8 does not decay to less than 100 psi. | Replace Pilot-to-Open check valve. |
| | Pilot-to-Open check valve is stuck open or contaminated. | Replace Pilot-to-Open check valve. |
| | Faulty cylinder seal. | Replace seal. |
| | Load-holding relief valves are out of adjustment, stuck open, or contaminated. | Adjust or replace load-holding relief valve. |
| Drill pipe elevator does not float back to center position. | Use manual override–if link tilts, the problem is electrical. If links to not tilt, the problem is hydraulic. | Test solenoid and connectors. Test hydraulic system. |
| Link does not tilt. | Solenoid valve is not shifting. | Check electrical continuity. |
| Links do not move together. | Load-holding valves are out of adjustment. | Adjust pressure for all four valves to 1,500 psi. |

# Troubleshooting the washpipe assembly

Use the following procedure to troubleshoot and repair the washpipe assembly if your unit experiences washpipe assembly leaks at low pressure (less than 1,700 psi):

1. Disassemble the unit and check for proper assembly (refer to the washpipe assembly engineering drawing).
2. Inspect the unit for damaged seals and the quality of the pipe finish.
3. Repack the seals with grease filling all empty spaces (use NGLI #2 grease).
4. Reassemble (checking for a tight seal lip to pipe interface) and reinstall the washpipe assembly on the TDS.
5. Grease the assembly in place (4-5 pumps of grease).
6. Rotate the mainshaft at 25-50 rpm for 5 minutes *without* mid pressure to seat the seals.
7. Rotate the mainshaft prior to turning on the pumps.
8. Check for leaks.



*If the assembly leaked for an extended period of time, the seals or pipe might be damaged.*

*Varco high pressure washpipe assembly seals are yellow/gold in color and the pipe has "TC" stamped on top near the splines. If either of these are missing, then the seals are either not high pressure (7,500 psi), or not manufactured by Varco.*