# FARR

TECHNICAL MANUAL

# HD8625

## 8-5/8" (22cm) 35K

### Hydraulic Power Tong

- *Specifications*
- *Operation*
- *Maintenance*
- *Assembly*



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## This manual covers the following models:

| TONG MODEL | REV | DESCRIPTION |
|---|---|---|
| 80-0605-6 | 1 | Tong is equipped with a two-speed hydraulic motor, motor valve, lift cylinder valve, rigid sling, and safety door. |

**NOTE:** **Some illustrations used in this manual may not exactly match your model of tong.**

**PATENTED & PATENTS PENDING**

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# WARNINGS

***A "LOAD-BEARING DEVICE" IS A CHAIN SLING, RIGID SLING, SPREADER BAR ASSEMBLY, FRAME, OR ANY OTHER DEVICE THAT BEARS THE PARTIAL OR TOTAL WEIGHT OF THE EQUIPMENT FOR WHICH THIS MANUAL HAS BEEN PRODUCED***

***THE LOAD-BEARING DEVICE SUPPLIED BY MCCOY DRILLING & COMPLETIONS IS DESIGNED TO SUPPORT THE EQUIPMENT DESCRIBED IN THIS MANUAL. MCCOY DRILLING & COMPLETIONS WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO SUPPORT ANY OTHER PART, ASSEMBLY OR COMBINATION OF PARTS AND ASSEMBLIES. MCCOY DRILLING & COMPLETIONS WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO LIFT OR SUPPORT THE EQUIPMENT DESCRIBED IN THIS MANUAL IF THERE ARE ANY MODIFICATIONS TO THE LOAD-BEARING DEVICE, OR ANY ADDITIONS TO THE EQUIPMENT DESCRIBED IN THIS MANUAL THAT ADD WEIGHT TO THE EQUIPMENT, UNLESS SUPPLIED BY MCCOY DRILLING & COMPLETIONS.***

***WHEN RE-ASSEMBLING LOAD-BEARING DEVICES (CHAIN SLINGS, RIGID SLINGS, BACKUP LEGS, ETC.) NOTE THAT THE ASSOCIATED FASTENERS MUST BE TIGHTENED TO THE CORRECT TORQUE SPECIFIED FOR THAT SIZE OF FASTENER (SEE SECTION 3 - OVERHAUL). ANY THREADED FASTENER IN A LOAD-BEARING DEVICE MUST BE SECURED WITH RED OR BLUE LOCTITE™.***

***ANY REPLACEMENT FASTENER (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED.***

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*McCoy has made every effort to ensure the information contained in this document is accurate and current. This manual is intended to provide equipment operation and safety instructions for your equipment. However, McCoy does not warrant or guarantee that the information is either complete or accurate in every respect and the user of the manual should consult with its McCoy sales representative for any clarifications and updates.*

*The user of the manual shall protect, indemnify, and hold harmless McCoy and its directors, officers, employees, and agents from and against all liability for personal injury, death, or property damage resulting directly or indirectly from the use of the information contained in this manual.*

*Observance of all descriptions, information and instructions set out in this manual is the full responsibility of the user. This manual is intended for guidance and informational purposes and must be used in association with adequate training and on-the-job supervision to provide safe and effective equipment use.*

*It is the responsibility of the user to conform to all regulations and requirements issued by an authority or agency which may affect the operation, safety or equipment integrity, that may overrule the content of this documentation.*

*The user will acknowledge and obey any general legal or other mandatory regulation in force relating to accident prevention, safety, and equipment integrity.*

| Summary Of Revisions | | | | |
|---|---|---|---|---|
| **Date** | **Section** | **Page** | **Description Of Revision** | **Approved** |
| June 2011 | | | Initial release | S.Hargreaves |
| Sep 2012 | 2 | 2.7 | Replaced hydraulic schematic and B.O.M. to reflect changes to hydraulic circuit. | M.Gerwing |
| | | 2.9 | Replaced Illustration 2.C.4 to reflect changes to hydraulic components | |
| | | 2.10 | Updated part number for standard flat die | |
| | 3 | 3.9 | Revised Section 3.G, "Overhaul Procedures - Disassembly" | |
| | | 3.11-3.21 | Revised Section 3.H, "Assembly Procedures" | |
| | | 3.22-3.23 | Revised Section 3.I, "Daily Inspection & Maintenance Checklist" | |
| | | 3.24-3.26 | Revised Section 3.J, "Monthly Inspection & Maintenance Checklist" | |
| | | | Removed Section, "Daily Inspection & Maintenance - Power Unit" | |
| | | 3.27-3.30 | Revised section 3.K, "Tubular Equipment Decommissioning", added packaging and shipping instructions and retitled "Tubular Connection Equipment De-Commissioning & Shipping". | |
| | 4 | 4.1 | Revised section 4.A, Troubleshooting - Tong Will Not Develop Sufficient Torque | |
| | | 4.2 | Inserted new section 4.B, Troubleshooting - Relief Valve | |
| | | 4.4 | Inserted new section 4.C, Troubleshooting - Safety Door | |
| | | 4.5 | Renumbered section 4.D, Troubleshooting - Tong Running Too Slowly | |
| | | 4.6 | Renumbered section 4.E, Troubleshooting - Failure of Jaws to Grip Pipe | |
| | | 4.7 | Renumbered section 4.F, Troubleshooting - Shifting | |
| | 5 | 5.15 | Updated B.O.M., Clutch Assembly | |
| | | 5.17 | Updated B.O.M., Manual Shifter | |
| | | 5.28-5.29 | Replaced illustration & updated B.O.M., Tong Door Assembly | |
| | | 5.30-5.31 | Replaced illustration & updated B.O.M., Tong Safety Door Components | |
| | 6 | | Removed illustration, Compression Load Cell Exploded | |
| | | 6.6 | Inserted new subsection 6.C.3, "Reference Checking Torque Measurement System" | |

***Continued on next page ...***

*The information presented in this document will provide setup, operating, and maintenance instructions for your HD8625 tong. Due to the wide variety of operating conditions, these instructions must be considered guidelines rather than absolute operating procedures. It is the responsibility of the user to use these guidelines together with an experienced manager to develop operating procedures that conform to all policies set forth by the operating authority (ies).*

## *IDENTIFICATION OF WARNINGS AND OTHER NOMENCLATURE OF IMPORTANCE USED IN THIS TECHNICAL MANUAL*

*Farr Canada Corp. uses three indicators to describe items of three degrees of importance.*

*A **HAZARD** to operators or equipment is represented by an exclamation point within a red triangle. identifies items of the highest importance. Failure to heed information identified by a **HAZARD** symbol may result in bodily injury, death, catastrophic equipment damage, or any combination of these. A **HAZARD** may also indicate the potential for dangerous environmental contamination.*

**This identifies a HAZARD to operators or equipment**

*A **WARNING** is represented by an exclamation point within an orange triangle, and contains information that will alert personnel to a potential safety hazard that is not life-threatening. A **WARNING** may also serve to alert the user to information critical to the correct assembly or operation of the equipment in use.*

**This identifies a WARNING to users**

*A **CAUTION** is represented by an exclamation point within a yellow triangle and highlights information that may aid the user during assembly or operation of your equipment. CAUTIONs are also used to ensure common errors are not made during assembly or operation of your equipment.*

**This identifies a CAUTION to users**

***Observance of the following is the full responsibility of the user:***

- ***all descriptions, information and instructions set out in this manual***
- ***any regulation or requirement issued by an authority or agency which may influence operation, safety or integrity of the equipment that overrules the content of this document.***
- ***any legal or other mandatory regulation in force governing accident prevention or environmental protection.***

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*Congratulations on the purchase of your FARR® HD8625 8-5/8" tong. This unit will provide you with years of outstanding performance. Simple maintenance and care will extend its life and ensure years of excellent performance and reliability. The setup, operating, and maintenance instructions in this manual will assist you in giving your equipment the care it requires. Please carefully read the manual before installing and using your equipment. Replacement parts are readily available from McCoy Drilling & Completions | Farr in Edmonton, Alberta. Note that many parts are transferable between FARR® tongs and backups. Should you need replacement parts, or should you experience any difficulty not covered in this manual, please contact:*

***McCoy Drilling & Completions | Farr***

*14755 121A Avenue*
*Edmonton, Alberta*
*Canada T5L 2T2*
*Phone: 780.453.3277*
*Fax: 780.455.2432*

*Sales Fax: 780.481.9246*
*Email Engineering: engFarr@mccoyglobal.com*
*Email Sales: salesFarr@mccoyglobal.com*

*Website: http://www.mccoyglobal.com/drilling-completions*


***ILLUSTRATION 1.A.1: HD8625 TONG***

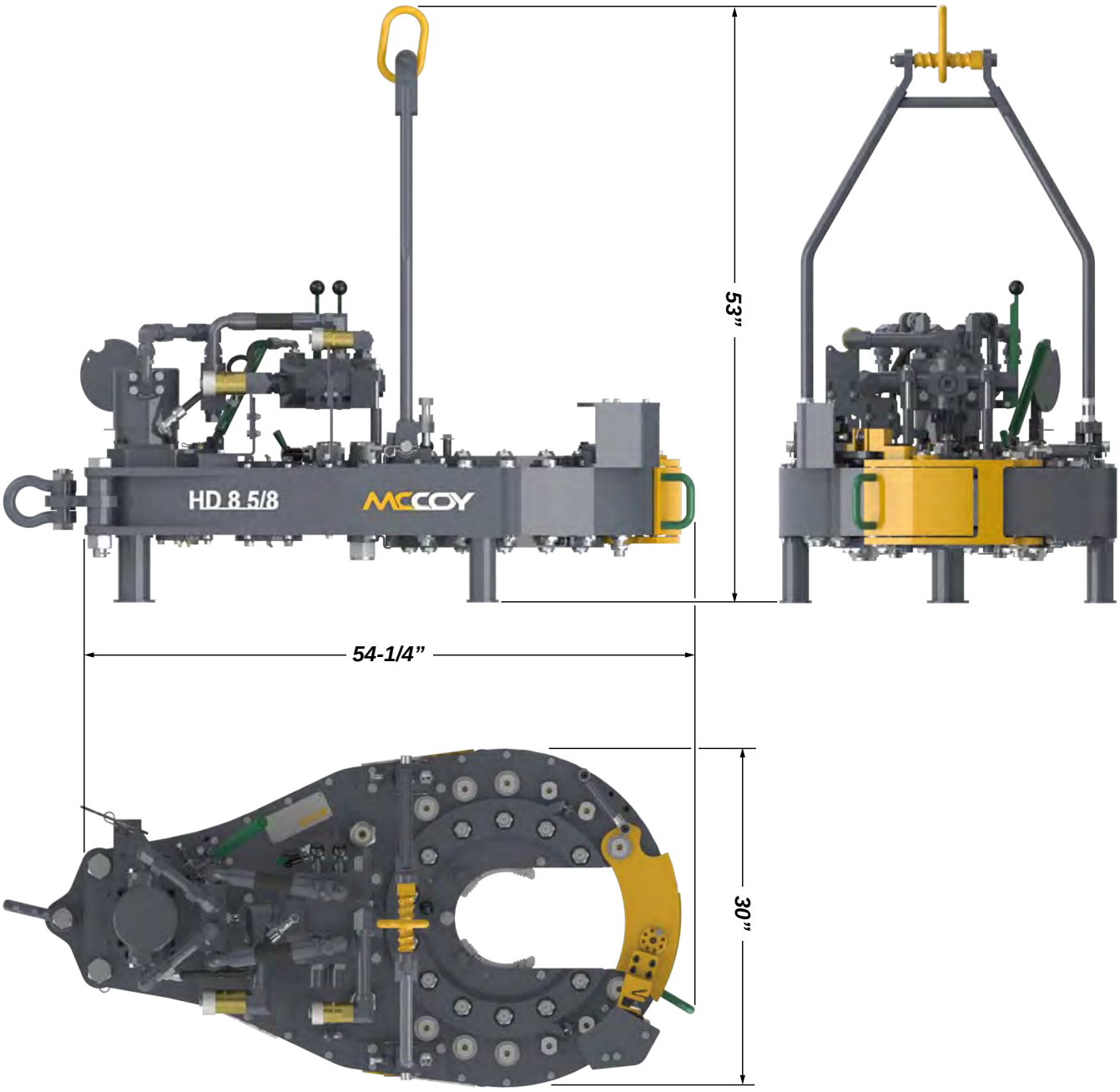


*ILLUSTRATION 1.A.2: HD8625 POWER TONG DIMENSIONS*

| Torque Table ** | | | | |
|---|---|---|---|---|
| Pressure | High Gear/High Speed | | Low Gear/Low Speed | |
| PSI / MPa | Lbs.-ft. | Nm | Lbs.-ft. | Nm |
| 1000 / 6.89 | 200 | 271 | 9400 | 12745 |
| 1500 / 10.34 | 400 | 542 | 16100 | 21829 |
| 2000 / 13.78 | 500 | 678 | 22800 | 30913 |
| 2500 / 17.23 | 700 | 949 | 29500 | 39997 |
| 3000 / 20.67 | 800 | 1085 | 36200 | 49081 |
| MAXIMUM RATED TORQUE: 35000 LBS.-FT. / 47454 Nm | | | | |

| Speed Table | | | | |
|---|---|---|---|---|
| | Gear / Displacement | | | |
| Flow (GPM/LPM) | Low/Full | Low/Half | High/Full | High/Half |
| 10 / 38 | 2 | 4 | 4 | 19 |
| 20 / 76 | 4 | 8 | 8 | 39 |
| 40 / 152 | 8 | 15 | 15 | 77 |
| 60 / 228 | 12 | 23 | 23 | 116 |

** These are ideal values. Actual achieved torque is highly dependant upon tong efficiency and final position of rotary gear when full torque load is reached.

**Hydraulic Requirements (max.):** 60 US GPM @ 1000 psi
(189 LPM @ 6.9 MPa)
10 US GPM @ 3000 psi
(38 LPM @ 20.7 MPa)

**Length (Doors Closed):** 54-1/4" inches / 137.8 cm

**Height:** 53" / 134.6 cm

**Width:** 30" / 76.2 cm

**Space Required on Pipe:** 8" / 20.3 cm

**Torque Arm Length:** 36 inches / 91.4 cm
- Centre line of pipe to centre line of load cell -

**Weight (Approximate):** 1550 lb. / 705 kg.

**Available Jaw Sizes:** See Pg. 2.10

***REPLACEMENT FASTENERS (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) MUST BE GRADE 8 OR EQUIVALENT (WHERE REQUIRED).***

***Use an EP synthetic grease that meets or exceeds the following specifications:***

| | |
|---|---|
| Thickener | Lithium Complex |
| NLGI consistency grade | 2 |
| NLGI performance grade | GC-LB |
| Penetration - ASTM D 217 (25°C [77°F] | 265-295 minimum |
| 0.1 mm) worked 60 strokes | |
| Dropping point, °F[°C] - ASTM D2265 | 550 [288] minimum |
| High temperature life, hours - ASTM D 3527 | 160 minimum |
| Oxidation stability, psi - ASTM D 942 | (100 hr/300 hr) 0/3 |
| Water washout, percent - ASTM D 1264 | 1.8 max |
| Rust and corrosion - ASTM D 1743 | pass |
| Oil separation, percent loss - ASTM D 1742 | 1.1 max |
| (24 hours, 25°C [77°F] | |
| Leakage, g lost - ASTM D 4290 | 1.0 max |
| Four ball wear test, mm scar - ASTM D 2266 | 0.40 max |
| Fretting wear, mg - ASTM D 4170 | 3.4 max |
| Four ball EP, kgf - ASTM D 2596 | |
| Weld point | 400 minimum |
| Load wear index | 50 minimum |
| Timken OK load test, lbs - ASTM D 2509 | 50 |
| Low temperature torque, N*m - ASTM D 4693 | 1.3 max |
| (-40°C [-40°F]) | |
| LT-37 pumpability, g/min | 360/7 |
| (60°F/0°F [16°C/-18°C]) | |
| Copper corrosion - ASTM D 4048 | 1B |
| Disc brake wheel bearing specifications | |
| Ford ESA-M1C 198A | Yes |
| Chrysler MS-3701 | Yes |
| Oil viscosity: 40°C [104°F], cSt | 151 |
| 100°C [212°F], cSt | 19.2 |
| Flash point, °F[°C] - ASTM 92 | 450[232] |

***Use a premium quality hydraulic fluid that meets or exceeds the following specifications:***

| | |
|---|---|
| Typical Density ($kg/m^3$) | 878 |
| Viscosity - cSt @ 40 °C | 68.8 |
| - cSt @ 100 °C | 8.7 |
| Viscosity Index | 97 |
| Pour Point °F [°C] | -22 [-30] |
| Flash Point °F [°C] | 432 [222] |
| Colour, ASTM | 1.5 |
| Neutralization Number | 0.40 |
| Rust Protection - Distilled Water | No Rust |
| - Sea Water | No Rust |
| Hydrolytic Stability - Cu Mass Loss, $mg/cm^2$ | 0.04 |
| Copper Corrosion Test | 1A |
| Filterability: Denison - Wet & Dry | Pass |
| Afnor - Wet & Dry | Pass |
| Cincinnati Milacron Spec Approved | P69 |
| Denison HF-0: | Approved |
| Denison P-46 Piston Pump: | Pass |
| Denison T6C Vane Pump: | Pass |
| Vickers 35VQ25 Vane Pump Test: | Pass |
| 104/105C Vane Pump Test: | No Data Available |
| Vane pump test total ring and vane wear, mg. | <10 |
| Oxidation Stability | |
| Turbine Oil Stability Test Life, hours | 2500+ |
| Rotary Bomb Oxidation Test, minutes | 325 |
| FZG Spur Gear Test, Failure Load Stage (FLS) | 12 |

*Adequate setup and proper hydraulic connections are essential in ensuring reliable operation of your tong. For best results and long term reliability, read and obey the start-up instructions in this section.*

***DO NOT ACCESS ROTATING COMPONENTS UNLESS HYDRAULIC POWER SUPPLY HAS BEEN DEACTIVATED OR ISOLATED.***

***A CLEARLY IDENTIFIED REMOTE POWER PACK EMERGENCY STOP MUST BE INSTALLED IN THE IMMEDIATE VICINITY OF THE TONG OPERATOR.***

### A. SLING / LOAD BEARING DEVICE SAFETY

***THE SUPPLIED LOAD-BEARING DEVICE (CHAIN SLING, RIGID SLING, SPREADER BAR ASSEMBLY, FRAME, OR ANY OTHER DEVICE THAT BEARS THE PARTIAL OR TOTAL WEIGHT OF THE EQUIPMENT DESCRIBED IN THIS MANUAL) HAS BEEN SPECIFIED OR DESIGNED TO SUPPORT THE EQUIPMENT DESCRIBED IN THIS DOCUMENT. FARR® WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO SUPPORT ANY OTHER PART, ASSEMBLY OR COMBINATION OF PARTS AND ASSEMBLIES, OR ANY ADDITIONS TO THE EQUIPMENT DESCRIBED IN THIS MANUAL THAT ADD WEIGHT TO THE EQUIPMENT, UNLESS SUPPLIED BY MCCOY.***

***MCCOY DRILLING & COMPLETIONS DOES NOT GUARANTEE THE INTEGRITY OF MODIFIED OR DAMAGED LOAD-BEARING DEVICES, UNLESS THOSE MODIFICATIONS ARE PERFORMED BY MCCOY.***

*McCoy Drilling & Completions recommends following an industry-accepted standard such as OSHA, ASME B30.9-2006, or manufacturer's guidelines when performing any rigging and overhead lifting. Use by untrained persons is hazardous. Improper use will result in serious injury or death. Do not exceed rated capacity. Slings will fail if damaged, abused, misused, overused, or improperly maintained.*

- *Only grade 80 or grade 100 alloy chain should be used for overhead lifting applications.*
- *Working Load Limit (WLL) is the maximum allowable load in pounds which may be applied to the load-bearing device, when the device is new or in "as new" condition, and when the load is uniformly and directly applied. The WLL must never be exceeded.*
- *Working Load Limit (WLL) is the maximum working load for a specific minimum sling angle, measured from the horizontal plane. The Working Load Limit is identified on the sling.*
- *The Working Load Limit or Design factor may be affected by wear, misuse, overloading, corrosion, deformation, intentional alterations, sharp corner cutting action and other use conditions.*
- *Shock loading and extraordinary conditions must be taken into account when selecting alloy chain slings.*
- *See OSHA Regulation for Slings 1910.184, ANSI/ASME B30.9-"SLINGS", ANSI/ASME B30.10-"HOOKS" and ANSI/AMSE B30.26 "RIGGING HARDWARE" for additional information.*

***THE MINIMUM SLING ANGLE (THE ANGLE OF THE LEG OF THE SLING MEASURED FROM THE HORIZONTAL) MUST NEVER FALL LOWER THAN THE ANGLE SPECIFIED FOR THE SLING IN USE***

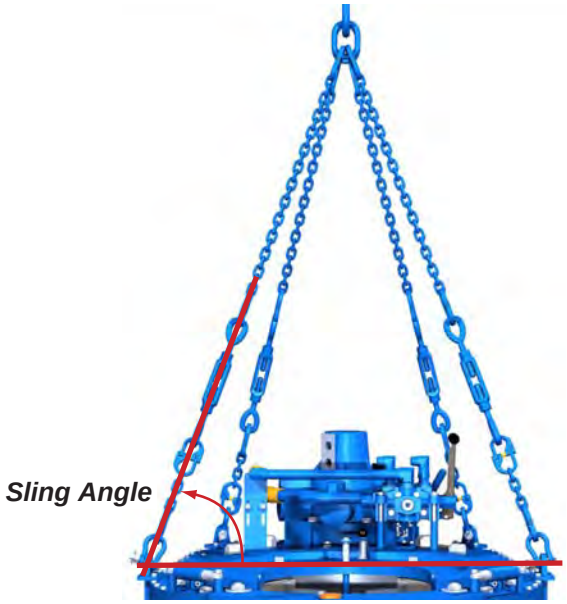


***ILLUSTRATION 2.A.1: SLING ANGLE***

1. **Inspection Of Slings**

**McCoy Drilling & Completions strongly recommends the following practices:**

*A complete inspection of new load-bearing devices and attachments shall be performed by a qualified, designated person prior to initial use. Each link and component shall be examined individually, taking care to expose and examine all surfaces including the inner link surface. The sling shall be examined for conditions such as those listed in the removal criteria below. In addition, daily inspection of slings, fastenings and attachments shall be performed by a designated person. If damage or defects are found at either inspection, the damaged or defective component shall be quarantined from service until it can be properly repaired or replaced.*

*Removal Criteria:*

*A load-bearing device shall be removed from service if conditions such as the following are present:*

- *Missing or illegible sling identification.*
- *Cracks or breaks*
- *Evidence of tampering is seen - sling tag has been modified or obscured, or tamper-proof nuts are missing.*
- *Signs of impact on load-bearing components, including spreader bars, lifting lugs, rigid slings & rigid sling weldments, and legs & leg mounts.*
- *Broken or damaged welds.*
- *Excessive wear, nicks, or gouges. Refer to the chart below to ensure minimum thickness on chain links supplied is not be below the values listed:*

| Minimum Allowable Chain Link Thickness at Any Point | | | |
|---|---|---|---|
| **Nominal Chain Size** | | **Minimum Thickness** | |
| Inches | MM | Inches | MM |
| 7/32 | 5.5 | 0.189 | 4.80 |
| 9/32 | 7 | 0.239 | 6.07 |
| 5/16 | 8 | 0.273 | 6.93 |
| 3/8 | 10 | 0.342 | 8.69 |
| 1/2 | 13 | 0.443 | 11.26 |
| 5/8 | 16 | 0.546 | 13.87 |
| 3/4 | 20 | 0.687 | 17.45 |
| 7/8 | 22 | 0.750 | 19.05 |
| 1 | 26 | 0.887 | 22.53 |
| 1-1/4 | 32 | 1.091 | 27.71 |
| **Refer To ASME B30.9** | | | |

- *Stretched, bent, twisted, or deformed chain links or components.*
- *Evidence of heat damage.*
- *Excessive pitting or corrosion.*
- *Lack of ability of chain or components to hinge (articulate) freely.*
- *Weld splatter.*
- *For hooks, removal criteria as stated in ASME B30.10*
- *Other conditions, including visible damage, that cause doubt as to the continued use of the sling.*

*Inspect all lugs and fixing points for signs of elongation and/or bending, or for material build-up around the hole. Repair or replace components that appear distorted. Ensure all hardware is tight and in good condition. Replace missing hardware if necessary. All hardware must be free of rust and corrosion.*

*Additional inspections shall be performed during sling use where service conditions warrant. Periodic inspection intervals shall not exceed one year. The frequency of periodic inspections should be based on:*

- *Frequency of use of the load-bearing device.*
- *Severity of service conditions*
- *Nature of lifts being made*
- *Experience gained on the service life of load-bearing devices used in similar circumstances.*

*Guidelines for the interval are:*

- *Normal Service - yearly*
- *Severe Service - monthly to quarterly*
- *Special Service - as recommended by a qualified person*

*Units designed and manufactured in accordance with EN 12079 and DNV 2.7-1 should be tested and examined in accordance with the following schedule of examination and test. The user of the load-bearing device shall place a permanent placard or plate upon which the type and date of the last test shall be recorded. To avoid confusion, the plate shall not carry the date of the next test or examination, only the most recent.*

| Test / Examination | | | | |
|---|---|---|---|---|
| Time / Interval | Lifting Tests[1] | Non-Destructive Examination (NDE) of Lifting Points | Thorough Visual Examination | Suffix To Be Marked On Plate Attached To Unit |
| Initial Certification By Farr® / Superior | YES | YES | YES | T |
| Interval Not Exceeding 12 Months | At the discretion of inspection body | At the discretion of inspection body | YES | T or VN[3] |
| Interval Not Exceeding 60 Months | At the discretion of inspection body | YES | YES | T or VN |
| Following Substantial Repair or Alteration[4] | YES | YES | YES | T |

1. Lifting test as per S 7.3 BS EN 12079 or DNV 2.7-1 May 1995
2. T = Proof Test, non-destructive examination; VN = non destructive examination and visual examination; V = visual examination.
3. Dependant upon whether non-destructive examination has been carried out.
4. For the purposes of this standard, a substantial repair or modification is defined as any repair and/or modification that has been carried out which may, in the opinion of the inspection body, affect the load-bearing elements of the container or lifting device, or elements that contribute directly to its structural integrity.

***IF MECHANICAL DAMAGE IS SEEN OR SUSPECTED ON A LOAD-BEARING DEVICE, OR IF THE LOAD-BEARING DEVICE HAS BEEN OVERLOADED, IT MUST BE REMOVED FROM SERVICE AND QUARANTINED UNTIL RECERTIFIED***

*Written records of the most recent periodic inspection shall be maintained, and shall include the condition of the sling.*

**2. *Proper Use Of Load-Bearing Devices***

*Whenever any load-bearing device is used, the following practices shall be observed.*

- *Load-bearing devices that are damaged or defective shall not be used.*
- *Slings shall not be shortened with knots or bolts or other makeshift devices.*
- *Sling legs shall not be kinked.*
- *Load-bearing devices shall not be loaded in excess of their rated capacities.*
- *Slings shall be securely attached to their load.*
- *Load-bearing devices shall be protected from snagging, and shall not be further obstructed by any object.*
- *Suspended loads shall be kept clear of all obstruction.*
- *All employees shall be kept clear of loads about to be lifted and of suspended loads.*
- *Hands or fingers shall not be placed between the sling and its load while the sling is being tightened around the load.*
- *Shock loading is prohibited.*
- *Do not stand directly under a load during lifting.*

**3. *Storage Of Load-Bearing Devices***

*Proper storage of out-of-service load bearing devices is important to ensure full integrity of the device once it is returned to service. Farr® recommends observing the following practices:*

- *Wipe off all excess grease. Use a solvent-based cleaner on rags to wipe all external surfaces to remove residual grease or hydraulic fluid. Once the outside surfaces have been de-greased, wipe all external surfaces with clean water to remove residual solvent.*
- *McCoy recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external surfaces. Refer to manufacturer data sheets for proper application and safety information. Allow the anti-corrosive coating ample time to dry - refer to manufacturer data sheets for drying times at room temperature.*
- *Store in a clean, dry location. When returning to service, note that a full inspection of the device must be performed.*

## B. MAJOR COMPONENT IDENTIFICATION

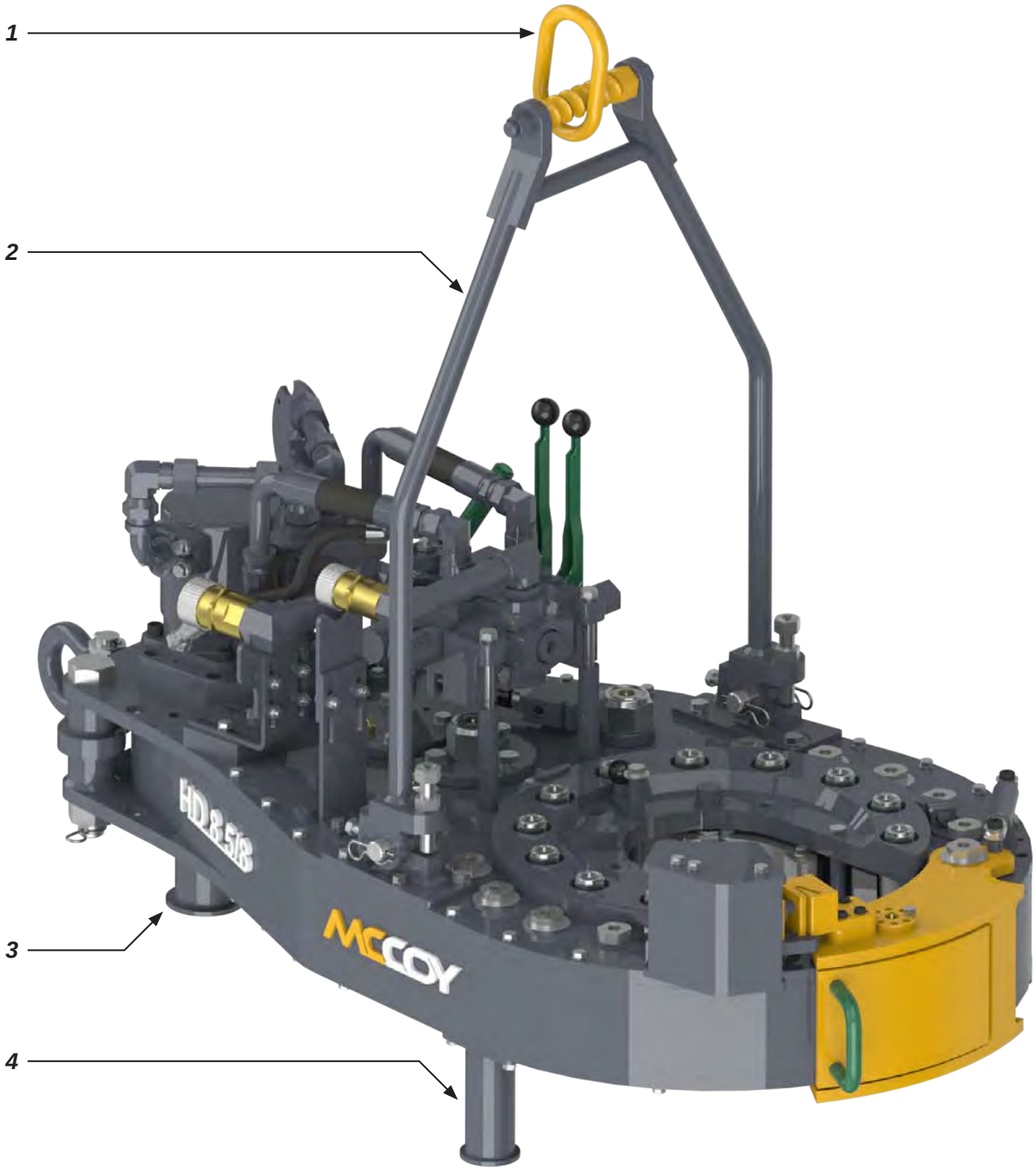


*ILLUSTRATION 2.B.1: MAJOR COMPONENT IDENTIFICATION 01*

| Item | Description |
|---|---|
| 1 | Master Link |
| 2 | Rigid Sling |
| 3 | Rear Leg |
| 4 | Front Leg |

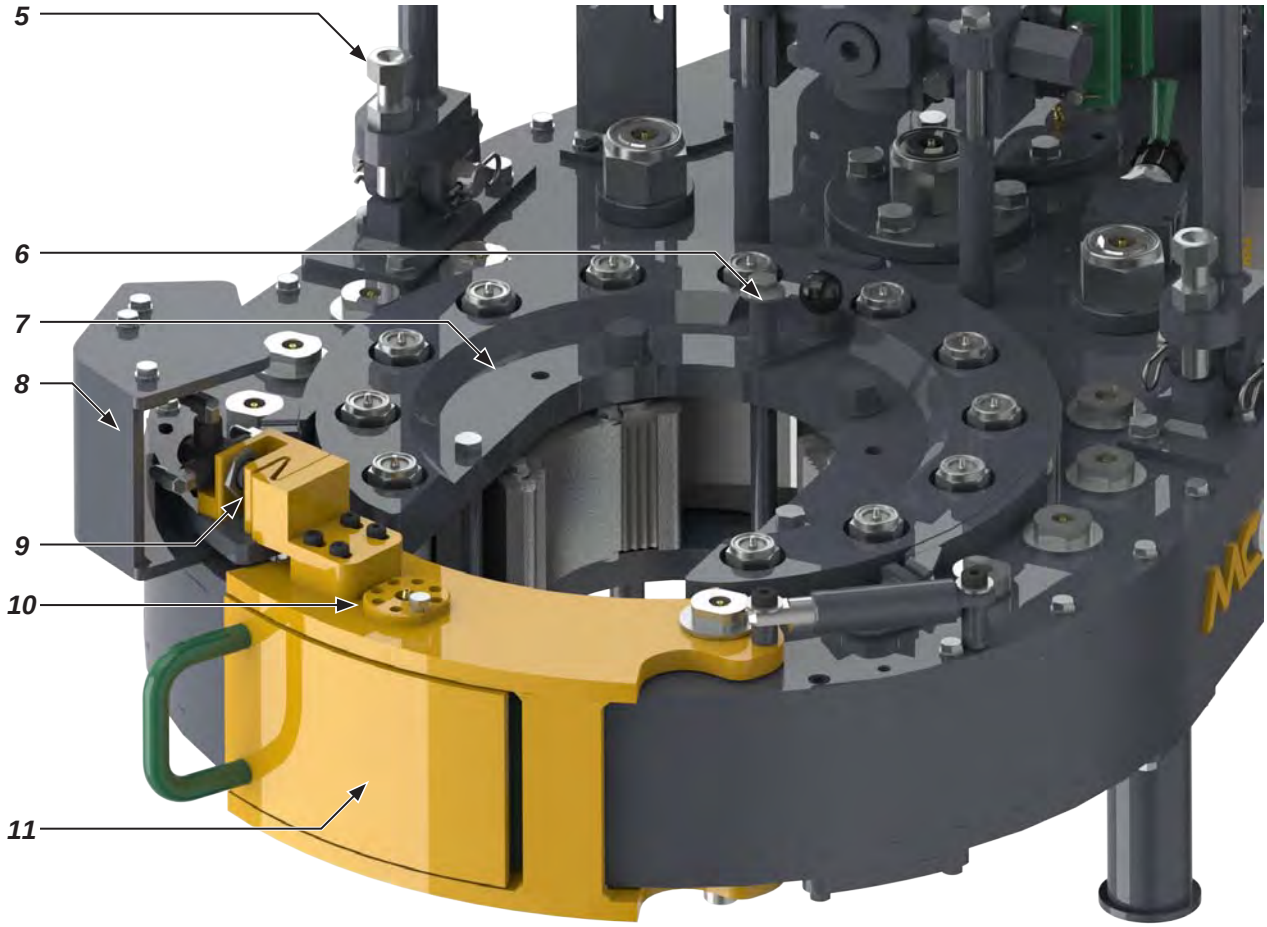


*ILLUSTRATION 2.B.2: MAJOR COMPONENT IDENTIFICATION 02*

| Item | Description |
|---|---|
| 5 | Tong Leveling Adjustment |
| 6 | Backing Pin Assembly |
| 7 | Cage Plate Assembly |
| 8 | Safety Door Guard |
| 9 | Safety Door Switch |
| 10 | Door Latch Cam Adjustment |
| 11 | Door Latch |

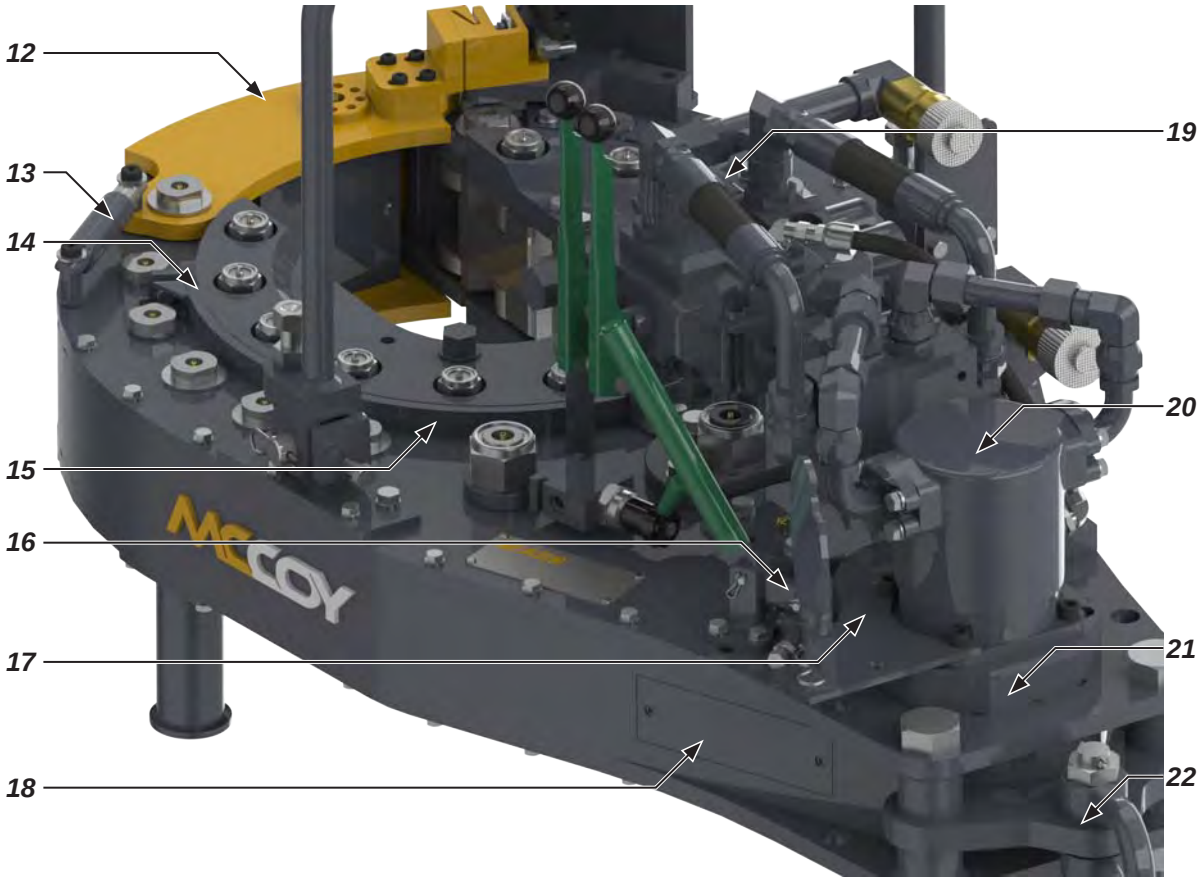


*ILLUSTRATION 2.B.3: MAJOR COMPONENT IDENTIFICATION 03*

| Item | Description |
|---|---|
| 12 | Tong Door Assembly |
| 13 | Tong Door Spring Cylinder |
| 14 | Brake Band Adjustment (top adjustment shown - bottom adjustment is identical) |
| 15 | Brake Band (top brake band shown - bottom brake band is identical) |
| 16 | Manual Shift Assembly |
| 17 | Torque Gauge Mount |
| 18 | Shifter / Gear Train Inspection Panel |
| 19 | Hydraulic Valve Assembly |
| 20 | Hydraulic Motor |
| 21 | Motor Mount |
| 22 | Snub Line Shackle |

### C. HYDRAULIC SCHEMATICS & VALVE IDENTIFICATION

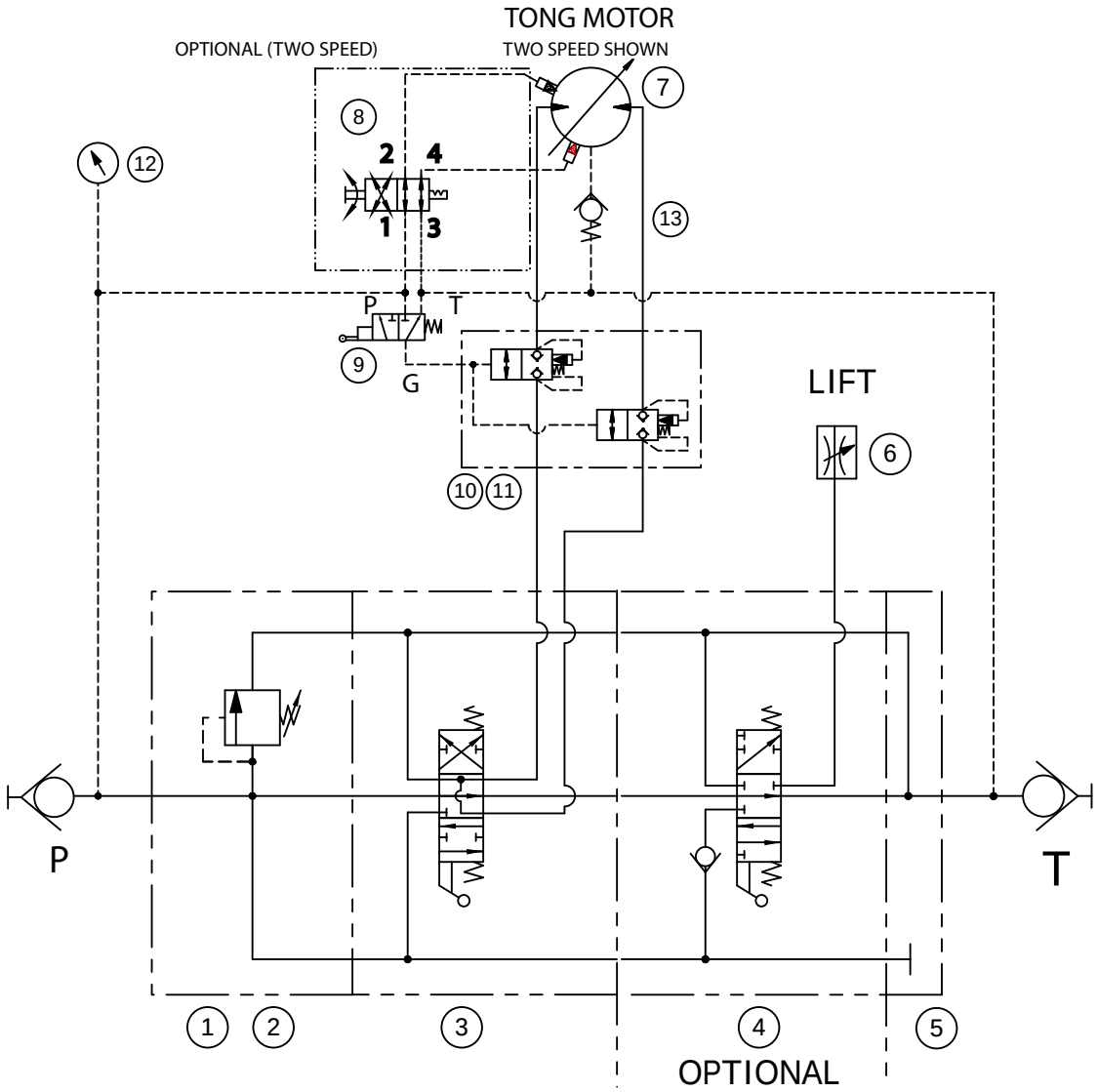


*ILLUSTRATION 2.C.1: HYDRAULIC SCHEMATIC*

| Item | Description | Part Number | Page |
|---|---|---|---|
| 1 | Inlet Valve | 10-9016 | 2.8 |
| 2 | Relief Valve, 2000 - 3500 PSI | 10-0062 | |
| 3 | Motor Valve Section | 10-9014 | |
| 4 | Lift Cylinder Valve Section (Optional) | 10-9015 | |
| 5 | Outlet Section | 10-0086 | |
| 6 | Lift Cylinder Flow Control Valve (Optional) | 08-9062 | |
| 7 | Two-Speed Motor | 87-0007 | |
| 8 | Motor Shift Valve | 10-9035 | |
| 9 | Safety Door Switch | 08-0337M | |
| 10 | Safety Door Check Valve | 08-1625 | 2.9 |
| 11 | Safety Door Valve Block | 101-0727 | |
| 12 | Pressure Gauge, 0 - 3000 PSI (Optional - Not Shown) | 02-0245 | |
| 13 | Check Valve (Optional - Not Shown) | 08-9022 | |

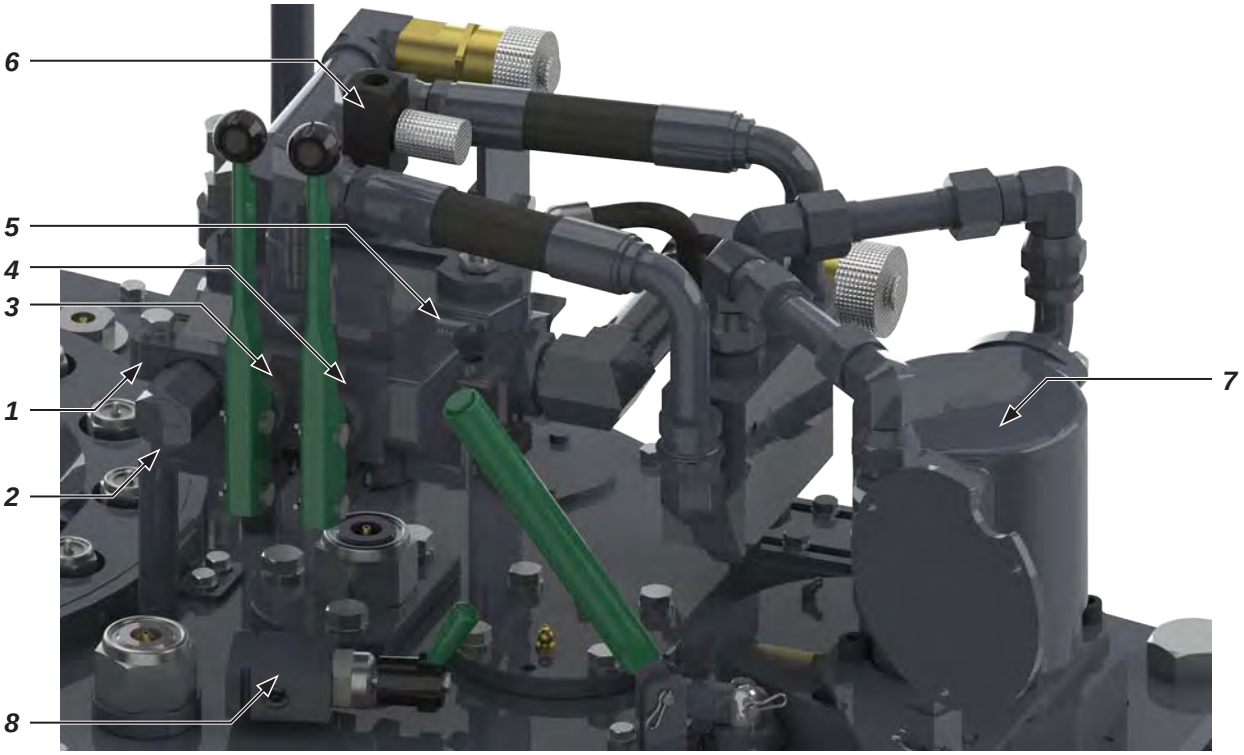


Illustration 2.C.2: Hydraulic Component Identification 01

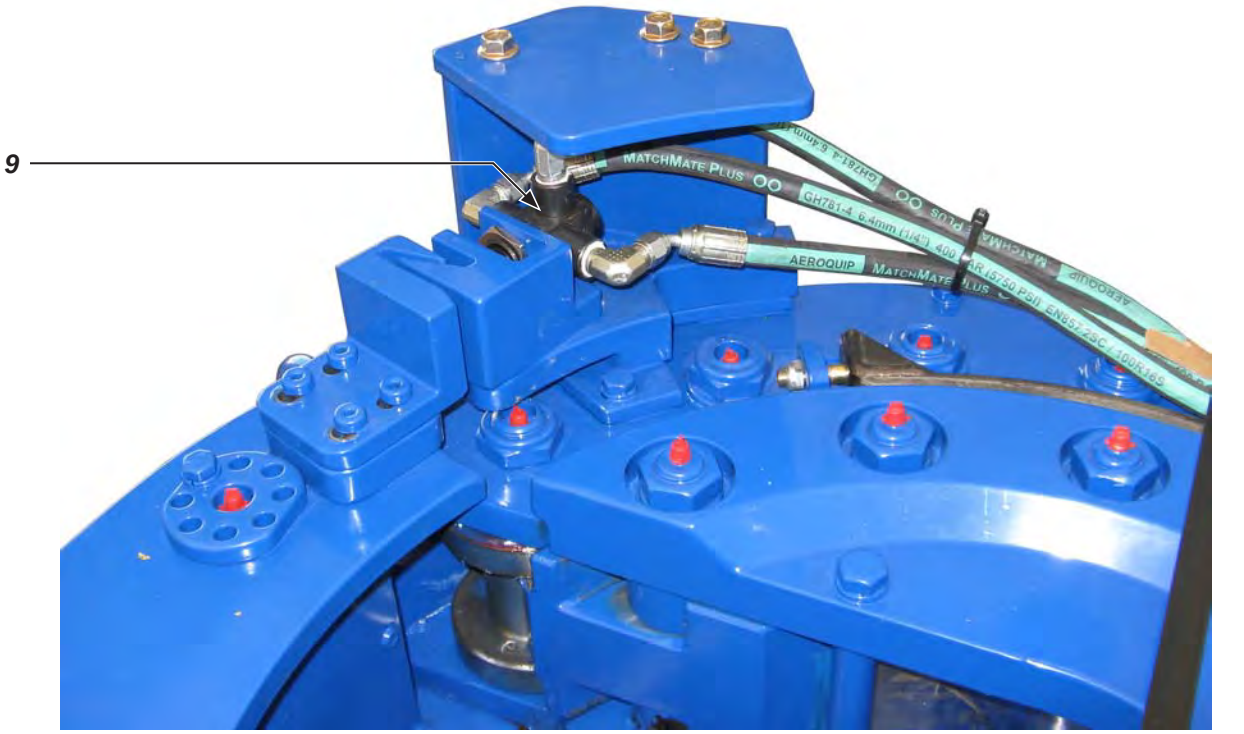


Illustration 2.C.3: Hydraulic Component Identification 02

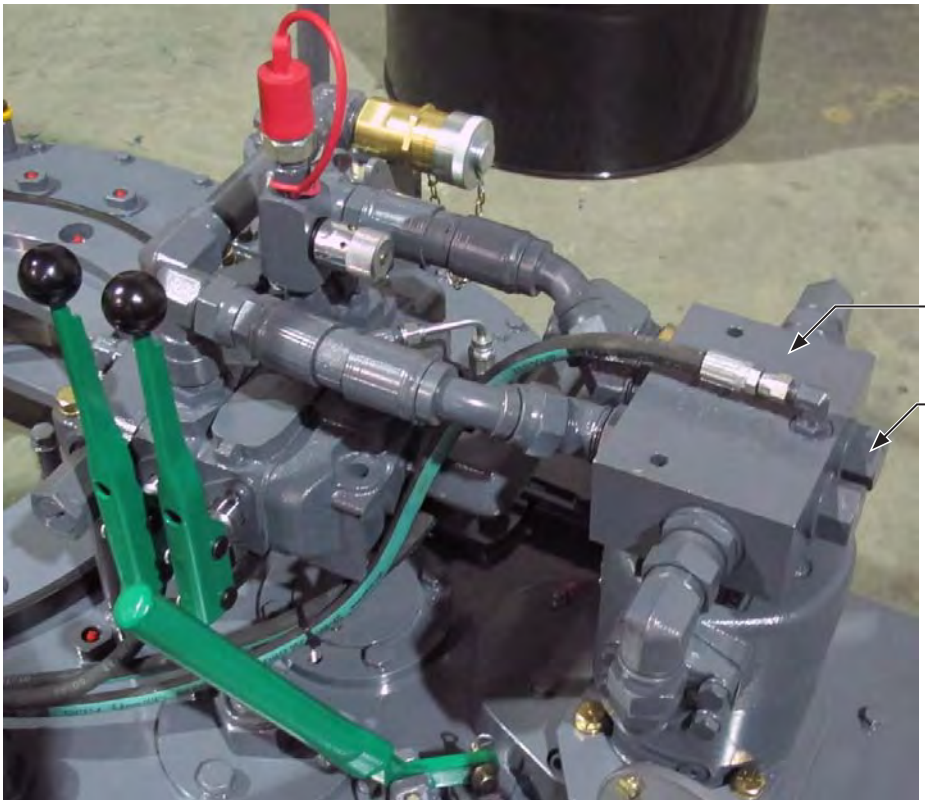


ILLUSTRATION 2.C.4: HYDRAULIC COMPONENT IDENTIFICATION 03

### D. HYDRAULIC CONNECTIONS

*A pair of hydraulic lines - a 1" supply line and a 1-1/4" return line - connect the tong to the power unit (see illustration below). Ancillary devices (hydraulic motors, hydraulic cylinders, etc.) are connected through the valve block.*

*Perform any hydraulic connection when the power unit is not running, or when the hydraulic pump is disengaged. The possibility of error in inter-changing the high pressure supply hose and the low pressure return hose has been eliminated, because the supply side coupling is smaller than the return side.*

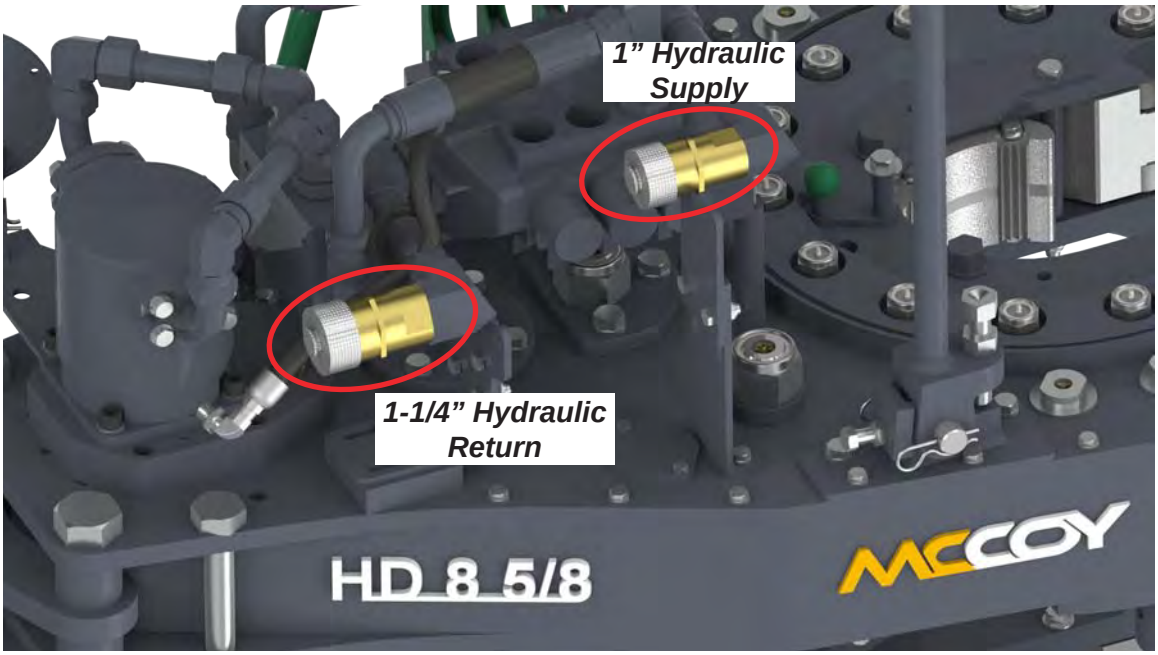


ILLUSTRATION 2.D.1: HYDRAULIC CONNECTIONS 01

*These hose couplings are self-sealing, and care should be taken to ensure complete engagement to prevent partial closure of the check valve in the coupling. Ensure that the nut (female) side is completely made up onto the male connector - there is a line on the male fitting that indicates complete make-up. Snug the female fitting right up to the line.*

***IMPROPERLY MADE CONNECTIONS WILL CONSTRICT OR COMPLETELY OBSTRUCT FLOW***

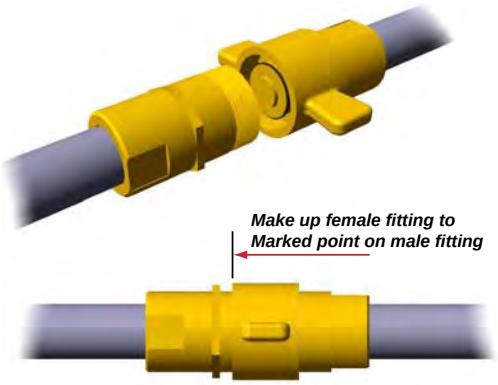


***ILLUSTRATION 2.D.2: HYDRAULIC CONNECTIONS 02***

### *E. TONG / BACKUP JAW AVAILABILITY & INSTALLATION*

#### *1. Availability*

*The following table lists all jaw die kits that are available as standard sizes for this model of tong. McCoy Drilling & Completions | Farr offers a good selection of standard jaw sizes. However, please note that we can custom-engineer and manufacture any size of jaw within the range of the tong. Jaw systems are available to allow use of die inserts intended for specialized applications. Call our sales office for information on jaw and die systems designed for higher or lower grip, or non-marking applications.*

*The table lists standard flat and contoured dovetail die inserts that are available as spare parts. However, a wide variety of diamond-tooth, GRITFACE®, aluminium, and wrap-around fine-tooth dies are available for specialized applications. Please refer to our website for complete information:*

***http://www.mccoyglobal.com/dies-inserts***

| Description | Part Number | Description | Part Number |
|---|---|---|---|
| 2-3/8" Jaw Die Kit (See Note Below) | 8625-JDK-105 [A] | 6" Jaw Die Kit | 8625-JDK-143 |
| 2-7/8" Jaw Die Kit | 8625-JDK-110 [B] | 6-1/2" Jaw Die Kit | 8625-JDK-144 |
| 3-1/2" Jaw Die Kit | 8625-JDK-115 [C] | 6-5/8" Jaw Die Kit | 8625-JDK-145 |
| 4" Jaw Die Kit | 8625-JDK-120 | 7" Jaw Die Kit | 8625-JDK-150 |
| 4-1/2" Jaw Die Kit | 8625-JDK-130 | 7-5/8" Jaw Die Kit | 8625-JDK-155 |
| 5" Jaw Die Kit | 8625-JDK-135 | 7-3/4" Jaw Die Kit | 8625-JDK-160 |
| 5-1/2" Jaw Die Kit | 8625-JDK-140 | 8-5/8" Jaw Die Kit | 8625-JDK-162 |
| | | | |
| A - Uses contoured insert PN 12-0004 | | | |
| B - Uses die insert PN 12-0007 | | | |
| C - Uses contoured insert PN 12-0011 | | | |
| All other jaw die kits use flat die PN 13-0008-314-0 | | | |

***MAXIMUM RATED TORQUE FOR THE 2-3/8" JAW DIE KIT IS 18,000 LBS.-FT.***

**2. Jaw & Die Removal**

*If necessary the entire jaw may be removed. Support the jaw from the bottom and remove the jaw pivot bolt. The jaw may then be slid out of and away from the cage plate. Reverse this procedure to replace the jaw assemblies (see Illustration 2.E.1)*

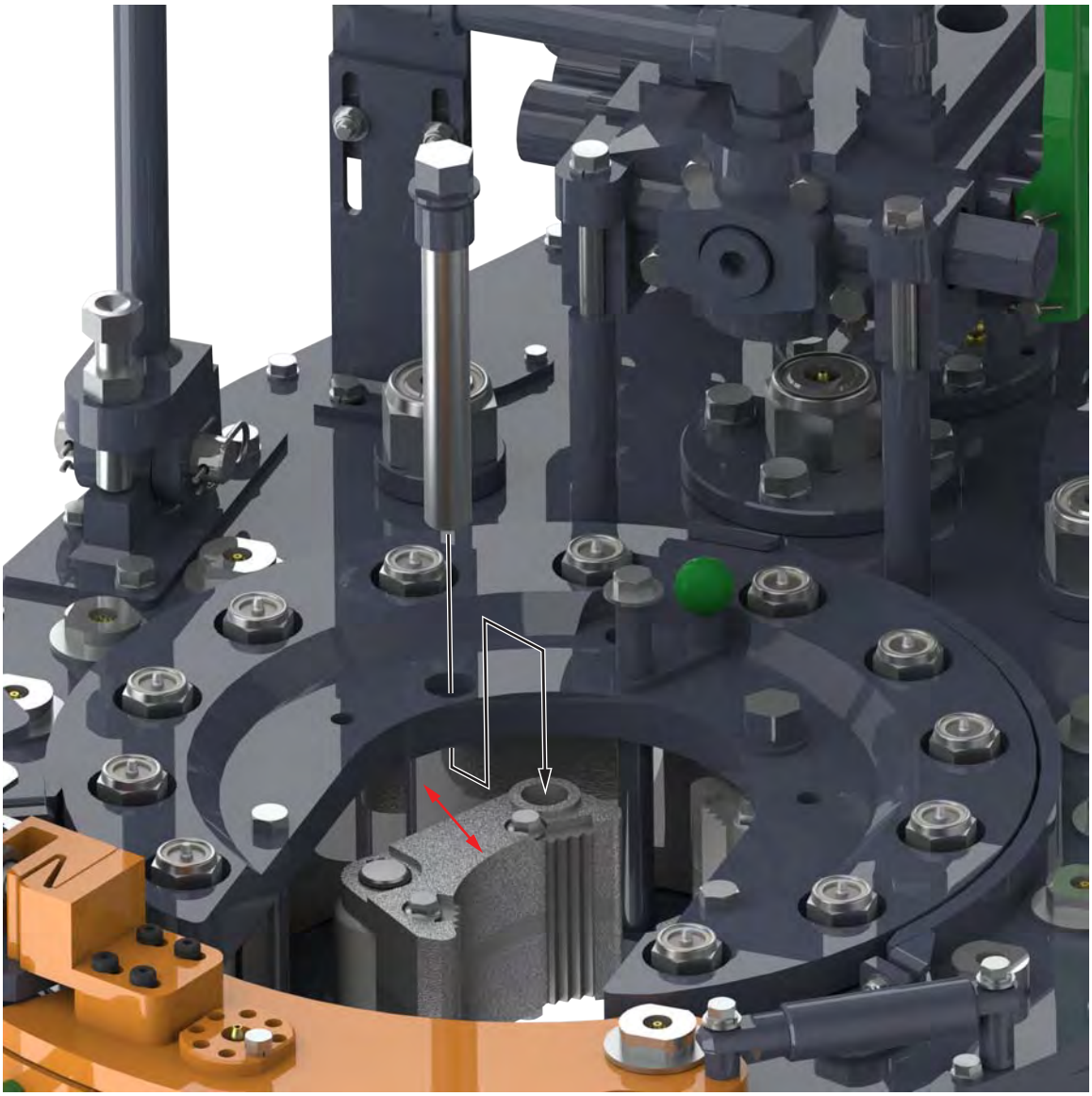

**ILLUSTRATION 2.E.1: JAW REMOVAL**

*Once the jaw has been removed, extract the die keeper screws and remove the dies by tapping dies lightly with a hammer. Replace the dies, tapping them into place if necessary, and replace the keeper screws.*

## F. TONG RIG-UP & LEVELING

**1. Suspension & Restraint**

*Suspend the tong from a location as near to the centre of the drill rotary as possible, and from a location high enough on the mast to ensure easy handling. The lower the point from which the tong is suspended, the more effort will be required to move the tong to and from the connection point.*

*The suspension line may be extended over a pulley and balanced by a counterweight equal to the weight of the tong, or simply tied off in the derrick to form a dead line. When using a dead line arrangement it is necessary to use a FARR® spring hanger assembly (see specification page for recommended spring hanger). This spring hanger compensates for the downward movement of the casing as the thread is made-up, and imparts additional force to the suspension cable:*

- *a "single spring" hanger typically applies 420 lbs. (191 kg.) to the suspension line for every inch of thread made up*
- *a "double spring" hanger typically applies 840 lbs. (382 kg.) to the suspension line for every inch of thread made up*

**Suspension & Restraint (Cont'd)**

*If you do not know which specific spring hanger is in use, check the specification page in this manual for information on the recommended spring hanger for this application. McCoy Drilling & Completions will not guarantee or specify spring hangers other than what has been supplied by McCoy.*

*Many applications use a lift cylinder for adjusting the height of the tong. Ensure the weight of the lift cylinder is known if it has not been included in the total weight of the tong.*

*All forces upon the suspension line must be considered when calculating necessary strength of the suspension line. The weight of the tong, the weight of the lift cylinder, the weight of the spring hanger, and the force imparted on the suspension line by the spring hanger must all be added together in order to arrive at the total force supported by the suspension line. Select your suspension line based upon the total force and the margins of safety dictated by the policies of your company and by established engineering practices. Ultimately, calculating the force on the suspension line and selection of the suspension line is the complete responsibility of the customer.*

*McCoy Drilling & Completions recommends using dual backup (snub) lines of sufficient strength to withstand the force imparted by the maximum rated torque of the tong in use. Calculate the force on the snub lines by dividing the maximum torque of the tong by the tong's torque arm (expressed in feet). For example, a 35,000 lbs.-ft. tong with a 36 inch (3 ft.) torque arm will generate 11667 lbs. of force against the snub line. Select your snub lines based upon the total force and the margins of safety dictated by the policies of your company and by established engineering practices. Ultimately, calculating the force on the snub line and selection of the snub line is the complete responsibility of the customer.*

*Snub lines must be securely connected to the rear of the tong, and tied off to a suitable anchor. One snub line must be secured to the load cell, which is then secured to the rear of the tong. The side of the tong the load cell connects to is dependant upon whether make-up or break-out activities are underway. To ensure accurate torque measurement, the torque measurement line must be connected perpendicular to the lengthwise axis of the tong, and perpendicular to the hang line (see illustrations 2.F.1 and 2.F.2). Connect the second snub line on the opposite side of the load cell, perpendicular to the lengthwise axis of the tong and perpendicular to the vertical.*

***MCCOY DRILLING & COMPLETIONS ACCEPTS NO RESPONSIBILITY FOR DESIGNING AND SELECTING AN ADEQUATE SUSPENSION AND RESTRAINT SYSTEM FOR YOUR DRILLING EQUIPMENT***

***ALL SELECTED FASTENERS, SHACKLES, CLAMPS, ETC. USED FOR CONSTRUCTING THE SUSPENSION AND SNUB LINES MUST BE RATED FOR THE CALCULATED FORCES.***

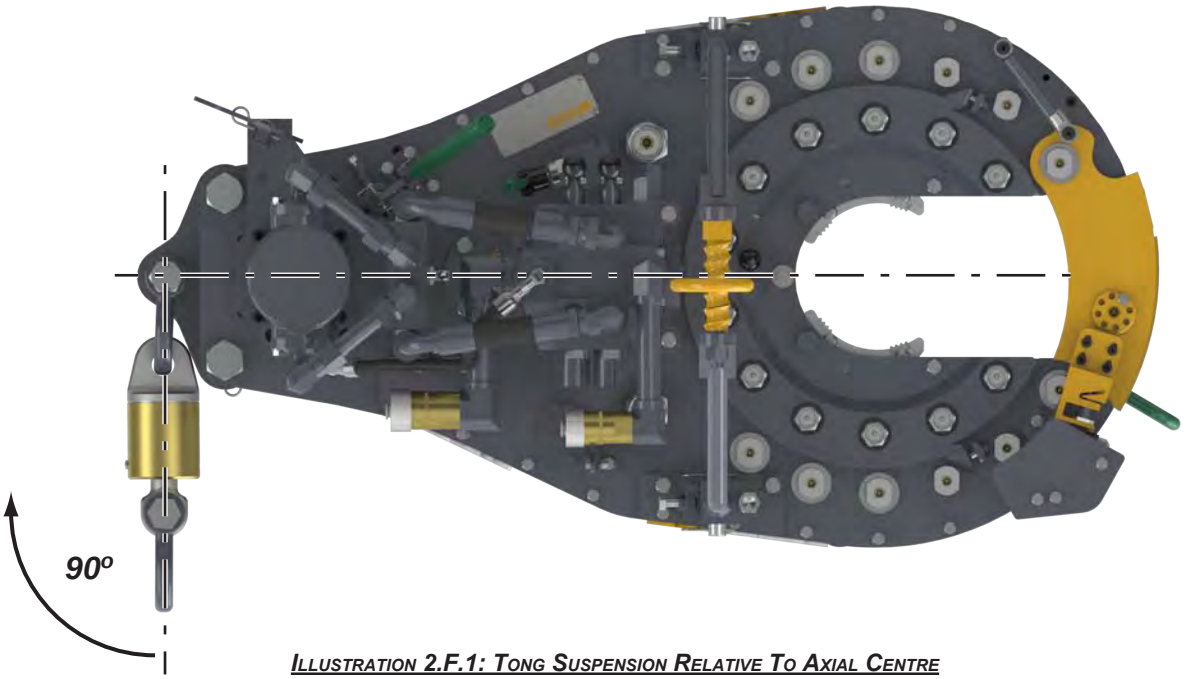


*ILLUSTRATION 2.F.1: TONG SUSPENSION RELATIVE TO AXIAL CENTRE*

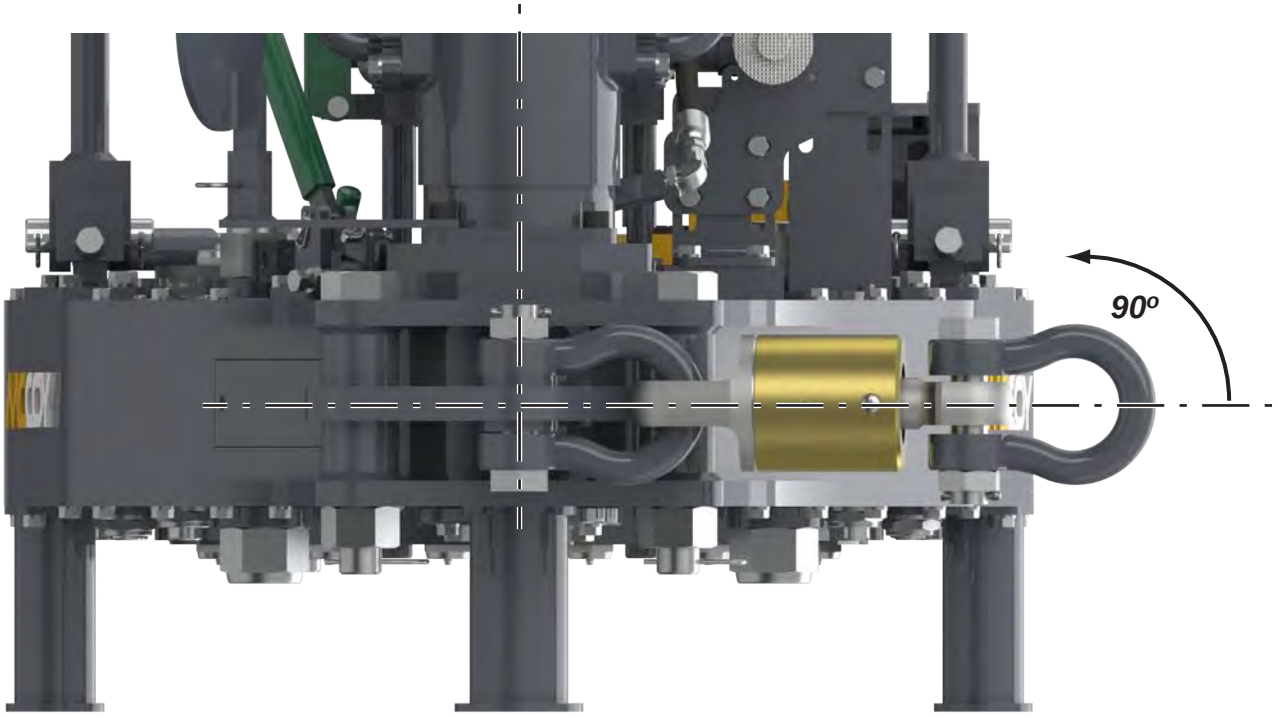


ILLUSTRATION 2.F.2: TONG SUSPENSION RELATIVE TO VERTICAL CENTRE

**2. Tong Leveling**

*The tong must be leveled side-to-side and front-to-rear before placing into service. We have provided the following guidelines for assisting you when leveling your tong.*

*i. Place a level axially (side to side) across the tong, ensuring that it is parallel with the surface of the tong. Use a thin wrench on the flat of the adjusting helix to rotate the helix, forcing the lift link to move towards the outer supports of the sling. The 3/4" nylock nut on the pin may have to be slightly loosened to allow the helix to rotate. Adjust the helix until the level shows that the tong is level side-to-side.*

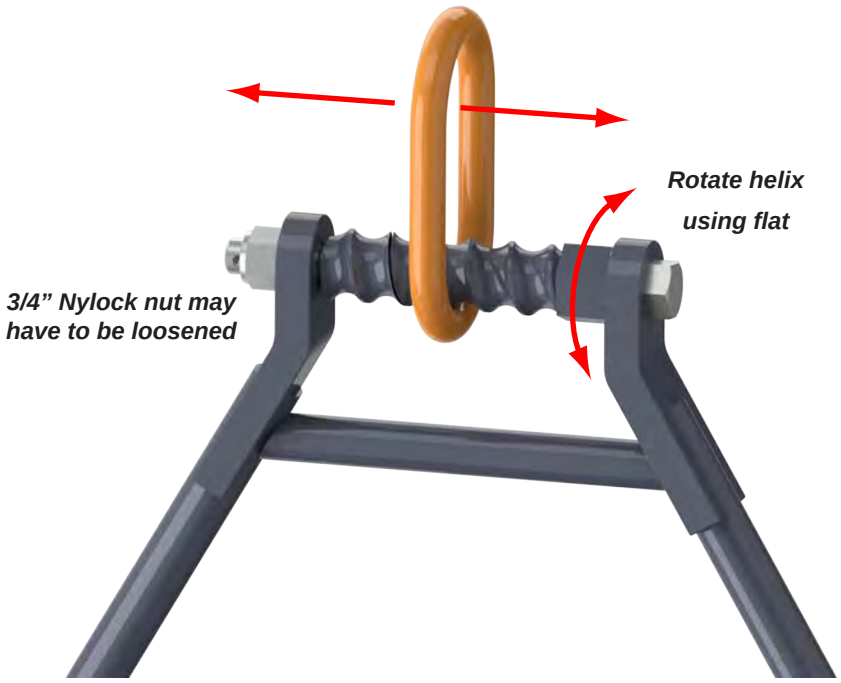


ILLUSTRATION 2.F.3: TONG LEVELING (SIDE-TO-SIDE)

ii. *Place a level lengthwise (front to back) along the tong, ensuring that it is parallel with the surface of the tong. Loosen the 1/2" jam nuts on the adjusting bolts on rigid sling brackets. Completely loosen the adjusting bolts. Turn each adjusting bolt equally until tong hangs level front-to-back. Lock adjusting bolts in place with the jam nuts.*

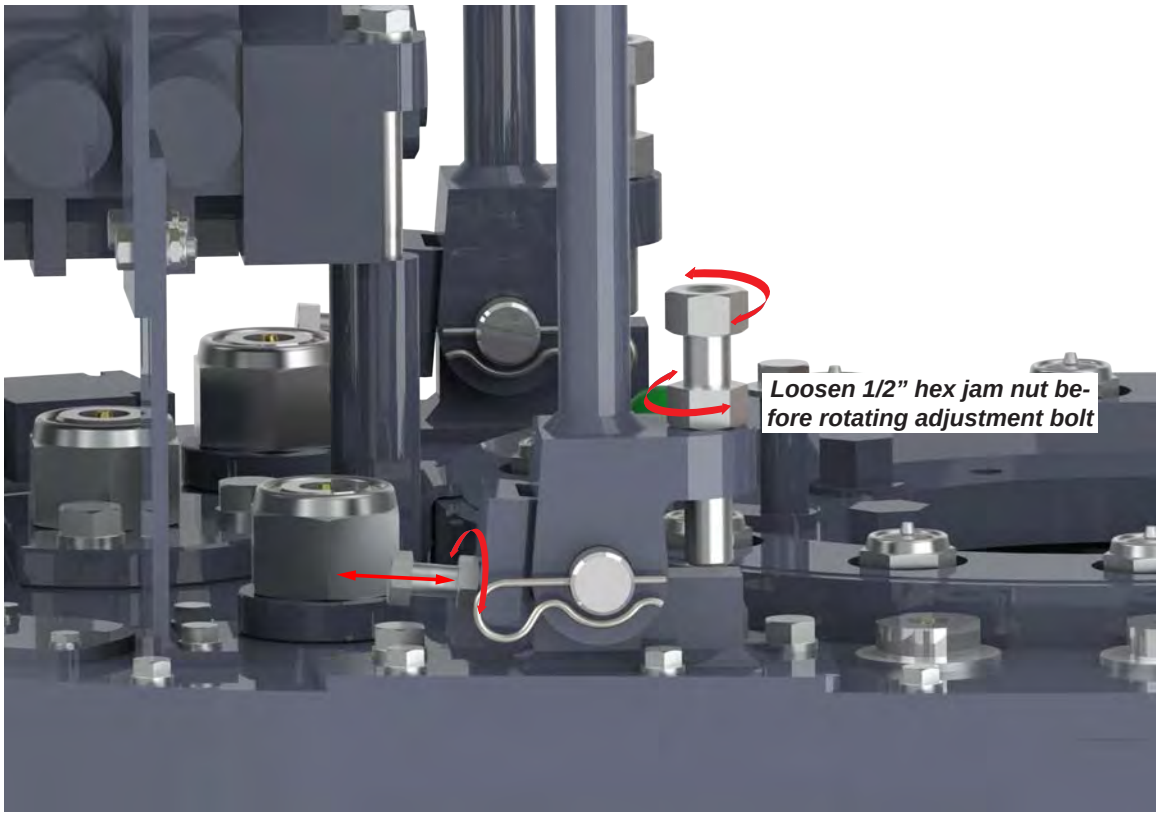


***ILLUSTRATION 2.F.4: TONG LEVELING (FRONT-TO-REAR)***

## G. TONG OPERATION

### 1. Initial Start-up and Break-in Procedure

***YOUR EQUIPMENT HAS BEEN THOROUGHLY TESTED AND INSPECTED AT THE FACTORY. HOWEVER, WE ADVISE INSPECTION AND TESTING OF YOUR NEW TONG AFTER TAKING POSSESSION IN ORDER TO ELIMINATE THE POSSIBILITY OF SHIPPING DAMAGE.***

*McCoy Drilling & Completions recommends that the following pre-operating tests be performed after receipt from the factory or after extended storage, prior to releasing the tong to operations:*

- *Perform a complete inspection of all fasteners to ensure none have loosened during transport.*
- *Connect the tong to the power unit, and apply full hydraulic pressure. Inspect and correct any leaks.*
- *Operate the tong at full speed and in high gear for a duration of one-half hour. Hot bearing caps may indicate impending bearing failure.*
- *Switch to low gear and operate for an additional one-half hour at full speed.*
- *Inspect all components and hydraulic fittings for possible defects following completion of the tests. All Farr® Tongs have been thoroughly tested at the factory prior to shipping, but shipping damage must be identified before running the tong in an operational environment.*
- *Carefully inspect the safety door components, and test to ensure that the safety device on each door is operating correctly before releasing the tong to the operating environment.*

***TONG DOOR MUST BE CLOSED AND SECURELY LATCHED BEFORE THE POWER UNIT IS STARTED IN ORDER TO ASSURE THE SAFETY OF OPERATING PERSONNEL***

*Ensure adequate lube oil and hydraulic oil levels before starting engine. Use start up procedures as recommended by the power unit engine operator's manual. Open the Bypass Valve on the hydraulic system, and inspect all pressure and return line hose connections to ensure correct and secure installation.*

***IMPROPERLY SECURED HYDRAULIC CONNECTIONS WILL INTERRUPT HYDRAULIC FLUID FLOW, AND COULD RESULT IN THE FOLLOWING FAILURES:***

- *A restriction in the pressure supply hose will result in high pressure within the power unit hydraulic system, which will activate the hydraulic governor and increase the engine speed to as high as maximum RPM.*
- *A restriction in the return line will result in high pressure within the power unit and the tong hydraulic system, causing engine speeds as high as maximum RPM, and possible failure of the motor seal.*

*Following inspection of the hoses, start the engine and allow it to idle until warm. Allow hydraulic fluid to circulate for approximately 10 minutes, then slowly close the Bypass Valve to allow hydraulic fluid to circulate through the hoses and to the tong (circulating pressure should not exceed 200 psi). Place the tong gear shifter in low gear and rotate the tong slowly forward and then reverse with the throttle valve control lever. Once this has been done and the proper size jaws have been installed, the tong is then ready to run pipe.*

**2. Valve Operation**

*4-way proportional valves control operation of hydraulic devices on the tong assembly such as hydraulic motors and cylinders. When any one valve is "centered" or in the detent position, there is no hydraulic output from the valve. When the valve is pushed forward there is an effect, and when the valve is pulled back, there is an opposite effect. These valves feature proportional control, which means that further extension of the valve handle (thereby further opening the valve orifice) results in proportionally higher hydraulic output to the controlled device.*

*The following illustration demonstrates the type and effect of the hydraulic valves with which this tong is may be equipped.*

*TONG MOTOR*

*This is a proportional valve. Pushing the valve handle forward will cause the tong motor to rotate in a clockwise direction (as seen from the top of the tong). This is the desired direction of rotation for making up a joint. Pulling the valve handle in the opposite direction results in counter-clockwise rotation, which is the desired direction of rotation for breaking out a joint.*

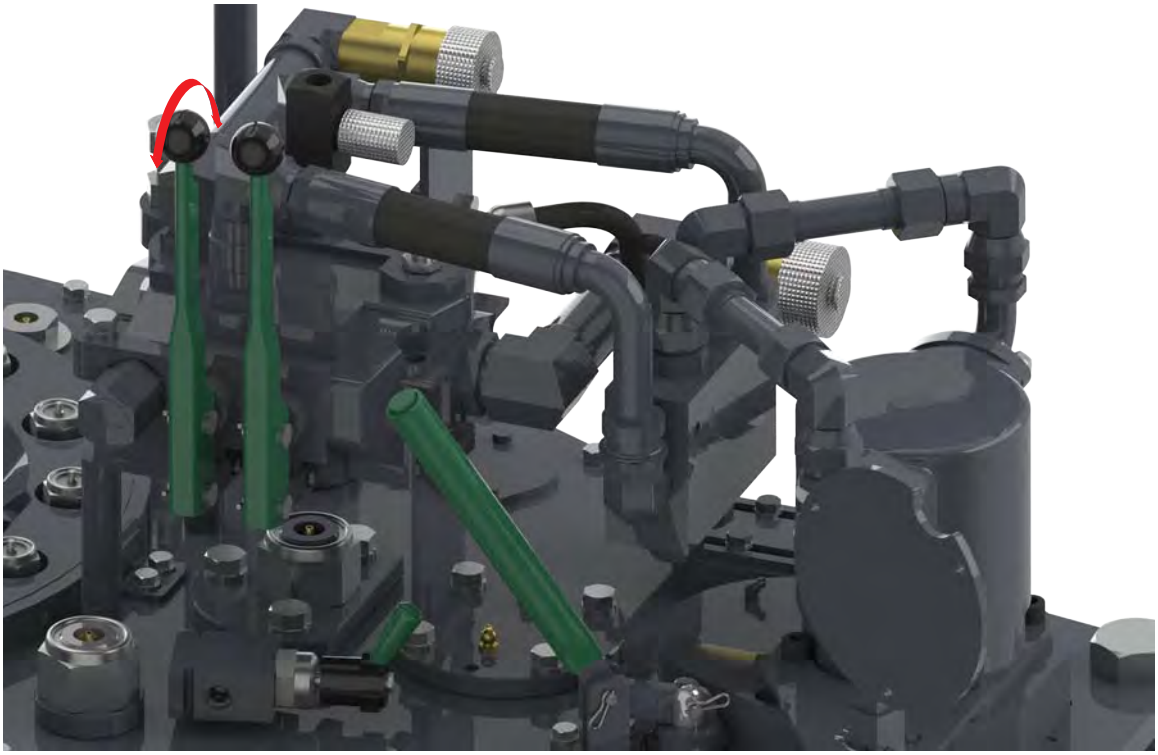

***ILLUSTRATION 2.G.1: TONG ROTATION CONTROL VALVE***

***Valve Operation** (Continued):*

*LIFT CYLINDER*

*This is a direct-acting valve. Pushing the valve handle forward will cause the lift cylinder to lower the tong vertically. Pulling the valve handle toward the operator will cause the lift cylinder to lift the tong.*

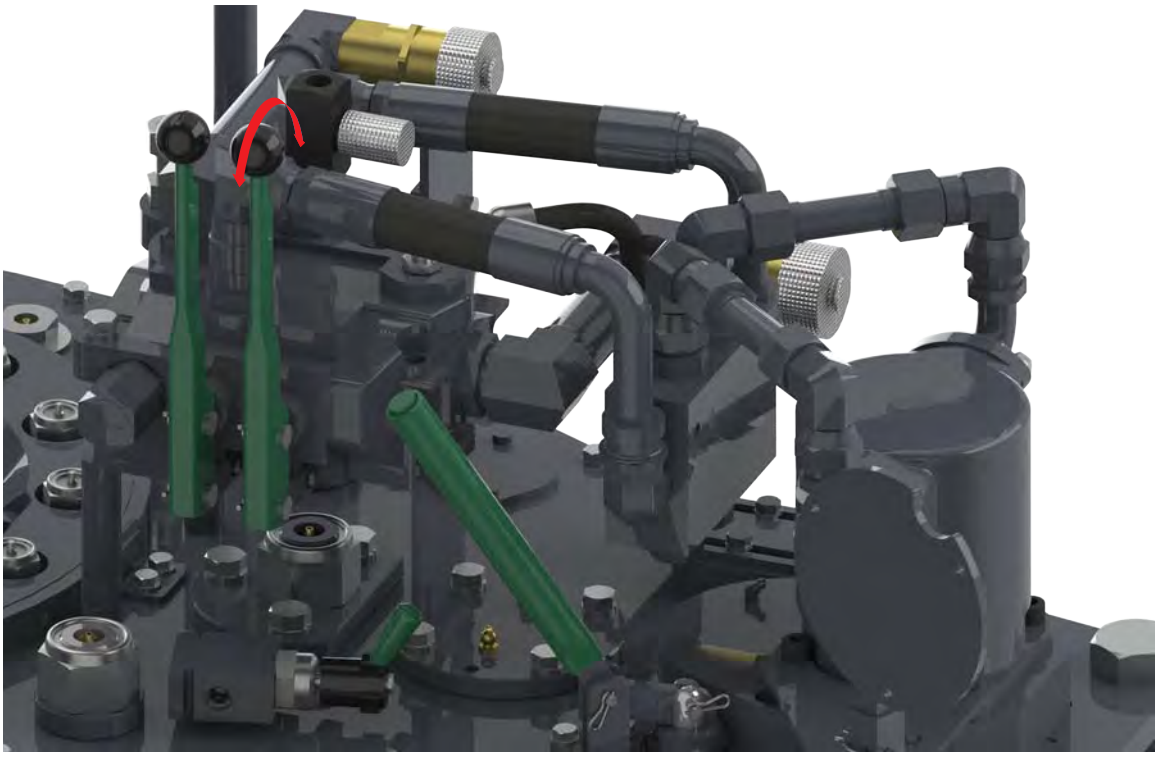

**ILLUSTRATION 2.G.2: TONG LIFT CYLINDER CONTROL VALVE**

*MOTOR SPEED*

*This valve sets the speed of the two-speed motor. Pulling the motor speed control all the way out sets the motor speed to LOW. Maximum torque is only available when the motor speed is set to LOW. Pushing the valve handle towards the centre of the tong sets the motor speed to HIGH, which is useful for rapidly un-threading broken connections.*

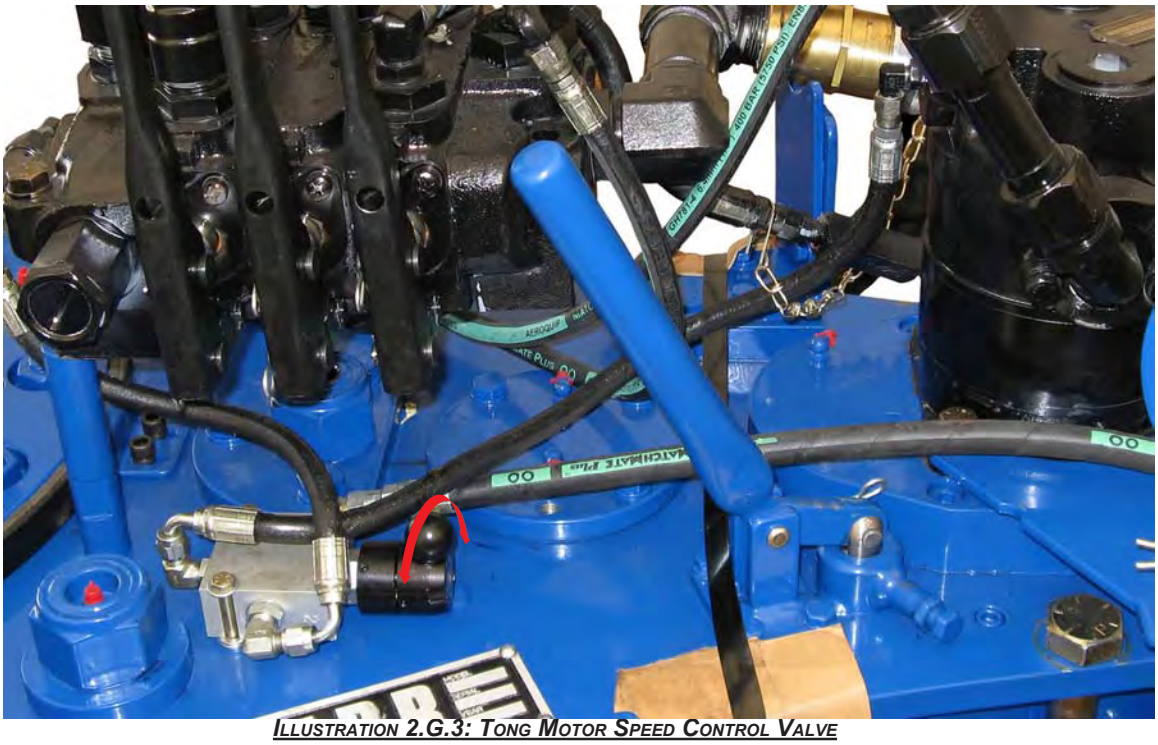

**ILLUSTRATION 2.G.3: TONG MOTOR SPEED CONTROL VALVE**

### 3. SHIFTING GEARS

*The shifting shaft has three "detent" positions identifying the low speed/high torque position, the "neutral" or free-spinning position, and the high speed/low torque position. The detent strength may be adjusted by releasing the locknut on the detent tube and increasing or relaxing pressure on the detent spring. Ensure the locknut is tightened once the desired detent pressure has been set.*

*To shift to the high-speed gear, move the shifting handle downward from neutral position. To shift to the low-speed gear, move the shifting handle up through the neutral detent to its highest position. Note that the high clutch gear or the low clutch gear may not be exactly aligned when shifting, so the operator may need to "bump" the motor control handle slightly to turn the main clutch gear shaft and shifting collar into alignment. This is most effective when applying a small amount of pressure on the gear shift lever in the direction you want to shift the tong, ensuring the shifting collar will "catch" when the main clutch gear aligns with either the high or low clutch gear (see Illustration 2.G.4).*

***SHIFTING TONG WHILE ROTATING THE MOTOR AND CAGE PLATE MAY RESULT IN CATASTROPHIC GEAR TRAIN FAILURE***

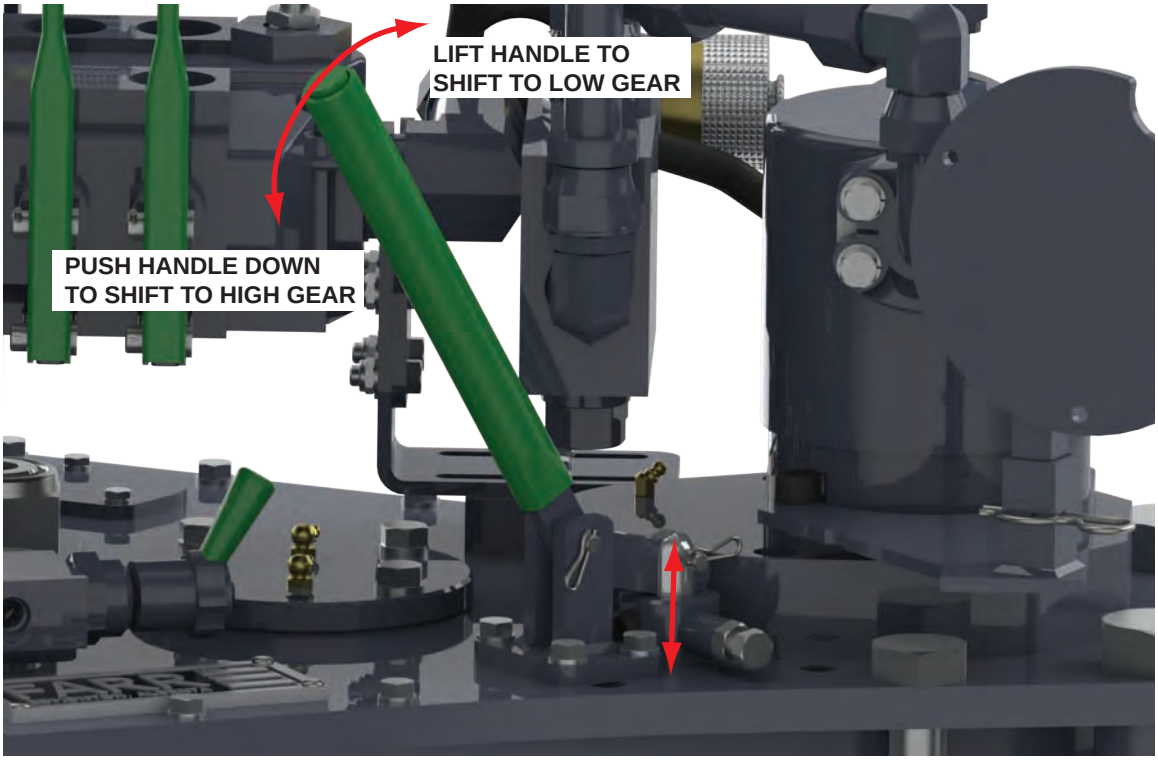


***ILLUSTRATION 2.G.4: TONG MANUAL SHIFT CONTROL***

### 4. General Comments

a) *Position rotary gear in contact with both idler gears when breaking out joints or collars where high torques are required.*

b) *When making-up integral (shouldered) joints, it is essential to make up the last turn of the threads in low gear. This reduces the tendency of an instant stop or a sudden increase in torque, which induces extremely high stresses on the gear train.*

c) *DO NOT employ the "snap break" method of breaking-out joints when pulling a string. By definition, the "snap break" method is a procedure used by some operators to break out connections, accomplished by leaving slack in the "jaw-pipe" engagement, and then quickly pulling the throttle valve control lever allowing the tong to snap into its loaded or high torque condition. Although this method is very effective in breaking out joints, the extremely high stress placed on the gear train frequently causes gear breakage.*

## H. MAKING AND BREAKING CONNECTIONS

***THESE OPERATING PROCEDURES ASSUME THE USER HAS PROPERLY SET UP AND PREPARED THE EQUIPMENT FOR OPERATION AS PER SECTIONS 2D, 2E, AND 2F OF THIS MANUAL.***

*Set up and prepare your equipment for operation as per Section 2 of this manual Refer to the following sections:*

- *2.D - Hydraulic Connections*
- *2.E - Tong Jaw Installation*
- *2.F.1 - Tong Rig-up and Leveling (Suspension)*
- *2.F.2 - Tong Rig-up and Leveling (Leveling)*

*Your tong and backup assembly should be properly suspended, connected to a hydraulic power source, and ready to make or break connections at this point.*

### 1. Making A Connection

a) *Ensure hydraulic power supply to the tong is energized. The master link on the rigid sling must be used to suspend the tong. Do not suspend the tong directly from the rigid sling.*

***ILLUSTRATION 2.H.1: MASTER LIFTING LINK***

***THE MASTER LINK MUST BE USED TO SUSPEND THE TONG ASSEMBLY***

b) *Ensure the backing pin is in the "make-up" position. From the front of the tong, the backing pin correctly configured for makeup will be in the 10 o'clock position (see Illustration 2.H.2 next page). If it is not, simply lift up and place in the correct position (see Illustration 2 next page). The cage plate opening must be aligned with the door opening when setting the backing pin position.*

*Making A Connection (Continued)*

ILLUSTRATION 2.H.2: BACKING PIN SET TO "MAKE-UP" POSITION

c) *Ensure the load cell and snub line(s) are properly configured for making up connections. A "snub line" is a length of wire rope that connects the rear of the tong body to a sturdy anchor on the drill floor (see Section 2.F.1). The snub line prevents the tong body from spinning in the opposite direction of the cage plate when torque begins to build in the joint. Farr Canada Corp. recommends using two snub lines when running the equipment to eliminate uncontrolled movement in either rotational direction. The snub line(s) must be rated for the applied torque plus whatever safety margins stated by your own operating policies. The snub line connection point on the drill floor must be sturdy enough to absorb all applied forces when making up the joints. When making up joints the load cell must be connected to the driller's side of the tong, which is the left side of the tong as seen from the rear. For accurate torque measurement the snub line between the tong body and the anchor must be perpendicular to the vertical, and perpendicular to the centre-line of the tong.*

d) *Actuate the lift cylinder control valve to lift the assembly from the drill floor. Pulling the valve toward the operator will retract the lift cylinder to raise the assembly (see Illustration 2.H.3 below). Note that rig personnel are required to stabilize the tong and backup as it is being lifted so it does not swing and collide with other rig equipment.*

**RIG PERSONNEL MUST STABILIZE THE TONG AS IT IS LIFTED FROM THE DRILL FLOOR**

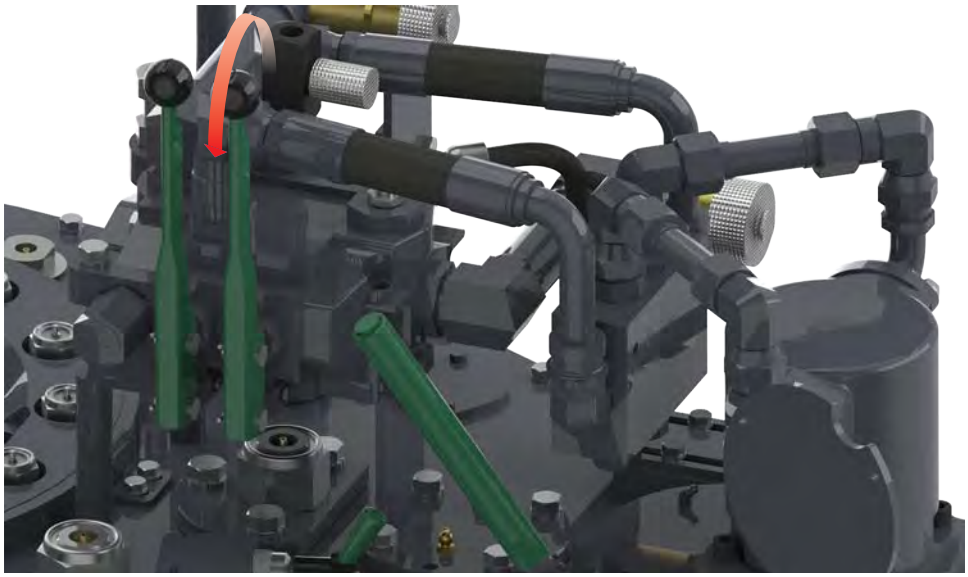

ILLUSTRATION 2.H.3: LIFT CYLINDER CONTROL - RAISE

***Making A Connection (Continued)***

e) *Grasp the tong door handle and pull the door to open (See Illustration 2.H.4). Since your equipment is equipped with a safety door, opening the doors will inhibit rotation of the cage plate.*

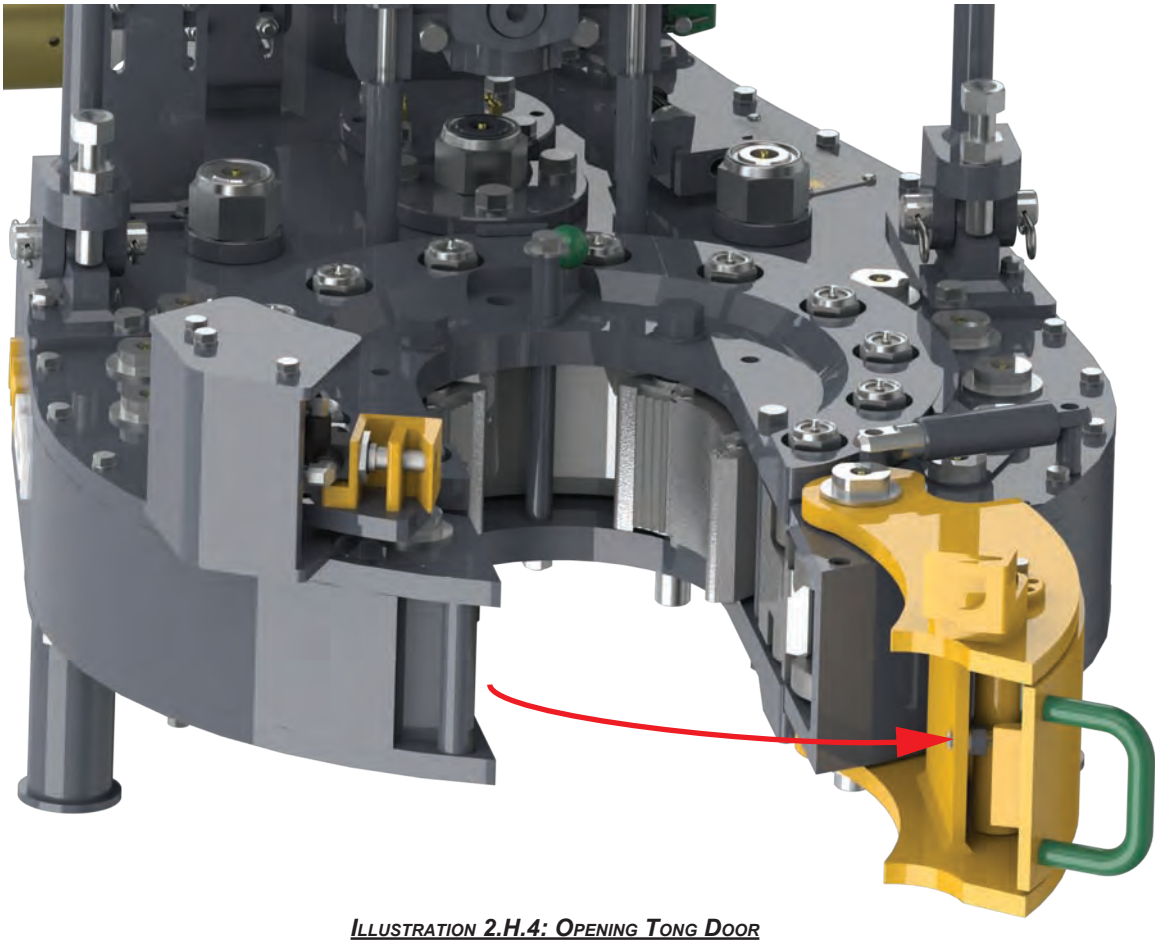

***ILLUSTRATION 2.H.4: OPENING TONG DOOR***

f) *Manually engage the threads of the tubing connection being made up. Ensure threads are not cross-threaded.*

g) *Move the tong on to the pipe above the tubing joint. Use the lift cylinder to ensure the tong jaws are at the correct location above the connection joint.*

h) *Firmly close the tong door against the latch post.*

i) *Begin rotation with the tong in high gear and the tong motor set to high speed (high speed/low torque). See Section 2.G.2 to set the tong motor to high speed, and Section 2.G.3 to properly set the tong to high gear. Do not shift gears while the tong is rotating.*

***SHIFTING TONG WHILE ROTATING THE MOTOR AND CAGE PLATE MAY RESULT IN CATASTROPHIC GEAR TRAIN FAILURE***

***Making A Connection (Continued):***

*j) Push the motor control valve toward the tong to rotate the cage plate in the make-up direction.*

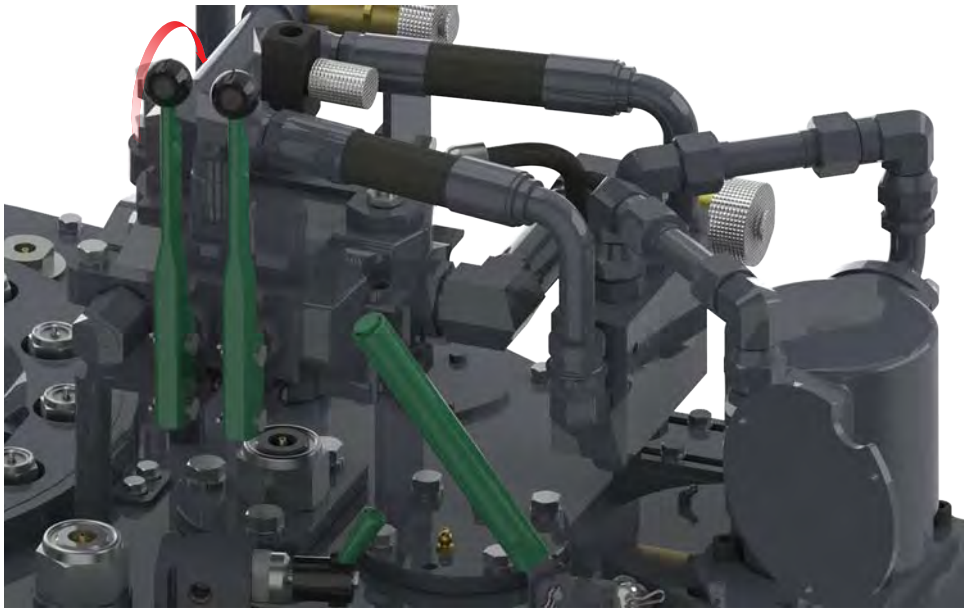

***ILLUSTRATION 2.H.5: MOTOR CONTROL - MAKE-UP***

*k) Push the rotation control handle toward the centre of the tong up to the stop once the tong jaws cam on to the tubing This threads the connection together at high speed. As the joint becomes fully made up the increasing torque demand will stall the motor, and displayed torque will increase.*

*l) Stop rotation, and set motor to low speed and shift to low gear (low speed/high torque - See Section 2.G.2 for instructions for setting motor to low speed, and Section 2.G.3 for shifting to low gear). This will enable the tong to produce adequate torque for making up the joint to specification.*

*m) Push the rotation control handle all the way in to complete the connection at low speed/high torque. Observe the torque gauge - stop rotation when the specified make-up torque is reached. Reverse the rotation control valve to release the tong jaws from the tubing (see Illustration 2.H.6).*

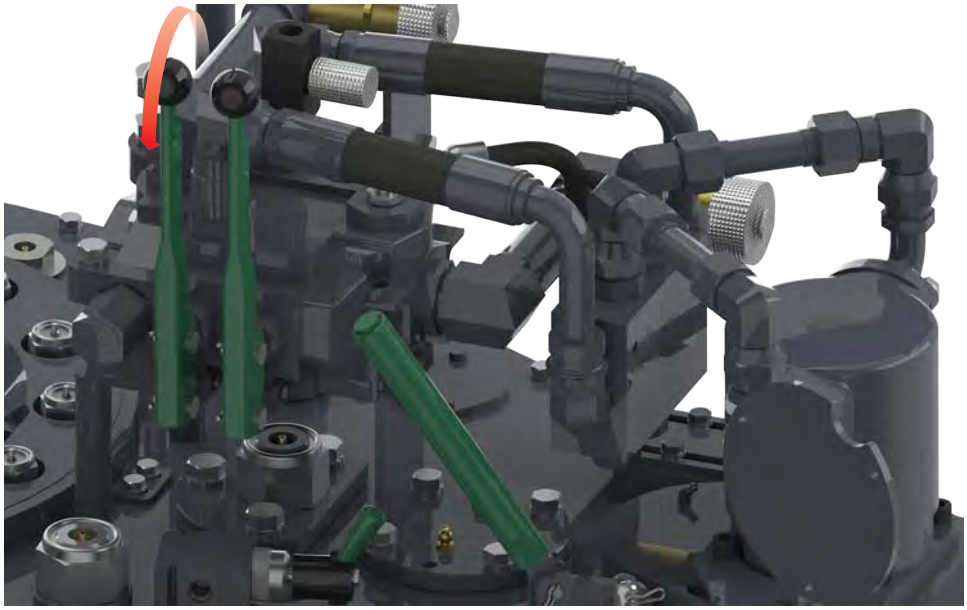

***ILLUSTRATION 2.H.6: MOTOR CONTROL - RELEASING JAWS***

***Making A Connection (Continued):***

*p) Align the opening in the rotary gear with the mouth of the tong once the jaws are free. Open the tong door. Note that rig personnel may be required to stabilize the tong as it completely releases from the drill string. Guide the tong away from the string and use the lift cylinder control to lower it to the drill floor if desired.*

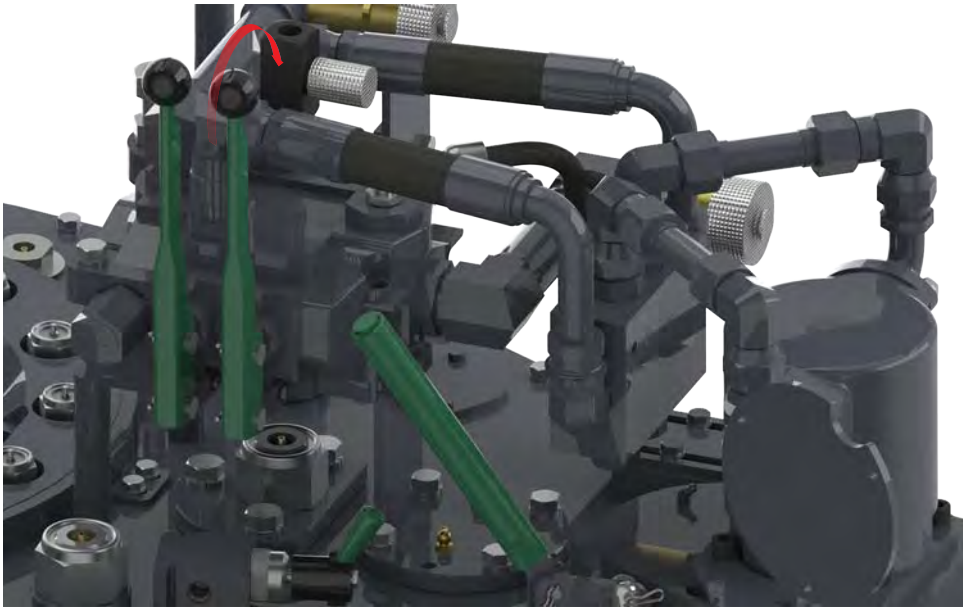

***ILLUSTRATION 2.H.7: LIFT CYLINDER CONTROL - LOWER***

*p) Repeat steps "e" through "p" until the desired number of connections are made up.*

**2. Breaking A Connection**

***YOUR TONG SHOULD BE PROPERLY SUSPENDED, CONNECTED TO A HYDRAULIC POWER SOURCE, AND READY TO BREAK CONNECTIONS.***

a) *Ensure hydraulic power supply to the tong is energized. The master link on the rigid sling must be used to suspend the tong. Do not suspend the tong directly from the rigid sling. See Illustration 2.H.1.*

b) *Set the backing pin on the tong "breakout" operation. Lift up on the backing pin and rotate it to the "breakout" position, which is 2 o'clock as seen from the front of the tong. The opening in the rotary gear must be aligned with the tong door opening in order to properly set the backing pin (see Illustration 2.H.8).*

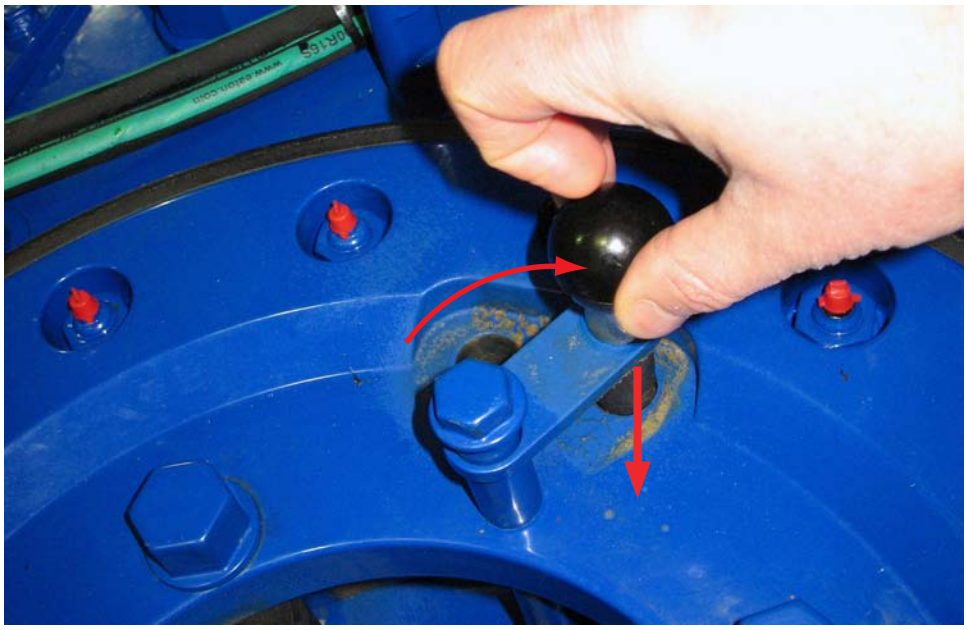

***ILLUSTRATION 2.H.8: SETTING BACKING PIN TO "BREAK-OUT" POSITION***

c) *Ensure the load cell is configured for break-out operation. If torque measurement for break-out is required, connect the load cell to the off-driller's side (the right-hand side as seen from the rear of the tong).*

d) *Connect snub lines to the rear of the tong to arrest uncontrolled rotation of the assembly. The snub lines must be rated for the applied torque plus whatever safety margins stated by your own operating policies. The snub line connection points on the drill floor must be sturdy enough to absorb all applied and potential forces.*

e) *Open the tong door (see Illustration 2.H.4).*

f) *Actuate the lift cylinder control valve to lift the assembly from the drill floor if necessary. Pulling the valve toward the operator will retract the lift cylinder to lift the assembly (see illustration 2.H.3). Note that rig personnel are required to stabilize the tong as it is being lifted so it does not swing and collide with other rig equipment. Move the tong on to the string.*

***RIG PERSONNEL MUST STABILIZE THE TONG AS IT IS LIFTED FROM THE DRILL FLOOR***

g) *Firmly close the tong door against the latch post.*

h) *Rig personnel may be required to stabilize the tong above the connection until the jaws have been clamped shut.*

i) *Break-out torque is only available when tong motor speed is set to low speed and tong is in low gear. See Section 2.G.2 to set tong to low speed and Section 2.G.3 to shift to low gear. Do not shift gears while the tong is rotating.*

***SHIFTING TONG WHILE ROTATING THE MOTOR AND CAGE PLATE MAY RESULT IN CATASTROPHIC GEAR TRAIN FAILURE***

***Breaking A Connection (Continued):***

*j) Gently pull the motor control valve toward the operator to cam the tong jaws on to the pipe.*

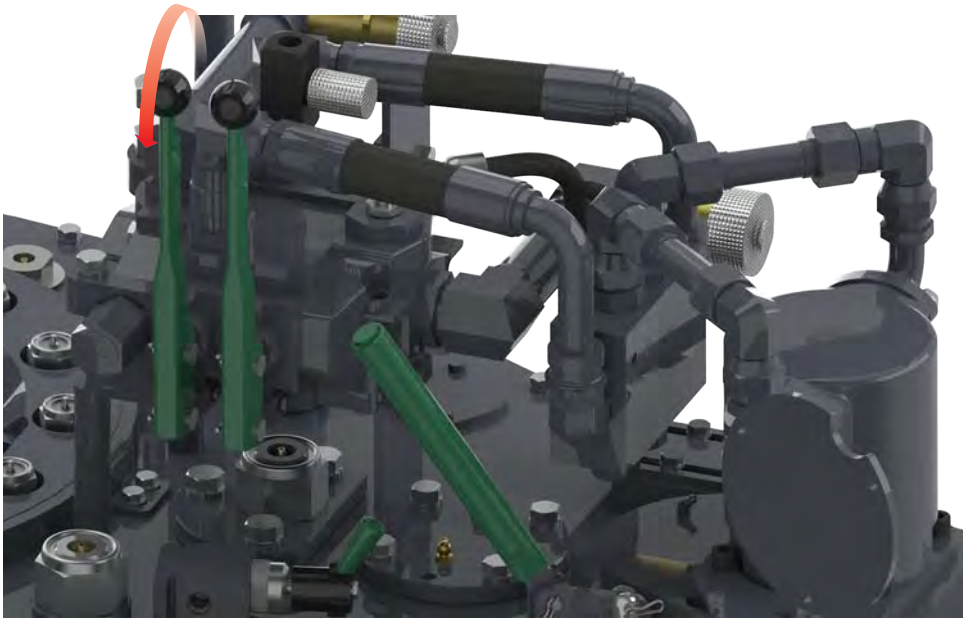

***ILLUSTRATION 2.H.9: ROTATION CONTROL - BREAK-OUT***

*k) Break the connection by pulling the rotation control handle all the way out once the tong jaws cam on to the tubing.*

*l) Un-thread the connection at high speed by setting the tong motor to high speed and shifting to high gear (see Section 2.G.2 to set motor speed and 2.G.3 to shift to high gear) once the connection is broken.*

*m) Pull the rotation control handle all the way out to completely un-thread the connection. Reverse the rotation control handle (push toward tong) to release the tong jaws from the tubing.*

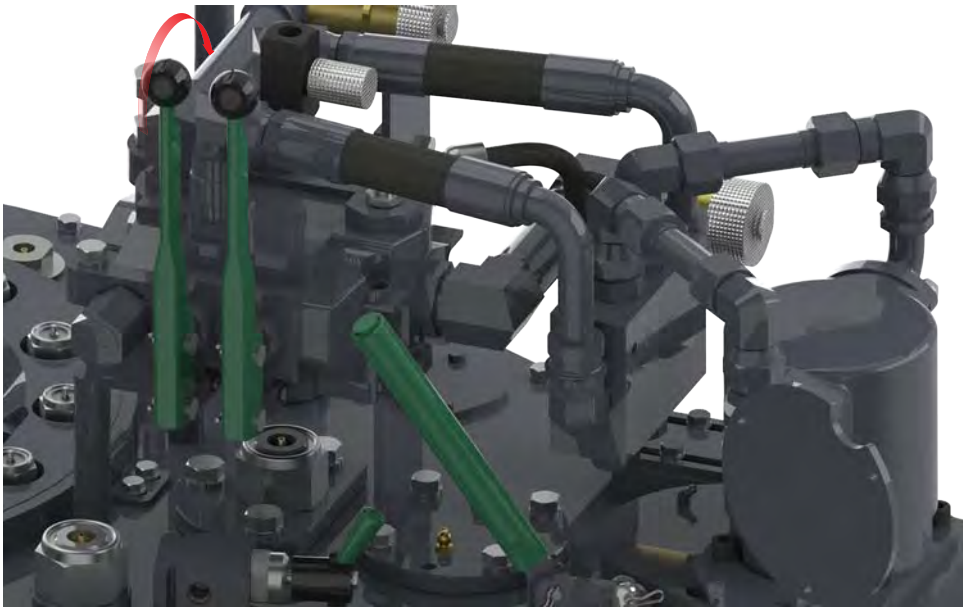

***ILLUSTRATION 2.H.10: USING MOTOR CONTROL TO RELEASE TONG JAWS FOLLOWING BREAK-OUT & UN-THREADING***

***Breaking A Connection (Continued)***

*n) Align the opening in the rotary gear with the mouth of the tong once the jaws are free. Open the tong door and guide the tong away from the string, and use the lift cylinder control to lower it to the drill floor if desired.*

***RIG PERSONNEL MUST STABILIZE THE TONG AS IT IS LOWERED TO THE DRILL FLOOR***

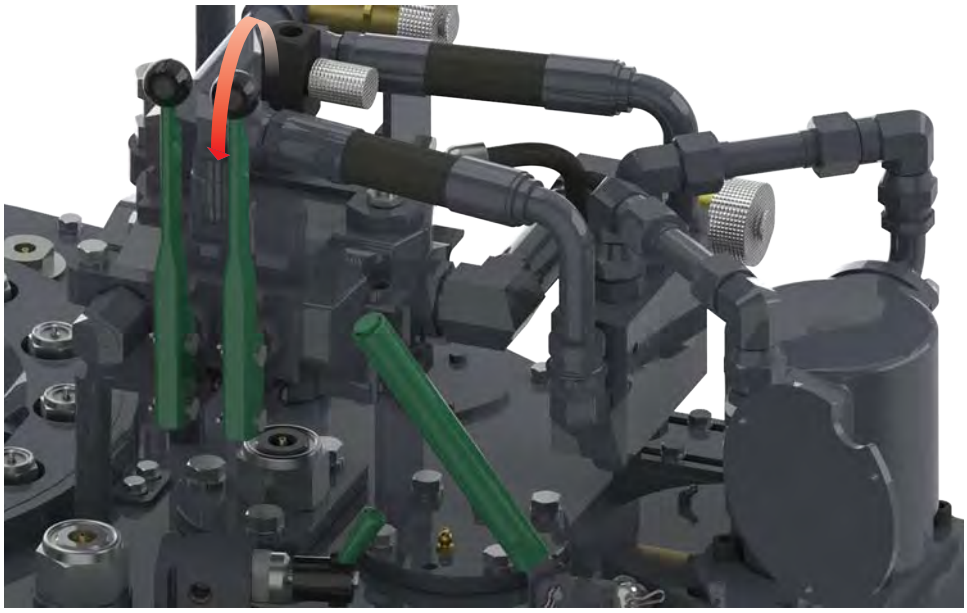

***ILLUSTRATION 2.H.11: LOWERING TONG USING LIFT CYLINDER CONTROL***

*o) Use your rig's standard pipe handling procedures to remove and rack the freed tubing stand.*

*p) Repeat steps "e" through "p" as many times as necessary to break out and un-thread the desired number of connections.*

## H. EXTREME COLD WEATHER OPERATION PROCEDURES

*1) Consult the power unit engine operator's manual for all cold weather operating procedures and precautions.*

*2) Select gear and bearing lubricants that are compatible with expected climatic conditions.*

*3) Select hydraulic fluid that is compatible with expected climatic conditions.*

*4) Allow hydraulic fluid to circulate for approximately 20 minutes after starting the power unit, prior to activating the bypass valve to allow fluid to circulate to tong. If the power unit is equipped with an oil temperature gauge, ensure that the fluid has reached operating temperature as specified by hydraulic fluid data sheet.*

*5) Allow for adequate drying of moisture (prior to lubricating) when cleaning tong parts in cold weather.*

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*McCoy Completions & Drilling recognizes that minor on-site repairs and modifications are required to maintain peak operating condition of your equipment, or to match your equipment with the operating environment. Examples of minor repairs are*

- *replacement of damaged hydraulic hoses and fittings.*
- *replacement of malfunctioning pressure gauges and valves.*
- *replacement of door spring stop cylinders*
- *replacement of fasteners*

*Any replaced component must be an identical component supplied by McCoy Completions & Drilling. Replaced fasteners must be Grade 8 or equivalent, or whatever fastener is specified by McCoy.*

### A. GENERAL MAINTENANCE SAFETY PRACTICES

*The practices identified here are intended as a guideline. All personnel are responsible for performing their tasks in a manner that ensures worker, equipment, and environmental safety, and may require taking additional steps that are not identified in this section.*

*Equipment maintenance shall be performed only by designated qualified maintenance personnel. Wear all personal protective equipment (PPE) specified by your company's HSE policy, and follow all of your company's safety guidelines. Do not begin a maintenance task without the proper tools or materials on hand, or the proper drawings and documentation necessary.*

*Schedule planned maintenance with operators to avoid conflicts, unnecessary downtime, and the danger of accidental equipment activation. Notify operations when maintenance procedures are complete and equipment functionality is restored and tested.*

*If on-site maintenance must be performed (in other words, if equipment cannot be transported to a controlled maintenance facility) isolate the location of the maintenance to prevent unaware personnel from inadvertently exposing themselves to a hazard. Use tape, rope, or signage to clearly indicate "off-limits" area.*

*Replacement of large, heavy individual parts and/or heavy structural components must be performed using an approved lifting device of sufficient lifting capacity. Use care when attaching the lifting device, and safeguard area to avoid endangering personnel or equipment.*

*All spare parts must meet or exceed OEM specifications in order to maintain equipment integrity, especially protective equipment.*

***DO NOT PERFORM MAINTENANCE UNTIL TUBULAR CONNECTION EQUIPMENT HAS BEEN COMPLETELY ISOLATED FROM HYDRAULIC POWER***

*Your equipment uses materials that may be harmful to the environment if improperly disposed of (hydraulic fluid, grease, etc.). Dispose of all materials according to your company's proscribed environmental protection regulations.*

### B. CLEANING

*Clean tong thoroughly cleaned with a good petroleum-based cleaning agent after each job, prior to storage. Farr® recommends that the motor and valve assembly be periodically removed, along with the top tong plate, so that guides, rollers and gears can be properly cleaned (see Section 3.H, Overhaul). Ensure that cleaning solvents and chemicals are captured to prevent environmental contamination, and dispose of all materials according to your company's proscribed environmental protection regulations.*

### C. PREVENTIVE MAINTENANCE PRACTICES

*Regular maintenance programs are necessary, and must be established to assure safe, dependable operation of your Hydraulic Tubular Connection System and to avoid costly breakdown maintenance. The following maintenance procedures provides information required to properly maintain your equipment. Your equipment may require more, or less maintenance depending upon the frequency of use and the field conditions under which your equipment operates. These maintenance procedures are designed for equipment operating at 10°C to 35°C ambient temperature for 10 hours per day. McCoy recommends that the inspection and maintenance procedures in this section be performed as recommended in the maintenance checklists (see Appendices), or in conjunction with your maintenance foreman's experience and best estimate of when your equipment is due for this maintenance.*

*Manufacturers of purchased components included with your hydraulic tubular connection equipment (for example: motors, valves, etc.) may specify maintenance tasks and intervals over and above what McCoy recommends as part of their recommended procedures. Users of this equipment may choose to perform or ignore these additional tasks at their discretion.*

*Filtration of the hydraulic fluid must be 10 microns or better. Premature fouling of particulate filters within your prime mover or ancillary hydraulic power unit requires immediate hydraulic fluid laboratory analysis to prevent premature wear of hydraulic system due to high levels of wear metals in the fluid.*

*McCoy Drilling & Completions recommends tracking all maintenance activity including the lubrication schedule and replacement of hydraulic hoses. This may be a simple as keeping a paper log, or using a software-based maintenance tracking utility. A maintenance log is a valuable tool that can be used for easily retrieving maintenance history or identifying trends that require correction.*

## D. LUBRICATION

*Use a quality multipurpose bearing lubricant that will remain within its viscosity range at expected operating temperatures. In addition, Farr® recommends the following lubrication procedure at the completion of each job prior to storage. Farr® recommends that a liberal coating of grease be applied to the cam surface of the rotary drive gear prior to jaw installation. Periodically remove the clutch inspection plate and apply a liberal coating of grease to the clutch, drive gears and shifting shaft.*

### 1. Cage Plate Cam Followers

*Apply grease to the cam followers through the grease fittings recessed into the top and bottom cage plates (thirteen locations top, thirteen locations bottom).*

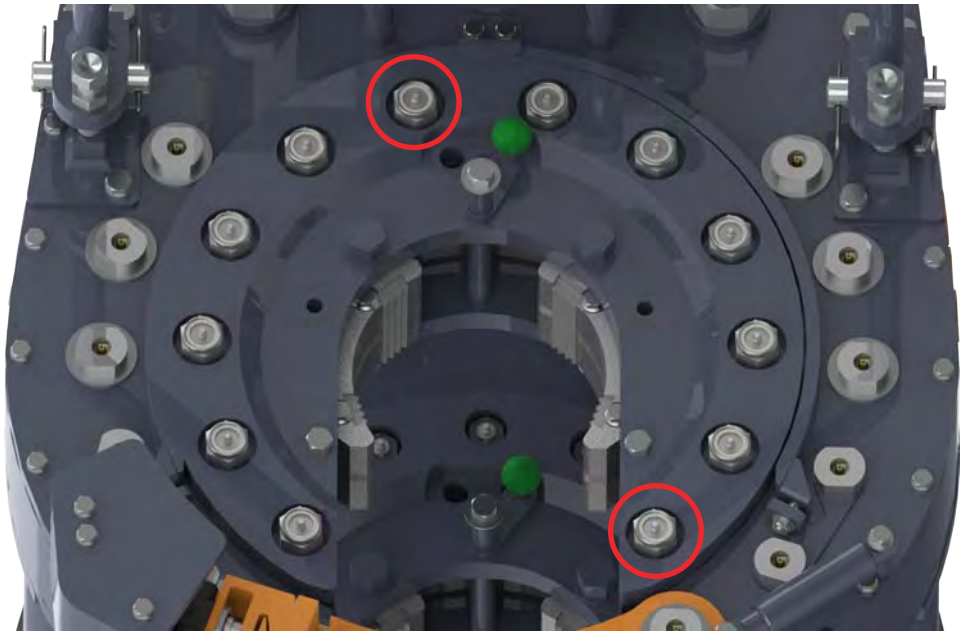


ILLUSTRATION 3.D.1: CAM FOLLOWER LUBRICATION

### 2. Support Rollers

*Apply grease to the support roller bearings through the grease fittings recessed into the top and bottom of each support roller shaft (12 locations total).*

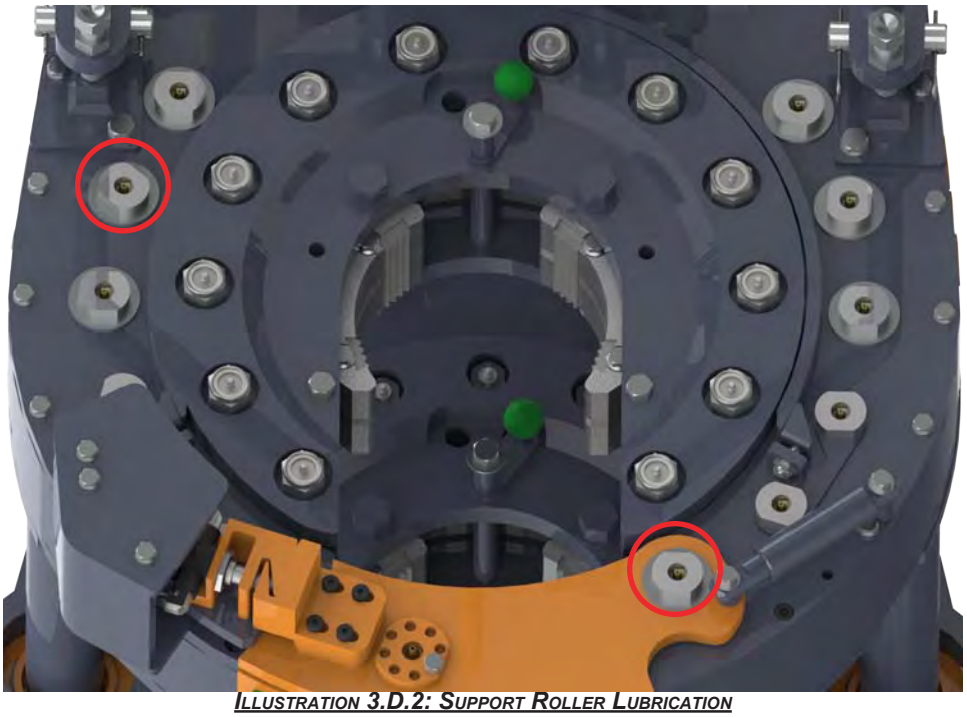


ILLUSTRATION 3.D.2: SUPPORT ROLLER LUBRICATION

3. **Rotary Idlers**

*Apply grease to the rotary idler bearings through the grease fittings recessed into the top of each shaft on the top of the tong (two locations total).*

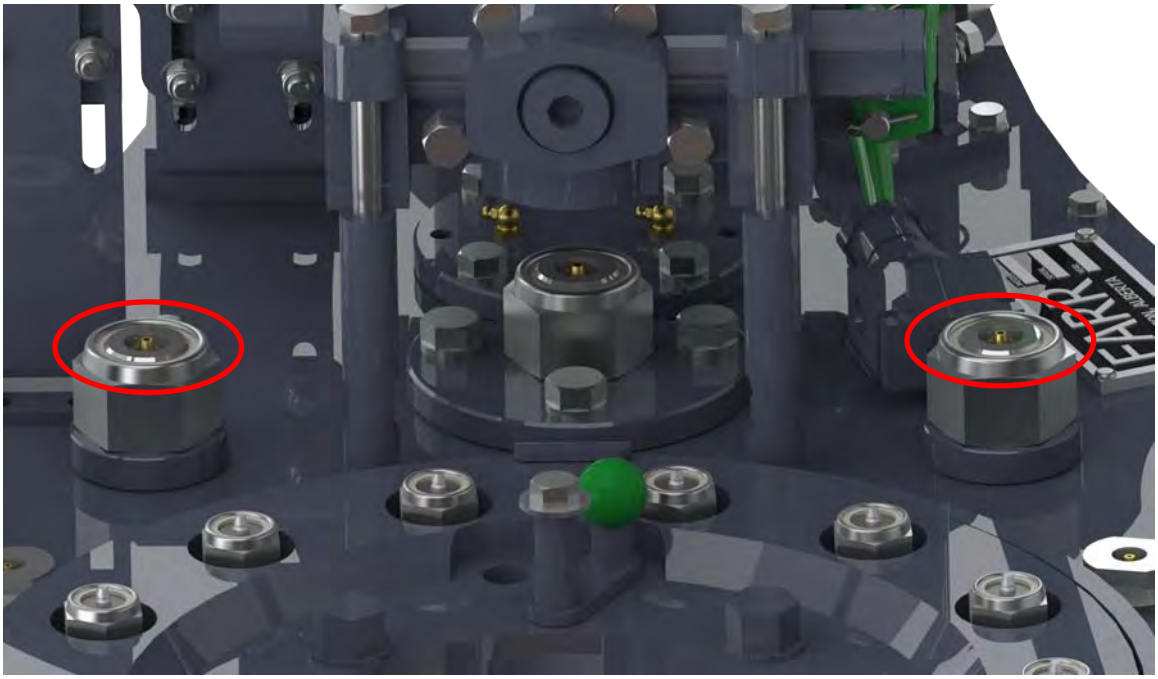


ILLUSTRATION 3.D.3: ROTARY IDLER LUBRICATION

4. **Pinion Idler**

*Apply grease to the pinion idler bearing through the grease fitting recessed into the top of the half-shaft, located on the top face of the tong under the valve bank (one location only).*

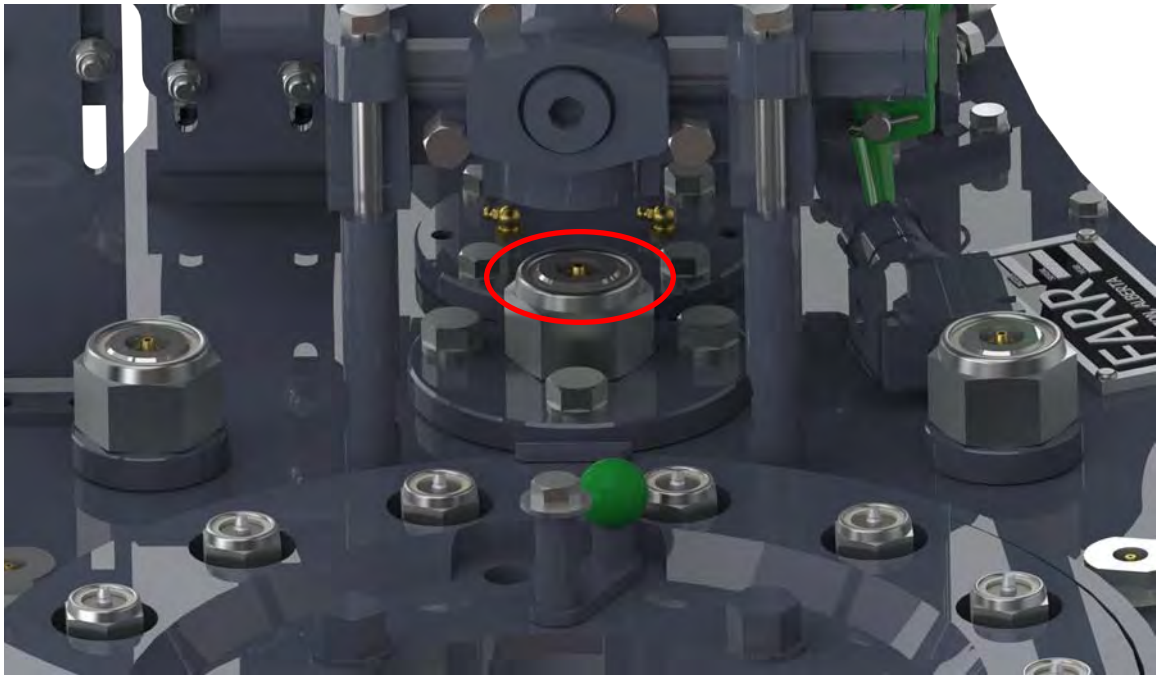


ILLUSTRATION 3.D.4: PINION IDLER LUBRICATION POINT

**5. Pinion**

*Apply grease to the pinion bearings through the grease fittings located on the bearing caps on the top and bottom faces of the tong (two locations top, two locations bottom).*


***ILLUSTRATION 3.D.5: PINION LUBRICATION POINTS***

6. **Clutch**

*Apply grease to the clutch bearings through the two grease fittings located on the clutch bearing cap on the bottom face of the tong, and the single grease fitting recessed into the end of the clutch shaft. (three locations total).*

*ILLUSTRATION 3.D.6: CLUTCH LUBRICATION POINTS*

7. **Motor Mount**

*Apply grease to the motor gear/clutch drive gear through the grease fitting located on the top of the motor mount (one location only).*

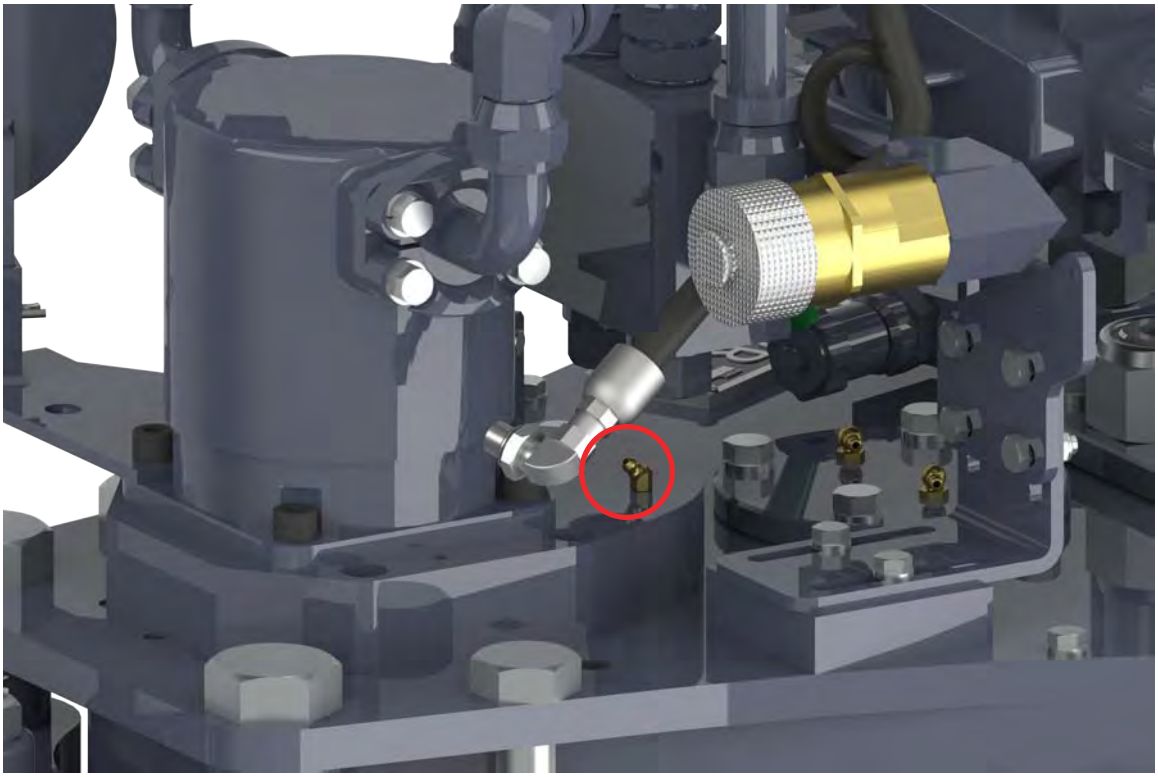


*ILLUSTRATION 3.D.7: MOTOR MOUNT LUBRICATION POINT*

**8. Shifting Shaft**

*Apply grease to the shifting shaft and top shifting shaft bushing. The shaft and shifting yoke can be accessed through the cover plate on the side of the tong.*

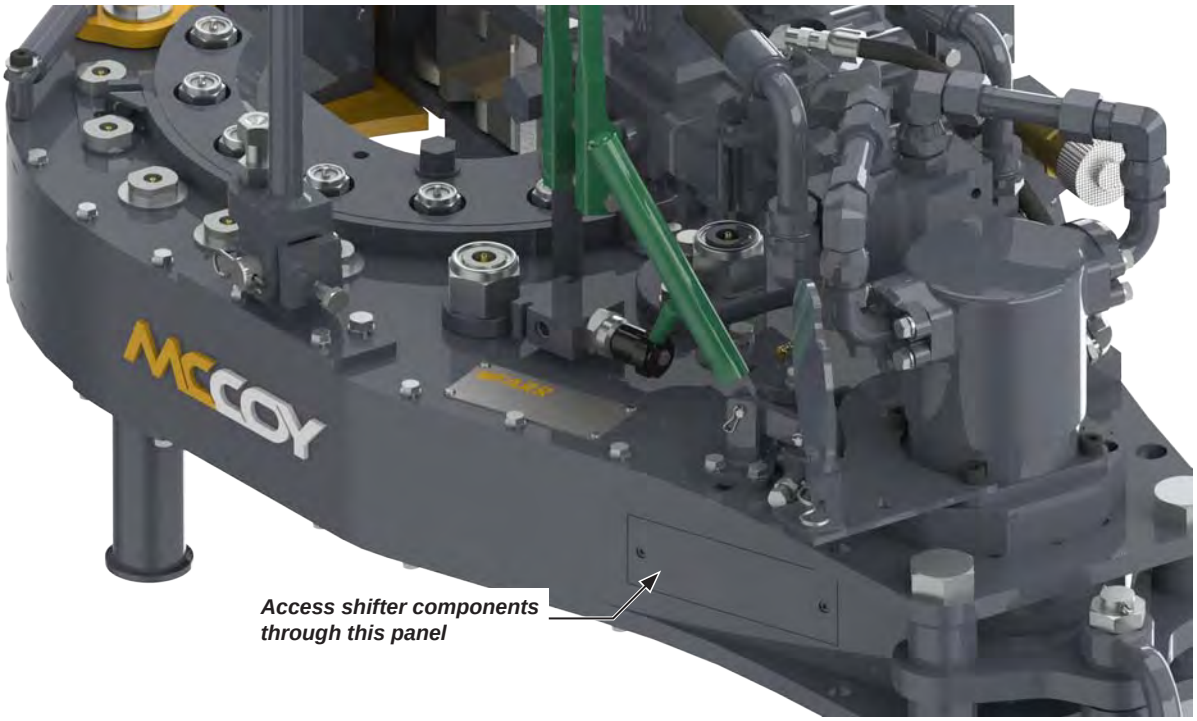



ILLUSTRATION 3.D.8: SHIFTER SHAFT LUBRICATION

**9. Door Lubrication**

*Apply grease to the door latch adjustment cam through the grease fitting located in the top of the adjustment cam shaft. Apply grease to the contact surfaces of the safety door switch plunger.*

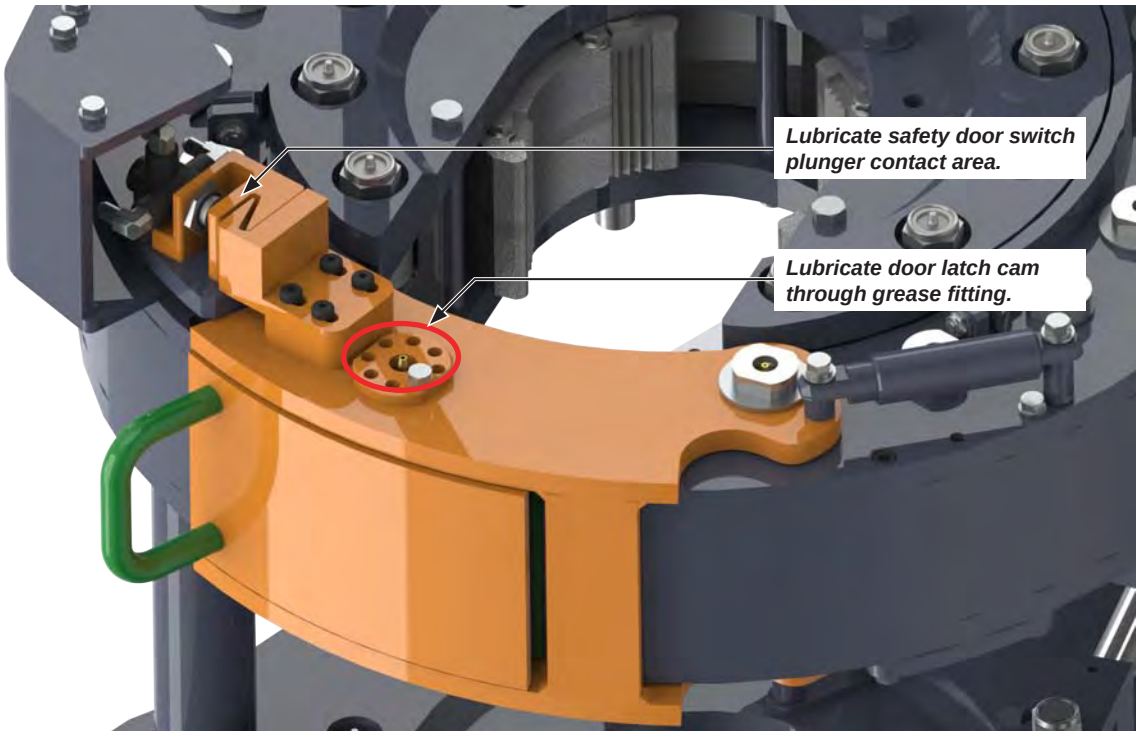



ILLUSTRATION 3.D.9: TONG DOOR LUBRICATION POINTS

### 10. DOOR STOP CYLINDER

*Periodically disassemble the door stop cylinders and coat the spring and cylinder with a general purpose lubricating oil.*

ILLUSTRATION 3.D.10: DOOR CYLINDER

## E. ADJUSTMENTS

### 1. Brake Band Adjustment:

*The brake bands must be periodically adjusted to continue to provide smooth and efficient jaw cam action. If the cage plate turns with the rotary gear, the jaws will not cam properly and, therefore, will not bite on the tubing or casing. Tightening the brake band against the cage plates will increase frictional resistance, allowing jaws to cam properly and grip the casing. Adjust the brake band using the adjustment nut and bolt set as shown in the illustration below. Do not over-tighten, as this causes excessive wear to the brake bands.*

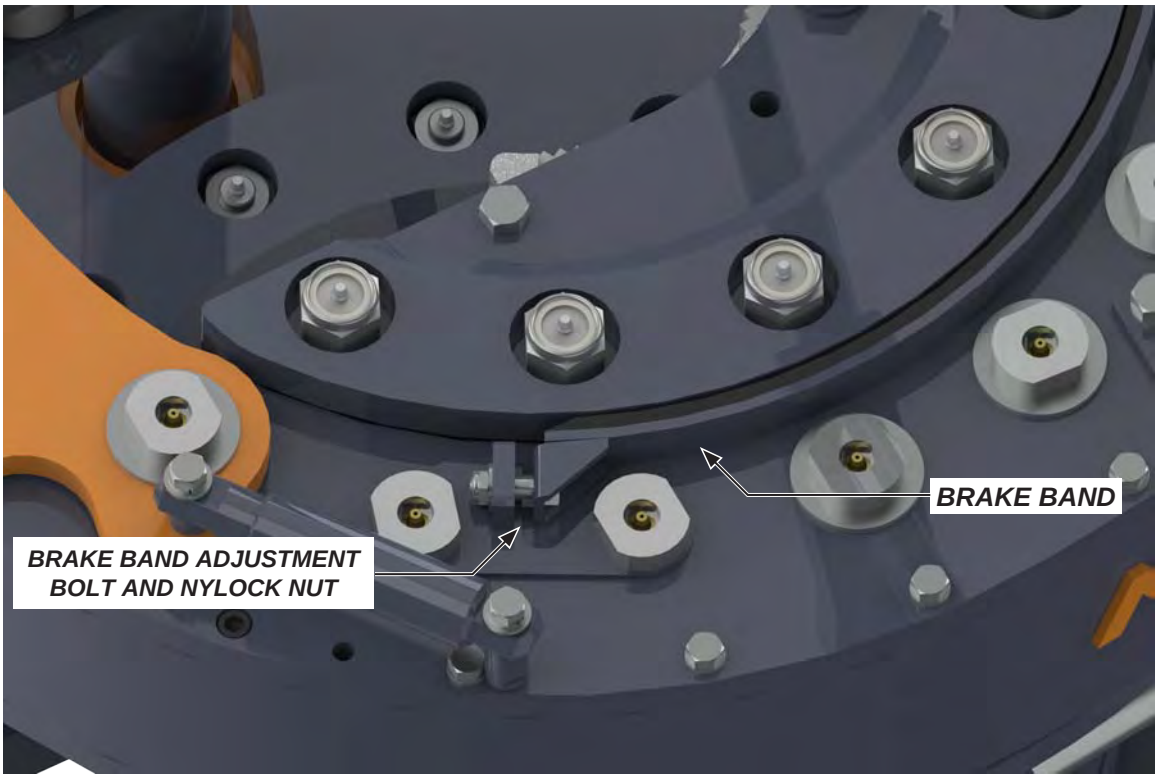



ILLUSTRATION 3.E.1: BRAKE BAND ADJUSTMENT

### 2. Door Latch Adjustment

*Normal operation of the tong may cause wear of the door latch, which will cause the door to develop a loose fit at the latch. A latch cam plate is located at the top face of the door. The cam plate has eight positioning holes located on a 360 degree bolt circle. The latch cam shaft extends down through the door and is secured at the top by a 3/8" hex head bolt. To make adjustments in door alignment, remove the 3/8" bolt and turn the cam with a wrench. When the door has been adequately aligned, replace the 3/8" bolt (see illustration 3.E.2 next page).*

***Door Latch Adjustment (Continued);***

***THE DOOR IS AN IMPORTANT PART OF THE STRUCTURAL INTEGRITY OF THE TONG. IT IS IMPERATIVE TO KEEP A SECURE FIT AT THE DOOR IN ORDER TO MAINTAIN PROPER GEAR ALIGNMENT, AND TO MINIMIZE THE POSSIBILITY OF DAMAGE TO THE GEAR TRAIN WHEN OPERATING THE TONG AT SPECIFIED TORQUE. A CLOSED DOOR ALSO ENSURES SAFETY OF OPERATING PERSONNEL.***

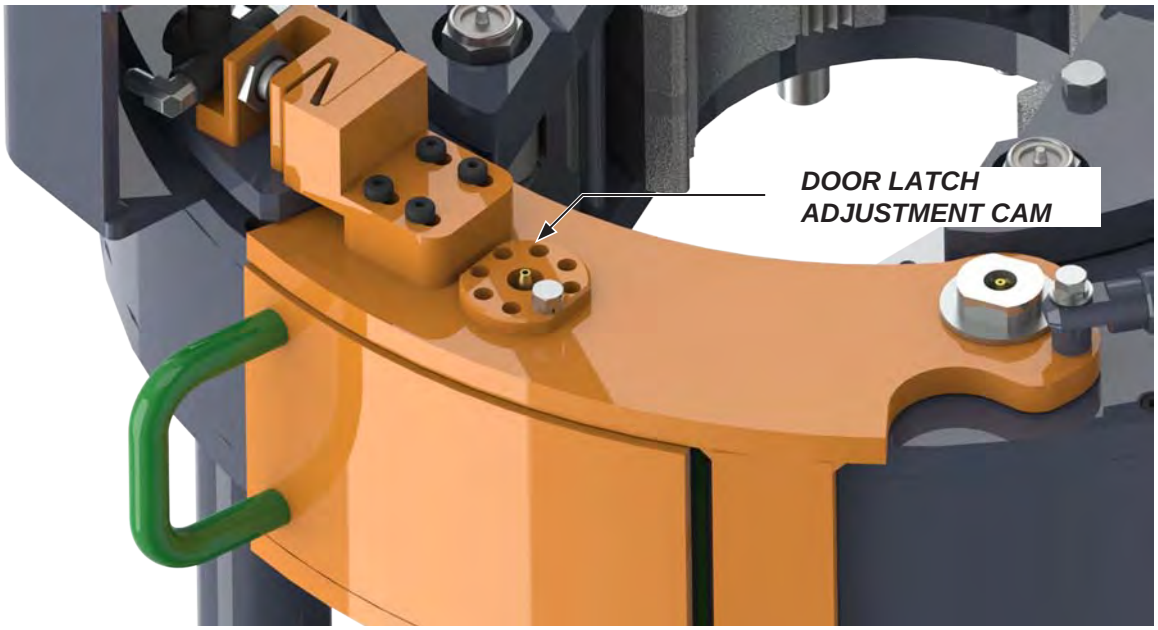



***ILLUSTRATION 3.E.2: TONG DOOR LATCH ADJUSTMENT***

***3. Shifter Detent Force Adjustment:***

*Over time wear to the shifting shaft, wear to the detent ball, and loss of spring tension in the detent spring may result in a loose or "sloppy" fit within the top shifter bushing. The detent pressure may be increased or otherwise adjusted by loosening the 7/16" UNF locking jam nut, and turning the 7/16" UNF detent bolt. Should adequate detent action not be achieved, the shifting shaft, detent ball, or detent spring (or possibly all three) may need to be replaced (see Pp. 5.12 - 5.13).*

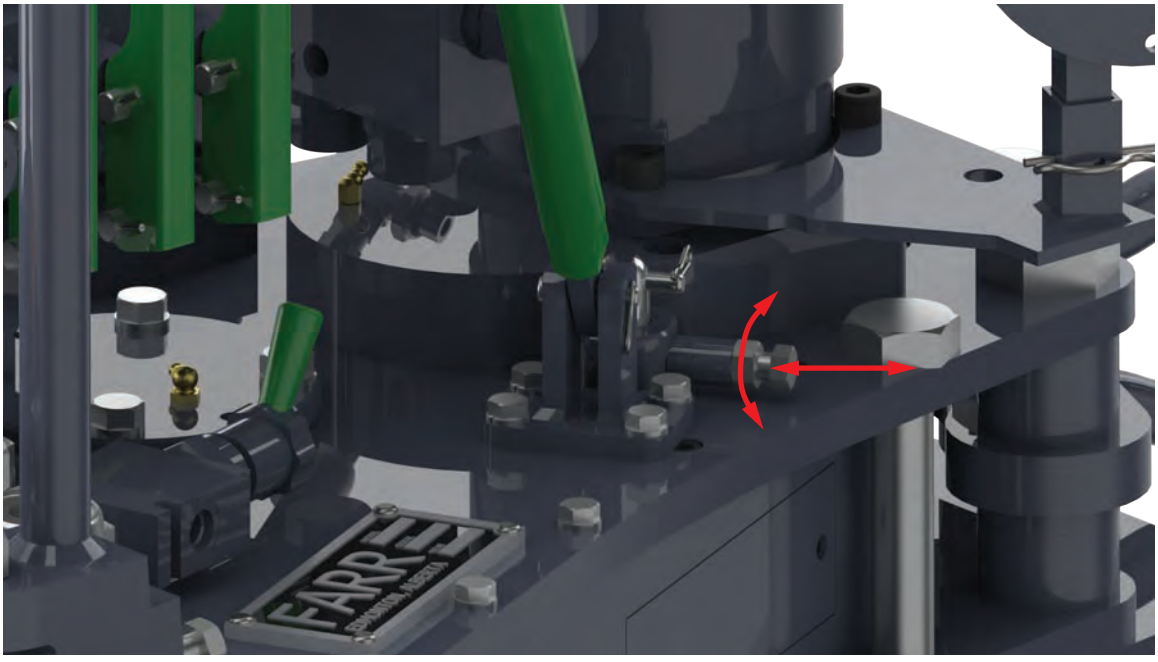


***ILLUSTRATION 3.E.3: SHIFTER DETENT FORCE ADJUSTMENT***

### F. RECOMMENDED PERIODIC CHECKS

**1. Door Stop Spring**

*The spring inside the actuator cylinder must be of sufficient strength to enable the door latch mechanism to snap closed properly. Door stop spring fatigue will result in sluggish latch operation. Replace the latch spring inside the cylinder when this occurs.*

**2. Shifting Shaft**

*The shifting yoke is secured to the shifting shaft by one hex jam nut and one locknut on the bottom of the yoke. Check these nuts after each job. Do this by removing the clutch inspection plate and ensuring a snug fit prior to lubrication.*

**3. Backing Pin**

*Perform a visual inspection of the backing pin after each job. Replace the pin if stress cracks or excessive wear is found, or if the pin appears bent.*

**4. Torque Gauge Assembly**

*Periodic calibration of the torque gauge is recommended to assure accurate torque readings. When having the torque gauge serviced and calibrated, it is critical to note the arm length of the tong, as indicated on page 1.3.*

### G. OVERHAUL PROCEDURES - DISASSEMBLY

*Once the tong has been removed from the backup it may be overhauled using the disassembly instructions specified in the following procedure. Access to the gear train is possible by removal of the top plate of the tong.*

***ALL MAINTENANCE AND OVERHAUL SHOULD BE PERFORMED FROM THE TOP. THE BOTTOM PLATE OF THE TONG IS TYPICALLY WELDED TO THE SIDE BODY AND CANNOT BE REMOVED.***

***REPLACEMENT FASTENERS (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT.***

***FASTENERS USED FOR MAINTENANCE OR OVERHAUL OF LOAD-BEARING COMPONENTS (CHAIN SLINGS, RIGID SLINGS, LEGS) MUST BE TIGHTENED TO THE PROPER TORQUE***

**SEPARATION OF TONG FROM BACKUP**

1. *Suspend tong assembly with crane. Construct a support structure that will support the weight of the backup. Lower the tong on to the constructed support.*
2. *Support the rigid sling with a crane. Remove the rigid sling assembly by disconnecting the leveling devices from the hanger brackets, and use the crane to lift the sling away from the tong. Store in a protected area.*
3. *Remove the two rigid sling hanger brackets.*
4. *Disconnect the three hydraulic connections from the motor. Undo the restraints securing the inlet and outlet lines connections to their supports, and lift the hydraulic valve section away from the tong. Remove the inlet and outlet support pieces.*
5. *Remove top brake band assembly (leave adjustment lug weldments in place for now).*
6. *Remove the tong door stop cylinder.*
7. *Remove door assembly by removing the door roller shaft. Support door assembly as the roller shaft is removed. Remove the nut from the top of the roller shaft, and use a soft alloy material (e.g. brass rod, etc.) to lightly tap the shaft down through the support roller assembly until it comes free at the bottom. Use caution that the threads on the ends of the support roller shafts are not damaged. Do not lose the door shoulder bushings.*
8. *Remove the hitch pin securing the torque gauge holder to the torque gauge mount weldment, and remove the mount.*
9. *Remove the four hex socket head cap screws securing the motor and the torque gauge mount weldment. Remove the torque gauge mount weldment, then lift the motor up and away from the motor mount. Inspect the motor gear, located at the bottom of the motor shaft, for gear clashing or tooth damage. Also, ensure that the motor gear is securely attached to the motor shaft.*
10. *Remove the cotter pin and clevis pin connecting the shifter handle to the shifter shaft (it is not necessary to disconnect the handle from the pivot lug weldment).*
11. *Unbolt the pivot lug weldment from the top plate, and remove the pivot lug and handle assembly.*
12. *Remove the four hex socket head cap screws securing the motor mount to the top plate. Use care not to dislodge and lose the two positioning dowels.*
13. *Remove the snap ring securing the drive gear to the top of the clutch shaft. Carefully remove the drive gear from the clutch shaft.*

***REMOVAL OF TOP PLATE (Continued):***

14. *Remove the two 10-24 x 3/4" hex socket head cap screws securing the top clutch bearing retainer to the top plate.*
15. *Remove the top clutch bearing retainer, and bearing retainer spacer. The top clutch bearing and clutch bearing bushing may come off with the bearing retainer.*
16. *Remove the 1-1/4" nylock nut and the three 5/8" bolts securing the pinion idler half-moon pad.*
17. *Pull the top pinion gear bearing cap by removing the four 1/2" bolts which secure the bearing cap. Thread two of the removed bolts into the extra holes on top of the bearing cap, and use them as lifting lugs to lift the bearing cap out of place.*

***IF THE BEARING REMAINS ATTACHED TO THE GEAR SHAFT AFTER THE BEARING CAP IS PULLED, FARR® SERVICE PERSONNEL RECOMMENDS LEAVING IT IN PLACE UNTIL THE TOP TONG PLATE IS REMOVED.***

18. *Remove the jaw pivot bolts and the jaw assemblies.*
19. *Ensure the bottom cage plate is supported before beginning this step. Remove the two front cage plate bolt and nut sets. Remove the backing pin assembly and the rear cage plate bolt, and the cage plate spacers. The top and bottom cage plates may now be removed - Note that the cam followers are fastened to the top and bottom cage plates, so use caution not to damage them.*

***THE CAGE PLATE BOLTS ARE THE ONLY ITEMS FASTENING THE BOTTOM CAGE PLATE TO THE TONG. SUPPORT THE BOTTOM CAGE PLATE FROM BELOW PRIOR TO REMOVING CAGE PLATE BOLTS IN ORDER TO PREVENT DAMAGE TO THE BOTTOM CAGE PLATE OR PERSONAL INJURY TO THE MECHANIC***

20. *Remove the top nuts and pads for the rotary idler gears.*
21. *Remove the remaining top roller shaft nuts. Note that the top brake band adjustment lug weldments are removed at this point.*
22. *Loosen, but do not remove the detent bolt on the top shifter lug weldment. Once the force from the detent ball has been removed from the shifter shaft, the top shifter bushing can be un-threaded from the top plate. Take care not to lose the detent ball when the bushing comes free of the shaft.*
23. *Remove the hex head bolts and hex flat head cap screws around the perimeter of the tong that secure the top plate.*
24. *With all the above steps taken, the top tong plate can be lifted off providing access to the inside of the gear case.*

## I. ASSEMBLY PROCEDURES

*Assembly of Farr Hydraulic Power Tongs is simple, and can be accomplished without the use of special tools. The instructions on this page are presented as a guide only, and are similar to the assembly sequence our technician would use while assembling the tong in our plant.*

***NOTE ON INSTALLATION PRACTICES: Ensure all bearings are liberally greased before installing over a shaft or into gears or bearing caps. When inserting a shaft through a support roller assembly ensure shaft is greased. Also ensure all metal-to-metal contact in the gear train is adequately greased. When graphics are not used in the assembly process, please refer to the relevant exploded diagrams in Section 5.***

***ALL FASTENERS USED DURING REASSEMBLY OF LOAD-BEARING COMPONENTS (CHAIN SLINGS, RIGID SLINGS, BACKUP LEGS) MUST BE TIGHTENED TO THE CORRECT TORQUE. THREADED FASTENERS USED IN LOAD-BEARING DEVICES MUST BE SECURED WITH RED LOC-TITE™.***

| TIGHTENING TORQUE GUIDE | | | |
|---|---|---|---|
| SAE GRADE 8 - FINE THREAD | | | |
| SIZE | CLAMP LOAD | PLAIN | PLATED |
| 1/4 - 28 (.250) | 3,263 | 14 ft. lbs. | 10 ft. lbs. |
| 5/16- 24 (.3125) | 5,113 | 27 ft. lbs. | 20 ft. lbs. |
| 3/8 - 24 (.375) | 7,875 | 49 ft. lbs. | 37 ft. lbs. |
| 7/16 - 20 (.4375) | 10,650 | 78 ft. lbs. | 58 ft. lbs. |
| 1/2 - 20 (.500) | 14,400 | 120 ft. lbs. | 90 ft. lbs. |
| 9/16 - 18 (.5625) | 18,300 | 172 ft. lbs. | 129 ft. lbs. |
| 5/8" - 18 (.625) | 23,025 | 240 ft. lbs. | 180 ft. lbs. |
| 3/4 - 16 (.750) | 33,600 | 420 ft. lbs. | 315 ft. lbs. |
| 7/8" - 14 (.875) | 45,825 | 668 ft. lbs. | 501 ft. lbs. |
| 1 - 12 (1.000) | 59,700 | 995 ft. lbs. | 746 ft. lbs. |
| 1 - 14 (1.000) | 61,125 | 1019 ft. lbs. | 764 ft. lbs. |
| 1 1/8 - 12 (1.125) | 77,025 | 1444 ft. lbs. | 1083 ft. lbs. |
| 1 1/4 - 12 (1.125) | 96,600 | 2012 ft. lbs. | 1509 ft. lbs. |
| 1 3/8 - 12 (1.375) | 118,350 | 2712 ft. lbs. | 2034 ft. lbs. |
| 1 1/2 - 12 (1.500) | 142,275 | 3557 ft. lbs. | 2668 ft. lbs. |
| SAE GRADE 8 - COARSE THREAD | | | |
| SIZE | CLAMP LOAD | PLAIN | PLATED |
| 1/4 - 20 (.250) | 2,850 | 12 ft. lbs. | 9 ft. lbs. |
| 5/16- 18 (.3125) | 4,725 | 25 ft. lbs. | 18 ft. lbs. |
| 3/8 - 16 (.375) | 6,975 | 44 ft. lbs. | 33 ft. lbs. |
| 7/16 - 14 (.4375) | 9,600 | 70 ft. lbs. | 52 ft. lbs. |
| 1/2 - 13 (.500) | 12,750 | 106 ft. lbs. | 80 ft. lbs. |
| 9/16 - 12 (.5625) | 16,350 | 153 ft. lbs. | 115 ft. lbs. |
| 5/8" - 11 (.625) | 20,325 | 212 ft. lbs. | 159 ft. lbs. |
| 3/4 - 10 (.750) | 30,075 | 376 ft. lbs. | 282 ft. lbs. |
| 7/8" - 9 (.875) | 41,550 | 606 ft. lbs. | 454 ft. lbs. |
| 1 - 8 (1.000) | 54,525 | 909 ft. lbs. | 682 ft. lbs. |
| 1 1/8 - 7 (1.125) | 68,700 | 1288 ft. lbs. | 966 ft. lbs. |
| 1 1/4 - 7 (1.125) | 87,225 | 1817 ft. lbs. | 1363 ft. lbs. |
| 1 3/8 - 6 (1.375) | 103,950 | 2382 ft. lbs. | 1787 ft. lbs. |
| 1 1/2 - 6 (1.500) | 126,450 | 3161 ft. lbs. | 2371 ft. lbs. |

***REPLACEMENT FASTENER (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED.***

***Assembly Procedures***

1. *Position the tong body gear case on a suitable stationary support, ensuring that the bottom body plate remains accessible.*
2. *Slide a support roller shaft spacer (PN 1037-C-134) into each support roller (PN 1037-135) (total of 12).*
3. *Press support roller bearings (PN 02-0094) into each side of the support rollers. Assemble five support roller assemblies as shown on Pp. 5.4 - 5.5.*
4. *Install five support roller assemblies along one side of the body case. Insert shafts through assemblies, but do not install the bottom nylock nuts or, where used, the top washers.*
5. *Install rotary gear, making sure the backing pin slots are on the side facing up. Ensure one side is supported by the support rollers installed in Step 4, and have the opening in the rotary gear oriented as shown in the following illustration.*


***ILLUSTRATION 3.H.1: TONG ASSEMBLY - ROTARY GEAR INSTALLATION***

6. *Install support roller assemblies in the locations exposed by the opening in the rotary gear. Continue to rotate the rotary gear, installing support roller assemblies in the rotary gear opening as it is rotated. Finish with the rotary gear aligned with the opening in the bottom plate and completely supported by the support rollers. Do not install the door pivot support roller assembly at this time.*
7. *Press pinion bearing (PN 1234-08-01B) into bottom pinion bearing cap (PN 1050-89), and install bearing cap into bottom plate of tong using four 1/2" NC x 1-1/2" hex bolts and 1/2" lock washers.*
8. *Press lower clutch bearing (PN 02-0014) into clutch bearing cap (PN 101-0120), and install bearing cap into bottom plate of tong using four 3/8" NC x 1-1/2" hex bolts and 3/8" lock washers.*
9. *Install a retainer clip (PN 02-0009) into both rotary idler gears (PN 997-A2-119C). Press an idler bearing (PN 02-0075) into each gear and secure with a second retainer clip.*
10. *Lightly grease the larger circumference of the two rotary idler shafts (PN 1050-D5-117) and slide them through the bearing and gears assemblies, centering the gear on the shaft.*
11. *Slide two bearing seals (PN 02-0010) over each end of the idler shafts and press against the retainer clips (see Pp. 5.6 - 5.7 for correct orientation).*
12. *Slide a bearing spacer (PN 1050-D5-121) over each end of the rotary idler shafts.*
13. *Place each rotary idler assembly through the bottom plate, ensuring the ends of the shafts with the threaded hole for the grease fitting are pointed upward and the rotary idler gears mesh with the rotary gear.*
14. *Place an idler pad (PN 997-D20-125) over the bottom side of each rotary idler shaft, and secure each with a 1-1/2" UNF nylock nut.*
15. *The low pinion gear (PN 997-A5-88) is machined with shoulders around the centre spline on both sides of the gear. Place the side of the low pinion gear with the smaller shoulder over the lower bearing and bearing cap, centering as best as able.*

***Assembly Procedures (continued...):***

16. *Install pinion gear shaft (PN 997-A7-86B) into the spline of the bottom pinion gear and the lower pinion bearing.*
17. *Slide 2 needle bearings (PN 02-1404) over each end of the clutch shaft (PN 997-HT-50), and press up against centre gear. Slide low clutch gear (PN 997-HT-52) over the bottom end of the clutch shaft (the bottom end of the clutch shaft can be identified by the threads for the grease fitting machined into the end) onto the two needle bearings. Ensure the smaller diameter of the low clutch gear is directly adjacent to the centre gear on the clutch shaft. Place lower end of clutch shaft into the lower clutch bearing that has been pre-mounted in the lower body plate.*
18. *Install shifting collar (PN 997-HT-62) over the top of the clutch shaft and mesh with low clutch gear and the centre gear on the clutch shaft.*
19. *Slide the shifting fork weldment (PN 1050-72) over the bottom (threaded) end of the shifting shaft (PN 1116-71) and secure with a 5/8" UNF hex nut and 5/8" UNF hex jam nut. Place the end of the shifting shaft in the lower shifting bushing (welded to the bottom plate) and mesh the shifting fork with the shifting collar.*
20. *Install a retainer clip (PN 02-0009) into the pinion idler gear (PN 997-A2-119C). Press an idler bearing (PN 02-0075) into the gear, and secure with the second retainer clip.*
21. *Slide the pinion idler half-shaft (PN 1050-D5-105) through the pinion idler gear assembly. Slide the bearing seal (PN 02-0010) over the end of the half-shaft, and secure to the half-shaft with a shaft retainer clip (PN 02-0008).*
22. *Place pinion idler assemblies, less the idler pads and top fasteners, on top of the lower pinion gear and place them as best as possible - their position may have to be adjusted slightly as the top plate is attached (see illustration 3.H.2).*

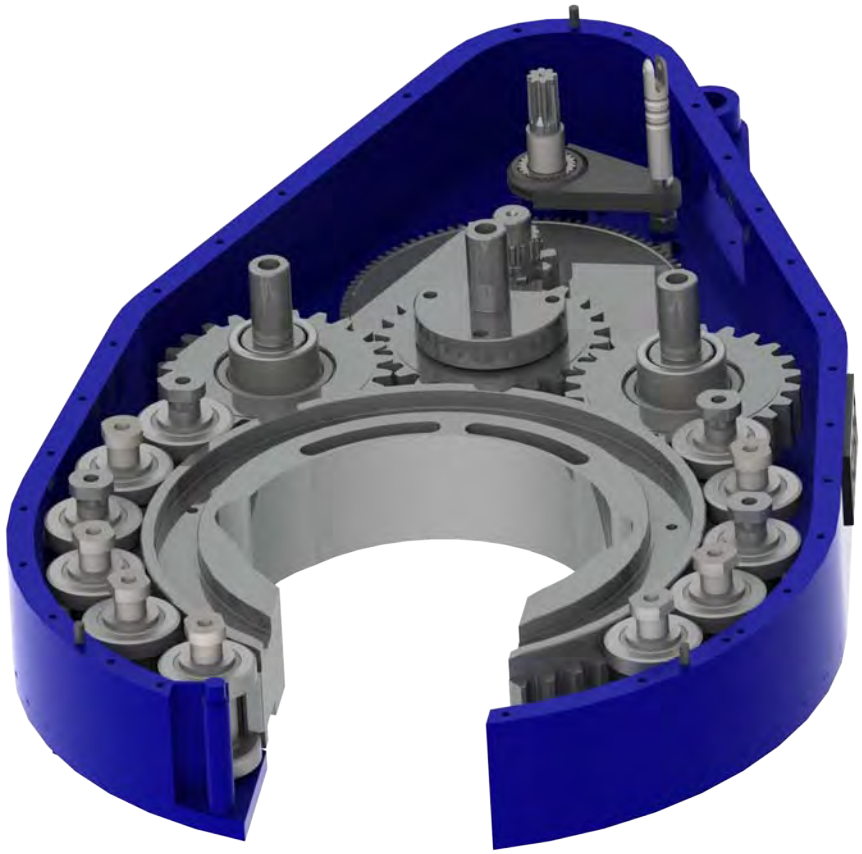


***ILLUSTRATION 3.H.2: TONG ASSEMBLY - GEAR ASSEMBLY POSITIONING***

23. *The high pinion gear (PN 997-A4-87B) is machined with shoulders around the centre spline on both sides of the gear. Place the side of the high pinion gear with the larger shoulder over the top of the splined pinion shaft and press against the centre gear on the pinion shaft.*
24. *Install high clutch gear (PN 997-HT-51B) on to the clutch shaft, ensuring the smaller diameter is directly adjacent to the centre gear on the clutch shaft.*
25. *Carefully remove all support roller shafts, using caution not to shift the position of the installed support roller assemblies or to damage the threads on the end of the shafts.*

***Assembly Procedures (continued...):***

26. *Locate the three un-threaded holes in the side body of the tong, one in the rear centre and one just to either side of the front opening. If old dowel pins are in place, remove them before installation of the top plate. If the dowel pins are in any way damaged or deformed McCoy recommends replacing them with new 3/8" x 1-1/2" hardened dowel pins. If necessary clean the dowel pin holes, and do not insert dowel pins until after the top plate has been installed.*
27. *Use a temporary lifting sling and crane to maneuver the top plate (PN 1050-7T) into position, and place on to the side body. Insert the three positioning dowel pins (PN 09-0092) through the top plate into their respective holes in the side body. Use a hammer to tap the dowel pins until they are flush with the top plate. Secure the top plate with 14 3/8" UNC x 1-1/2" hex bolts and 3/8" lock washers, and ten 3/8" UNC x 1" hex socket head cap screws as shown in illustration 3.H.3. Do not install fasteners at the rigid sling hanger locations, indicated by the red circles, or the door cylinder mounting lug location indicated by the green circle.*

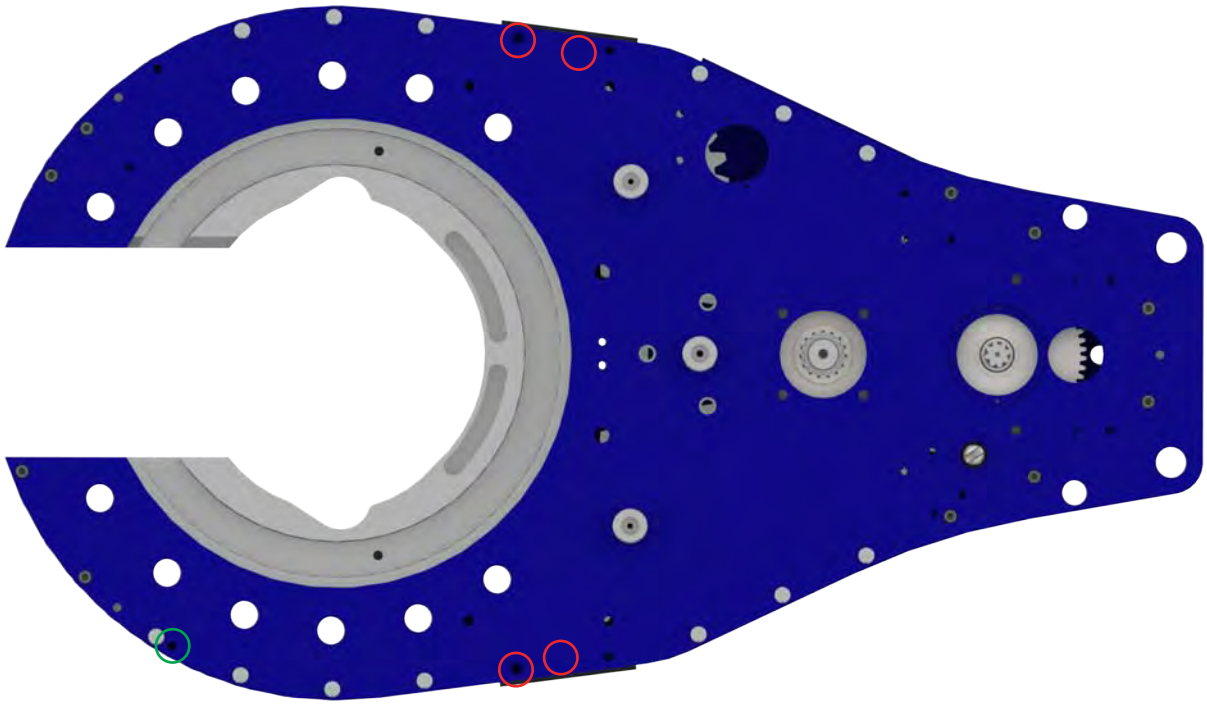


***ILLUSTRATION 3.H.3: TONG ASSEMBLY - TOP FASTENER LOCATIONS***

28. *Install half-moon idler pad (PN 997-D17-109) over the end of the pinion idler shaft and secure with three 5/8" NC x 2-3/4" hex bolts and 5/8" lock washers, followed by a 1-1/2" UNF nylock nut.*
29. *Slide the remaining rotary idler pads over the rotary idler shafts and secure with 1-1/2" UNF nylock nuts.*
30. *Press the remaining pinion bearing (PN 1234-08-01B) into the top pinion bearing cap and install over the top of the pinion gear shaft - secure with four 1/2" NC x 1-1/2" hex bolts and 1/2" lock washers.*
31. *Install top clutch bearing retainer (PN 997-HT-59) over the clutch shaft into the cutout in the top plate and secure with two 10-24 x 3/4" hex socket head cap screws.*
32. *Insert top clutch bearing (PN 02-1403), followed by the clutch bearing bushing (PN 997-HT-60).*
33. *Install clutch drive gear (PN 997-HT-61) and secure with retaining snap ring (PN 1234-00-04).*

***Assembly Procedures (continued...):***

34. *Re-install support roller shafts:*

    i) *Install all support roller shafts (PN 101-3939) that are NOT coincidental with the brake band lug weldments as shown in illustration 3.H.4 (seven total). Ensure a 1-1/8" narrow flat washer is installed on the support roller shaft before inserting through the top body plate and support roller assemblies. Do not install the door pivot roller at this time.* ***ASSEMBLY NOTE:*** *The shafts coincidental with the front leg weldments are shown circled in red.*

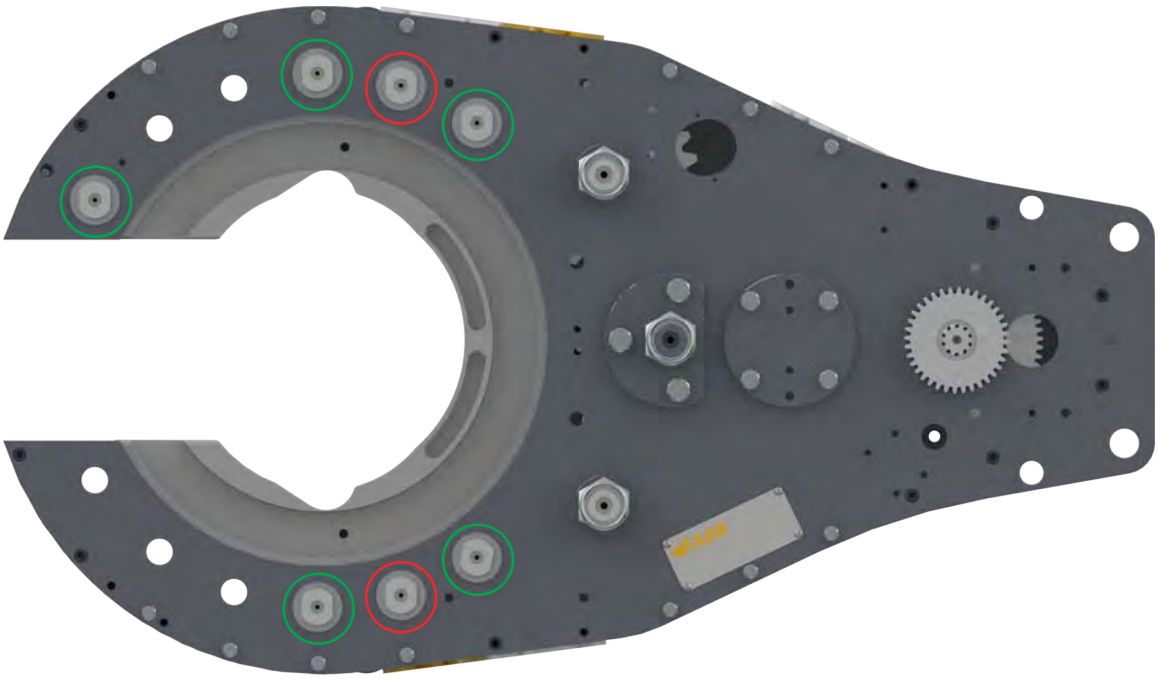


***ILLUSTRATION 3.H.4: TONG ASSEMBLY - SUPPORT ROLLERS (SECURING LEG MOUNTS)***

34. *Re-install support roller shafts continued:*

    ii) *Secure the bottoms of the support roller shafts with 1" narrow flat washers and 1" UNS thin nylock nuts. Install the RH front leg mount weldment (PN 101-0163) and the LH front leg mount weldment (PN 101-0162) on the to the support roller shafts using 1" UNS thin nylock nuts and two 3/8" UNC x 1-3/4" hex bolts and lockwashers per weldment (see Illustration 3.H.5).* ***ASSEMBLY NOTE:*** *Do not use flat washers when installing the 1" UNS nut on the shaft coincidental with the leg weldments .*

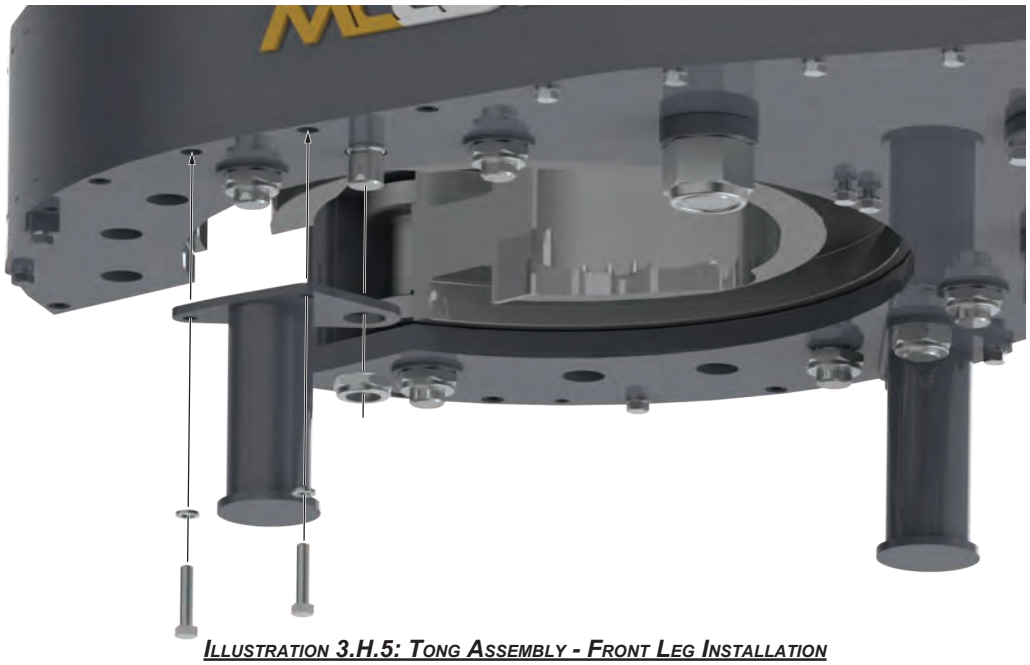


***ILLUSTRATION 3.H.5: TONG ASSEMBLY - FRONT LEG INSTALLATION***

***Assembly Procedures (continued...):***

34. *Re-install support roller shafts continued:*

    iii) *Install support roller shafts (PN 101-3939) in four locations where they are coincidental with the top and bottom brake band lug weldments (top left & bottom right weldment PN = 101-0083, top right & bottom left weldment PN = 101-0096) as shown in illustration 3.H.6. These support rollers do not use top or bottom washers.*

***ILLUSTRATION 3.H.6: TONG ASSEMBLY - SUPPORT ROLLERS (BRAKE BAND WELDMENTS)***

35. *Thread the top shifter bushing (PN 101-0020) into the top plate, over the shifter shaft, until snug. Thread the detent tube (PN 101-0019) into the top shifter bushing as shown in illustration 3.H.7. Thread three 5/8" NC x 5/8" hex socket set screws into the remaining three ports in the bushing - these set screws are intended to be used as contamination barriers only. Do not bottom out the set screws on the shifting shaft, or the shaft will not move.*

***Assembly Procedures (continued...):***

36. *Insert the shifter detent ball (PN 02-0018) into the detent tube, followed by the detent spring (PN 01-0040). Thread a 7/16" NF hex jam nut onto a 7/16" UNF x 1-1/4" hex nut, then thread the 7/16" bolt into the detent tube. This is the detent force adjustment bolt and lock nut.*

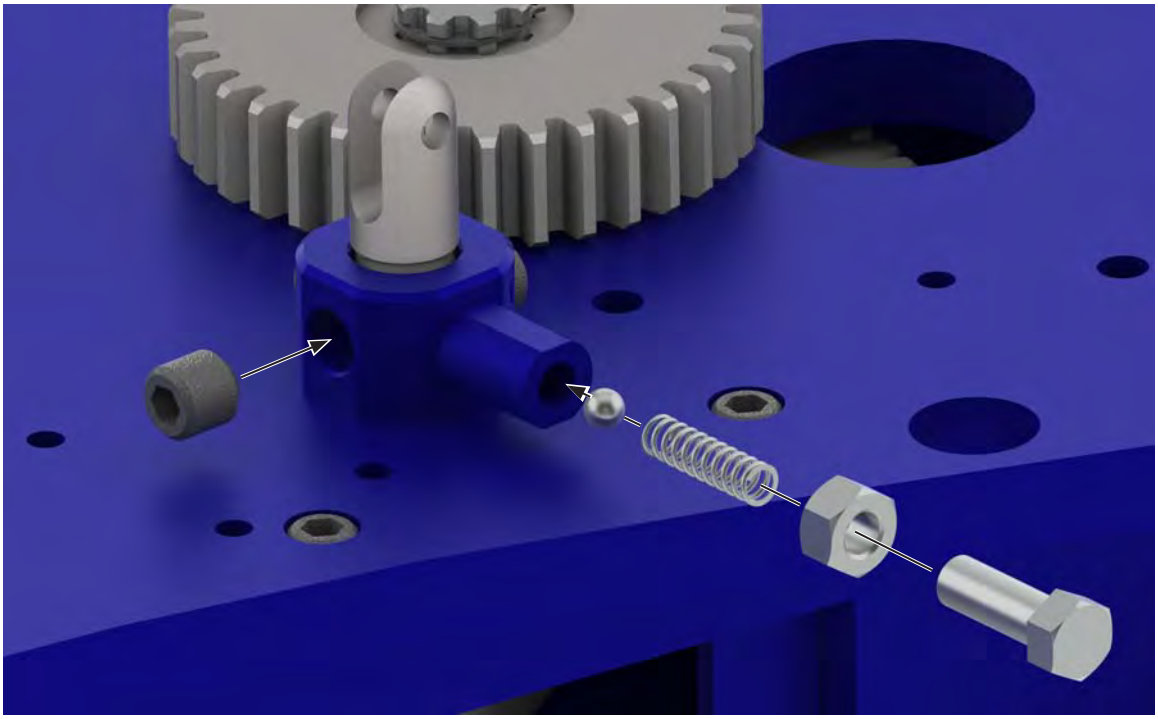


***ILLUSTRATION 3.H.7: TONG ASSEMBLY - TOP SHIFTER BUSHING ASSEMBLY***

37. *Insert two 5/16" x 3/4" dowel pins (PN 09-0170) into the un-threaded holes in the rear of the tong, behind the clutch drive gear on either side of the cutout in the top plate.*
38. *Place motor mount (PN 1050-150) on to top plate over the dowel pins installed in the previous step, and secure with four 1/2" NC x 1-1/2" hex socket head cap screws.*
39. *Bolt the shifter lug weldment (PN 101-0016) onto the top plate with four 3/8" NC x 1-1/4" hex bolts and 3/8" lock washers.*
40. *Attach the motor gear (PN 997-A10-149) to the motor shaft, securing with two 3/8" NC x 3/8" flat point hex socket set screws. Do not neglect to install the 5/16" square x 1-1/2" key between the gear and the motor shaft..*
41. *Install the motor (PN 87-0007) onto the motor mount. Secure the RH side of the motor to the motor mount with two 1/2" NC x 1" hex socket head cap screws and 1/2" lock washers.*
42. *The LH side of the motor is secured with two 1/2" NC x 1-1/4" hex socket head cap screws and 1/2" lock washers, which also secures the torque gauge holder weldment (PN 1500-09-04A).*
43. *Install shifting handle (PN 1037-D-20B). Secure the handle to the shifter shaft and shifter pivot lug weldment with 5/16" x 1-1/2 clevis pins. Use a hitch pin on each clevis pin to ensure they do not become dislodged.*
44. *Install thirteen cam followers (PN 02-0107) in the top cage plate (PN 1050-21HT), and secure each a with 5/8" UNF hex jam nut and 5/8" lock washer. Once installed the cam followers will ride in the top groove in the rotary gear.*
45. *Install thirteen cam followers (PN 02-0107) in the bottom cage plate (PN 1050-22HT), and secure each a with 5/8" UNF hex jam nut and 5/8" lock washer. Once installed the cam followers will ride in the bottom groove in the rotary gear.*
46. *Support the bottom cage plate assembly against the bottom of the rotary gear, with the cam followers in the groove in the bottom of the rotary gear and the opening of the cage plate aligned with the opening in the tong body.*
47. *Place the top cage plate assembly on the top of the rotary gear, with the cam followers in the groove in the top of the rotary gear and the opening of the cage plate aligned with the opening in the tong body.*

***Assembly Procedures (continued...):***

48. *Insert two cage plate spacers (PN 1050-C3-38) between the cage plates at the front of the cage plates next to the rotary gear. Secure the cage plates through the spacers using 1/2" UNC x 7-1/2" hex bolts, 1/2" narrow flat washers (on the bottom) and 1/2" UNC nylock nuts.*

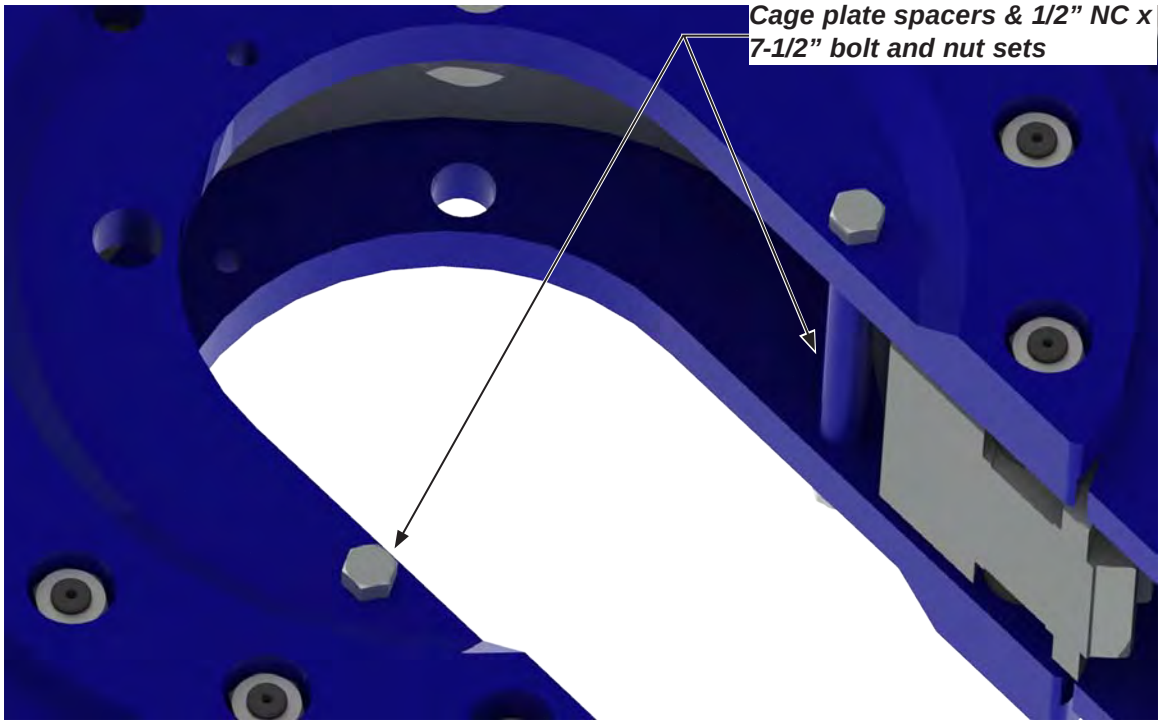



***ILLUSTRATION 3.H.8: TONG ASSEMBLY - FRONT CAGE PLATE SPACERS***

49. *Slide a 1/2" flat washer on to a 1/2" UNC x 9-1/2" hex bolt, followed by the backing pin spacer (PN 101-4186). Slide the larger diameter hole in the backing pin retainer link (PN 101-4187) ever the end of the 9-1/2" hex bolt on to the backing pin spacer.*
50. *Coat half of the threaded connecting stud (PN 101-4097) with blue Loctite and screw in to the backing pin (PN 101-4188).*
51. *Insert the exposed half of the threaded dowel pin through the smaller diameter hole of the backing pin retainer link. Slide the small backing pin spacer (PN 101-4096) over the threaded dowel against the backing pin retainer link.*
52. *Position the remaining cage plate spacer (PN 1050-C3-38) between the cage plates at the rear of the opening. Insert the bolt of the backing pin assembly through the cage plates and cage plate spacer, and the backing pin in to one of the backing pin holes at the rear of the top cage plate. Secure the bolt with a 1/2" narrow washer and a 1/2" UNC nylock nut.*
53. *Thread the rear door cylinder mounting lug (PN 1050-12-001) into the top plate next to the LH top brake band lug weldment (see illustration 3.H.3).*
54. *Install the door pivot shoulder bushings (PN 101-0110) in the door weldment assembly (PN 1050-C4-10) (see Pp. 5.28- 5.29 for correct bushing orientation).*
55. *If not already done, install the remaining support roller assembly less the shaft and fasteners between the body plates in the door pivot location.*
56. *Align the pivot holes in the door weldment with the pivot holes in the top and bottom plates. Slide a 1-1/8" narrow flat washer on to the door pivot roller shaft (PN 101-3940) and insert the shaft through the door bushings, support roller components, and body plates. Once the shaft is fully inserted (it may need to be lightly tapped) secure with a 1" narrow flat washer and 1" UNS thin nylock nut.*
57. *Thread a 1/2" UNC hex nut on to a 1/2" UNC x 1-3/4" hex bolt. Thread the hex bolt in to the threaded hole on the front of the door weldment.*
58. *Refer to Pp. 5.28 - 5.29 for a door assembly illustration. Lightly grease the door latch adjustment cam (PN 1037-A-14). Position the door latch weldment (PN 1050-15) at the front of the door weldment, and insert the two latch springs (PN 997-16) between the latch weldment and the door weldment. Press the latch weldment against the door weldment until the latch pivot holes align, and insert the door latch cam shaft. Secure the latch adjustment cam to the top plate of the door weldment with a 3/8" UNC x 3/4" hex bolt and 3/8" lock washer.*
59. *Install mechanical door stop (PN 101-1833) to the bottom plate of the tong next to the LH brake band retainer weldment. Secure with two 3/8" NC x 2" bolts and 3/8" lock washers.*

***Assembly Procedures (continued...):***

59. *Install mechanical door stop (PN 101-1833) to the bottom plate of the tong next to the LH brake band retainer weldment. Secure with two 3/8" NC x 2" bolts and 3/8" lock washers.*
60. *Install the door spring cylinder (PN 101-0069) using two 1/2" x 1/2" hex socket shoulder bolts (UNC).*
61. *Install upper and lower lined brake band weldments (PN 1050-D4-29). Secure each brake band to the top or bottom plate with a brake band retainer (PN 101-0140),and 3/8" NC x 1" hex bolts and 3/8" lock washers. Attach the fronts of each brake band weldment to the brake band lug weldments with 3/8" UNC x 1-1/2" hex bolts, 3/8" narrow flat washers, and 3/8" UNC hex nylock nuts. These nut and bolt sets are used for adjusting the brake band tension.*
62. *Install the safety door switch assembly using the following procedure (see Pp. 5.30 - 5.31):*
    - i. *Attach safety door latch spacer (PN 101-1411) to the top of the door weldment using two 3/8" NC x 1" hex socket head cap screws and 3/8" lock washers.*
    - ii. *Attach safety door latch block (PN 101-1104) to the latch spacer using four 3/8" NC x 1/2" shoulder bolts.*
    - iii. *Attach safety door latch block (PN 101-1103) to safety door latch plate (PN 101-1410) using three 3/8" NF x 1" flat head countersunk cap screws.*
    - iv. *Place the safety door latch plate (PN 101-1410) onto the bottom plate of the safety switch base and guard weldment (PN 101-1475) and align the bolt holes. Secure to the top plate using two 3/8" NC x 2-1/4" hex socket head cap screws and one 3/8" NC x 1-1/4" socket head cap screw. Note that the two longer cap screws in this step replace two of the tong's perimeter fasteners.*
    - v. *Insert load plunger (PN AE12-306) into LH safety door latch block (PN 101-1103).*
    - vi. *Attach three 1/4" NPT x 1/4"JIC elbows (PN 08-0284) to the Deltrol safety door valve (PN 08-0337M). Position a 15/16" valve lock nut (PN 09-0278) as shown in illustration 3.H.9, and secure the safety door valve to the safety door latch block using the valve lock nut.*

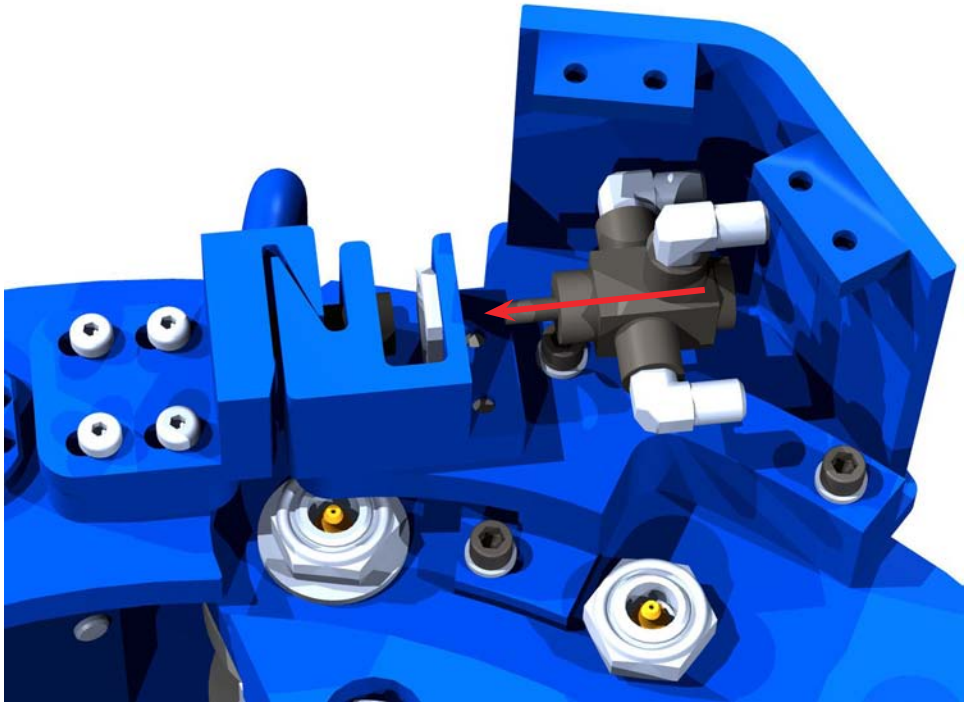


***ILLUSTRATION 3.H.9: TONG ASSEMBLY - SAFETY DOOR VALVE INSTALLATION***

    - vii. *Attach the top plate of the switch guard (PN 101-1474) to the switch guard weldment using three 3/8" UNC x 1" hex bolts and 3/8" lock washers.*
63. *Install the LH & RH rigid sling mounting lugs (LH = PN 101-0113, RH = PN 101-0115) using two 3/8" NC x 1-3/4" hex bolts and 3/8" lock washers, and two 1/2" NC x 1-1/4" hex bolts and lock washers per side.*
64. *Slide the master lifting link (PN 02-0516) over the adjustment helix (PN 1053-1-H), and install the adjustment helix in the rigid sling weldment (PN 101-0112) using a 3/4" UNC x 8" hex bolt and 3/4" UNC nylock nut.*
65. *Use a crane to hoist the rigid sling weldment. Connect the rigid sling weldment to the rigid sling mounting lugs with rigid sling pins (PN 1053-C-1C). Secure each pin with two 0.148" x 2.938" hitch pins.*

***Assembly Procedures (continued...):***

66. *Thread a 3/4" UNC hex nut on to each of two rigid sling leveling adjustment weldments (PN 1053-C-1L). Thread the leveling adjustment weldments into the front of the rigid sling weldment mounting brackets, roughly adjusting them so the rigid sling is approximately perpendicular to the top plate of the tong (see illustration 3.H.10).*

67. *Thread 1/2" UNC hex nuts on to two 1/2" UNC x 1-3/4" hex bolts. Thread the bolts into the rear of the rigid sling weldment mounting brackets. (see illustration 3.H.10).*

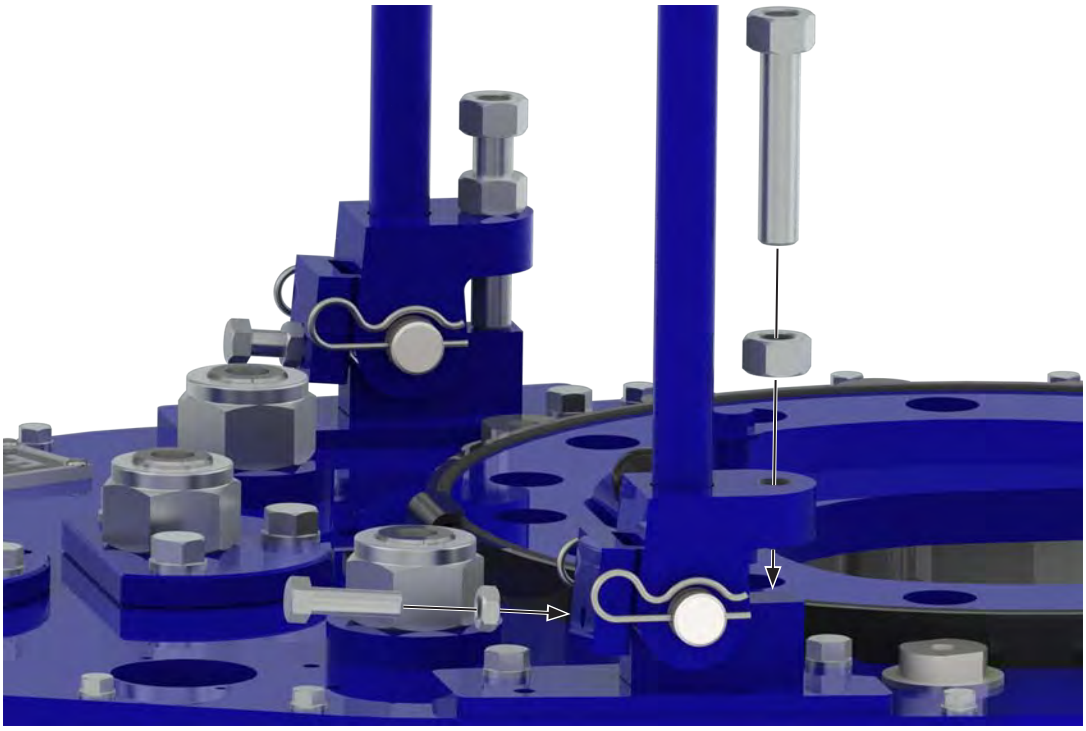


***ILLUSTRATION 3.H.10: TONG ASSEMBLY - RIGID SLING ADJUSTMENT BOLT INSTALLATION***

68. *Attach the rear leg weldment (PN 997-D8-160A) to the bottom plate of the tong using a 7/8" UNC x 1" hex socket head cap screw and a regular 7/8" flat washer.*

69. *Install grease fittings:*

    a) *Install one 1/4" straight thread grease fitting (PN 02-0097) into the top side of each support roller shaft, including the door pivot rollers (12 locations total).*

    b) *Install one 1/4" straight thread grease fitting (PN 02-0097) into the top side of the latch adjustment cam.*

    c) *Install one 1/8" NPT grease fitting (PN 02-0005) into the top of each idler shaft or half-shaft (three locations total).*

    d) *Install one 1/8" NPT grease fitting (PN02-0005) into the end of the clutch shaft, in the centre of the clutch bearing cap.*

    e) *Install two 1/8" NPT 90° grease fittings (PN 02-0093) in each pinion bearing cap (four locations total).*

    f) *Install two 1/8" NPT 90° grease fittings (PN 02-0093) in clutch bearing cap (two locations total).*

    g) *Install one 1/8" NPT 90° grease fitting (PN 02-0093) or one 1/8" NPT 45° grease fitting (PN 02-0006) in the top of the motor mount.*

    h) *Install drive-in grease fittings (PN 02-0012) into the ends of each tong cage plate cam follower (26 locations total).*

    i) *Install drive-in grease fittings (PN 02-0012) into the ends of each backup cage plate cam follower (26 locations total).*

70. *Install hydraulic inlet support base (PN 101-1138) to the top plate directly adjacent to the RH rotary idler, using two 3/8" NC x 1" hex bolts and 3/8" lock washers. Attach the adjustment plate (PN 101-0022) to the support base using two 3/8" NC x 1" hex bolts, 3/8" narrow flat washers, and 3/8" UNC hex nylock nuts.*

71. *Attach the outlet coupling support mounting base (PN 101-0021) to the top plate on the RH side of the motor mount using four 3/8" UNC x 2" hex socket head cap screws.*

72. *Attach the outlet coupling support weldment (PN 101-0023) to the weldment mount using two 3/8" NC x 1" hex bolts and 3/8" lock washers. Attach the adjustment plate (PN 101-0277) to the outlet support weldment using four 3/8" NC x 1" hex bolts, 3/8" narrow flat washers, and 3/8" UNC hex nylock nuts.*

73. *Coat the threads of the hydraulic valve mounting posts (PN 101-0116) with Loctite and thread into the top plate just behind the brake band on either side of the brake band retainer.*

***Assembly Procedures (continued...):***

74. *Mount the DVA35 hydraulic valve assembly on the mounting posts using two 1/2" UNC x 4-1/2" hex bolts and 1/2" narrow flat washers.*
75. *Attach two #20 (1-1/4") / 1" JIC flange elbows (PN 02-9216) to the motor using #20 split flange kits (PN 02-9217).*
76. *Connect the safety door valve block (PN 101-0727) directly to the flange elbows on the hydraulic motor (the block will sit on top of the motor following installation). Connect the rotation control valve on the DVA35 valve assembly to the safety door block.*
77. *Connect the safety door switch to the safety door block and hydraulic valve assembly. Refer to hydraulic schematic, or call McCoy Drilling & Completions - Farr® engineering department for assistance.*
78. *Install desired jaw die kit in the tong using the jaw pivot bolts (PN 1050-C5-28).*

## I. DAILY INSPECTION & MAINTENANCE CHECKLIST (POWER TONG)

*Farr recommends that the following inspection and maintenance procedures be performed before each use, and at least once per day when the tong is in steady use, in the order in which they are listed.*

1. ☐ *Rotate cage plate/rotary gear until the opening in the rotary gear faces towards the rear of the tong.*

***DO NOT PERFORM ANY FURTHER ACTIONS OR MAINTENANCE WHILE THE TONG IS CONNECTED TO ANY HYDRAULIC POWER SUPPLY. FARR RECOMMENDS THAT ALL HYDRAULIC LINES ARE FULLY DISCONNECTED, AND RESIDUAL HYDRAULIC PRESSURE IS BLED OFF. ENSURE ADEQUATE CONTAINMENT IS IN PLACE TO PREVENT ENVIRONMENTAL CONTAMINATION FROM RESIDUAL HYDRAULIC FLUID.***

***DEPRESSURIZE HYDRAULIC SYSTEM IN PREPARATION FOR MAINTENANCE:***

2. ☐
   1) *Rotate the tong to the "open throat" position. Ensure tong and backup doors (if equipped) are closed. Fully extend the lift cylinder*
   2) *De-energize the power unit.*
   3) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
   4) *Remove the hydraulic SUPPLY line from the equipment.*
   5) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
   7) *Disconnect the hydraulic RETURN line from the equipment.*
   8) *Disconnect remaining hoses such as case drains.*

***HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE INJURIES***

3. ☐ *Perform an initial wash of the tong in order to remove the majority of dirt and grease build-up. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid and dirty grease.*

4. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*

5. ☐ *Use a flashlight to perform a visual inspection of the gear train through the access panel and the opening of the rotary gear. If gear damage or chips of metal are seen, the tong should be removed from service and overhauled to avoid further damage. Replace access panel when inspection is complete.*

6. ☐ *Perform a visual inspection of all fasteners and protruding body pieces (example: hydraulic valve mounts, inlet & outlet line supports, tong legs, shifter handle pivot lugs). Tighten or replace loose or missing fasteners. Farr recommends that damaged or missing body parts be repaired or replaced.*

7. ☐ *Inspect the jaws and dies. Inspect the jaw roller pins for signs of damage - replace pins if necessary. If the pins are welded in place, replace the entire jaw assembly. Ensure dies are secure in the jaw - replace worn dies if necessary. Ensure that the jaw rollers rotate freely. Check to ensure the size of the loaded jaws match the size of casing or pipe you are running.*

8. ☐ *Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service.*

9. ☐ *Inspect tong for signs of premature wear, or moving parts that are rubbing (bare metal where there used to be paint is a good indication of wear.*

10. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*

11. ☐ *Inspect top and bottom brake band linings - replace if necessary. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*

12. ☐ *Perform a visual inspection of all hydraulic lines. Replace flexible lines if they appear to be cracked, fatigued, or have visible signs of wear from contact with a rigid object.*

13. ☐ *Perform a complete greasing of the tong - refer to Maintenance section of the technical manual*

14. ☐ *Ensure main supply and return connections to the tong are fully made up. Re-connect the remainder of the hydraulic lines, and, if applicable, the electrical line to the turns counter.*

***FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.***

15. ☐ *Perform a visual inspection of the load cell. If using a tension load cell, replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression. Inspect hydraulic line, fittings, and diaphragm seals for fluid leaks.*

16. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*

*If using a stand-alone power unit, start it now - refer to the power unit technical manual for startup procedures. Listen to power unit for a moment to see if there are any unusual mechanical sounds (rubbing, grinding, excessive pump noise). If using a diesel unit, allow sufficient time for the engine to reach operating temperature before increasing engine RPM. Once engine is warm, gradually increase engine RPM until operating speed is reached.*

17. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*

18. ☐ *Perform a visual inspection of pressurized hydraulic lines. Document and correct any hydraulic fluid leaks.*

19. ☐ *Perform a full functional test of the tong (refer to section 2.I.4).*

20. ☐ *Test safety door feature (if equipped). Open the tong door(s), and attempt to rotate the cage plate at low speed (low gear) in both directions (makeup and breakout). If cage plate begins rotating, the safety door mechanism is not functional, and the tong must be removed from service until the safety door mechanism can be repaired. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

***NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR***

21. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved.*

## J. MONTHLY MAINTENANCE CHECKLIST - POWER TONG

*The following maintenance checklist is intended as a guideline rather than a definitive maintenance schedule. Your equipment may require more, or less, maintenance depending upon the frequency of use, the percentage of maximum torque that your equipment is routinely subjected to, and the field conditions under which your equipment operates. Farr recommends that the following inspection and maintenance procedures be performed monthly, or in conjunction with your maintenance foreman's experience and best estimate of when your equipment is due for this maintenance.*

1. ☐ *Rotate cage plate/rotary gear until the opening in the rotary gear faces towards the rear of the tong.*

***DO NOT PERFORM ANY FURTHER ACTIONS OR MAINTENANCE WHILE THE TONG IS CONNECTED TO ANY HYDRAULIC POWER SUPPLY. FARR RECOMMENDS THAT ALL HYDRAULIC LINES ARE FULLY DISCONNECTED, AND RESIDUAL HYDRAULIC PRESSURE IS BLED OFF. ENSURE ADEQUATE CONTAINMENT IS IN PLACE TO PREVENT ENVIRONMENTAL CONTAMINATION FROM RESIDUAL HYDRAULIC FLUID.***

***DEPRESSURIZE HYDRAULIC SYSTEM IN PREPARATION FOR MAINTENANCE:***

2. ☐
   1) *De-energize the power unit.*
   2) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
   3) *Remove the hydraulic SUPPLY line from the equipment.*
   4) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
   5) *Disconnect the hydraulic RETURN line from the equipment.*
   6) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

***HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE INJURIES***

3. ☐ *Clean the exterior of the tool thoroughly, using either water (if using a pressure washer ensure a low-pressure wash wand is used), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents.*

4. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*

5. ☐ *Clean the interior of the tong thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents. Make a note if any metal shavings or metal pieces are flushed out of the gear train cavity - if shavings or metal pieces are seen the tong must be overhauled before it is returned to service.*

6. ☐ *Inspect all fasteners and fastener safety wires (if equipped). Replace any missing fasteners - use Grade 8 bolts only unless otherwise specified. Re-torque all external fasteners to SAE specifications.*

7. ☐ *Repair or replace any damaged or missing external body parts, such as torque gauge mounts, hydraulic supports, safety door protectors, etc.*

8. ☐ *Perform a visual inspection of all fasteners and protruding body pieces (example: hydraulic valve mounts, inlet & outlet line supports, tong legs, shifter handle pivot lugs). Tighten or replace loose or missing fasteners.*

9. ☐ *Inspect tong for signs of premature wear, or moving parts that are rubbing (bare metal where there used to be paint is a good indication of wear.*

10. ☐ *Inspect all paint - locations in which the paint has been damaged must be repaired prior to the tong being returned to service. Prepare areas to be painted to ensure they are free of grease, dirt, or solvent. Touch up using a solvent-based acrylic paint - "McCoy Grey" is paint color number RAL7015, "McCoy Yellow" (hazard areas) is RAL1007, and McCoy Green is RAL6029 (contact Farr sales for paint number for custom paint applications). Allow sufficient time for paint to dry before proceeding.*

11. ☐ *Visually inspect all load-bearing welds. Any weld that is cracked or separating must be repaired and repainted before returning the tong to service.*

12. ☐ *Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service. Refer to Section 2A of the technical manual (Sling/Load Bearing Device Safety) for information on recommended testing and recertification. Please note that turnbuckles with part number 101-3086 (short turnbuckles) use a high-strength pin which must be supplied by Farr.*

***"SHORT" TURNBUCKLES HAVING PART NUMBER 101-3086 EMPLOY HIGH-STRENGTH PINS WHICH MUST BE SUPPLIED BY FARR.***

13. ☐ *Remove hydraulic motor and rotate the gear train by hand, and use a flashlight to perform a visual inspection of the gear train through the access panel and the opening of the rotary gear while the gear train is being rotated. If gear damage or chips of metal are seen, the tong should be removed from service and overhauled to avoid further damage. Replace access panel when inspection is complete.*

14. ☐ *Inspect all jaws and dies in use for the maintenance interval. Remove pin & roller, and inspect for signs of damage - replace pins if necessary. If the pins are welded in place & the welds are found to be damaged, remove and quarantine the jaw until the weld is repaired. Clean the pins and rollers, and reassemble using a liberal coating of anti-seize compound. Ensure dies are secure in the jaw & die retainers are present. Replace worn dies if necessary. Ensure that the jaw rollers rotate freely.*

15. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*

16. ☐ *Inspect top and bottom brake band linings - replace if lining is found to be flaking or is missing pieces of material. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*

17. ☐ *Inspect door springs. Ensure the springs retain sufficient strength to be able to assist the opening of the door, and to keep the door open. The springs should also help to "snap" the door shut.*

18. ☐ *Inspect backup springs (if applicable). The rear extension springs (where used) should be equally extended, and the front leg springs should be equally compressed. Ensure that neither of the rear backup springs have been over-extended and lack sufficient tension to adequately support the backup. Ensure that neither of the front leg springs (or, when installed, the single rear backup leg spring) have been over-compressed, and still retain enough spring strength to support the front of the backup.*

19. ☐ *Extend all hydraulic cylinders, and inspect cylinder rods for signs of mechanical damage, flaking, or rust. Farr recommends that damaged cylinders be replaced prior to storage.*

20. ☐ *Perform a visual inspection of all hydraulic lines. Replace flexible lines if they appear to be cracked, fatigued, or have visible signs of wear from contact with a rigid object. If your tong is equipped with rigid hydraulic lines, replace any line that is dented or appears to be stressed or cracked.*

21. ☐ *Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear. Perform a full lubrication - refer to Maintenance section of manual to determine lubrication points.*

22. ☐ *Ensure main supply and return connections to the tong are fully made up. Re-connect the remainder of the hydraulic lines.*

***FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.***

*If using a stand-alone power unit, start it now - refer to the power unit technical manual for startup procedures. Listen to power unit for a moment to see if there are any unusual mechanical sounds (rubbing, grinding, excessive pump noise). If using a diesel unit, allow sufficient time for the engine to reach operating temperature before increasing engine RPM. Once engine is warm, gradually increase engine RPM until operating speed is reached.*

23. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*

24. ☐ *Perform a visual inspection of pressurized hydraulic lines. If any hydraulic fittings or hoses are leaking they must be repaired or replaced before proceeding.*

25. ☐ *Rotate tong for one minute in both high and low gear. Stop the tong and reverse the direction of rotation for another minute in both high and low gear, ending with the opening of the rotary gear facing the gear train. De-energize the power unit, and perform another generous lubrication of the gear train, including the gear housing.*

26. ☐ *Energize power unit. Rotate tong for one minute in both high and low gear. Stop the tong and reverse the direction of rotation for another minute in both high and low gear, ending with the opening of the rotary gear facing the gear train.*

27. ☐ *De-energize the power unit, and perform a third generous lubrication of the gear train, including the gear housing.*

28. ☐ *Rotate tong in low gear for 5 minutes while monitoring pressurized seals and hydraulic lines. If a seal, line, or fitting begins to leak while tong is rotating, it must be replaced before the equipment is returned to service.*

29. ☐ *Rotate tong in high gear for 5 minutes while monitoring temperature of top and bottom bearing caps. If the bearing caps are hot to the touch (higher than approximately 50°C) replace the applicable bearings. Likewise if the tong is making unusual noises check for damaged bearings (see Maintenance Manual for all bearing locations).*

30. ☐ *Install load cell. If using a tension load cell, perform a visual inspection and replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression. Inspect load cell for damage or signs of stress. Check oil level in load cell and fill if necessary (refer to technical manual Section 7 or Section 8).*

31. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*

32. ☐ *If applicable, the weld securing the single load cell anchor to the bridge bar main plate must be inspected (compression load cell only). If the integrity of the weld has been compromised, the tong must be removed from service until the weld is repaired. The load cell beam will need to be disconnected and removed so the weld is visible. Before re-installing the beam, liberally grease the anchor pin before reinserting into the load cell beam.*

33. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*

34. ☐ *Perform a full functional test of the tong including, if applicable, backup components, lift cylinder, and float frame components (refer to Section 2.I.4). Report and correct any hydraulic leaks from the hydraulic valve bank, or from any hydraulic cylinders that are used.*

35. ☐ *Test safety door feature (if equipped). Begin rotating the tong at low speed, and open the tong door(s). If rotation does not immediately stop, this is an indication that the safety door mechanism is not operating correctly and the tong must be removed from service until the mechanism is repaired. Repeat the test while operating the tong in the opposite direction. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

***NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR***

36. ☐ *Farr recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external unpainted surfaces (and chain slings) EXCEPT cylinder rods, jaw rollers, and rotary gear camming surfaces. Refer to manufacturer data sheets for proper application and safety information.*

***Once all of the above maintenance checklist items have been satisfactorily completed the tool may be returned to service.***

### K. TUBULAR CONNECTION EQUIPMENT DE-COMMISSIONING & SHIPPING PROCEDURE

*Perform the following decommissioning procedures when removing tubular connection equipment from service, with the intent of short to long-term storage. These procedures are essential for ensuring proper protection of the equipment from environmental attack, and to aid in the quick turnaround when returning the equipment to service.*

*Store all o-rings, seals, packings, gaskets, etc. in strong moisture proof, airtight containers. Ensure that these items are not crushed, nicked, or otherwise damaged.*

*Do not perform any further actions or maintenance while the tong is connected to any hydraulic power supply. Farr recommends that all hydraulic lines are fully disconnected, and residual hydraulic pressure is bled off. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid.*

***IN ORDER TO MAINTAIN THE INTEGRITY OF INSTALLED SEALS, MCCOY RECOMMENDS THAT THE MAXIMUM STORAGE INTERVAL NOT EXCEED ONE YEAR. AT LEAST ONCE PER YEAR ALL TUBULAR CONNECTION IN LONG-TERM STORAGE SHOULD BE RECOMMISSIONED AS PER SECTION 3.M. IF FURTHER STORAGE IS REQUIRED, THE EQUIPMENT SHOULD THEN BE PUT THROUGH ANOTHER DE-COMMISSIONING PROCEDURE.***

***DEPRESSURIZATION PROCEDURE IN PREPARATION FOR STORAGE:***

1) *Rotate the tong so that the opening in the rotary gear faces the gear train (towards the rear of the tong). Ensure tong and backup doors (if equipped) are closed. Fully extend the lift cylinder (if equipped). If mounted in a frame, retract the float cylinders (if equipped).*
2) *De-energize the power unit.*
3) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
4) *Remove the hydraulic SUPPLY line from the equipment.*
5) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
7) *Disconnect the hydraulic RETURN line from the equipment.*
8) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

***HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE-INDUCED INJURIES***

1. ☐ *Perform an initial wash of the tool in order to remove the majority of dirt and grease build-up. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid and dirty grease.*
2. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*
3. ☐ *Clean the interior of the tong thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents. Make a note if any metal shavings or metal pieces are flushed out of the gear train cavity - if shavings or metal pieces are seen the tong must be overhauled before it is returned to service.*
4. ☐ *Clean the exterior of the tool thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents.*
5. ☐ *Inspect all fasteners and fastener safety wires. Replace any missing fasteners - use Grade 8 bolts only. Re-torque all external fasteners to SAE specifications.*
6. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*
7. ☐ *Repair or replace any damaged or missing external body parts, such as torque gauge mounts, hydraulic supports, safety door protectors, etc.*
8. ☐ *Inspect all paint - locations in which the paint has been damaged must be repaired prior to storage. Prepare areas to be painted to ensure they are free of grease, dirt, or solvent. Touch up using a solvent-based acrylic paint - "McCoy Grey" is paint number RAL7015. Allow sufficient time for paint to dry before proceeding.*
9. ☐ *Perform a liberal lubrication of the equipment - refer to Maintenance section of manual to determine lubrication points. Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear.*
10. ☐ *Connect the equipment to a hydraulic power unit. Ensure all lines are fully made up to prevent equipment damage from excessive back pressure. Do not neglect to connect the motor drain.*

11. ☐ *Energize power unit.*

12. ☐ *Rotate tong for one minute, stop, and reverse the direction of rotation for another minute, ending with the opening of the rotary gear facing the gear train. De-energize the power unit, and perform another generous lubrication of the gear train, including the gear housing.*

13. ☐ *Energize power unit. Rotate tong for one minute, stop, and reverse the direction of rotation for another minute, ending with the opening of the rotary gear facing the gear train.*

14. ☐ *De-energize the power unit, and perform a third generous lubrication of the gear train, including the gear housing.*

15. ☐ *Energize power unit, and rotate the tong for a final time, one minute in one direction, stop, and reverse the direction of rotation for another minute, this time ending with the rotary gear in the "open throat" position.*

16. ☐ *Extend all hydraulic cylinders, and inspect cylinder rods for signs of mechanical damage, flaking, or rust. Farr recommends that damaged cylinders be replaced prior to storage.*

17. ☐ *If you are using a frame-mounted tool, the tong must be lowered onto the backup in order to remove the risk of sudden and catastrophic movement when pressure is removed from the float cylinders. Cover the top of the backup with protective cloth to protect the paint on the backup. Place two wooden beams across the top of the tong, ensuring that the beams have a minimum size of 4" x 4" x the width of the tong. Cover the tops of the wooden beams with more protective cloth to prevent paint damage to the tong. When lowering the tong onto the beams, ensure that the beams come into flat contact with the bottom of the tong, away from bearing caps, brake bands, or other protrusions on the bottom of the tong. Ensure that the tong hanger chains are loose, but not dangling into contact with the hangers or top plate of the tong.*

***DEPRESSURIZATION PROCEDURE FOR STORAGE:***

1) *Rotate the tong to the "open throat" position.*
2) *Exercise each hydraulic cylinder several times - open the tong and backup doors (if equipped), retract and extend the remote backing pin ramp (if equipped), retract and extend the float cylinders. Leave all cylinders except for the door cylinders in their fully retracted position. The general idea is to have as little of the chrome cylinder rods exposed as possible.*
3) *De-energize the power unit.*
4) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
5) *Remove the hydraulic SUPPLY line from the equipment.*
6) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
7) *Connect a low-pressure air supply line (10 PSI or less) to the hydraulic supply line, and force a small amount of the remaining hydraulic fluid from the valve assembly - this will allow for thermal expansion of the hydraulic fluid if the equipment is stored or transported in high ambient temperatures. Failure to do this may result in damaged or destroyed seals in the equipment.*
8) *Disconnect the hydraulic RETURN line from the equipment.*
9) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

18. ☐ *If any hydraulic fittings or hoses are leaking they must be repaired or replaced before proceeding.*

19. ☐ *Wipe all excess grease from outside of equipment. Replace the access door panel. Use a solvent-based cleaner on rags to wipe all external surfaces to remove residual grease or hydraulic fluid. Once the outside surfaces have been de-greased, wipe all external surfaces with clean water to remove residual solvent.*

20. ☐ *Farr recommends that chain slings be removed and stored separately. Rigid slings and other rigid suspension devices may remain in place.*

21. ☐ *Apply grease or heavy oil to all exposed cylinder rods.*

22. ☐ *Farr recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external surfaces EXCEPT cylinder rods (including chain slings). Refer to manufacturer data sheets for proper application and safety information.*

***DO NOT ALLOW ANTI-CORROSIVE AGENTS TO CONTACT CYLINDER RODS. CYLINDER ROD DAMAGE WILL OCCUR.***

23. ☐ *Allow the anti-corrosive coating ample time to dry - refer to manufacturer data sheets for drying times at room temperature.*

24. ☐ *Wrap entire assembly in 100 gauge (1 mil) corrosion-inhibiting wrap, at least 3 layers thick. Attempt to ensure that the tool is well-sealed within the wrapping, including the bottom.*

*If possible, store in a sealed, climate controlled environment. If isolated storage is not available, Farr recommends storing your wrapped equipment in a secure, out-of-the-way location, using silica gel desiccant to reduce the humidity within the wrapping. As a guideline, use 125 g. of desiccant for each cubic metre of space, or 3.5 g. per cubic foot.*

### CALCULATION OF REQUIRED DESICCANT

1) *Calculate the trapped air volume by measuring the outside dimensions of the tool to be stored, and treat that as the volume to be stored. For example, the external dimensions of a KT20000 20" power tong are 80.25" x 50.5" x 28", which calculates to an approximate volume of 113500 $in^3$, or 66 $ft^3$ (1.87 $m^3$).*

2) *Multiply the calculated air volume, in cubic feet, by the recommended amount of desiccant per cubic foot. Carrying forth the example used in the previous step, the required desiccant charge would be 3.5 g. x 66 $ft^3$, equaling 231 g. Several manufacturers offer silica gel desiccant in packaged quantities of 125 grams per bag, so two packages of desiccant would be required. Please keep in mind that this is a guideline only - more or less desiccant may be required in extreme environmental conditions.*

*For best corrosion resistance the equipment should be removed from storage and exercised on a regular basis, depending on the storage environment. Farr recommends that for equipment stored in a salt-water maritime or exposed dusty environment, repeat steps 9 through 24 monthly. For equipment stored in isolated storage in a non-maritime environment, repeat steps 9 through 24 quarterly. Replace desiccant packs at this time - depleted desiccant packs may be treated as regular dunnage.*

### SHIPPING INSTRUCTIONS

*The following procedure lists the steps to be followed to prepare your tong for shipping.*

1. *If not already done remove accessories (tong jaws, load cell, torque gauge, etc.) McCoy recommends wrapping these items in protective wrap and placing in a separate wooden crate.*

2. *Place the equipment on a sturdy pallet constructed of 4" x 4" cross-members and 2" x 4" flooring. McCoy recommends placing a 2" x 6" board across the width of the tong under the legs (see Illustration 3.M.1). Ensure the pallet is large enough to accommodate the wooden crate containing the tong accessories.*


*ILLUSTRATION 3.L.1: SHIPPING INSTRUCTIONS - PALLET*

**SHIPPING INSTRUCTIONS (CONTINUED):**

3. *Use a crane to support the chain sling (if equipped). Wrap the chain sling with bubble wrap or another similar protective wrapping, and secure the wrapping with tape. Lower the wrapped chain sling so it sits inside the opening of the tong.*

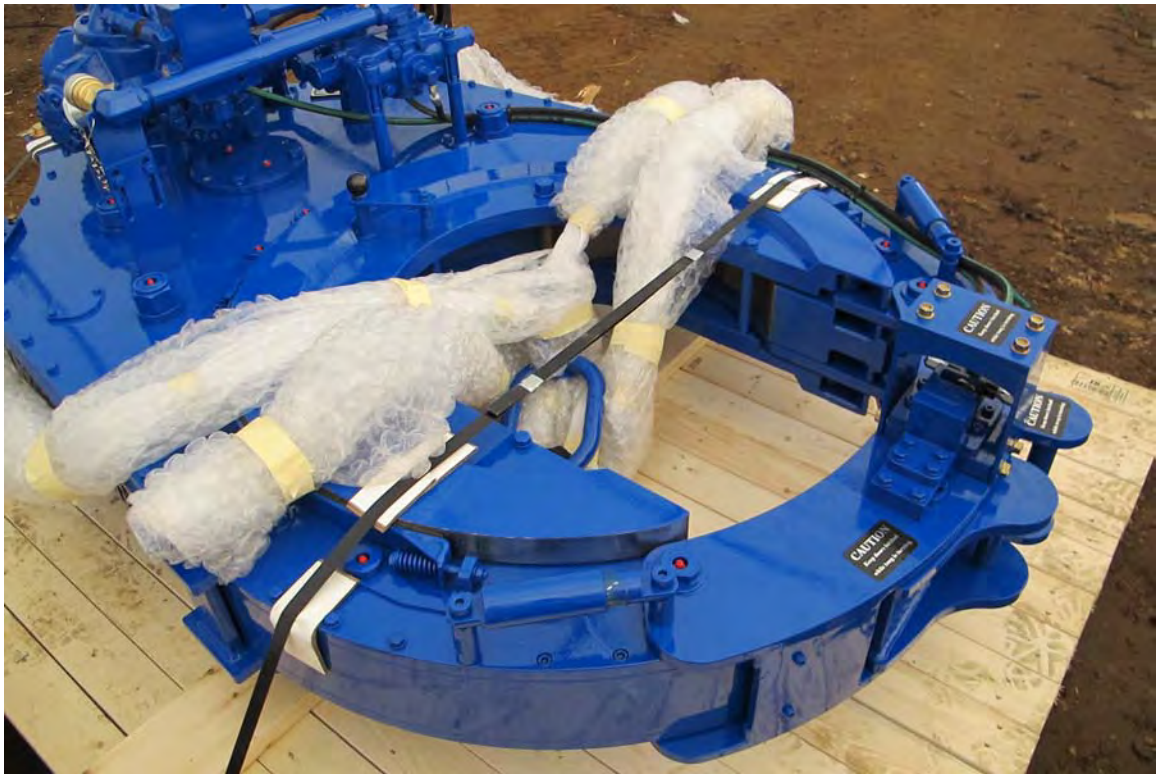


**ILLUSTRATION 3.L.2: SHIPPING INSTRUCTIONS - WRAPPING CHAIN SLING & STRAPPING TO PALLET**

4. *Securely strap the equipment in place using metal strapping (see Illustration 3.L.2). Place strapping as close to the cross-members under the equipment legs as possible, and use caution not to entrap any flexible hydraulic hoses beneath the strapping (guide strapping through beneath the hydraulic hoses). Use the following guidelines to determine the strapping requirements:*

   *Assemblies weighing 1000 lbs. (454 kg.) or less:*

      *3/4" x 0.029" metal strapping, 3320 lbs. (1509 kg.) tensile strength*
      *Minimum two straps*

   *Assemblies weighing more than 1000 lbs. (454 kg.) or less:*

      *1-1/4" x 0.031" metal strapping, 5500 lbs. (2500 kg.) tensile strength*
      *Minimum **two** straps for assemblies weighing less than 5000 lbs. (2273 kg.)*
      *Minimum **three** straps for assemblies weighing more than 5000 lbs. (2273 kg.)*

   *Before tightening strapping, place strapping protectors wherever the metal strapping comes into contact with the equipment.*

   *Place the wooden crate containing the tong accessories on the crate next to the equipment. Strap the crate to the pallet using 3/4" x 0.029" metal strapping. If it is not practical to place larger loose items in a wooden crate, ensure they are also securely strapped to the pallet using 3/4" x 0.029" metal strapping.*

5. *Use a large polyethylene shipping bag (sometimes called a pallet cover) to completely enclose the equipment. Seal polyethylene bag to the pallet using 1 mil polyethylene wrap. Use the wrap to conform the plastic cover to the general shape of the equipment, but do not wrap so tight that sharp edges on the equipment perforate the cover.*

6. *McCoy recommends enclosing the equipment in a sturdy shipping crate which is securely fastened to the pallet.*

### M. TUBULAR CONNECTION EQUIPMENT RE-COMMISSIONING PROCEDURE

*Perform the following recommissioning procedures when removing tubular connection equipment from short or long-term storage back into regular service. These procedures are essential for ensuring proper equipment preparation and operation. The following procedures also assume that the decommissioning and storage procedures recommended by Farr have been strictly observed.*

1. ☐ *Remove all protective plastic wrapping. If there are desiccant packs with the assembly, they may be disposed of with the regular garbage.*
2. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*
3. ☐ *Wipe excess grease or heavy oil from exposed cylinder rods.*
4. ☐ *If applicable, re-connect chain sling to lifting lugs. Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service. If your company requires yearly certification of lifting equipment, ensure that the most recent test date falls within the past year. Perform recertification if necessary.*
5. ☐ *Perform a liberal lubrication of the equipment - refer to Maintenance section of manual to determine lubrication points. Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear.*
6. ☐ *Connect the equipment to a hydraulic power unit. Ensure all lines are fully made up to prevent equipment damage from excessive back pressure. Do not neglect to connect the motor drain.*

***FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.***

7. ☐ *Energize power unit.*
8. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*
9. ☐ *Perform a thorough inspection of pressurized hydraulic lines and fittings. Any leaking hydraulic fluid lines or fittings must be replaced before the equipment is returned to service.*
10. ☐ *Perform a thorough inspection of all seals. Any seal that is leaking or "weeping" must be replaced before the equipment is returned to service.*
11. ☐ *Rotate tong in low gear for 5 minutes while monitoring pressurized seals and hydraulic lines. If a seal, line, or fitting begins to leak while tong is rotating, it must be replaced before the equipment is returned to service. Finish this step with the rotary gear opening facing the gear train. De-energize the power unit.*
12. ☐ *Inspect all flexible hydraulic lines for signs of wear, blistering, or any other signs of potential failure - replace if signs of potential failure are identified.*
13. ☐ *Inspect the gear train housing. If the amount of grease is inadequate, liberally grease the gear train through the access panel, and through the opening in the rotary gear.*
14. ☐ *Inspect top and bottom brake band linings - replace if necessary. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands. Ensure that all grease is wiped from brake band linings and the parts of the cage plates that come into contact with the brake band linings*
15. ☐ *Re-install access panel. Install a set of pre-inspected jaws that are the correct size for the pipe or casing being run.*
16. ☐ *Install load cell. If using a tension load cell, perform a visual inspection and replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression.*
17. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*
18. ☐ *If applicable, the weld securing the single load cell anchor to the bridge bar main plate must be inspected (compression load cell only). If the integrity of the weld has been compromised, the tong must be removed from service until the weld is repaired. The load cell beam will need to be disconnected and removed so the weld is visible. Before re-installing the beam, liberally grease the anchor pin before reinserting into the load cell beam.*
19. ☐ *Re-energize power unit.*

20. ☐ *Perform a full functional test of the equipment including, if applicable, backup components and float frame components. Report and correct any hydraulic leaks from the hydraulic valve bank, or from any hydraulic cylinders that are used.*

21. ☐ *If using a frame-mounted tong and backup system, raise the tong off the beams that it is resting upon. Remove the beams and protective cloths - inspect the paint on top of the backup and the bottom of the tong to ensure it has not been damaged by the beam.*

22. ☐ *Test safety door feature (if equipped). Open the tong door(s), and attempt to rotate the cage plate at low speed (low gear) in both directions (makeup and breakout). If cage plate begins rotating, the safety door mechanism is not functional, and the tong must be removed from service until the safety door mechanism can be repaired. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

***NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR***

23. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved.*

24. ☐ *When all of the previous steps are completed, you may return your re-commissioned equipment to service.*

*Adequate maintenance and proper fluid selection is essential for minimizing hydraulic-related failures. All troubleshooting must be performed by a technician trained in hydraulic systems, and familiar with the equipment design, assembly and operation.*

*The following troubleshooting instructions are intended to be guidelines only. Any faults not solved through the use of this guide should be referred to our engineering department for their evaluation and recommendations.*

### A. TONG WILL NOT DEVELOP SUFFICIENT TORQUE

| | POSSIBLE PROBLEM | SOLUTION(S) |
|---|---|---|
| 1 | Malfunctioning relief valve on tong hydraulic circuit | See Section 4.B, Relief Valve Troubleshooting |
| 2 | Directional valve is leaking | Check directional valve. Neutral position should return fluid directly to the reservoir. Replace or repair valve to ensure correct operation |
| 3 | Power unit is not producing adequate pressure | Troubleshoot power unit (see user's manual for your particular unit) |
| 4 | Poor hydraulic pressure at the tong despite adequate pressure at the power unit, or excessive back pressure in the return line. | Restrictions exist in line between power unit and tong. Inspect integrity of self-sealing couplings to ensure they are allowing full fluid flow. Check to ensure no other restrictions exist (contaminated catch screens or filters, for example) |
| 5 | Fluid viscosity is not appropriate (too high or too low) | Ensure hydraulic fluid being used is the viscosity recommended by McCoy Drilling & Completions. Power unit pump may not prime if fluid is too heavy, and the hydraulic system will overheat if fluid is too light. Replace with proper viscosity fluid |
| | | Hydraulic fluid viscosity is affected by environmental conditions. Ensure the fluid being used is suitable for high or low temperatures. Replace with proper viscosity fluid for the operating conditions if necessary |
| 6 | Worn or damaged tong motor causing slippage | Replace or repair worn or damaged motor |
| 7 | Damaged bearings or gears causing excessive drag | Replace or repair worn or damaged gears or bearings |
| 8 | Jaws slipping on pipe | Ensure jaw dies are not worn to the point that they cannot grip. Ensure the correct sized jaws are in use |
| 9 | Torque gauge is indicating incorrectly | Incorrect gauge is being used. Ensure gauge is the proper range, and has been properly calibrated for the arm length of the equipment in use |
| | | Gauge has been damaged. Check gauge operation and calibration on independent system |
| | | Gauge has mistakenly been married to an incorrect load cell |
| 10 | Load cell is measuring incorrectly | Incorrect load cell is being used |
| | | Air is trapped in torque measuring circuit (load cell, hydraulic line, or gauge. Refer to torque measurement troubleshooting in Section 6 of this manual |
| | | Load cell has been damaged. Replace load cell, or return to McCoy for repair and re-calibration |

***MCCOY DRILLING & COMPLETIONS GUARANTEES CALIBRATION OF A LOAD CELL/TORQUE GAUGE ASSEMBLY FOR A PERIOD OF ONE YEAR. MCCOY SUGGESTS THAT THE LOAD CELL/TORQUE GAUGE ASSEMBLY BE RETURNED TO THE FACTORY FOR RE-CALIBRATION ON A YEARLY BASIS.***

| | POSSIBLE PROBLEM | SOLUTION(S) |
|---|---|---|
| 11 | Incorrect motor speed selected (applies to 2-speed motors only) | Maximum torque can only be developed when LOW motor speed (maximum hydraulic displacement) is selected. |
| 12 | Incorrect tong gear selected | Maximum torque can only be developed when LOW motor gear is selected |

**B. RELIEF VALVE IS INCORRECTLY SET OR NOT FUNCTIONING**

| | POSSIBLE PROBLEM | SOLUTION(S) |
|---|---|---|
| 1 | Relief pressure set too low, resulting in insufficient tong torque | Adjust setting (See following procedure): |
| | Relief pressure set too high, resulting in crushed pipe or gear train failure | |

a. If your tong is equipped with a system pressure indicator proceed to step "f". If your tong does not have a system pressure indicator, a temporary 0 - 3000 PSI indicator must be installed on the hydraulic inlet.

b. Isolate your tong from hydraulic power, and depressurize following the procedure in section 3.D.

c. Tee in a temporary indicator at the safety door supply pressure port. Ensure all hydraulic connections are performed by a qualified hydraulic technician.

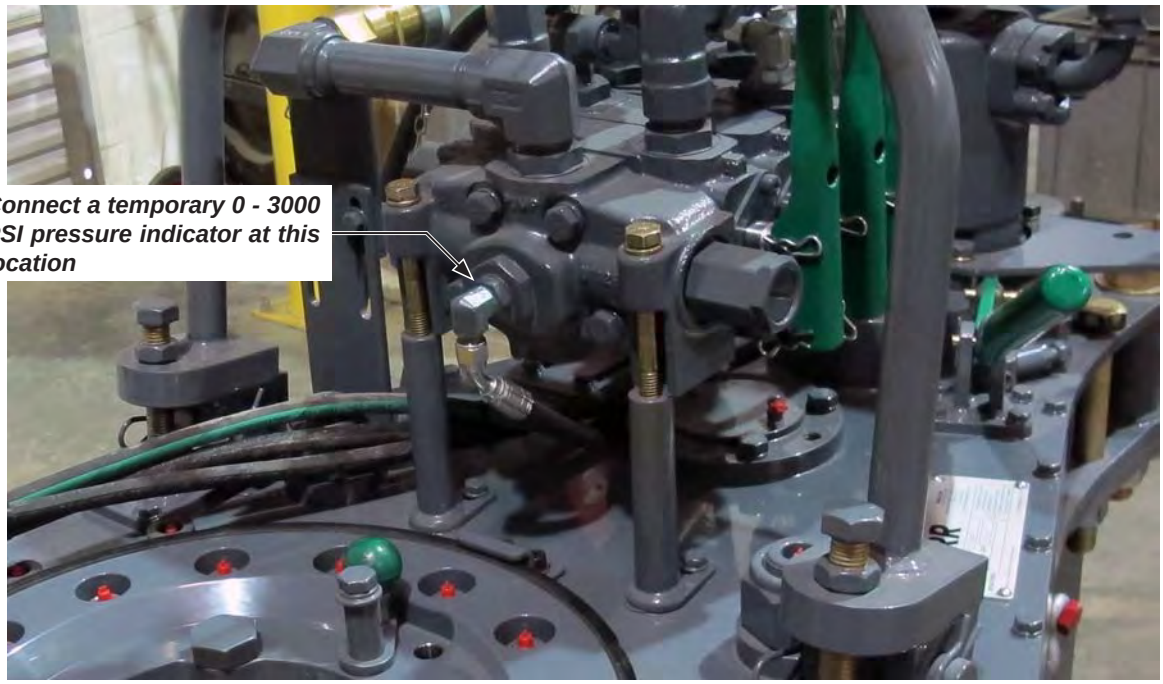



ILLUSTRATION 4.B.1: RELIEF VALVE TROUBLESHOOTING - TEMPORARY GAUGE INSTALLATION

d. Re-establish hydraulic power to your tong. Ensure that no equipment functions are active.

e. Loosen the locking nut on the pressure relief valve.

f. Open the tong door to activate the safety door system and inhibit tong rotation.

g. Activate motor control valve. Observe the pressure displayed on the pressure indicator. Adjust the relief valve until the pressure indicated is at the maximum system pressure specified on the specifications page (maximum system pressure is the pressure at which your tong achieves its specified torque).

**DO NOT ADJUST PRESSURE RELIEF TO A SETTING THAT ALLOWS HIGHER THAN MAXIMUM SYSTEM PRESSURE. DOING SO CREATES A POTENTIAL FOR SERIOUS INJURY OR DEATH, AND MAY CAUSE CATASTROPHIC EQUIPMENT FAILURE.**

h. Release the motor control valve and tighten the locking nut on the pressure relief valve.

i. Isolate your tong from hydraulic power, and depressurize following the procedure in section 3.D.

j. Close the tong door, and remove the temporary pressure indicator. Restore the safety door pressure supply line to factory specifications. Verify that safety door is operating correctly (see section 2.I.5.k).

**Continued on next page**

***RELIEF VALVE IS INCORRECTLY SET OR NOT FUNCTIONING Cont'd:***

| | POSSIBLE PROBLEM | SOLUTION(S) |
|---|---|---|
| 2 | Relief cannot be adjusted to maximum system pressure (high fluid bypass results in low system pressure | Debris on valve seat |
| | | Valve spring is broken |
| | | Valve spring has lost spring force due to continuous tension |

***PROCEDURE:***

a. Isolate your tong from hydraulic power, and depressurize following the procedure in section 3.D

b. Loosen the locking nut on the pressure relief valve.

c. Use a large flat-head screwdriver to completely un-thread the poppet and spring from the relief assembly.

d. Inspect the relief valve spring, poppet, and valve seat.

e. If no debris is found in relief valve and if seat and poppet are undamaged, replace relief valve spring.

f. Reassemble relief valve.

g. Relief valve must be re-set to allow maximum system pressure. Follow the procedure in Step 1 of this section to properly adjust relief valve.

h. If maximum system pressure still cannot be reached, replace the entire relief valve assembly.

### C. SAFETY DOOR DOES NOT OPERATE OR IS MALFUNCTIONING

| | POSSIBLE PROBLEM | SOLUTION(S) |
|---|---|---|
| 1 | Safety door switch requires adjustment. | Adjust switch as per section 3.F.5 |
| 2 | Safety door switch has failed | Test safety door switch for proper function and replace if necessary |
| 3 | Contamination in hydraulic lines | Ensure all three flexible hydraulic lines to safety door switch are free-flowing |
| 4 | Pilot-to-open valve in safety door valve block is malfunctioning. | Remove each valve. Inspect seats and springs. Replace valve(s) if damage is seen on valve seats, or if spring appears to be damaged or broken. |

### D. TONG RUNNING TOO SLOWLY

| | POSSIBLE PROBLEM | SOLUTION(S) |
|---|---|---|
| 1 | Obstruction in tong hydraulic circuit preventing adequate flow | Inspect self-sealing couplings to ensure they are properly engaged |
| | | The main hydraulic lines (supply and discharge) to the tong are obstructed. Remove and clean if required |
| 2 | Power unit is not producing adequate flow or pressure | Troubleshoot power unit (see user's manual for your particular unit) |
| 3 | Tong motor is excessively worn and is leaking hydraulic fluid past the vanes | Replace motor, or rebuild as per Section 7 of this manual |
| 4 | Bearings in gear train and rotary section are excessively worn | Overhaul tong. See Section 3 of this manual for tong overhaul procedures |
| 5 | Shifter has malfunctioned and the tong is not shifting to high gear | Inspect and repair shift mechanism as necessary |
| 6 | Hydraulic fluid viscosity too high | Ensure hydraulic fluid meets McCoy Drilling & Completions specifications |
| | | Ensure hydraulic fluid is appropriate for climatic conditions, especially during cold-weather operation |
| 7 | By-pass valve not functioning | Check and repair |

### E. FAILURE OF JAWS TO GRIP PIPE

| | POSSIBLE PROBLEM | SOLUTION(S) |
|---|---|---|
| 1 | Dies have become too dull to provide adequate grip | Replace dies |
| 2 | Incorrect jaws are being used | Double-check jaw size to ensure they are rated for the diameter of pipe or casing being run |
| 3 | Incorrect dies are being used | Ensure dies loaded in the jaws are appropriate for the type of pipe or casing being run |
| 4 | Brake band(s) is (are) insufficiently adjusted, not allowing jaws to cam properly | Adjust brake bands to give proper resistance to cage plates |
| 5 | Jaw roller broken or worn | Remove jaw assembly and inspect. Replace rollers that are visibly "flat-spotted" or otherwise damaged |

### F. FAILURE OR DIFFICULTY OF TONG TO SHIFT

| | POSSIBLE PROBLEM | SOLUTION(S) |
|---|---|---|
| 1 | Bent or broken shifter handle | Replace shifter handle |
| 2 | Bent or broken shifter yoke | Inspect components through inspection door. Replace shifter yoke if necessary. |
| 3 | Bent or broken shifter shaft | Replace |
| 4 | Locking nuts on shifting shaft have loosened and position of yoke has changed | Reposition yoke and re-tighten locking nuts |
| 5 | Shifting yoke has come loose from shifting shaft | Inspect yoke and inspect for damage. If free of damage, replace on shaft and tighten locking nuts |
| 6 | Tong pops out of gear | Adjust shifter detent force (See Pg. 3.8) |
| 7 | "Frozen" or hard to move shifter handle | Lubricate shifting shaft. May require shifter shaft removal and cleaning of varnish or other deposits on the shaft. |

### G. GENERAL COMMENTS

*The following factors generally contribute to poor hydraulic operation and premature wear of equipment:*

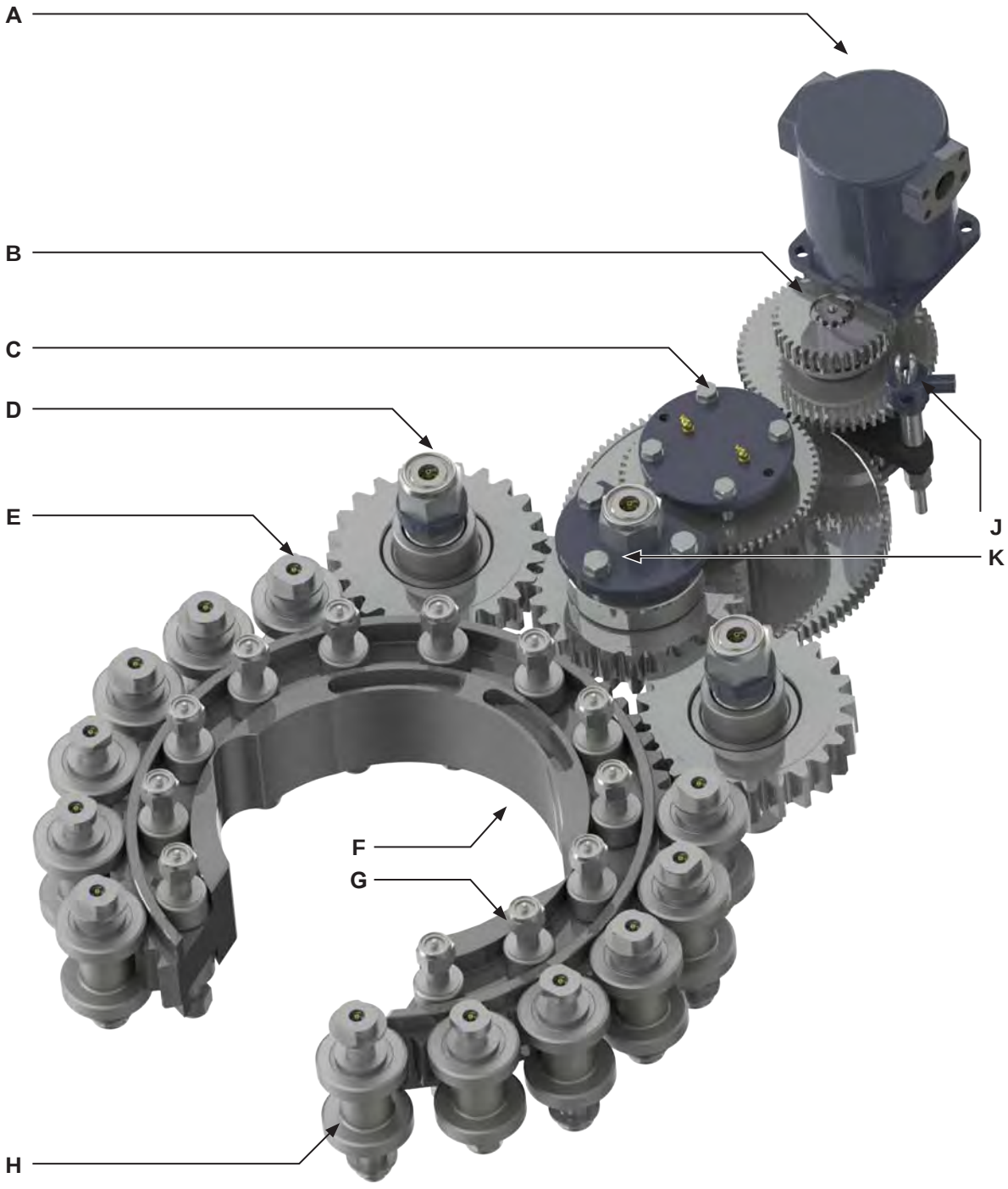
1. *Contaminated hydraulic fluid due to overuse, overheating, or inadequate fluid filtration.*
2. *Unsuitable hydraulic fluid, especially in extreme climatic conditions.*
3. *Defective packing or seals in components of the hydraulic system.*
4. *Poor or incomplete hydraulic system training. Users must be fully qualified to operate the equipment, and have complete understanding of the hydraulic system.*

*If your hydraulic troubleshooting procedures involve flow and pressure tests at the power unit, McCoy Drilling & Completions recommends construction of a test rig that can easily be connected to the main suction and discharge ports of the power unit.*

# HD8625 8-5/8" 35K Tong



# Parts and Assemblies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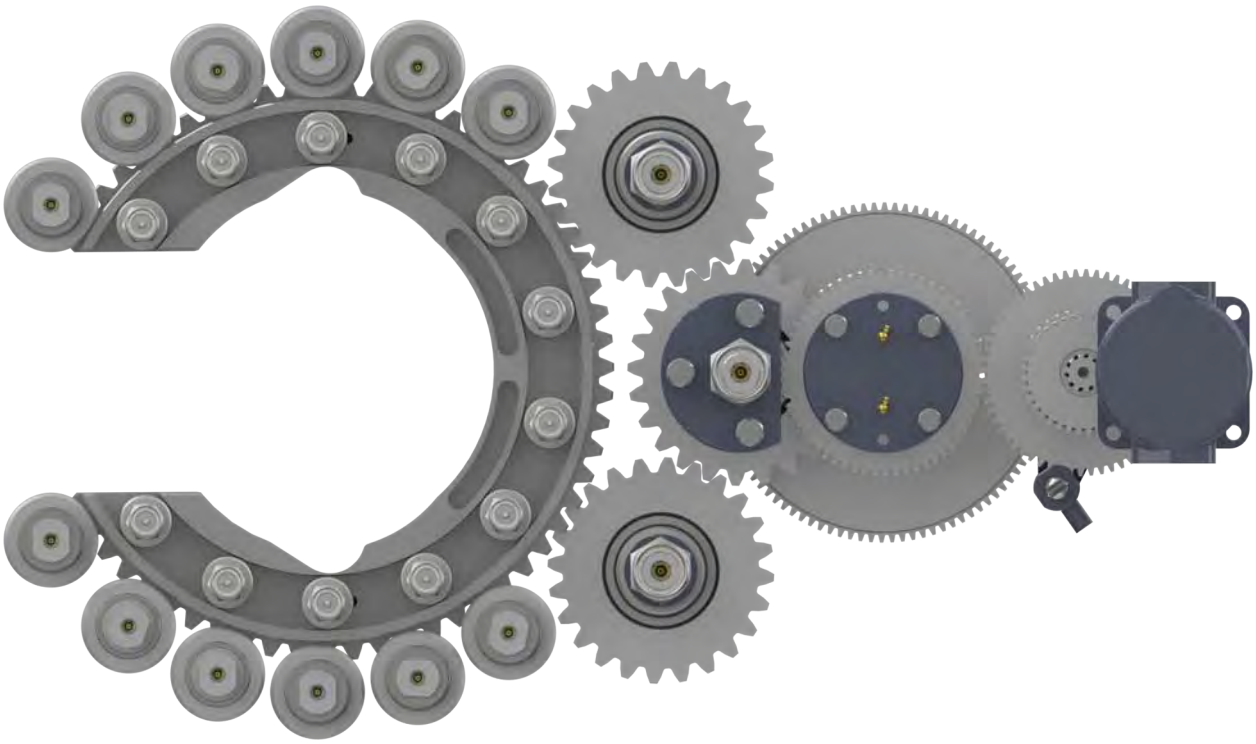
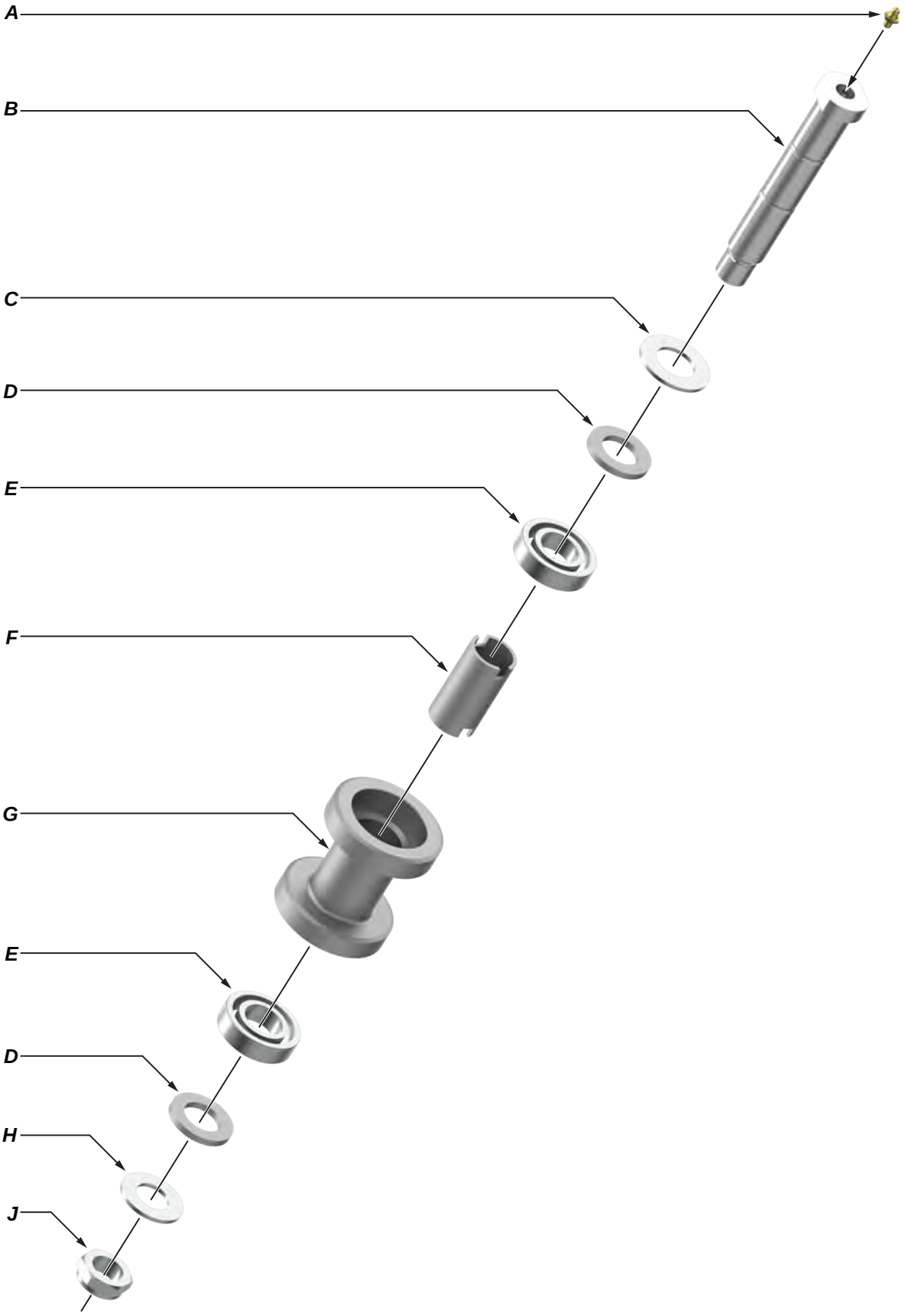
| ITEM | TYPE | DESCRIPTION | QTY | PART NUMBER |
|---|---|---|---|---|
| A | Part | Hydraulic Motor | 1 | 87-0007 |
| B | Assembly | Clutch Assembly (See Pp. 5.14 - 5.15) | 1 | |
| C | Assembly | Pinion Assembly (See Pp. 5.12 - 5.13) | 1 | |
| D | Assembly | Rotary Idler Assembly (See Pp. 5.8 - 5.9) | 2 | |
| E | Assembly | Support Roller Assembly (See Pp. 5.4 - 5.5) | 11 | |
| F | Part | Rotary Gear | 1 | 1172-D1-HT |
| G | Assembly | Cam Follower Assembly (See Pp. 5.18 - 5.19) | 24 | |
| H | Assembly | Door Pivot Roller Assembly (See Pp. 5.6 - 5.7) | 1 | |
| J | Assembly | Shifter Assembly (See Pp. 5.16 - 5.17) | 1 | |
| K | Assembly | Pinion Idler Assembly (See Pp. 5.10 - 5.11) | 1 | |
| L | Part | Motor Gear | 1 | 997-A10-149 |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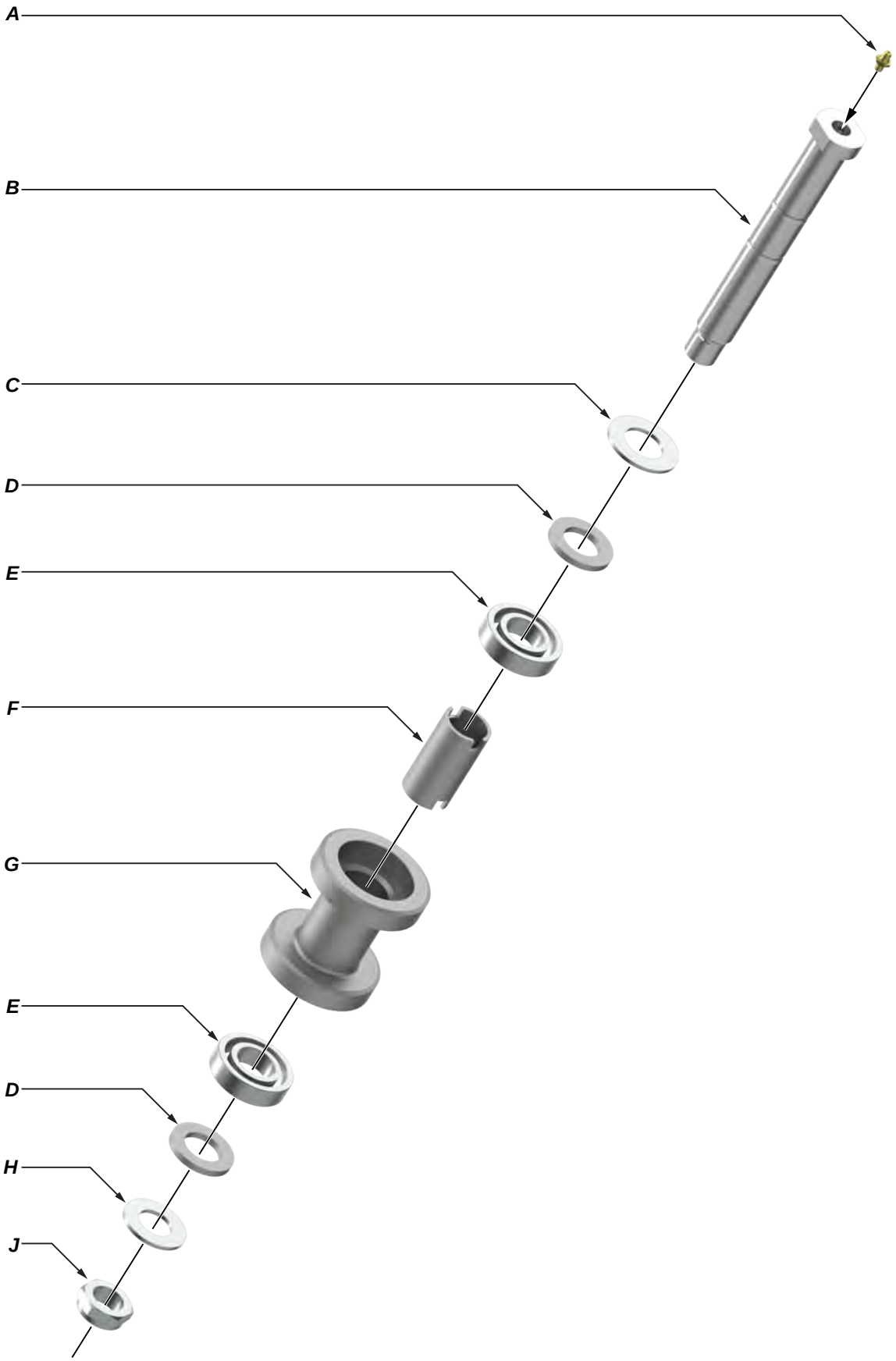
| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | 1/4" Straight Thread Grease Fitting | 1 | 02-0097 |
| B | Part | Support Roller Shaft | 1 | 101-3939 |
| C | Part | 1-1/8" Narrow Flat Washer (1) | 1 | 02-0471 |
| D | Part | Support Roller Spacer | 2 | 101-3871 |
| E | Part | Bearing | 2 | 02-0094 |
| F | Part | Support Roller Internal Spacer | 1 | 1037-C-134 |
| G | Part | Support Roller | 1 | 1037-135 |
| H | Part | 1" Narrow Washer (1) | 1 | 09-5120 |
| J | Part | 1" UNS Thin Nylock Nut | 1 | 09-9167 |

(1) Where support rollers are coincidental with brake band lug weldments upper and lower washers are not used. Where support rollers are coincidental with leg mount weldments lower washers are not used.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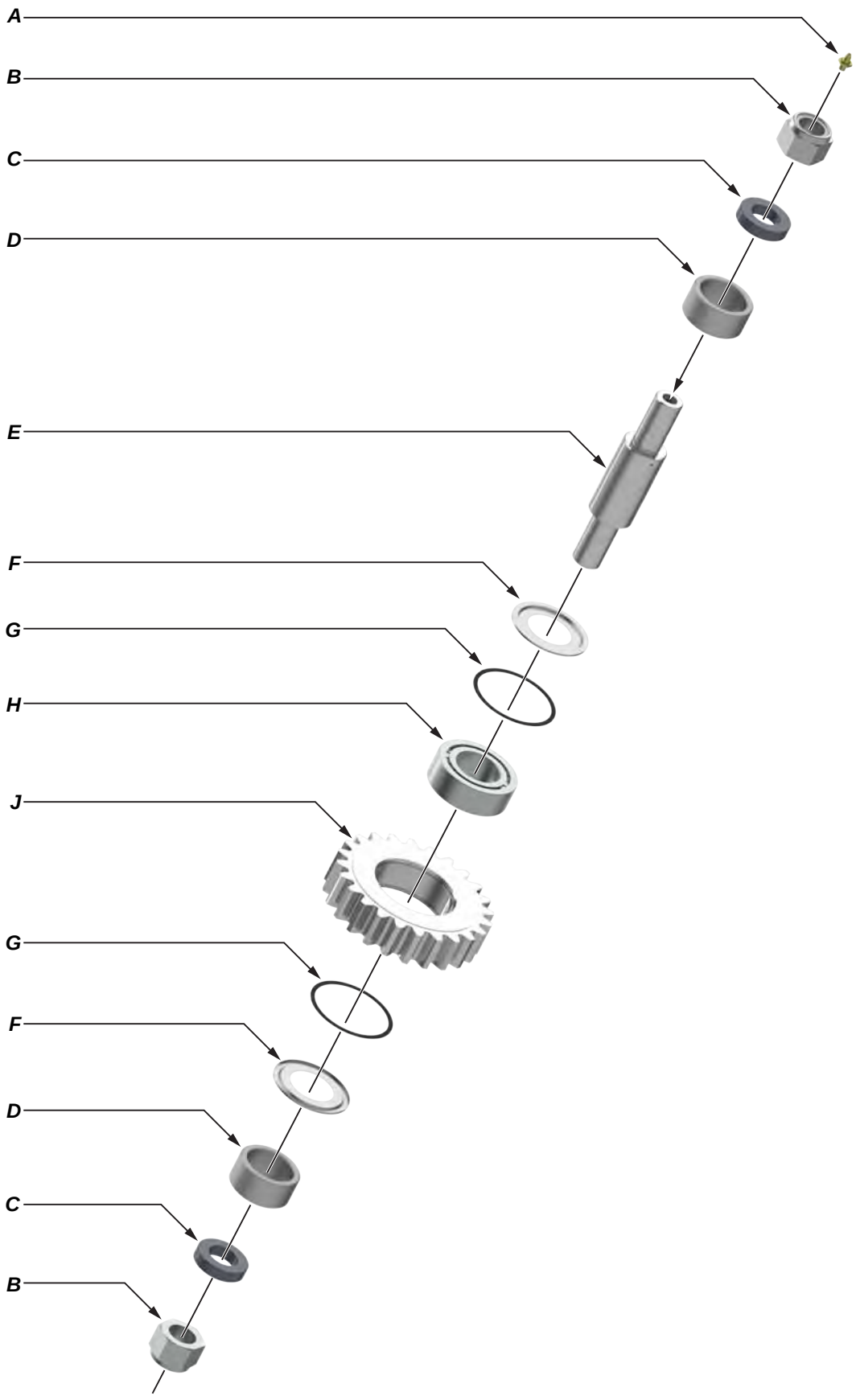
| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | 1/4" Straight Thread Grease Fitting | 1 | 02-0097 |
| B | Part | Door Pivot Roller Shaft | 1 | 101-3939 |
| C | Part | 1-1/8" Narrow Flat Washer | 1 | 02-0471 |
| D | Part | Support Roller Spacer | 2 | 101-3871 |
| E | Part | Bearing | 2 | 02-0094 |
| F | Part | Support Roller Internal Spacer | 1 | 1037-C-134 |
| G | Part | Support Roller | 1 | 1037-135 |
| H | Part | 1" Narrow Washer | 1 | 09-5120 |
| J | Part | 1" UNS Thin Nylock Nut | 1 | 09-9167 |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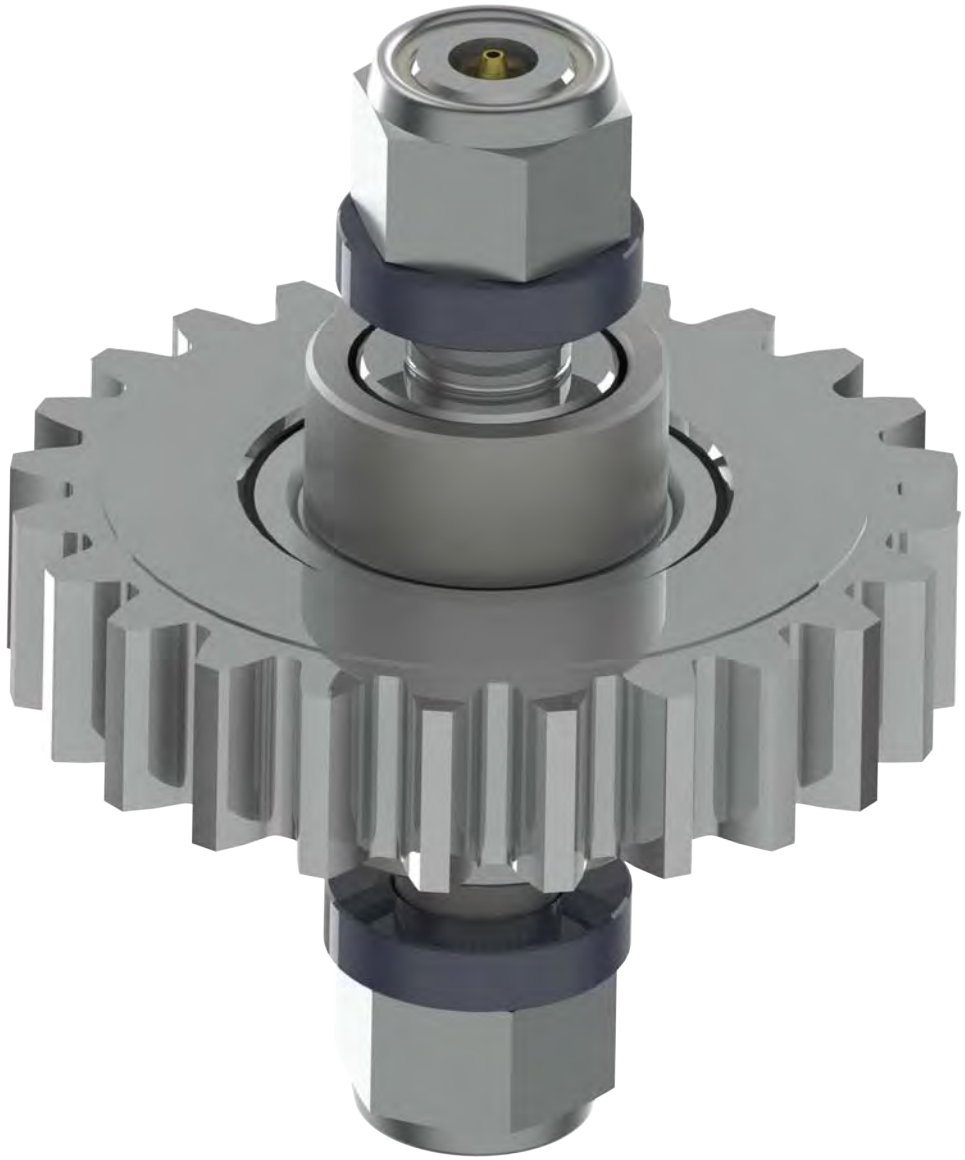
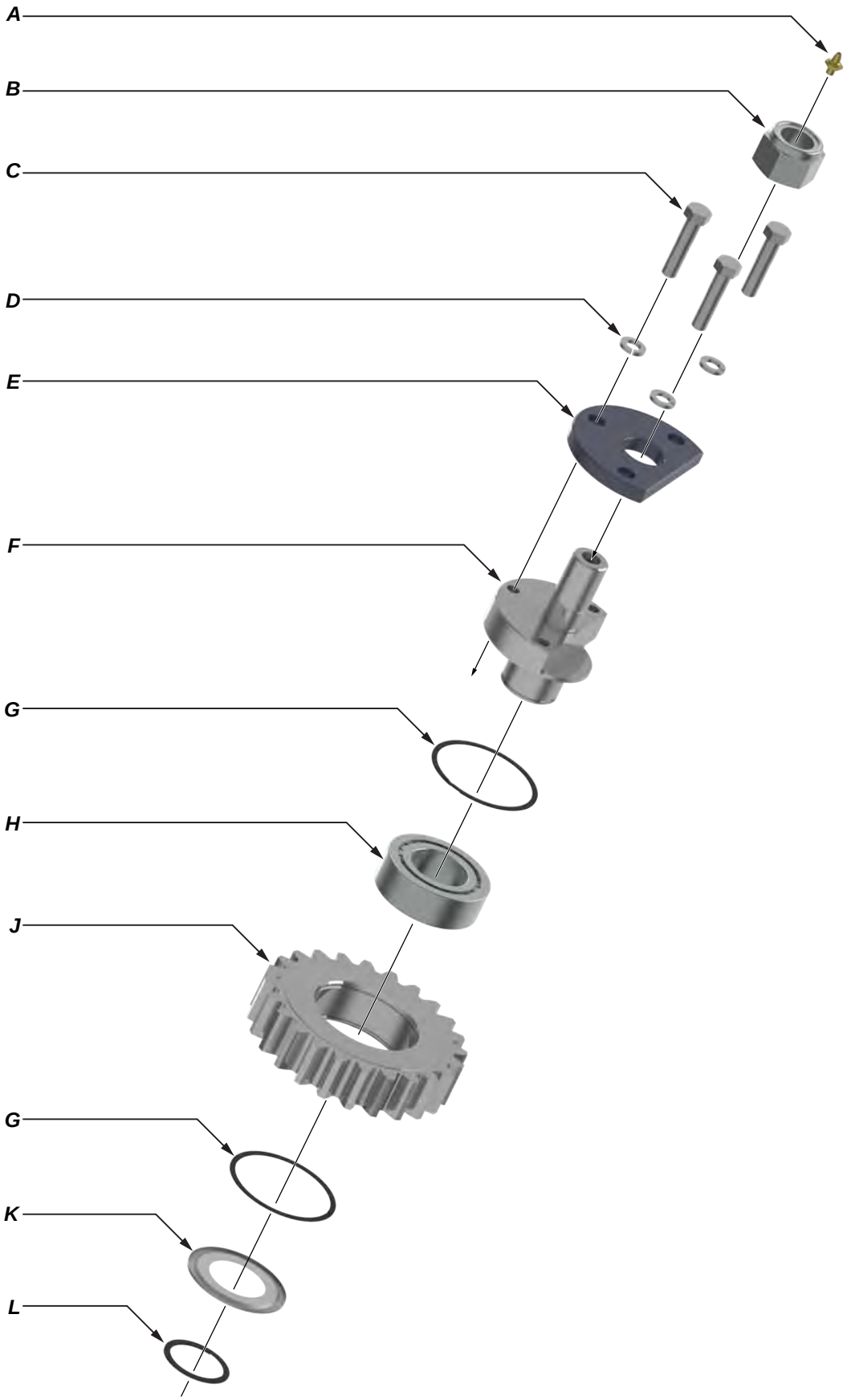


| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | 1/8" NPT Grease Fitting | 1 | 02-0005 |
| B | Part | 1-1/4" UNF Hex Nylock Nut | 2 | 09-5740 |
| C | Part | Idler Pad | 2 | 997-D20-125 |
| D | Part | Rotary Idler Spacer | 2 | 1050-D5-121 |
| E | Part | Rotary Idler Shaft | 1 | 1050-D5-117 |
| F | Part | Bearing Seal | 2 | 02-0010 |
| G | Part | Retaining Ring | 2 | 02-0009 |
| H | Part | Bearing | 1 | 02-0075 |
| J | Part | Rotary Idler Gear | 1 | 997-A2-119C |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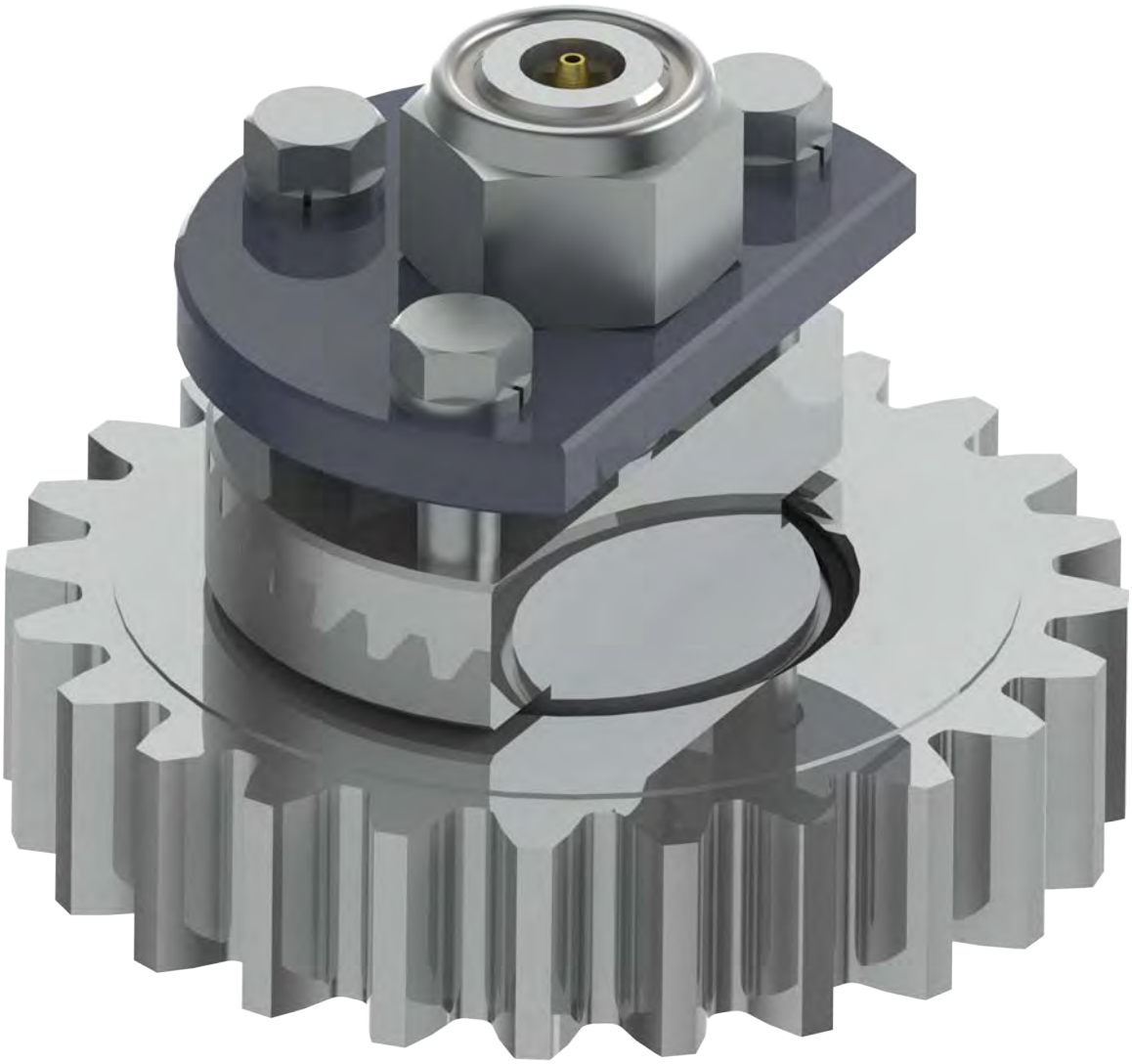
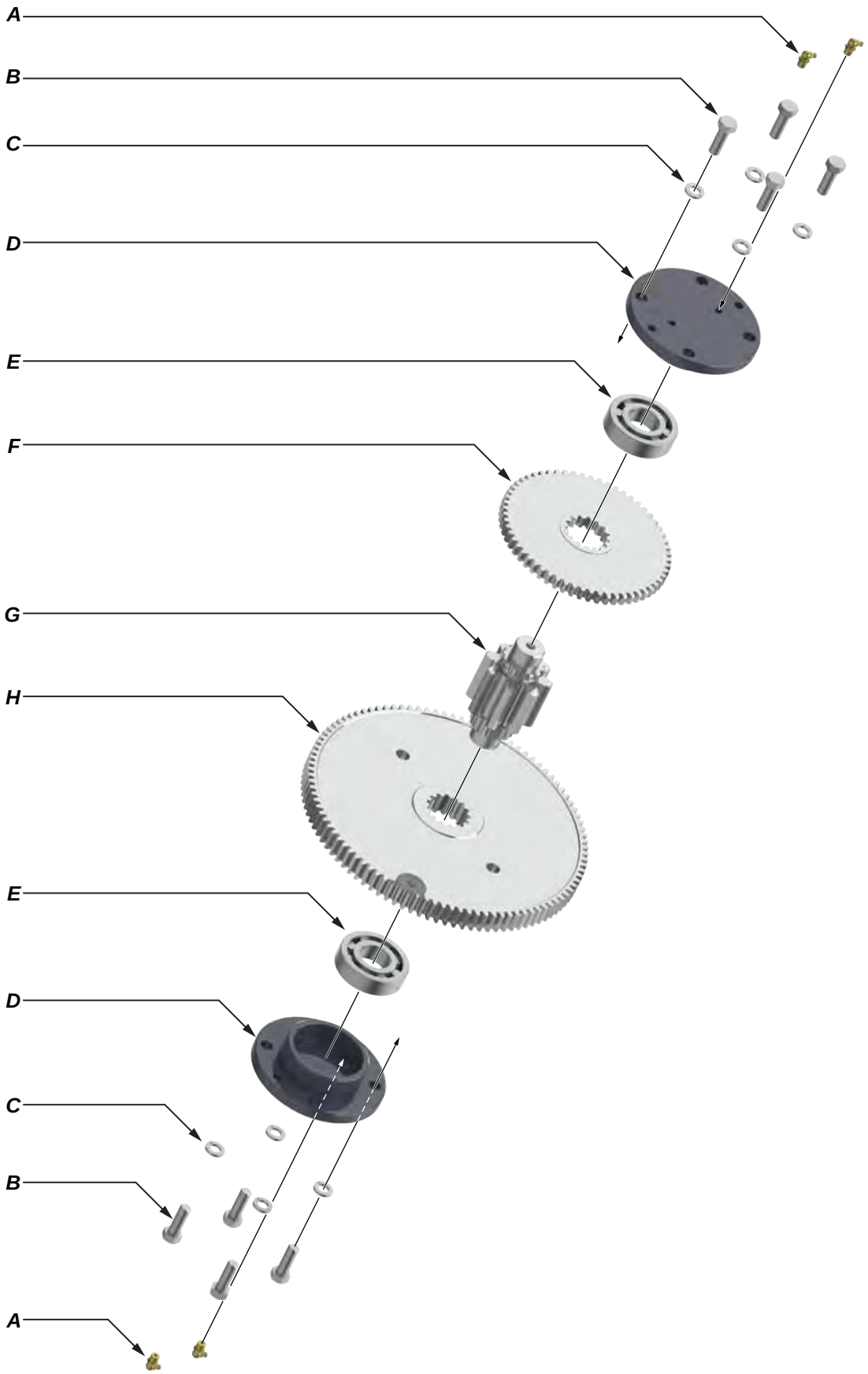


| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | Grease Fitting, 1/8" NPT | 1 | 02-0005 |
| B | Part | 1-1/2" UNF Hex Nylock Nut | 1 | 09-5740 |
| C | Part | 5/8" UNC x 2" Hex Bolt | 3 | 09-1234 |
| D | Part | 5/8" Lock Washer | 3 | 09-5114 |
| E | Part | Idler Pad | 1 | 997-D17-109 |
| F | Part | Pinion Idler Half Shaft | 1 | 1050-D5-105 |
| G | Part | Retaining Ring | 2 | 02-0009 |
| H | Part | Bearing | 1 | 02-0075 |
| J | Part | Pinion Idler Gear | 1 | 997-A2-119C |
| K | Part | Bearing Seal | 1 | 02-0010 |
| L | Part | Bearing Retainer | 1 | 02-0008 |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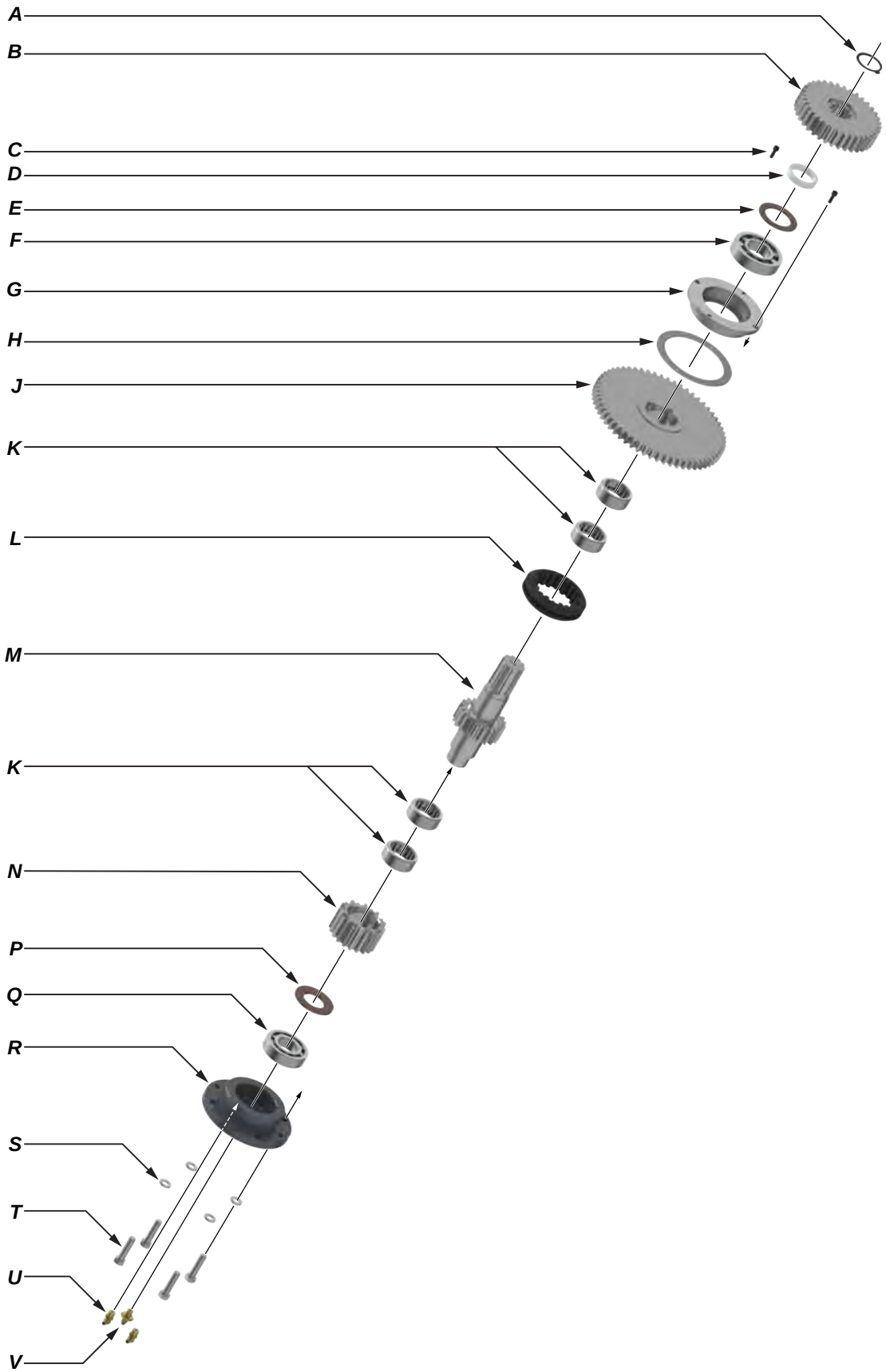
| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | 1/8" NPT 90 DEG Grease Fitting | 4 | 02-0093 |
| B | Part | 1/2" NC x 1-1/2" Hex Bolts | 8 | 09-1170 |
| C | Part | 1/2" Lock Washers | 8 | 09-5110 |
| D | Part | Pinion Bearing Cap | 2 | 1050-89 |
| E | Part | Pinion Bearing | 2 | 1234-08-01B |
| F | Part | High Pinion Gear | 1 | 997-A4-87B |
| G | Part | Pinion Gear Shaft | 1 | 997-A7-86B |
| H | Part | Low Pinion Gear | 1 | 997-A5-88 |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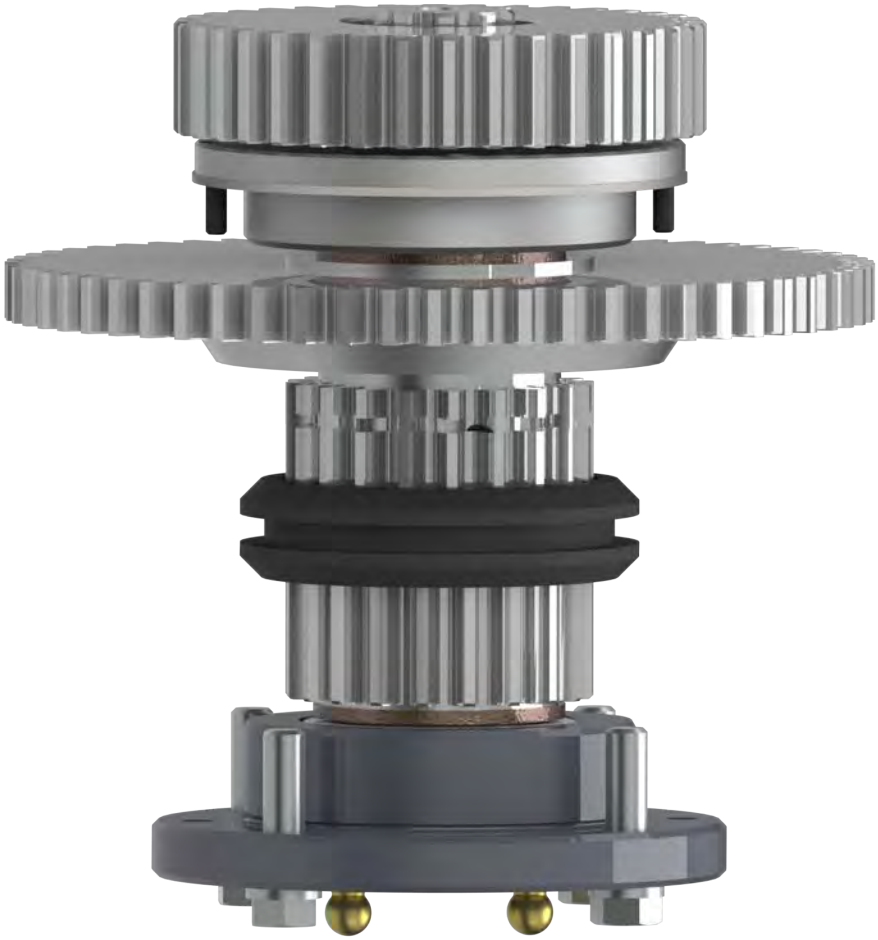
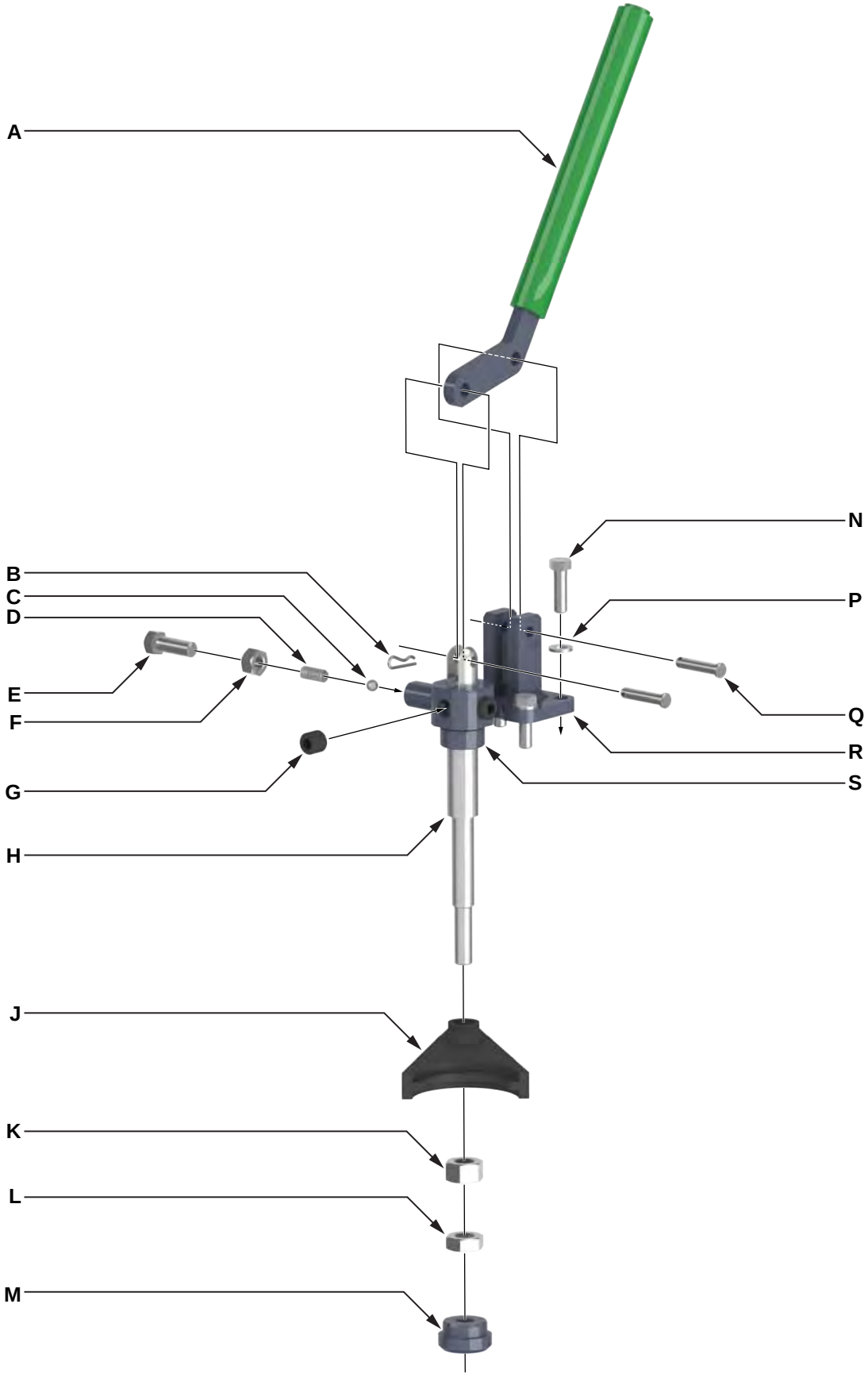


| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | Outside Snap Ring | 1 | 1234-00-04 |
| B | Part | Drive Gear | 1 | 997-HT-61 |
| C | Part | #10-24 x 3/4" Hex SHCS | 2 | 09-0001 |
| D | Part | Top Clutch Bearing Spacer | 1 | 997-HT-60 |
| E | Part | Top Clutch Spacer | 1 | 101-3599 |
| F | Part | Top Clutch Bearing | 1 | 02-1403 |
| G | Part | Top Bearing Retainer | 1 | 997-HT-59 |
| H | Part | Bearing Retainer Spacer | 1 | 101-5312 |
| J | Part | High Clutch Gear | 1 | 997-HT-51B |
| K | Part | Needle Roller Bearing | 4 | 02-1404 |
| L | Part | Shifting Collar | 1 | 997-HT-62 |
| M | Part | Splined Clutch Shaft | 1 | 997-HT-50 |
| N | Part | Low Clutch Gear | 1 | 997-HT-52 |
| P | Part | Bottom Clutch Spacer | 1 | 997-99 |
| Q | Part | Bottom Clutch Bearing | 1 | 02-0014 |
| R | Part | Clutch Bearing Cap | 1 | 101-0120 |
| S | Part | 3/8" Lock Washer | 4 | 09-5106 |
| T | Part | 3/8" NC x 1-1/4" Hex Bolt | 4 | 09-1048 |
| U | Part | 1/8" NPT 90 Deg. Grease Fitting | 2 | 02-0093 |
| V | Part | 1/8" NPT Grease Fitting | 1 | 02-0005 |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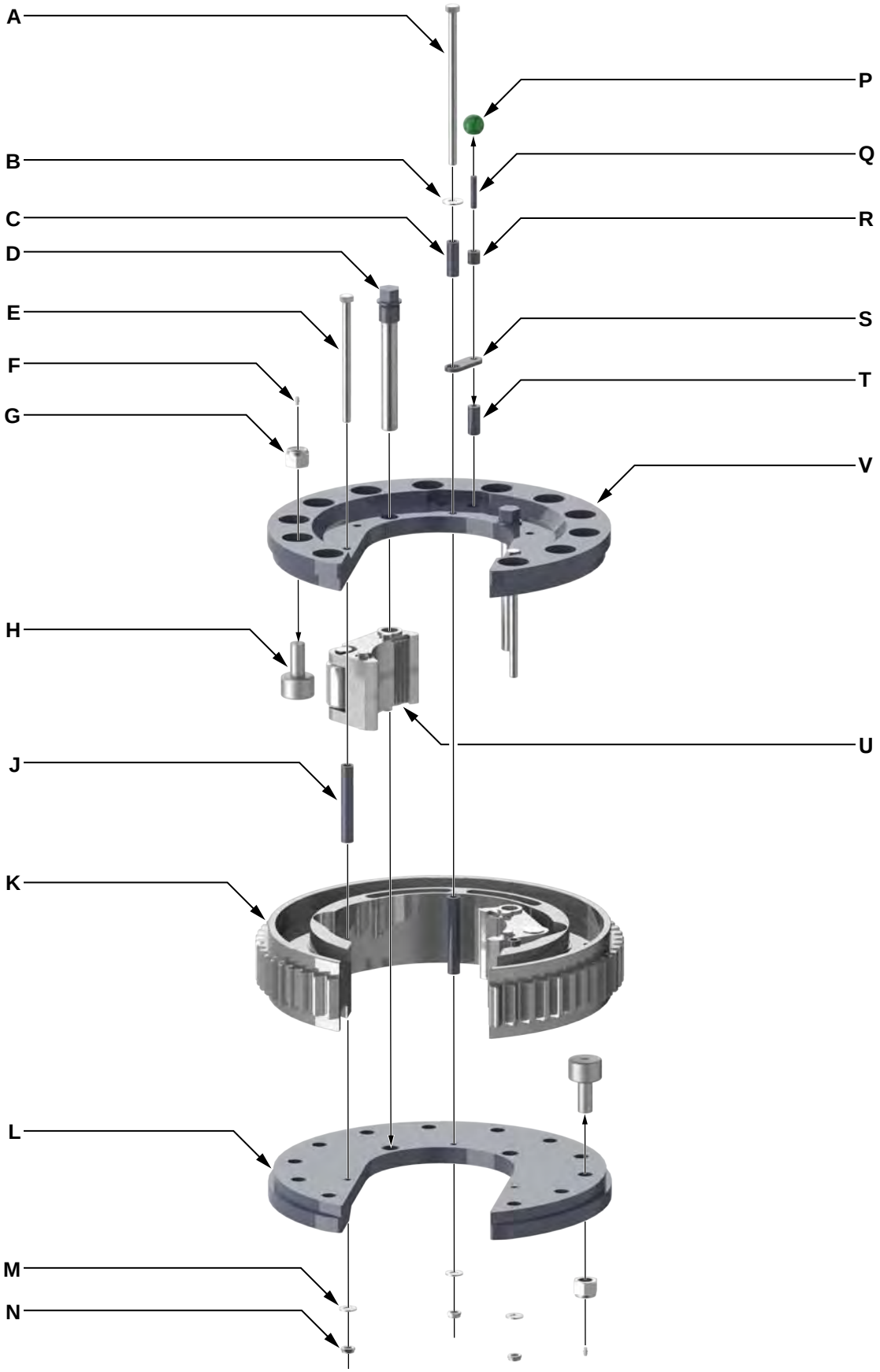
| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Weldment | Shifting Handle Weldment | 1 | 1037-D-20B |
| B | Part | HITCH PIN .0930 X 1.125 | 2 | 02-0274 |
| C | Part | Detent Ball | 1 | 02-0018 |
| D | Part | 7/16" UNF x 1-1/4" Hex Bolt | 1 | 09-1608 |
| E | Part | 7/16" UNF Hex Jam Nut | 1 | 09-5508 |
| F | Part | Detent Spring | 1 | 997-0-64 |
| G | Part | 5/8" UNC x 5/8" Hex Socket Set Screw | 3 | 09-2011 |
| H | Part | Shifting Shaft | 1 | 101-2816 |
| J | Weldment | Shifting Fork Weldment | 1 | 997-HT-72 |
| K | Part | 5/8" UNF Hex Nut | 1 | 09-5914 |
| L | Part | 5/8" UNF Hex Jam Nut | 1 | 09-5915 |
| M | Part | Lower Shifter Bushing (typically welded to bottom plate) | 1 | 1064-B1-95 |
| N | Part | 3/8" UNC x 1" Hex Bolt | 4 | 09-1046 |
| P | Part | 3/8" Lock Washer | 4 | 09-5106 |
| Q | Part | 5/16" x 1-1/2" Clevis Pin | 2 | 09-0256 |
| R | Part | Shifter Lug Weldment (Bolted) | 1 | 101-0016 |
| S | Part | Top Shifter Bushing (threaded) | 1 | 101-0020 |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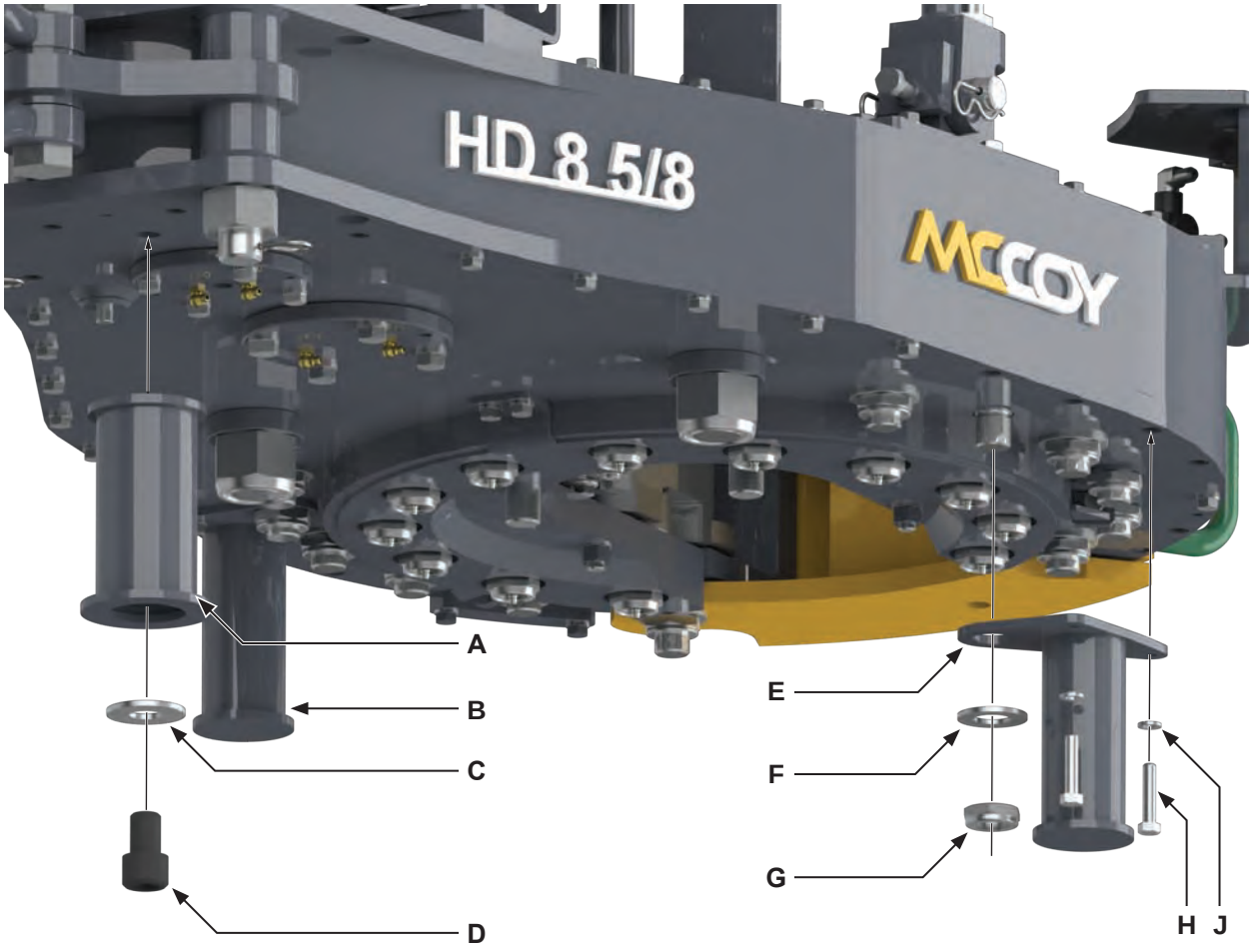
| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | 1/2" UNC x 9-1/2" Hex Bolt | 1 | 09-1203 |
| B | Part | 1/2" Regular Flat Washer | 1 | 09-5010 |
| C | Part | Backing Pin Spacer | 1 | 101-4186 |
| D | Part | Jaw Pivot Bolt | 2 | 1050-C5-28 |
| E | Part | 1/2" UNC x 7-1/2" Hex Bolt | 2 | 09-1196 |
| F | Part | 3/16" Straight Drive-In Grease Fitting | 24 | 02-0012 |
| G | Part | 7/8" Standard Nylock Nut | 24 | 09-9177 |
| H | Part | Cam Follower | 24 | 02-0107 |
| J | Part | Cage Plate Spacer | 3 | 1050-C3-38 |
| K | Part | Rotary Gear | 1 | 1172-D1-HT |
| L | Part | Cage Plate - BOTTOM | 1 | 1050-22HT |
| M | Part | 1/2" Narrow Flat Washer | 3 | 09-5119 |
| N | Part | 1/2" UNC Thin Nylock Nut | 3 | 09-5610S |
| P | Part | Backing Pin Knob | 1 | 02-0017 |
| Q | Part | 3/8" UNF x 2" Threaded Stud | 1 | 101-4097 |
| R | Part | Backing Pin Spacer | 1 | 101-4096 |
| S | Part | Backing Pin Retainer | 1 | 101-4187 |
| T | Part | Backing Pin | 1 | 101-4188 |
| U | Assembly | Jaw Die Kit (5-1/2" shown - see Pg. 2.8) | 2 | |
| V | Part | Cage Plate - TOP | 1 | 1050-21HT |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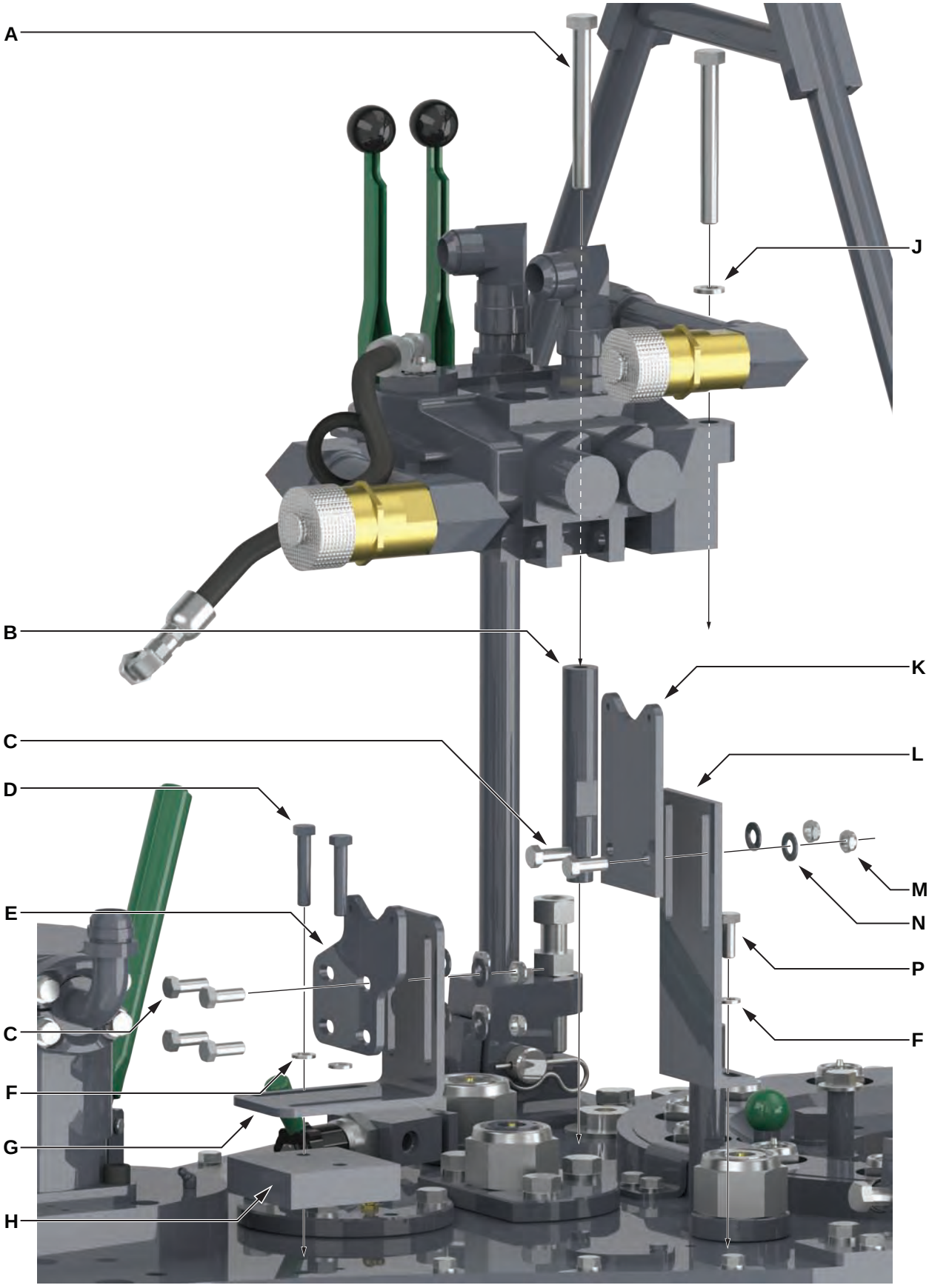
| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Weldment | Rear Leg Weldment | 1 | 997-D8-160A |
| B | Weldment | LH Leg Weldment | 1 | 101-0162 |
| C | Part | Regular 7/8" Flat Washer | 1 | 09-5022 |
| D | Part | 7/8" UNC x 1-1/4" Hex Socket Head Cap Screw | | |
| E | Weldment | RH Leg Weldment | 1 | 101-0163 |
| F | Part | 1" Narrow Washer | 1 | 09-5120 |
| G | Part | 1" UNS Thin Nylock Nut | 1 | 09-9167 |
| H | Part | 3/8" NC x 2" Hex Bolt | 4 | 09-1054 |
| J | Part | 3/8" Carbon Steel Lock Washer | 4 | 09-5106 |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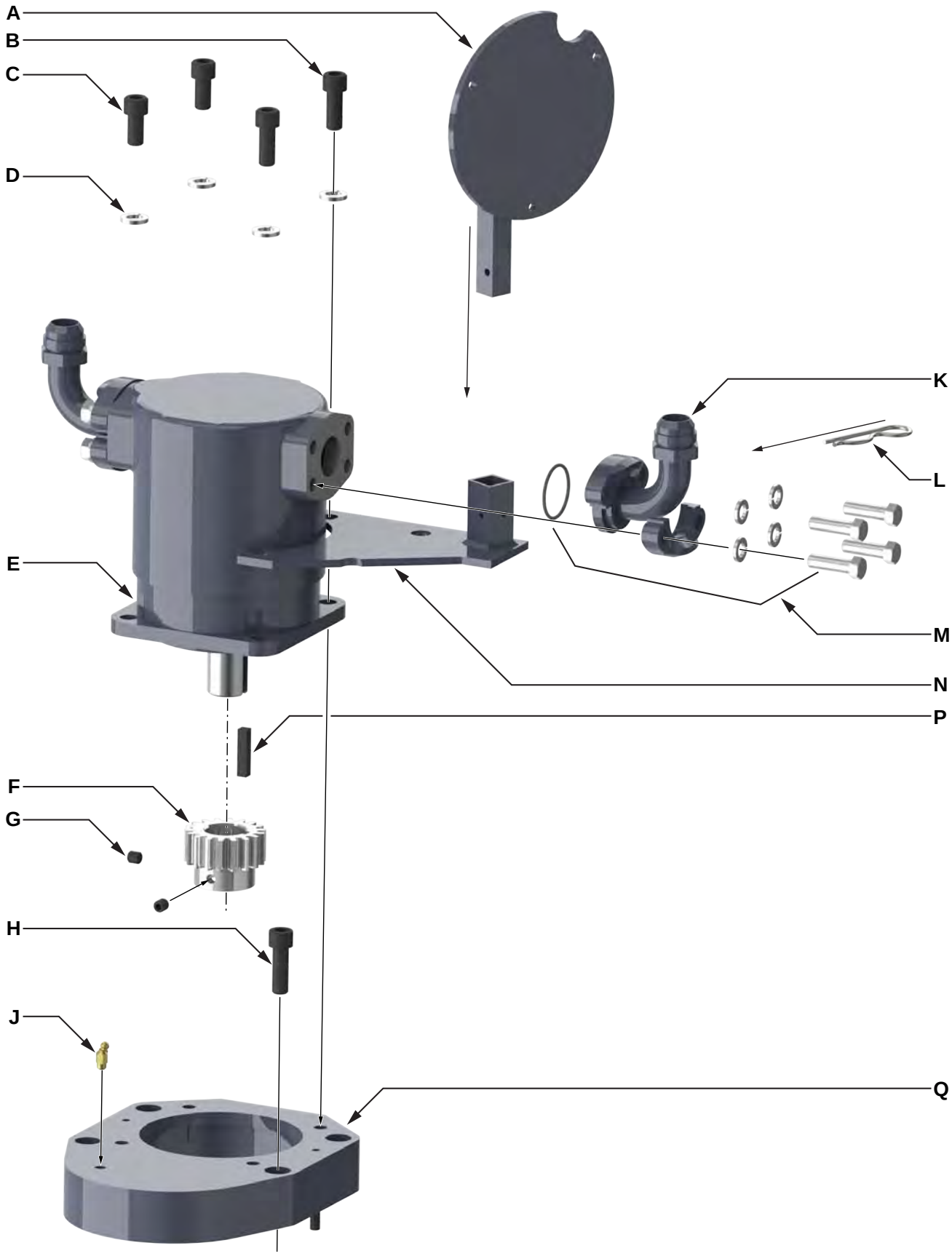
| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | 1/2" UNC x 4-1/2" Hex Bolt | 2 | |
| B | Part | Hydraulic Valve Mount Post | 2 | 101-0116 |
| C | Part | 3/8" NC x 1" Hex Bolt | 6 | 09-1046 |
| D | Part | 3/8" NC x 2" Hex Bolt | 2 | 09- |
| E | Part | Adjustable Plate - Discharge Line Support | 1 | 101-0277 |
| F | Part | 3/8" Carbon Steel Lock Washer | 4 | 09-5106 |
| G | Part | Discharge Line Support Mounting Plate | 1 | 101-0023 |
| H | Part | Discharge Line Support Mounting Base | 1 | 101-0021 |
| J | Part | 1/2" Carbon Steel Lock Washer | 2 | 09- |
| K | Part | Adjustable Plate - Inlet Line Support | 1 | 101-0022 |
| L | Weldment | Inlet Line Support Mounting Base | 1 | 101-1138 |
| M | Part | 3/8" UNC Thin Nylock Nut | 6 | 09- |
| N | Part | 3/8" Narrow Flat Washer | 6 | 09-5124 |
| P | Part | 3/8" NC x 1-1/4" Hex Bolt | 2 | 09-1048 |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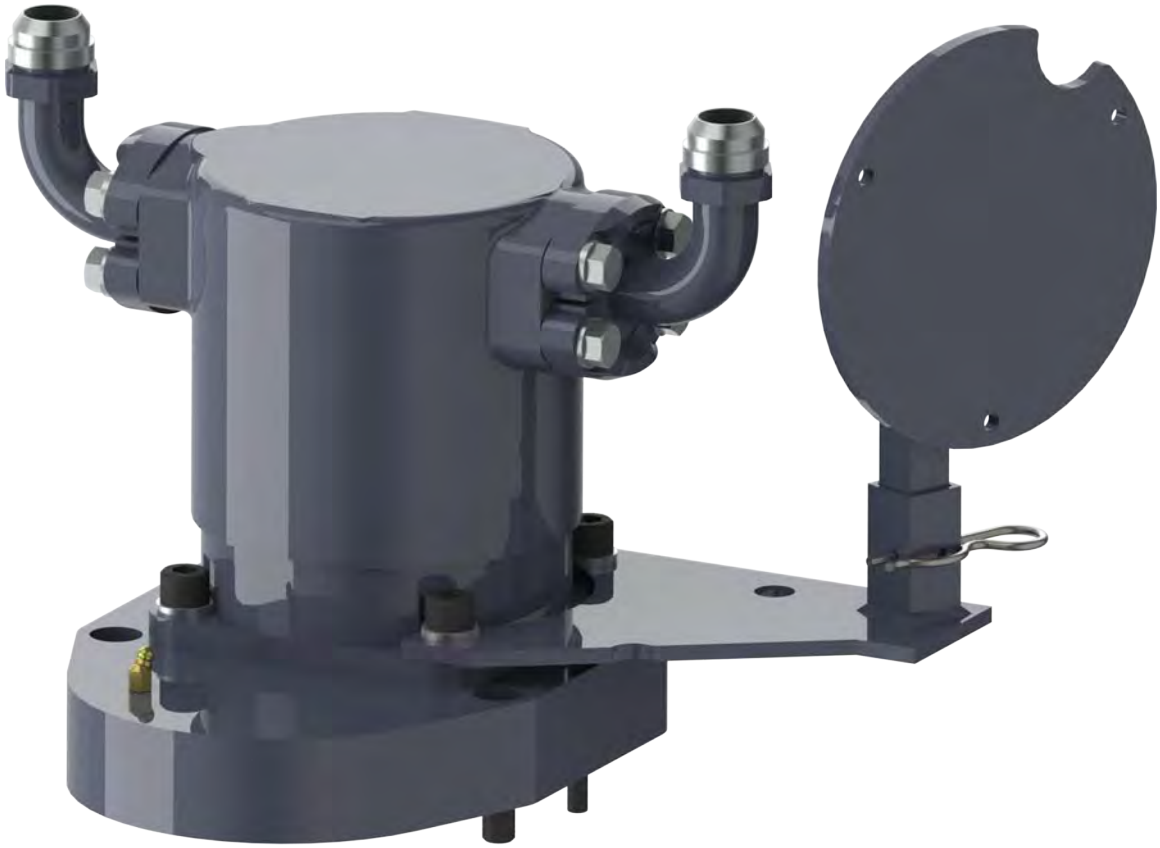
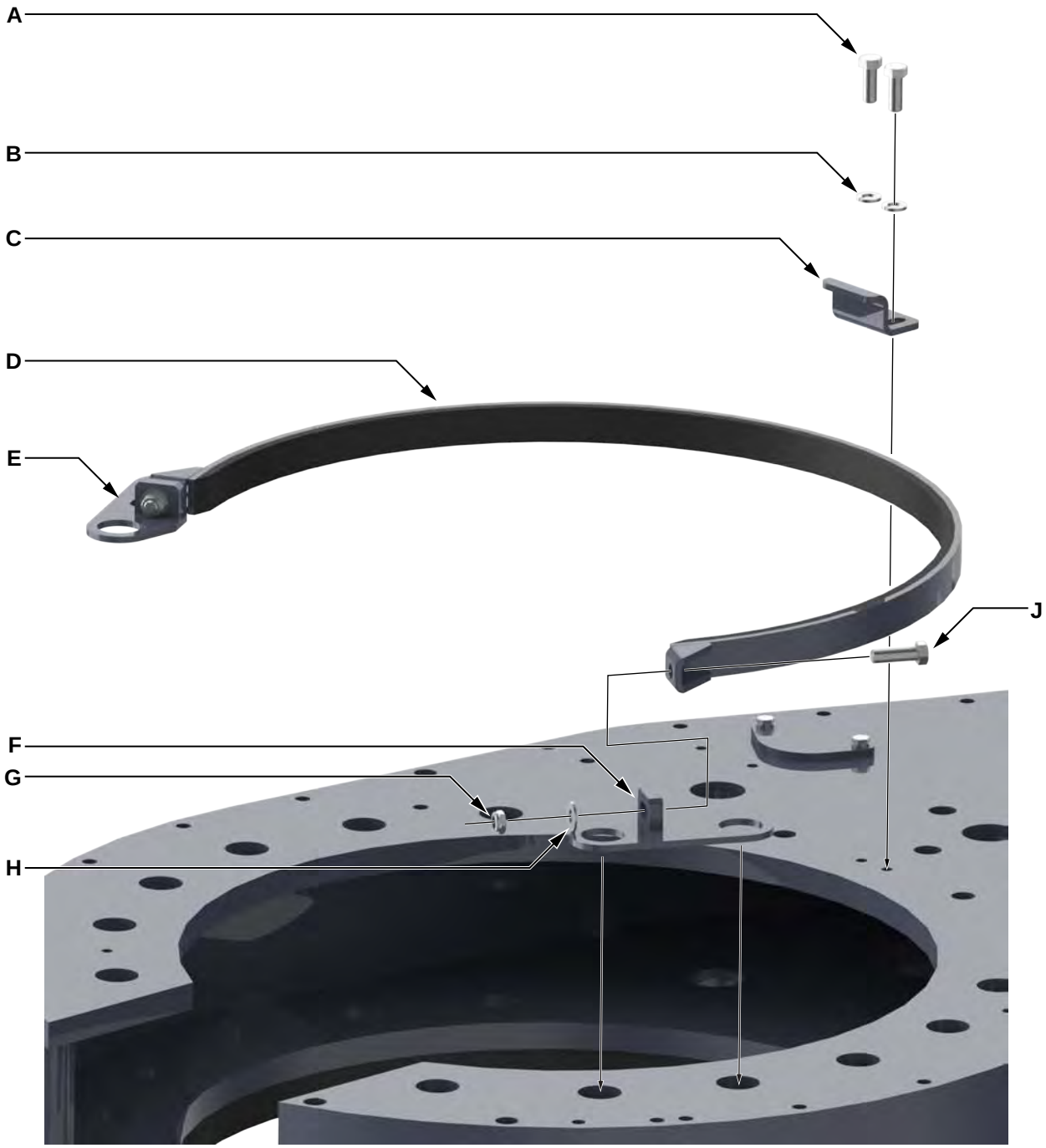


| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Weldment | Torque Gauge Mount Weldment | 1 | 1500-09-03A |
| B | Part | 1/2" NC x 1-1/4" Hex Socket Head Cap Screw | 2 | 09-2168 |
| C | Part | 1/2" NC x 1 Hex Socket Head Cap Screw | 2 | |
| D | Part | 1/2" Lock Washer | 4 | 09-5110 |
| E | Part | Two-Speed Hydraulic Motor | 1 | 87-0007 |
| F | Part | Motor Gear | 1 | 997-A10-149 |
| G | Part | 3/8" NC x 3/8" Hex Socket Set Screw | 2 | 09-0106 |
| H | Part | 1/2" NC x 1-1/2" Hex Socket Head Cap Screw | 4 | 09- |
| J | Part | 1/8" NPT 90 DEG Grease Fitting | 1 | 02-0093 |
| K | Part | #20 (1-1/4")/JIC 1" Flange Elbow | 2 | 02-9216 |
| L | Part | 0.148" x 2.938" Hitch Pin | 1 | |
| M | Part | #20 (1-1/4") Split Flange Kit | 2 | 02-9217 |
| | Part | O-Ring | 1 | |
| | Part | #20 (1-1/4") Split Flange | 2 | |
| | Part | 7/16" Lock Washer | 4 | |
| | Part | 7/16" NC x 1-1/2" Hex Bolt | 4 | |
| N | Weldment | Torque Gauge Holder Weldment | 1 | 1500-09-04A |
| P | Part | 5/16" x 5/16" x 2" Square Gear Key | 1 | |
| Q | Part | Motor Mount | 1 | 1064-C8-150 |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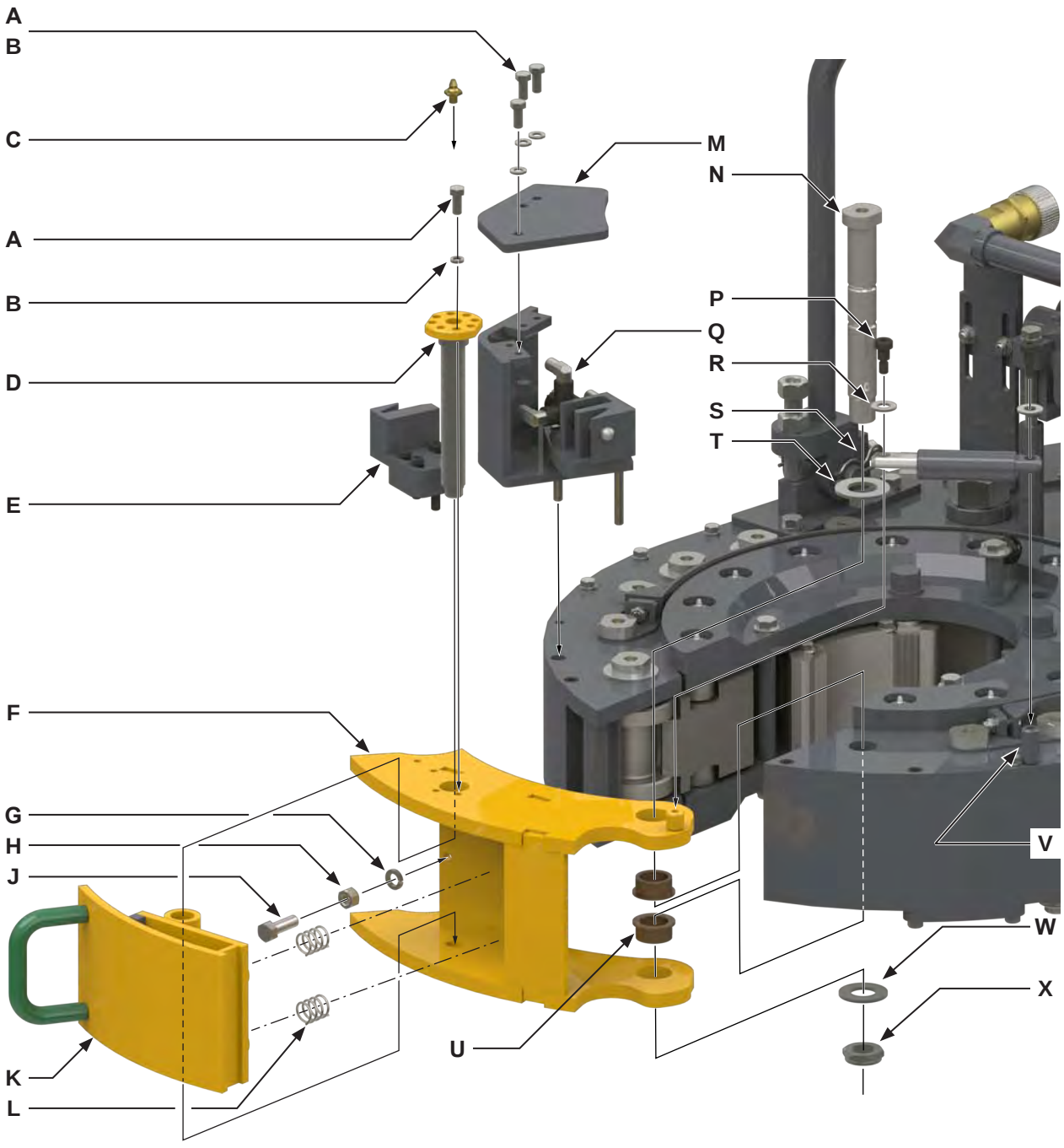
| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | 3/8" x 1" Hex Cap Screw | 4 | 09-1046 |
| B | Part | 3/8" Lock Washer | 4 | 09-5106 |
| C | Part | Brake Band Retainer | 2 | 101-0140 |
| D | Weldment | Lined Brake Band Weldment | 2 | 1050-D4-29 |
| E | Weldment | Brake Band Lug Weldment (Top Right, Bottom Left) | 2 | 101-0096 |
| F | Weldment | Brake Band Lug Weldment (Bottom Right, Top Left) | 2 | 101-0083 |
| G | Part | 3/8" Narrow Flat Washer | 4 | 09-5124 |
| H | Part | 3/8" UNC Thin Nylock Nut | 4 | |
| J | Part | 3/8" UNC x 1-1/4" Hex Bolt | 4 | 09-1048 |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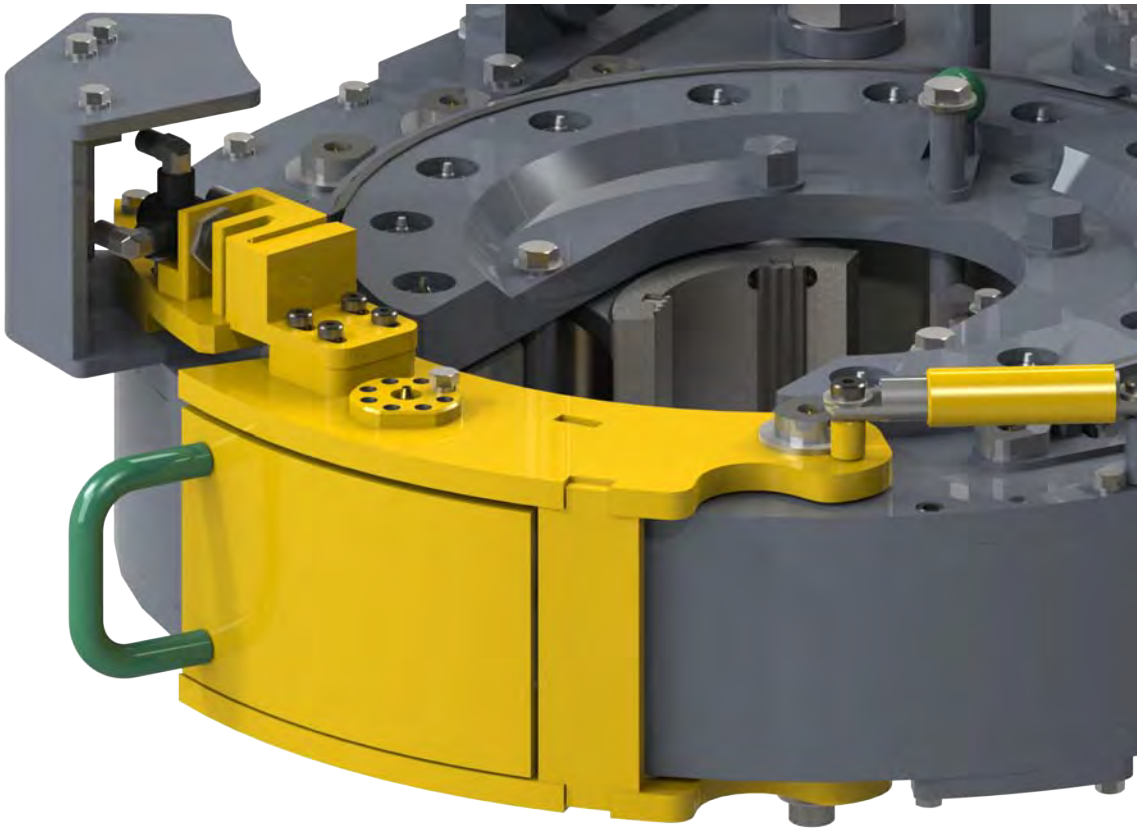
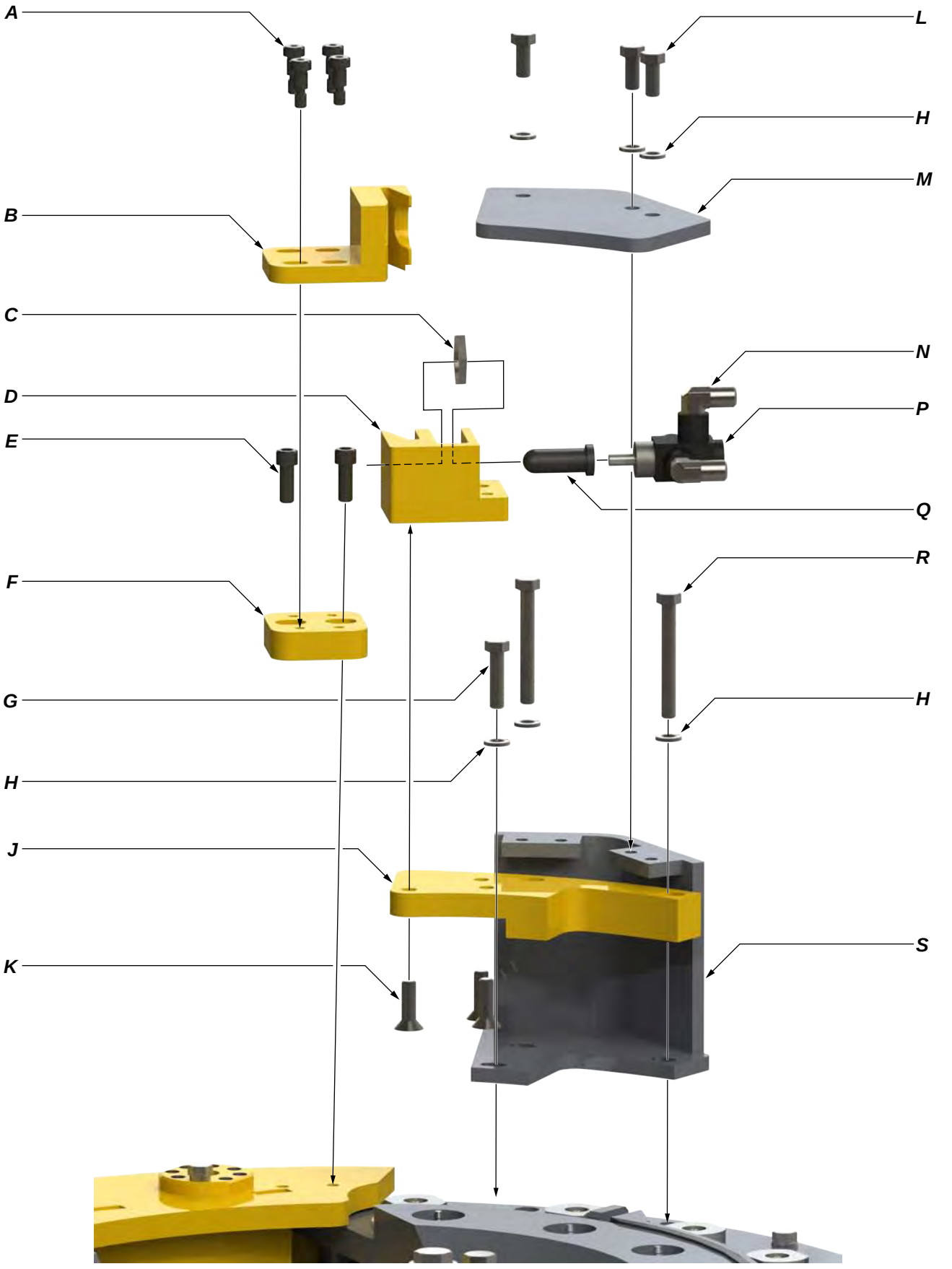


| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | 3/8" UNC x 3/4" Hex Bolt | 4 | 09-1044 |
| B | Part | 3/8" Carbon Steel Lock Washer | 4 | 09-5106 |
| C | Part | 1/8" NPT Grease Fitting | 1 | 02-0005 |
| D | Part | Adjustment Cam | 1 | 1037-A-14 |
| E | Assembly | Safety Door Latch Block Assembly (Pp. 5.30 - 5.31) | 1 | |
| F | Weldment | Door Weldment | 1 | 1050-C4-10 |
| G | Part | 1/2" Lock Washer | 1 | 09-5110 |
| H | Part | 1/2" UNC Hex Nut | 1 | 09-9124 |
| J | Part | 1/2" x 1-3/4" Hex Bolt | 1 | 09-2172 |
| K | Weldment | Door Latch Weldment | 1 | 1050-15 |
| L | Part | Latch Spring | 2 | 997-16 |
| M | Part | Switch Guard Top Plate | 1 | 101-1474 |
| N | Part | Door Pivot Support Roller Shaft | 1 | 101-3940 |
| P | Part | 1/2" x 1/2" Hex Socket Shoulder Bolt UNC | 2 | 02-0973 |
| Q | Assembly | Safety Door Latch Switch Assembly (Pp. 5.30 - 5.31) | 1 | |
| R | Part | 1/2" Narrow Flat Washer | 2 | 09-5119 |
| S | Assembly | Door Cylinder | 1 | 101-0069 |
| T | Part | 1 1/8" Narrow Washer (Door Pivot Roller) | 1 | 02-0471 |
| U | Part | Shoulder Bushing | 2 | 101-0110 |
| V | Part | Door Cylinder Mounting Lug | 1 | 1050-12-001 |
| W | Part | 1" Narrow Washer (Door Pivot Roller) | 1 | 09-5120 |
| X | Part | 1" UNS Thin Nylock Nut (Door Pivot Roller) | 1 | 09-9167 |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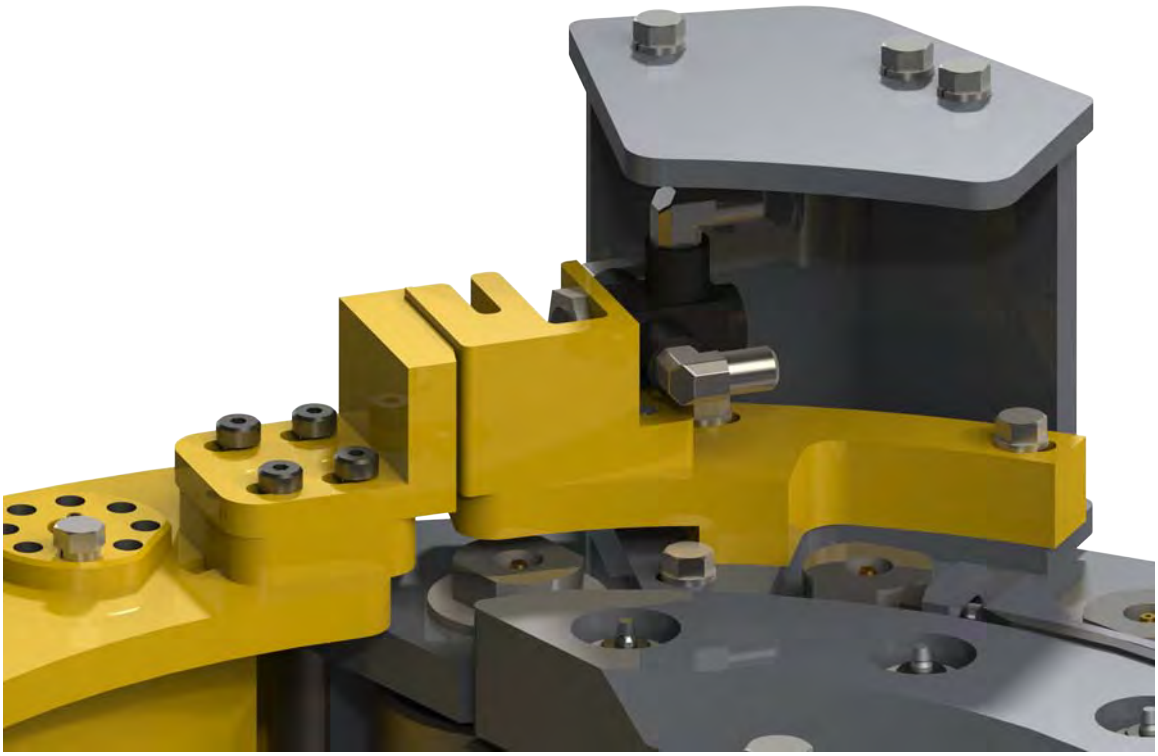
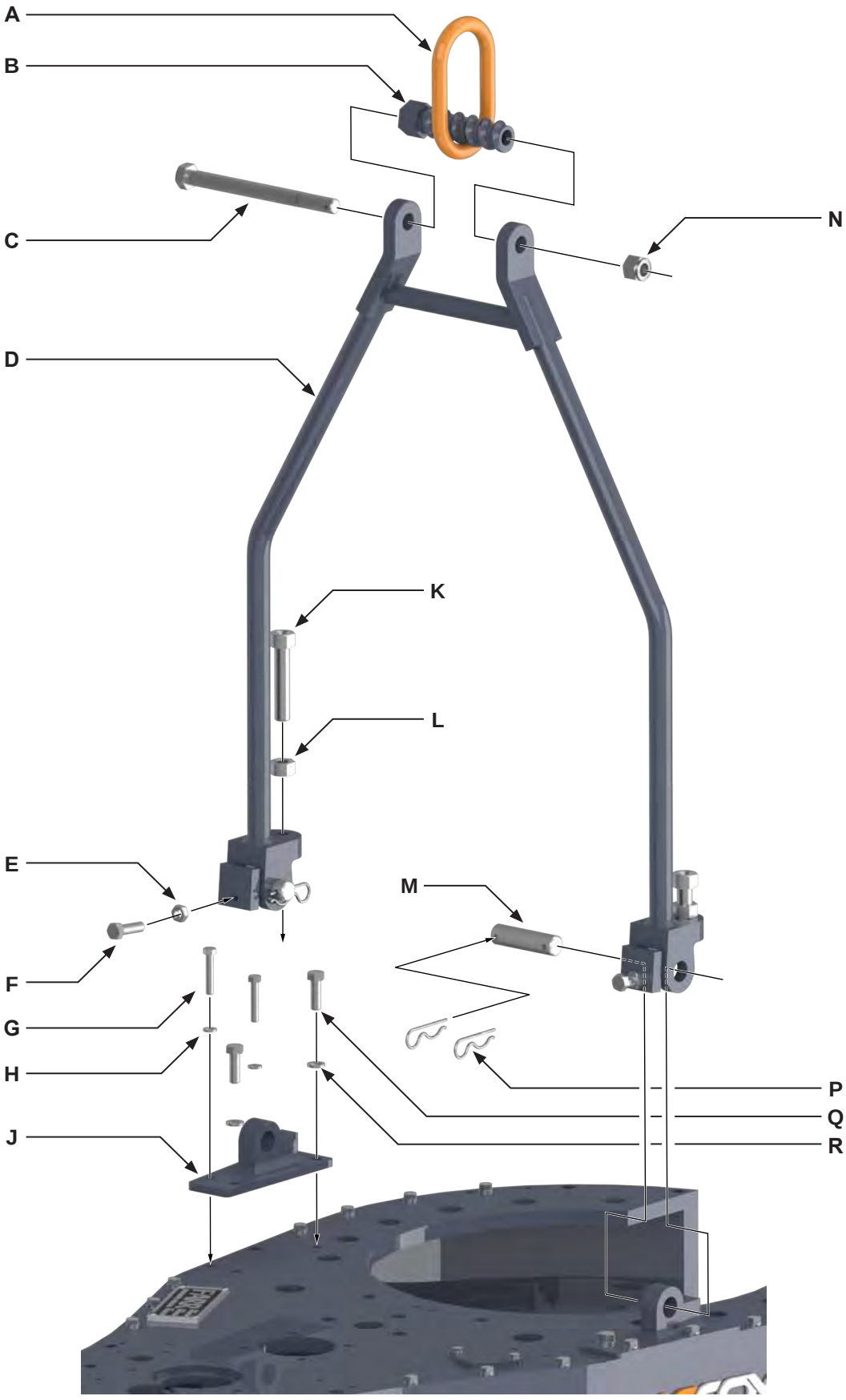


| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | 3/8" x 1/2" Shoulder Bolt, UNC | 4 | 09-0125 |
| B | Part | Safety Door Latch Block | 1 | 101-1104 |
| C | Part | 15/16" Valve Lock Nut | 1 | 09-0278 |
| D | Part | Safety Door Latch Block | 1 | 101-1103 |
| E | Part | 3/8" UNC x 1" Hex Socket Head Cap Screw | 2 | 09-1738 |
| F | Part | Safety Door Latch Spacer | 1 | 101-1411 |
| G | Part | 3/8" UNC x 1-1/2" Hex Bolt | 1 | 09-1553 |
| H | Part | 3/8" Carbon Steel Lock Washer | 6 | 09-5106 |
| J | Part | Safety Door Latch Plate | 1 | 101-1410 |
| K | Part | 3/8" UNC x 1" Hex Socket Flat Countersunk Cap Screw | 3 | 09-4046 |
| L | Part | 3/8" UNC x 3/4" Hex Bolt | 4 | 09-1044 |
| M | Part | Switch Guard Top Plate | 1 | 101-1474 |
| N | Part | 1/4" NPT - JIC 90 degree elbow 2024-4-4 | 3 | 08-0284 |
| P | Part | Safety Door Switch | 1 | 08-0337M |
| Q | Part | Load Plunger | 1 | AE12-306 |
| R | Part | 3/8" UNC x 3" Hex Bolt | 2 | 09-1058 |
| S | Weldment | Safety Door Switch Guard Weldment | 1 | 101-1475 |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***ALL FASTENERS USED TO ASSEMBLE LOAD-BEARING COMPONENTS (CHAIN SLINGS, RIGID SLINGS, BACKUP LEGS) MUST BE TIGHTENED TO THE CORRECT TORQUE.***

SEE PAGE 3.11

| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| A | Part | Lifting Link | 1 | 02-0516 |
| B | Part | Rigid Sling Adjustment Helix | 1 | 1053-1-H |
| C | Part | 3/4" NC x 9" Hex Bolt | 1 | 09-1322 |
| D | Weldment | Rigid Sling Weldment | 1 | 101-0112 |
| E | Part | 1/2" NC Hex Jam Nut | 2 | 09-5810 |
| F | Part | 1/2" NC x 1-3/4" Hex Bolt | 2 | 09-1172 |
| G | Part | 3/8" NC x 2" Hex Bolt | 4 | 09-1046 |
| H | Part | 3/8" Helical Lock Washer | 4 | 09-5106 |
| J | Weldment | LH Rigid Sling Bracket | 1 | 101-0113 |
| | Weldment | RH Rigid Sling Bracket | 1 | 101-0115 |
| K | Weldment | Level Adjustment Bolt | 2 | 1053-C-1L |
| L | Part | 3/4" UNC Hex Nut | 2 | 09-5818 |
| M | Part | Rigid Sling Pin | 2 | 1053-C-1C |
| N | Part | 3/4" NC Nylock Nut | 1 | 1429-39-02 |
| P | Part | 3/16" Hitch Pin | 4 | 02-0028 |
| Q | Part | 1/2" UNC x 1-1/2" Hex Bolt | 4 | 09-1170 |
| R | Part | 1/2" Lock Washer | 4 | 09-5110 |

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## A. BASIC TORQUE MEASUREMENT

*Basic torque measurements are performed using a simple hydraulic measurement system. A hydraulic load cell connects to a calibrated torque gauge through a reinforced flexible hydraulic hose. The torque gauge is factory-calibrated to display accurate torque measurements for a tong or tong and backup assembly with a particular arm length. The arm length is a measurement from the centre of the pipe or casing to the centre of the force being applied to the load cell.*

*Two load cell options are available. A tension load cell is typically used with a suspended stand-alone tong. This application requires that the load cell be attached to the rear of the tong as part of the restraint line that opposes the force generated when the tong makes up or breaks out a joint. A compression load cell is used in a tong and backup assembly, and is typically located on the rear of the backup between the backup and a stationary frame. The load cell must be located in the centre of the compression force vector generated between the backup and the frame.*

*Hydraulic force generated by a load cell is transmitted to the torque gauge via a reinforced flexible hydraulic line. The hydraulic force is displayed as torque in units of Ft.-Lbs. The torque gauge has a red "peak torque" indicator that tracks with the torque gauge needle to the point of highest torque, and remains at the point of highest torque until manually reset. Note that every model of tong and tong and backup assembly has a unique arm length, and the torque gauge must be calibrated for that arm length. Torque gauges that are not calibrated for the arm length of the tool in service will not display correct torque. To ensure correct torque measurement, ensure the arm length or "handle" as displayed on your torque gauge matches the arm length of the tool in service as listed on the specifications page of the technical manual.*

*The images on this page are for illustration purposes only and may not accurately represent the torque gauge and load cell that have been supplied with your equipment.*

***THE IMAGES DISPLAYED ARE SUPPLIED FOR ILLUSTRATION PURPOSES ONLY***


***ILLUSTRATION 6.A.1: TORQUE GAUGE (FOR ILLUSTRATION PURPOSES ONLY)***

***ILLUSTRATION 6.A.2: TENSION LOAD CELL***

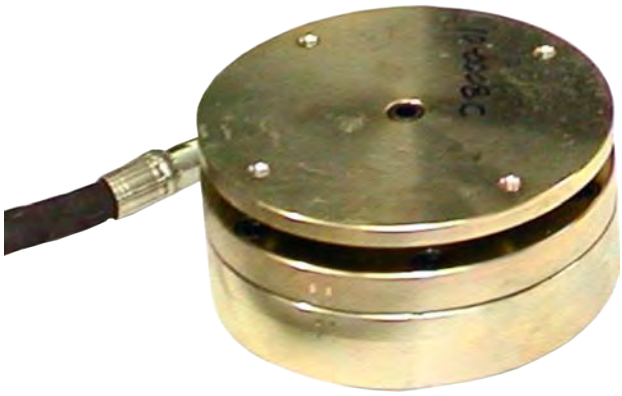


***ILLUSTRATION 6.A.3: COMPRESSION LOAD CELL***

*Torque gauges and load cells are supplied as a matched calibrated pair. Substituting one or the other will render the calibration inaccurate even if the actual model numbers appear to be identical. The serial numbers of matching load cell and torque gauges are clearly identified on the calibration certificate. Should you suspect the accuracy of your torque measurements, or wish to replace either component the pair should be returned to the factory for re-calibration before placing into service.*

***TORQUE GAUGES AND LOAD CELLS ARE FACTORY-SUPPLIED SUPPLIED AS MATCHED CALIBRATED PAIRS. IF REPLACING EITHER COMPONENT THE LOAD CELL AND TORQUE GAUGE MUST BE RETURNED TO THE FACTORY FOR RE-CALIBRATION BEFORE PLACED INTO SERVICE.***

**BASIC TORQUE MEASUREMENT (Continued:)**

*The images on the preceding page are for illustration purposes only and may not accurately represent the torque gauge and load cell that have been supplied with your equipment. Please note that the parts listed in the following table are correct for accurate torque measurement while using the equipment for which this manual is supplied.*

***THE TORQUE GAUGE USED IS FULLY DEPENDANT UPON THE ARM LENGTH AND TORQUE RANGE OF THE EQUIPMENT IN USE. THE PART NUMBERS LISTED IN THE FOLLOWING TABLE ARE CORRECT FOR ACCURATELY MEASURING TORQUE USING THE EQUIPMENT FOR WHICH THIS MANUAL IS SUPPLIED.***

| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| | Assembly | 36" Arm - 40K Torque Gauge / Compression Load Cell Assembly | 1 | 10-0016C |
| 1 | Part | 36" Arm 40,000 Ft.-Lbs.Torque Gauge | 1 | 10-0016G |
| 2 | Part | Compression Load Cell | 1 | 10-0008C |
| 3 | Part | Hydraulic Hose | 1 | 02-0069 |
| 4 | Part | Torque Gauge Flange | 1 | 997-D7-5 |
| 5 | Part | 1" Tension Load Cell Shackle | 1 | 02-9134 |

| Item | Type | Description |
|---|---|---|
| | Assembly | Tension Load Cell, 4.08 $in^2$ |
| A | Part | 1/4" NC x 1/2" Binding Head Machine Screw |
| B | Part | Stat-O-Seal |
| C | Part | O-Ring |
| D | Part | O-Ring |
| E | Part | Load Cell Piston |
| F | Part | Flange Gasket |
| G | Part | Load Cell End |
| H | Part | Load Cell Rod |
| J | Part | Wiper |
| K | Part | O-Ring |
| L | Part | Load Cell Body |
| M | Part | 3/8" NC x 3/8" Cup Point Hex Set Screw |
| Seal Kit | | Replacement Seal Kit 4.08 $in^2$ Tension Load Cell |

***This is the standard tension load cell supplied by McCoy Drilling & Completions | Farr. Contact our sales department for information about optional application-specific tension load cells.***

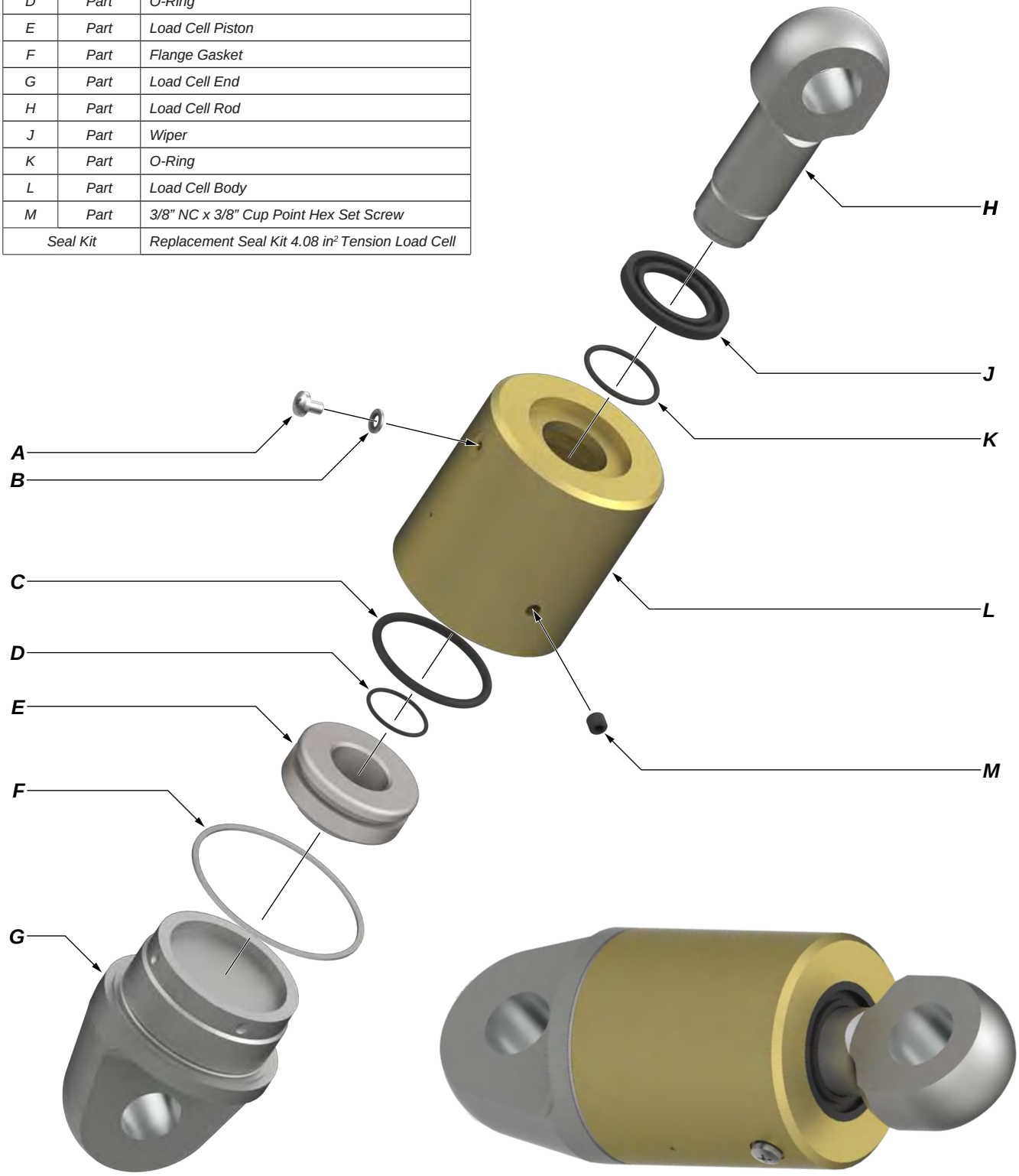
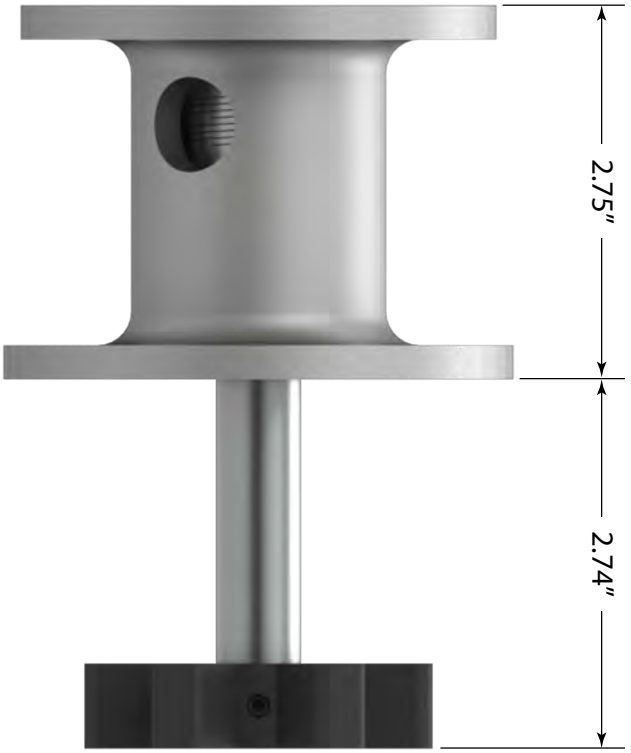
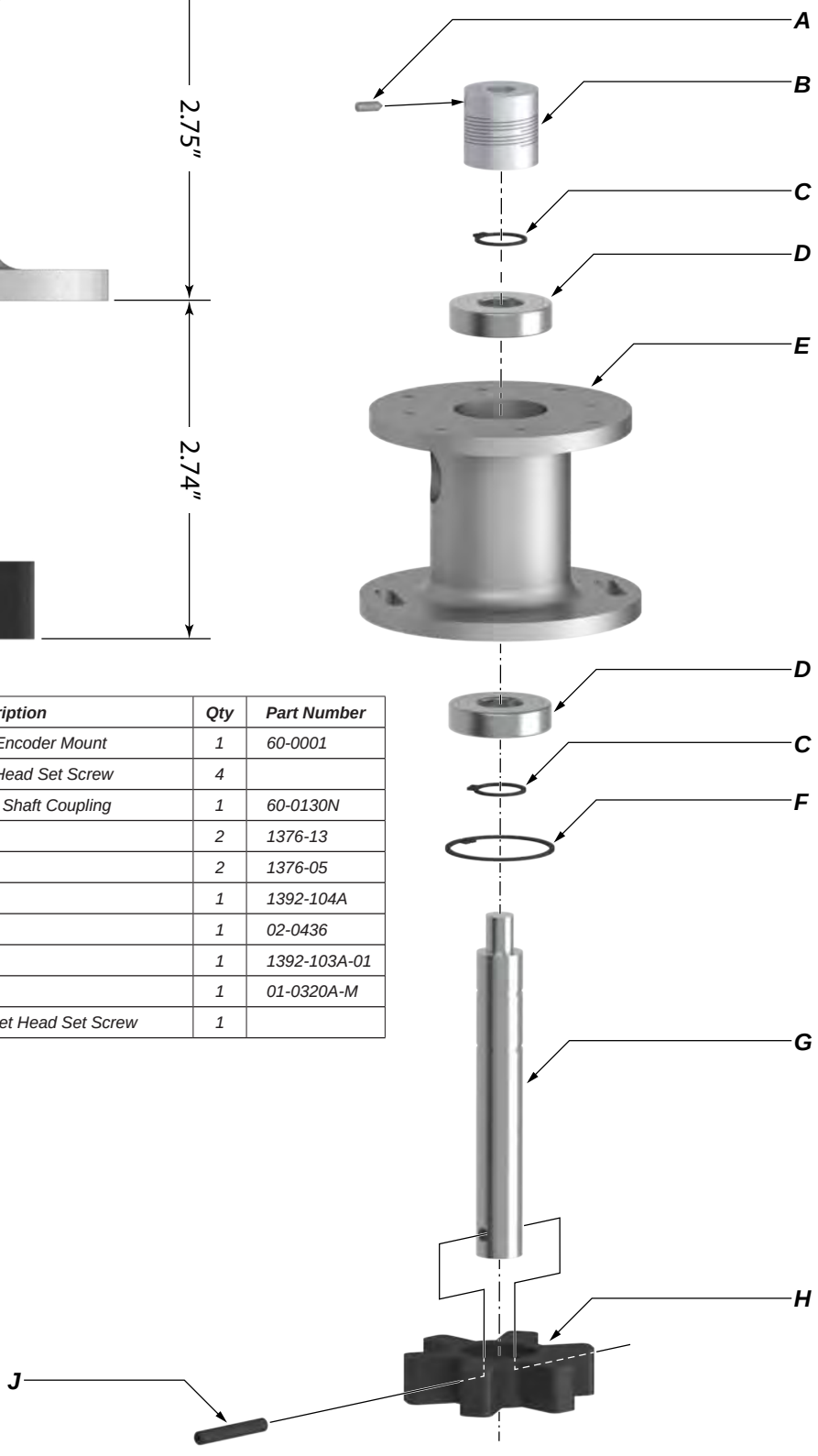



*ILLUSTRATION 6.A.4: TENSION LOAD CELL EXPLODED*




| Item | Type | Description | Qty | Part Number |
|---|---|---|---|---|
| | Assembly | Standard Turn Counter Encoder Mount | 1 | 60-0001 |
| A | Part | 6-32 x 3/8" Hex Socket Head Set Screw | 4 | |
| B | Part | Helical Flexible Encoder Shaft Coupling | 1 | 60-0130N |
| C | Part | Internal Retainer Ring | 2 | 1376-13 |
| D | Part | Bearing | 2 | 1376-05 |
| E | Part | Encoder Housing | 1 | 1392-104A |
| F | Part | Internal Retainer Ring | 1 | 02-0436 |
| G | Part | Encoder Shaft | 1 | 1392-103A-01 |
| H | Part | Encoder Gear | 1 | 01-0320A-M |
| J | Part | 10-24 x 1-1/4" Hex Socket Head Set Screw | 1 | |

*ILLUSTRATION 6.A.5: TURN COUNTER ENCODER MOUNT EXPLODED*

## B. TROUBLESHOOTING

*Under normal operating conditions, and with proper maintenance, the torque gauge and load cell system are designed to give lasting trouble-free performance. Faulty indication on the gauge will very often define a fault within the gauge.*

***IF TROUBLESHOOTING REVEALS THAT THERE IS INSUFFICIENT FLUID IN THE SYSTEM, BEFORE RECHARGING, CHECK THAT ALL SYSTEM COMPONENTS ARE FREE FROM DAMAGE. THIS WILL ENSURE THAT FLUID LOSS WILL NOT CONTINUE AFTER RELOADING***

**1. Symptom: No indication on gauge.**

*Possible Problem:* Obstruction in hydraulic hose.

*Solutions:* Check hydraulic hose for kinks.
Replace hydraulic hose.

*Possible Problem:* Loss of hydraulic fluid.

*Solution:* Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

*Possible Problem:* Internal mechanism of torque gauge is damaged.

*Solution:* Replace gauge.

**2. Symptom: Gauge indication unexpectedly high.**

*Possible Problem:* Excessive hydraulic fluid.

*Solutions:* Completely drain hydraulic fluid from torque gauge/load cell system. Recharge following the procedure in Section 6.C.

*Possible Problem:* Internal mechanism of gauge is damaged.

*Solution:* Replace gauge.

*Possible Problem:* Incorrect torque gauge in use (not part of the original torque gauge/load cell pair).

*Solution:* Replace gauge with gauge properly calibrated for the load cell in service.

**3. Symptom: Gauge indication unexpectedly low**

*Possible Problem:* Insufficient hydraulic fluid.

*Solution:* Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

*Possible Problem:* Obstruction in hydraulic hose.

*Solutions:* Check hydraulic hose for kinks.

Replace hydraulic hose.

*Possible Problem:* Snub line not at right-angle to tong handle.

*Solution:* Check angle of snub line and correct if necessary.

*Possible Problem:* Internal mechanism of gauge is damaged.

*Solution:* Replace gauge.

*Possible Problem:* Incorrect torque gauge in use (not part of the original torque gauge/load cell pair).

*Solution:* Replace gauge with gauge properly calibrated for the load cell in service.

**4. Symptom: Gauge indication is erratic or sluggish**

*Possible Problem:* Insufficient hydraulic fluid in torque measurement section.

*Solution:* Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

*Possible Problem:* Loss of damping fluid in torque gauge.

*Solution:* Top up or refill damping fluid (NOTE: Ensure leakage points in gauge are identified and repaired to prevent further loss of damping fluid).

*Possible Problem:* Air bubbles in hydraulic fluid in the torque measurement system.

*Solution:* Bleed air from load cell and torque gauge and top up fluid (if necessary) as per Section 6.C.

*Possible Problem:* Internal mechanism of gauge is damaged.

*Solution:* Replace gauge.

## C. PERIODIC INSPECTION AND MAINTENANCE

***ONLY QUALIFIED, DESIGNATED PERSONNEL ARE PERMITTED TO PERFORM MAINTENANCE ON THE TORQUE MEASUREMENT SYSTEM.***

### 1. Inspection

*The torque measurement system supplied with your equipment is designed and built to provide years of trouble-free service with minimum maintenance. Periodic inspections of the load cell, hydraulic lines and fittings are recommended in order to keep the system in top operating condition. A thorough inspection should be made at each rig-up.*

### 2. Fluid Recharge

*Recharge hydraulic system with W15/16 fluid through the check valve on the torque indicating gauge. Recharging must only be performed when there is no load on the load cell. Refer to the illustrations on pages 6.3 & 6.4 for guidance if required.*

a. *Place the torque indicating gauge higher than the load cell. Remove the brass 1/4" cap from the fitting on the check valve on the top of the gauge.*

b. *Connect the hand pump to the check valve fitting.*

c. *Elevate the load cell so it is higher than the torque gauge and hand pump.*

***UN-CONTAINED SPILLAGE OF THE HYDRAULIC FLUID IN THIS SYSTEM MAY CONTRAVENE GOVERNMENTAL ENVIRONMENTAL REGULATIONS, OR THE ENVIRONMENTAL REGULATIONS AND POLICIES OF YOUR COMPANY. FARR CANADA CORP. HIGHLY RECOMMENDS PLACING YOUR LOAD CELL IN A CONTAINMENT BASIN BEFORE PROCEEDING WITH THE BLEEDING & REFILLING PROCESS.***

d. *Fill hand pump bowl with W15/16 hydraulic fluid.*

***MAINTAIN GREATER-THAN HALF FULL FLUID LEVEL IN THE HAND PUMP BOWL TO AVOID PUMPING AIR INTO THE SYSTEM. DO NOT ALLOW THE LEVEL TO FALL BELOW ONE-HALF FULL***

e. *Remove the vent plug screw and Stat-O-Seal (Items C and D on Illustration 6.A.4, or item H on Illustration 6.A.5) to allow trapped air to escape.*

f. *Pump fluid into the system until no more air is seen escaping from the vent port.*

g. *Replace the vent plug screw and Stat-O-Seal and tighten securely.*

h. *Remove load cell from containment vessel and wipe clean. Reclaim the hydraulic fluid (if it is clean) or dispose of all waste materials according to governmental or your company's proscribed environmental protection regulations.*

i. *Disconnect the hand pump from the torque gauge.*

j. *Replace the brass cap on the torque gauge check valve fitting.*

### 3. Reference Checking Your Torque Measurement System

*The following steps define a process for determining if your torque measurement system is correctly measuring and indicating within an expected range. This procedure is best suited for performing in a shop or location removed from the drill floor, within range of a crane. This is a reference check and not a calibration. Calibrations must be performed at an authorized calibration facility.*

*Tension Load Cell*

a. *Locate a known weight in the range of approximately 500 to 1000 lbs (227 to 455 kg), and move the weight next to the tong and backup assembly.*

b. *Remove the tension load cell from the tong, but do not disconnect from the torque gauge.*

c. *Suspend the load cell, piston side up, from a crane capable of supporting the known weight in Step 3a.*

d. *Connect the rod side of the load cell to the known weight, and use the crane to hoist the weight from the surface to be suspended freely.*

***Continued on next page...***

***Reference Checking Your Torque Measurement System (continued):***

*Tension Load Cell (continued):*

e. *Perform a simple calculation to determine the expected indication on the torque gauge based on the known hoisted weight. This is a calculation that must be performed using imperial units (eg., pounds and feet). The calculation is: [KNOWN WEIGHT] x [ARM LENGTH (in feet)]. For example, if the arm length is 36 inches and the hoisted weight is 1000 lbs the calculation is:*

*1000 x (36/12) = 3000*

*Therefore, the expected indication on the torque gauge should be 3000 lbs-ft.*

***4. Repair And Calibration***

*Return the load cell and indicator gauge to the authorized repair facility for repairs and calibration.*

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MOVING GLOBAL ENERGY FORWARD

DRILLING & COMPLETIONS

FARR

# Section 7: Hydraulic Component Information

*The manufacturer information contained in this section has been obtained from publicly available web sites and has been provided for information purposes only. McCoy Drilling & Completions does not guarantee the accuracy of the information contained in this section. All original copyrights claimed by the manufacturer(s) apply.*

MANUFACTURER OF HYDRAULIC MOTORS
RINEER HYDRAULICS, INC.

15 series

POWER to be the Best!

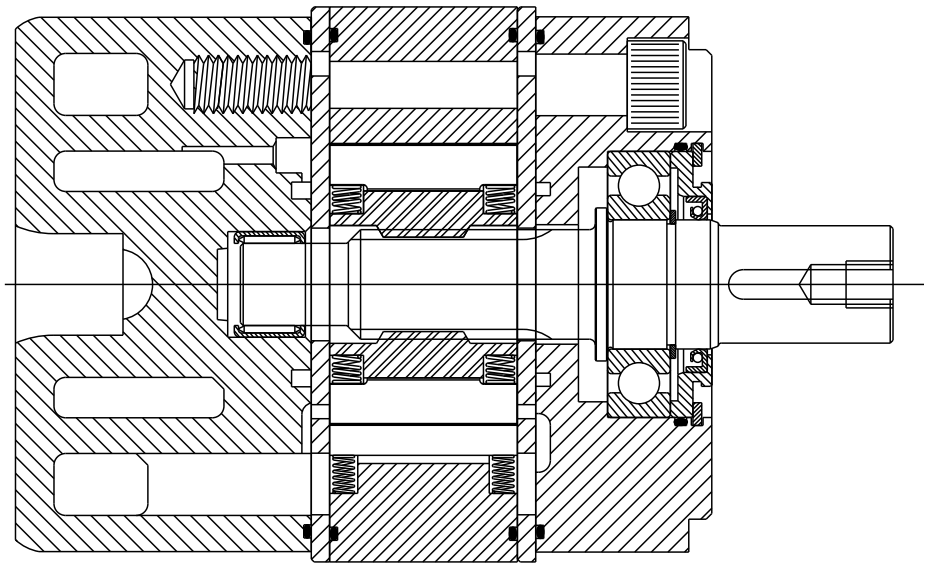
MOTOR SELECTION GUIDE

# 15 Series Two Speed

Weight = 51 lbs.

- All available displacements of standard motor.
- Spool valve shift from full to partial displacement.
- Standard shift ratio is 2:1 - Some special ratios available.
- Shift on the run.
- Typical applications - winch, track and wheel drives.

## CROSS SECTION



Made in USA

PUBLICATION DS151005 8/03

# Technical Information - All Styles

## VANE CROSSING VANE
The Rineer patented vane crossing vane design produces much higher volumetric and mechanical efficiencies than is possible with a standard vane type design. This design provides a sealing vane between cavities to improve mechanical and volumetric efficiencies.

## STARTING AND STALL TORQUE
The Rineer motor produces torque curves which are virtually flat, with starting and stall torque equal to approximately 90-94% of theoretical torque.

## MORE POWER STROKES PER REVOLUTION
The 15 Series has four stator cavities and 10 rotor vanes. Each rotor vane works in each stator cavity once per revolution, which results in 40 power strokes per revolution. This helps produce higher mechanical efficiency and flatter torque curves.

## BEARING LOADING
The bearings in the 15 Series can accept radial load per the radial capacity chart. Thrust load is not recommended under most conditions. Consult with a Rineer Application Engineer for optional bearing configurations to match your application.

## SEALS
Buna N seals are supplied as standard on the Rineer 15 series motors. Viton seals may be ordered as an option.

## ROTATING GROUP - 1S or 1H
Under most operating conditions, 1S (standard rotating group parts) should be used. Under some high speed conditons 1H can be specified.

## ROTATION
The 15 Series Motor rotates equally well in either direction and smoothly throughout its entire pressure and speed range. Looking into the end of the shaft, rotation is clockwise when oil is supplied to port "A".

## HORSEPOWER LIMITATION
Maximum horsepower limitations may vary with different applications. ***When using the 15 Series Motor above 75 HP, consult a Rineer Application Engineer.***

## FILTRATION
25 micron minimum.

## FLUID
We suggest premium grade fluids containing high quality rust, oxidation and foam inhibitors, along with anti-wear additives. For best performance, minimum viscosity should be maintained at 100 SSU or higher. Fluid temperature should not exceed 180° F. Elevated fluid temperature will adversely affect seal life while accelerating oxidation and fluid breakdown. Fire resistant fluids may be used with certain limitations. Contact Rineer for additional information.

## CASE DRAIN
The 15 Series Motor is designed for either internal or external case drain. Two case drain ports are supplied. When using internal case drain, simply plug the two ports. When using external case drain, use the port at the highest elevation. We recommend case drain pressure of 35 PSI or less when using the standard seals.

## CASE DRAIN CIRCULATION
Fluid should be circulated through the case when a temperature differential exists between the motor and the system in excess of 50° F. ***Should this occur, contact a Rineer Application Engineer.***

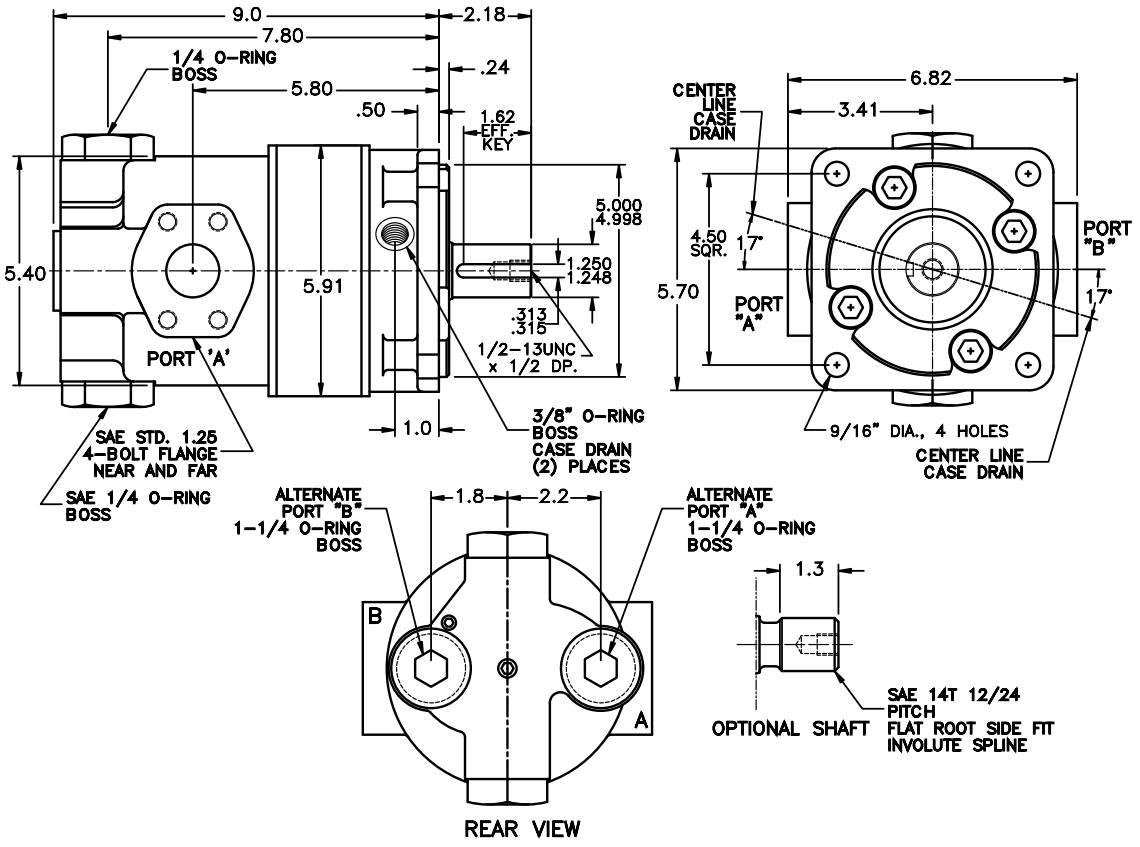
## MOUNTING
The mounting position is unrestricted. The shafts, pilots, and mounting faces should be within .002 TIR.

## INTERMITTENT CONDITIONS
Intermittent conditions are to be less than 10% of every minute.

## OTHER AVAILABLE MOTORS
For information on additional Rineer Motors, request one of the following publications:

37 Series .....Publication DS371003
57 Series .....Publication DS571003
125 Series .....Publication DS1251003

## 15 Series Two Speed Envelope



# Technical Information - Two Speed Motor

### DISPLACEMENT CHANGE
When a motor is shifted from full to partial displacement the motor is changed to 50%, 35%, or 28% of its original displacement depending on its shift ratio.

### STANDARD SHIFT RATIO
The standard 15 Series displacements of 15, 13, 9.5, 8, 7, and 6 CID are available in the 15 Series Two Speed with a shift ratio of 2:1. For example, a 15 CID motor shifted to partial displacement becomes a 7.5 CID motor.

### SPECIAL SHIFT RATIOS
There are two special displacements available in the 15 Series Two Speed which offer higher shift ratios, the 10.5 and the 11.5 CID. The 10.5 CID motor has a shift ratio of 3.5:1, which when shifted becomes a 3 CID motor. The 11.5 CID motor has a shift ratio of 2.875:1, which when shifted becomes a 4 CID motor.

### SHIFTING METHOD
Selecting between full and partial displacement is accomplished by shifting the two-position spool valve incorporated in the motor. Motors are available in either single or double pilot configurations.

### SINGLE PILOT
Single pilot motors require a pilot line to be connected to port "C". When port "C" is pressurized the spool shifts the motor to partial displacement. When port "C" is vented to tank, an internal spring shifts the spool, returning the motor to full displacement.

### DOUBLE PILOT
Double pilot motors require two pilot lines. One line is connected to port "C" while the other line is connected to port "D". The motor is in full displacement when port "D" is pressurized and port "C" is vented to tank. The motor is in partial displacement when port "C" is pressurized and port "D" is vented to tank.

### OPEN DURING CROSSOVER SPOOLS
Open during crossover spools allow port "A" to be directly connected to port "B" when the spool is shifting between full and partial displacement. Motors with -62 or -65 designations are open during crossover.
WARNING! IN SOME WINCH APPLICATIONS, OPEN DURING CROSSOVER SPOOLS (-62 or -65) ARE NOT RECOMMMENDED.

### CLOSED DURING CROSSOVER SPOOLS
Closed during crossover spools do not allow port "A" to be directly connected to port "B" when the spool is shifting between full and partial displacement. Motors with -63 or -67 designations are closed during crossover. These motors contain an internal factory preset relief valve. This valve protects the motor during shifting only and is not a system relief valve.

### PILOT PRESSURE
A minimum of 100 PSI over case drain pressure is required to shift the spool. The maximum allowable pressure to port "C" or "D" is 3,500 PSI.

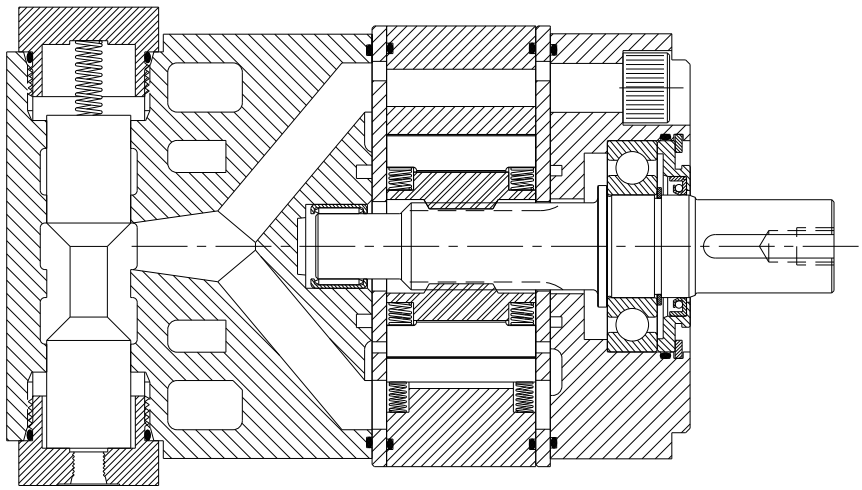
### SHIFT ON THE RUN
The 15 Series Two Speed Motor may be shifted on the run while loaded or unloaded.

### MAXIMUM SPEED
Maximum rated speed is the same for either full or partial displacement as stated in the performance data.

### CASE DRAIN AND CROSS PORT LEAKAGE
The combined case drain and cross port leakage of the 15 Series Two Speed Motor is approximately 1 GPM per 1,000 PSI. This will vary with the oil viscosity.

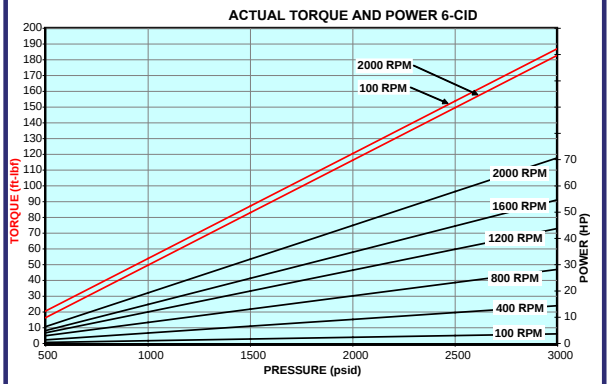
### OTHER INFORMATION
All other information as specified under Techinal Information also applies to the 15 Series Two Speed Motor. (See page 5)

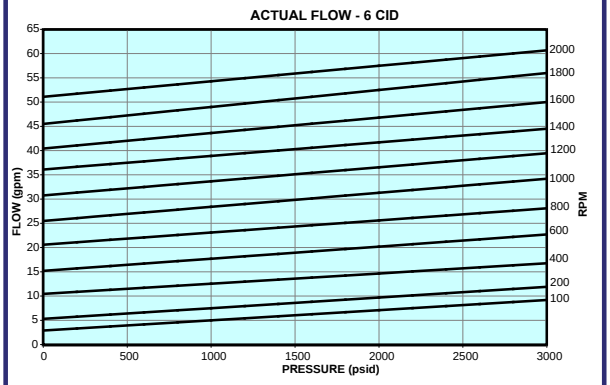
## Cross Section - Two Speed Motor



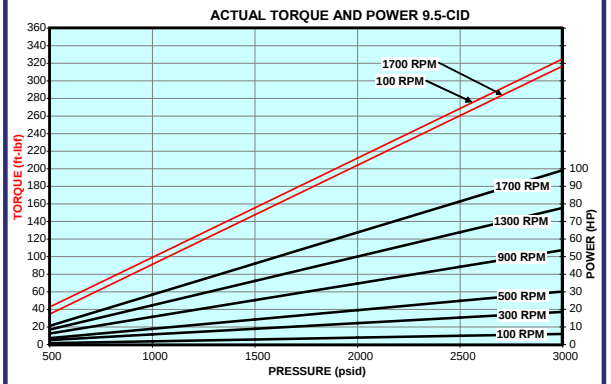
## Performance Data - Selected Displacements

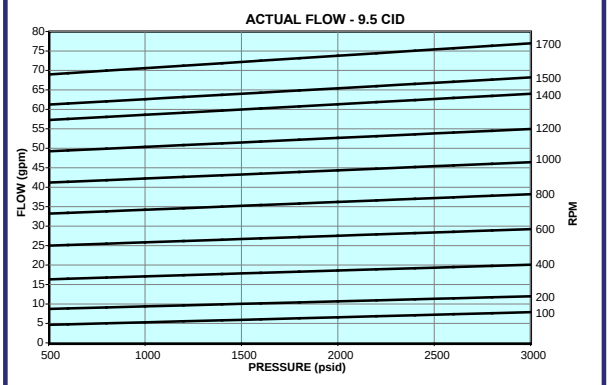
### 6 C.I.D.



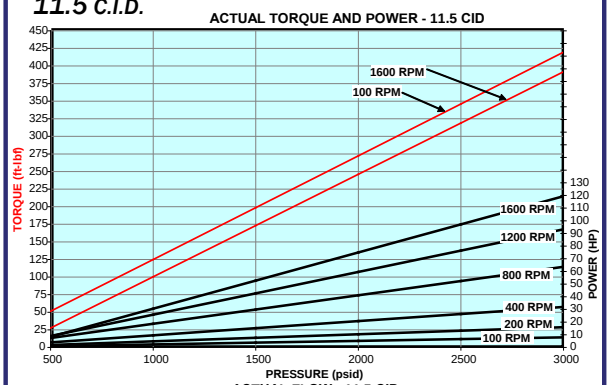



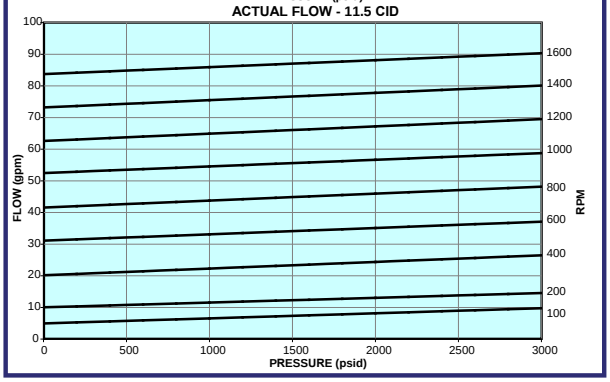

### 9.5 C.I.D.



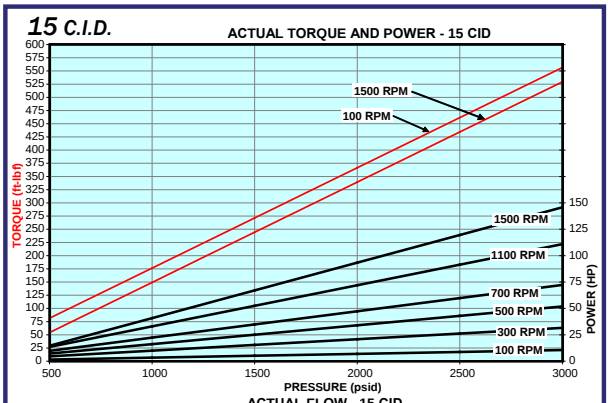



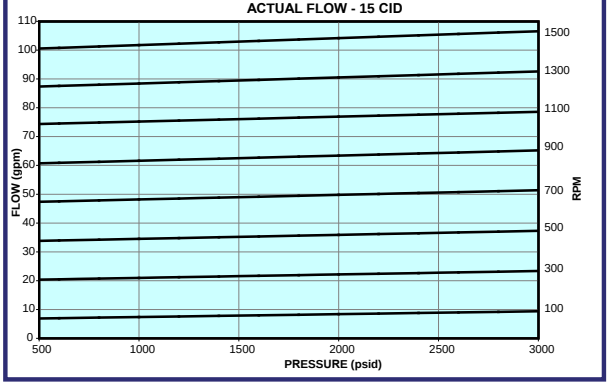

### 11.5 C.I.D.




### 15 C.I.D.




The above performance data was obtained at 140°F with ISO 46(DTE 25). These values must be maintained to obtain the performance indicated. Contact Rineer Hydraulics, Inc. for additional displacements.

## Model Code

**M015 - 61/62**

M015 - 61 = 015 Single Speed
M015 - 62 = 015 Two Speed

Options:
62 = Two Speed Single Pilot Open During Crossover
63 = Two Speed Single Pilot Closed During Crossover
65 = Two Speed Double Pilot Open During Crossover
67 = Two Speed Double Pilot Closed During Crossover

**-1S**

1S = Std.
1H = High Speed

**-015**

006 = 6 $in^3$ (98cc)/rev.
007 = 7 $in^3$ (115cc)/rev.
008 = 8 $in^3$ (131cc)/rev.
009 = 9.5 $in^3$ (156cc)/rev.
010 = 10.5 $in^3$ (172cc)/rev.
011 = 11.5 $in^3$ (189cc)/rev.
013 = 13 $in^3$ (213cc)/rev.
015 = 15 $in^3$ (246cc)/rev.

**-31**

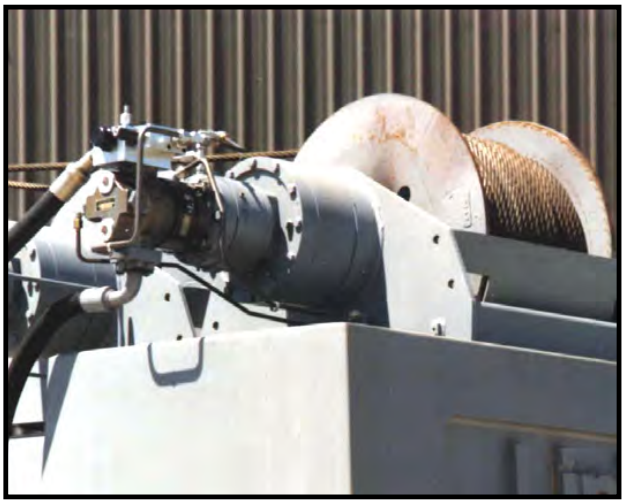
30 = Keyed Shaft
31 = Splined Shaft
32 = Wheel Motor
34 = Double Key
50 = Retractable
53 = API Thread

**-B1** Bearing Package Selection

**-TV** Seal - Package Selection

**-000** Special Code Designator

## Applications



## For durable hydraulic motors that meet your demands, specify Rineer.

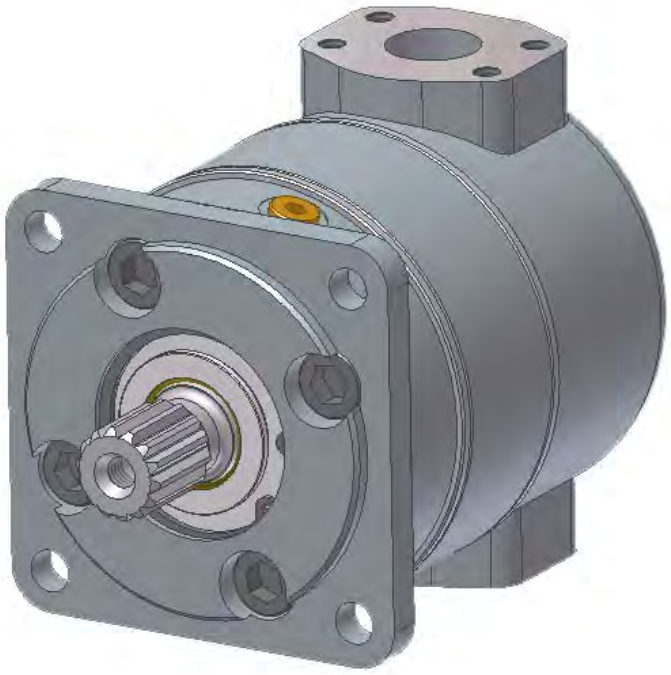
For over 35 years, we have specialized in only one thing - engineering the right motor for your needs. Rineer delivers the performance you can count on·

### Limited Warranty Policy

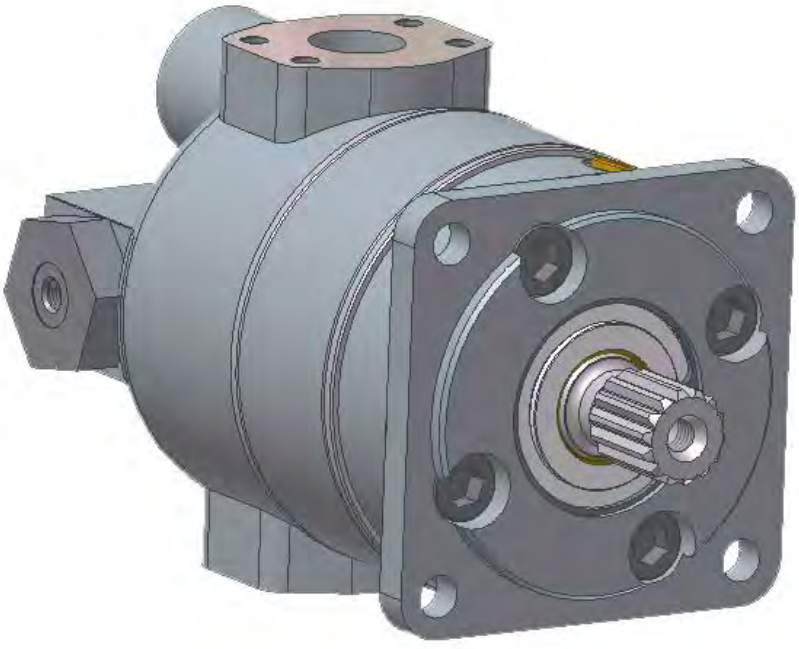
Rineer Hydraulics, Inc. warrants that, at the time of shipment to Purchaser, our product will be free of defects in the material and workmanship. The above warranty is LIMITED to defective products returned by Purchaser to Rineer Hydraulics, Inc., freight prepaid within four hundred and fifty-five (455) days from date of shipment, or one (1) year from date of first use, whichever expires first. We will repair or replace any product or part thereof which is proved to be defective in workmanship or material. There is no other warranty, expressed or implied, and in no event shall Rineer Hydraulics, Inc. be liable for consequential or special damages. Dismantling the product, operation of the product beyond the published capabilities or for purposes other than that for which the product was designed, shall void this warranty.

# Repair Manual

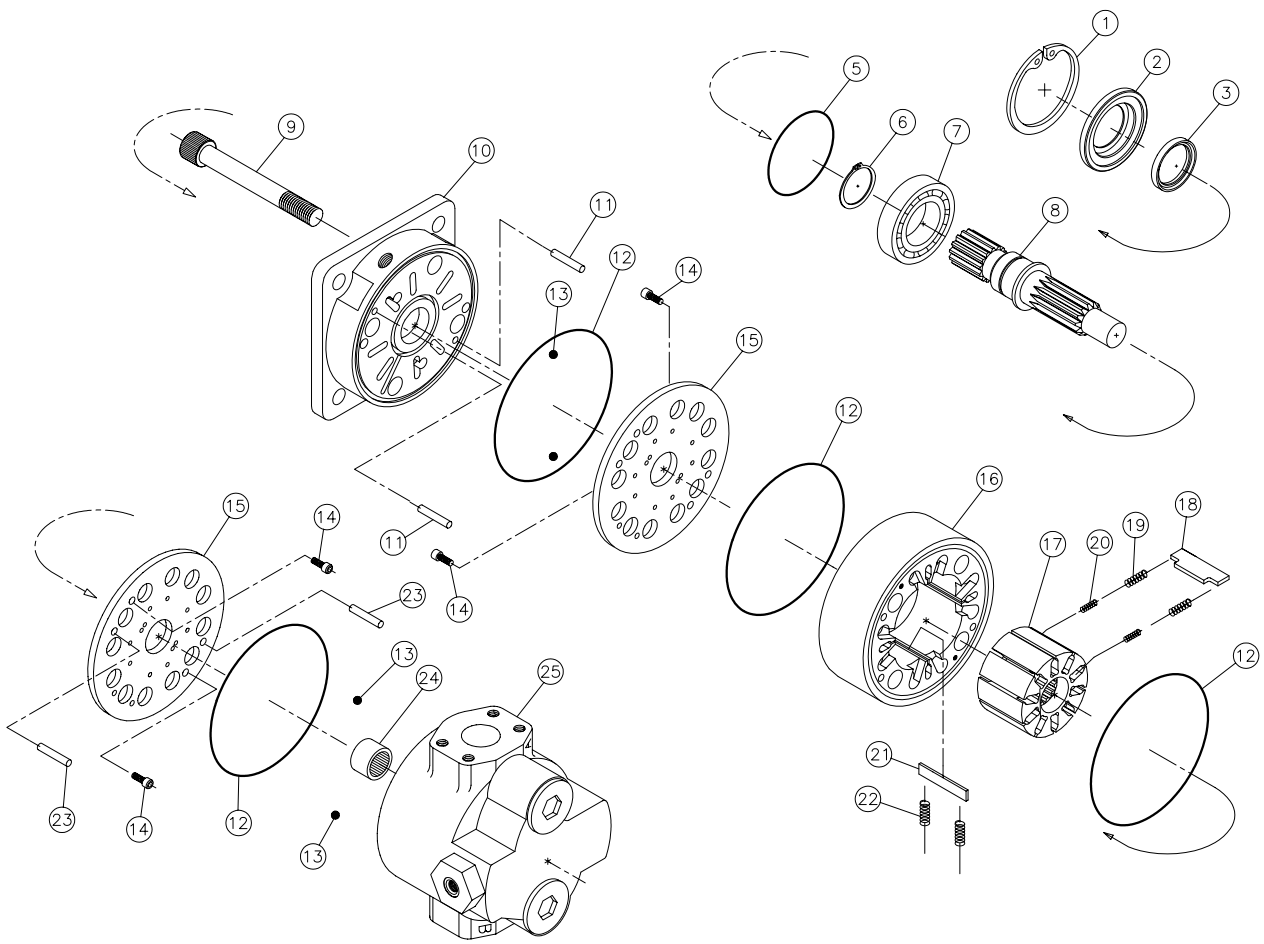
## 15 Series



Standard Motor



Two Speed Motor




| SERIES 15 STD. TWO SPEED EXP. VIEW | | | |
|---|---|---|---|
| ITEM | PART NO. | DESCRIPTION | QTY |
| 1 | 0150111 | SEAL PLATE SNAP RING | 1 |
| 2 | 0150135 | SEAL PLATE | 1 |
| 3 | 1250161 | SEAL, SHAFT, TCN | 1 |
| 4 | | NOT USED | |
| 5 | 0150114 | SEAL PLATE O-RING | 1 |
| 6 | 0150730 | SNAP RING, BEARING | 1 |
| 7 | 0150710 | BALL BEARING | 1 |
| | 0150701 | SHAFT, KEYED | 1 |
| 8 | 0150702 | SHAFT, SPLINED | 1 |
| 9 | 0150901 | BOLT | 4 |
| 10 | 0150102 | FRONT HOUSING-INTERNAL | 1 |
| 11 | 0150428 | DOWEL PINS - FRONT | 2 |
| 12 | 0150610 | O-RING | 4 |
| 13 | 0150902 | BALL CHECKS | 4 |
| 14 | 0150620 | PLATE SCREW | 4 |
| 15 | 0150609 | PLATE, TWO SPEED | 2 |
| 16 | 0150401 | STATOR GA 15 | 1 |
| | 0150402 | STATOR GA 13 | 1 |
| | 0150403 | STATOR GA 9.5 | 1 |
| | 0150404 | STATOR GA 8.0 | 1 |
| | 0150407 | STATOR GA 6 | 1 |
| | 0150408 | STATOR GA 10.5-2S | 1 |
| | 0150414 | STATOR GA 11.5-2S | 1 |
| | 0150419 | STATOR GA 5 | 1 |
| 17 | 0150300 | ROTOR | 1 |
| 18 | 0150313 | ROTOR VANE | 10 |
| 19 | 0150320 | ROTOR VANE SPRING OUTER | 20 |
| 20 | 0150321 | ROTOR VANE SPRING INNER | 20 |
| 21 | 0150410 | STATOR VANE | 4 |
| 22 | 0150420 | STATOR VANE SPRING | 8 |
| 23 | 0150429 | DOWEL PINS - REAR | 2 |
| 24 | 0150720 | NEEDLE BEARING | 1 |
| 25 | 0150841 | REAR HOUSING, TS, #62 | 1 |
| | 0150842 | REAR HOUSING, TS, #63 | 1 |
| | 0150843 | REAR HOUSING, TS, #64 | 1 |

| | | |
|---|---|---|
| SERIES: 15 | EXPLODED VIEW | MODEL CODE: 015-62-1S-015-30 (31)-B1-TB |
| | | STANDARD TWO SPEED |
| RINEER HYDRAULICS<br>CORPUS CHRISTI, TEXAS | RECORD REFERENCE | DATE: 6-19-00 |
| | DRAWN BY: JERRY W | DWG. NO. 0150044 |

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

## REMOVAL OF SHAFT SEAL

1

1) Remove snap ring

WARNING: Use caution when removing snap ring. If released accidentally it can become an airborne hazard.

2

1) Pry out shaft seal plate with two screw drivers.
2) Remove seal plate o-ring from groove in bearing bore.

## REMOVAL OF WHEEL MOTOR SEAL PLATE AND BEARING BOX

3

1) Loosen and remove 8 each 10-32 bolts.
2) Pry off seal plate with screw driver.

4

Loosen and remove 8 each 3/8" bolts with 5/16" socket head wrench.

5

1) Two of the 3/8" bolt holes are provided with jack screw threads.
2) Insert a piece of 1/4" round stock by 2-1/2" long into each jack screw hole
3) Screw two 7/16-14 bolts into the jack screw threads until the bearing box is free of the motor.

6

Lift up on the bearing box to remove from motor.

## DISASSEMBLY OF WHEEL MOTOR BEARING BOX

7

1) Loosen clamp screw in lock nut.
2) Unscrew lock nut and remove.

8

1) Press shaft out of bearing box.
2) Proceed to step 9, disregarding steps 11 & 12

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

## DISASSEMBLY OF FRONT HOUSING AND SHAFT

9

1) Mark one side of the motor for proper assembly, paying careful attention that the cartridge will not be installed upside down.
2) Secure the motor prior to loosening the 5/8-11 bolts.

10

1) Remove front housing
2) Note: Two 5/16" ball checks and one main body o-ring may be dislodged and fall free.

11

With the seal plate removed, press shaft and ball bearing out of front housing.

12

1) Remove snap ring from shaft.
2) Press shaft out of bearing.

## DISASSEMBLY OF ROTOR/STATOR CARTRIDGE

13

Lift up rotor/stator cartridge and remove from the rear housing.

14

1) Place cartridge on any object which will hold it off the table.
2) Remove two each 10-32 place screws.
3) Remove timing plate.

15

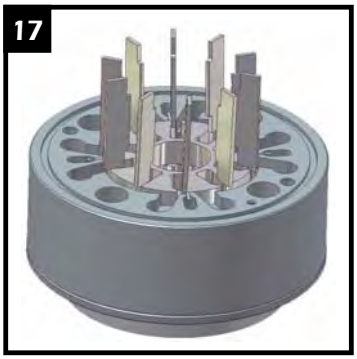
1) Remove o-ring and springs with a small screwdriver.
2) Remove dowels pins.

16

1) Replace plate on rotor/stator cartridge.
2) Turn rotor/stator cartridge over.
3) Repeat steps 14 & 15.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

17



1) Remove the rotor.
2) Remove both the rotor and stator vanes.
3) Note: On motors manufactured prior to 1987, rotor vane slots and rotor vanes should be numbered so that vanes can be reassembled in the same vane slot.

## INSPECTION AND REPLACEMENT OF PARTS

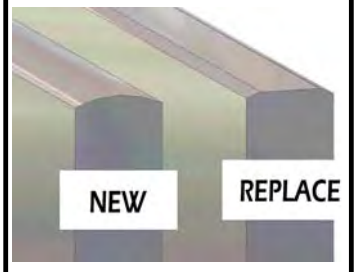
18

Inspect all springs and seals. We recommend replacement of all seals and springs whenever the motor has been disassembled.

19

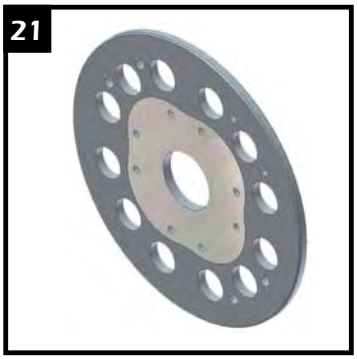
Inspect all parts and replace any parts which obviously show excessive wear or damage.

20




VANES: Normal wear results in slight flattening of vane tips which does not impair motor performance. Replace vane if radius is reduced by 50%. Clearance between the rotor vane and rotor vane slot varies with the vane selection. The design allows the vane to "lean" slightly in the slot, providing the required mechanical seal.

21

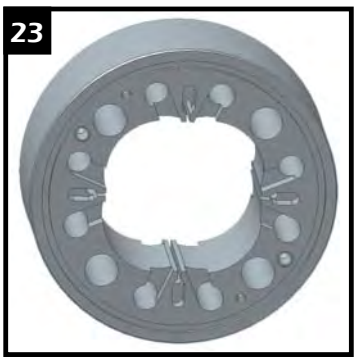


PLATES: Normal wear results in marking of timing plates which does not impair motor performance. Replacement of the timing plate is required if any smearing, galling, or heat cracks are present.

22

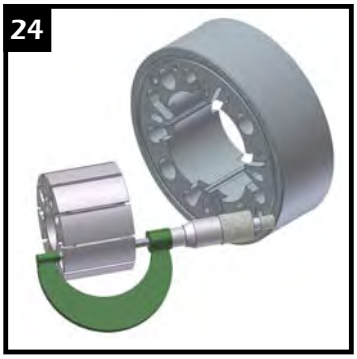
ROTOR: Normal wear results in polishing of rotor faces which does not impair motor performance. Examine the rotor vane slots closely. Polishing down in the slots is normal, but if there is any indication of a "pocket" forming in the wall of the slot, the rotor should be replaced.

23



STATOR: Normal wear results in polishing of cam form which does not impair motor performances. Noticeable wear may be apparent along the corner of one side of the staor vane slot. This does not necessarily require replacement of the stator, but may slightly affect volumetric efficiency.

24



Note: Measure the rotor and stator length to the fourth decimal point and supply measurement when ordering rotor, stator, or vanes.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

## ASSEMBLY OF ROTOR/STATOR CARTRIDGE

25

1) Reverse the procedures in steps 17, 16, 15, and 14
2) NOTE: Make sure that the radiused edge of each stator vane points to the rotor and the radiused edge of each rotor vane points to the stator.
3) NOTE: Make sure springs are seated in the bottom of the spring pocket in both the rotor and stator.

## ASSEMBLY OF FRONT HOUSING

26

1) Press bearing onto shaft.
2) Install snap ring.

27

Press shaft and bearing assembly into front housing by pressing on the outer race of bearing.

28

1) Place seal in seal plate.
2) Place seal plate o-ring into groove in the front housing.
3) Press seal plate into front housing.
4) Install snap ring.
5) Proceed to step 30.

## ASSEMBLY OF WHEEL MOTOR FRONT HOUSING

29

1) Reverse the procedures in steps 8 thru 3.
2) Screw lock nut onto shaft until all threads are engaged.
3) Tighten clamp screw until lock nut turns with a slight drag.
4) Tighten lock nut until desired rolling drag of bearing is obtained - see procedure Page 9.
5) Tighten clamp screw
6) Tighten all seal plate bolts.

## ASSEMBLY OF MOTOR

30

1) Install dowel pins into rear housing.
2) Install ballchecks into rear housings.
3) Install main body o-ring.

31

1) Place rotor/stator cartridge onto rear housing.
2) NOTE: Make sure assembly marks from step 3 are lined up.

32

1) Install main body o-ring into front housing.
2) Install ball checks into front housing.
3) Place a small amount of grease over ball checks and o-ring.
4) Wipe off excess grease.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

**33**

1) Install dowel pins into rotor/stator cartridge.
2) Pour a small amount of clean oil into the cartridge.
3) Install front housing onto rotor/stator cartridge.
4) Make sure alignment marks are lined up.

**34**

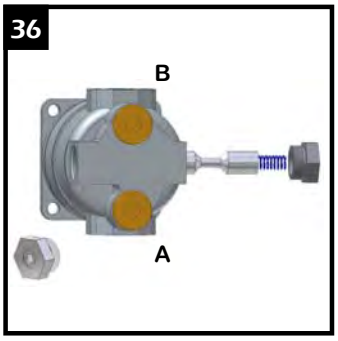
1) Install 5/8-11 bolts.
2) Torque bolts to 50 ft./lbs.

**35**

1) Rotate shaft in both directions to assure that the shaft turns smoothly.
2) Torque motor to 190 ft./lbs.
3) Rotate shaft again in both directions to assure that the shaft turns smoothly.

**SPOOL ASSEMBLY FOR THE TWO SPEED MOTOR**

**36**




NOTE: Spool should be oriented as shown for two speed motors with model codes 62, 63, 68, & 69.

NOTE: Slight design variations may exist in motors manufactured either before or after the printing of this manual.

## WHEEL MOTOR SHAFT AND BEARING ASSEMBLY PROCEDURE

1) Clean ALL assembly parts w/ lacquer thinner.
2) Dip clampnut and clamping bolt separately in lacquer thinner.
   (Steps 3 thru 10 must be conducted to completion ONE assembly at a time.)
3) Press bearing cups into bearing housing. Make sure they are pressed completely against bearing shoulders.
4) Coat inner race of large cone with #609 (green) Loctite and press cone onto the shaft. Make sure the cone is completely against the shoulder of the shaft.
5) Insert shaft and large cone into bearing housing.
6) Coat inner race of small cone with #609 (green) Loctite and press small cone onto shaft.
7) Apply #272 (red) Loctite to the clampnut threads of the shaft. Apply #242 (blue) Loctite to the threads of the clamping bolt and install in the clampnut.
8) Spin clampnut onto shaft with the "B" face towards bearings. After the nut threads are fully engaged, but prior to the nut contacting the bearings, tighten the clamping bolt until there is drag on the clamping nut (see note Fig. 1). Tighten the nut until a 20 to 30 inch pound rolling torque is achieved.
9) Tighten clamping bolt on clampnut to 70 inch pounds and recheck rolling torque. Apply inspectors lacquer to head of the bolt.
10) Allow a minimum of 24 hrs. to dry.

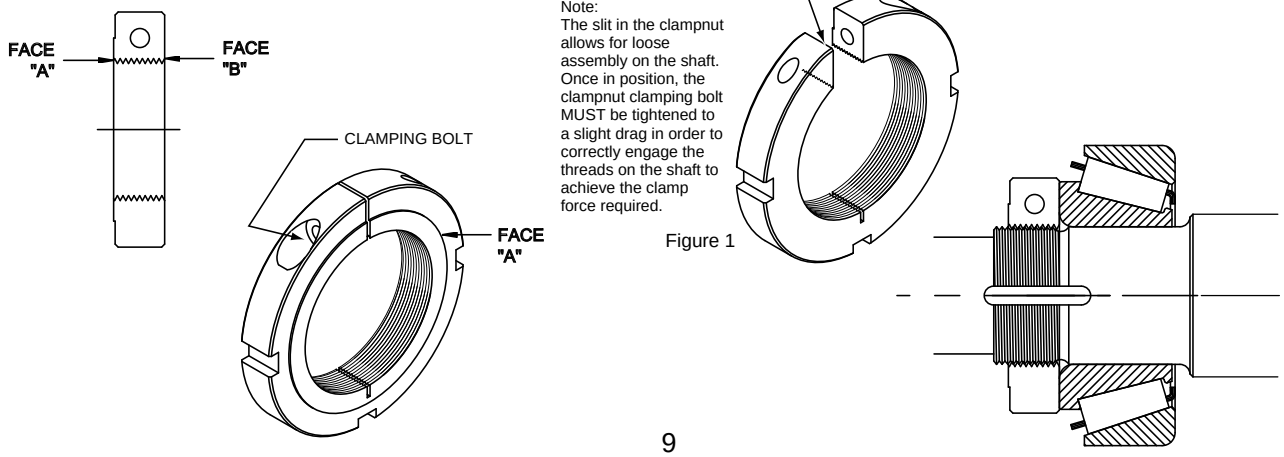



Figure 1

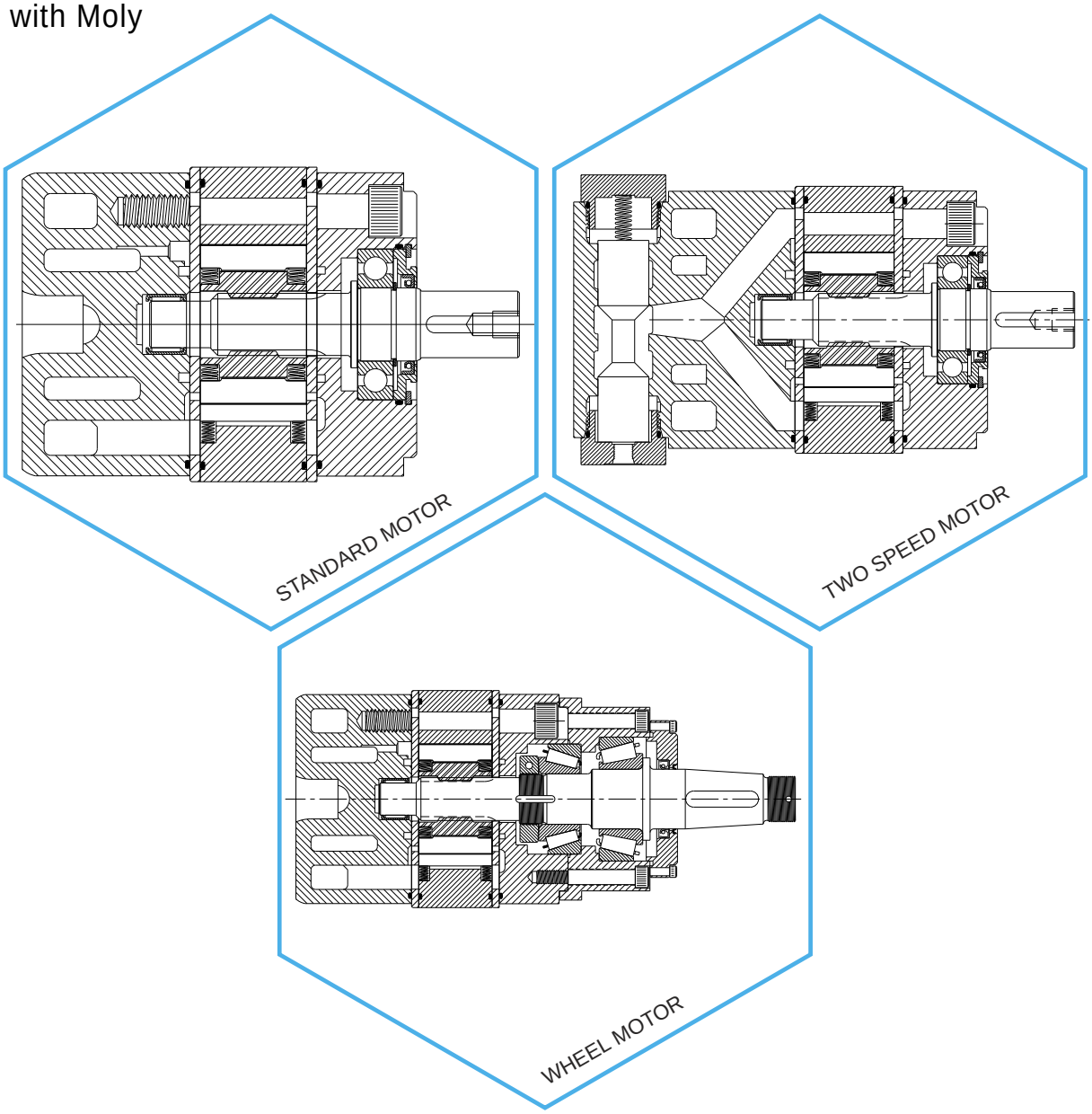
## Information:

Bolt Torque -
- Main Bolts (5/8-11): 190 ft. lbs.
- Seal Plate (3/8-16)
- (Wheel Motor only): 45 ft. lbs.

Grease used for bolt threads and o-ring retention:
- Pennzoil 707L RED

Shaft seal assembly lube:
- Mobilgrease special with Moly

Seal Kits:
- Standard 15 series seal kit #0150940
- Standard 15 two speed seal kit #0150940
- Standard 15 wheel motor seal kit #0150936

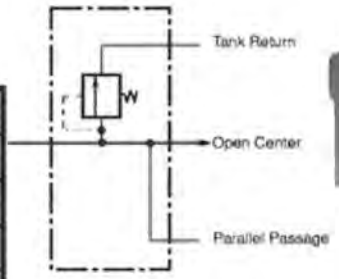


# Inlets (2500 psi)

## End Inlet

| Code | End Port | Top Port |
|---|---|---|
| DVA35-A440 | 1" NPT | 1" NPT |
| DVA35-A880 | SAE-16 | SAE-16 |
| DVA35-A980 | SAE-20 | SAE-16 |
| DVA35-A000 | NON-PORTED HOUSING | |

NOTE: Inlets are machined for a main R/V or R/V plug and are furnished with plastic closures.
See Section G, Page 32 for inlet port plugs




Schematic shown with main R/V

Note: For inlets with solenoid section pilot supply machining, see DVG35 inlet section E1

# Adjustable Relief Valve Cartridges

## For Inlets and Mid-section Inlets

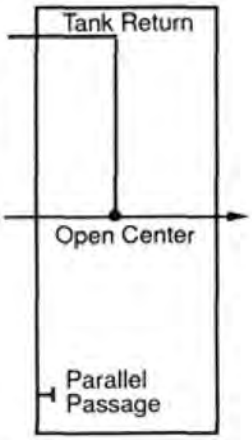
| Code | Description |
|---|---|
| DVA35-MRV-1 | Main R/V pressure range 800-2000 psi. Factory set @ 1500 psi @ 50 gpm |
| DVA35-MRV-2 | Main R/V pressure range 2001-2500 psi. Factory set @2500 psi @ 50 gpm. |
| DVA35-MRVP | Main relief valve plug |

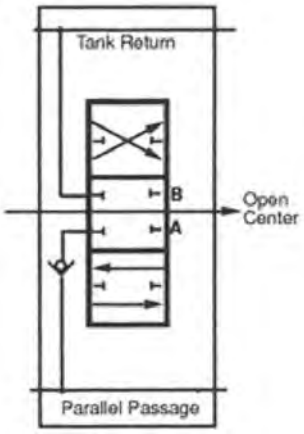
# Outlets

## Tank Return Type

| Code | End Port | Top Port |
|---|---|---|
| DVA35-TR55 | 1 1/4" NPT | 1 1/4" NPT |
| DVA35-TR99 | SAE-20 | SAE-20 |
| DVA35-TR00 | NON-PORTED HOUSING | |

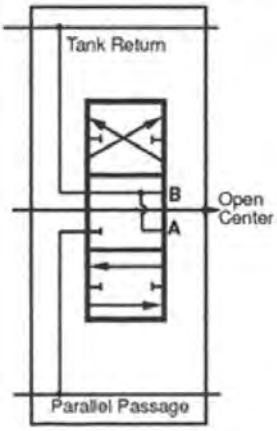
NOTE: See Section G, Page 32 for Port Plugs





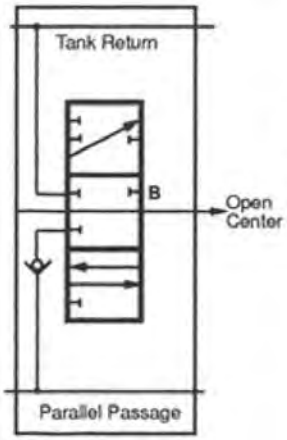

## DA8

Double-Acting Section
4-Way, 3-Position, Hold in Neutral
Cylinder Spool




## MA8

Double-Acting Section
4-Way, 3-Position, Float in Neutral
Motor Spool




## SA8

Single-Acting Section
3-Way, 3-Position, Hold in Neutral
Cylinder Spool

# Brief Circuit Descriptions

## Series Circuit

Available in DVA20 sections only.

If a machine's work cycle requires simultaneous as well as separate operation of individual hydraulic work functions, a series circuit is right for the job.

As with the other circuits, the oil flows through the open center when all spools are in neutral. There is no parallel passage in standard series sections because they feed directly from the open center passage. If more than one spool is operated, pump flow goes first to the section closest to the inlet. Return flow from the first section is fed back into the open center for use by downstream sections.

Downstream sections can be series, parallel or tandem and will operate in series with the upstream section.

In series circuits, operating pressure is cumulative. Therefore, the sum of the pressures in the circuits can not exceed the circuit or main relief valve setting.

## Parallel Circuits

Parallel circuits are the most common on mobile equipment because more than one function can be operated simultaneously and at random. If two or more functions are fully operated at the same time, the one with the lightest load will assert priority because the fluid will take the path of least resistance. However, the operater can divide the flow between functions by metering the spools.

Movement of the spool meters or shuts off the flow of oil thru the open center passage and pressurizes the parallel passage. Oil is then available, at the operator's discretion, to all work ports connected to the parallel passage.

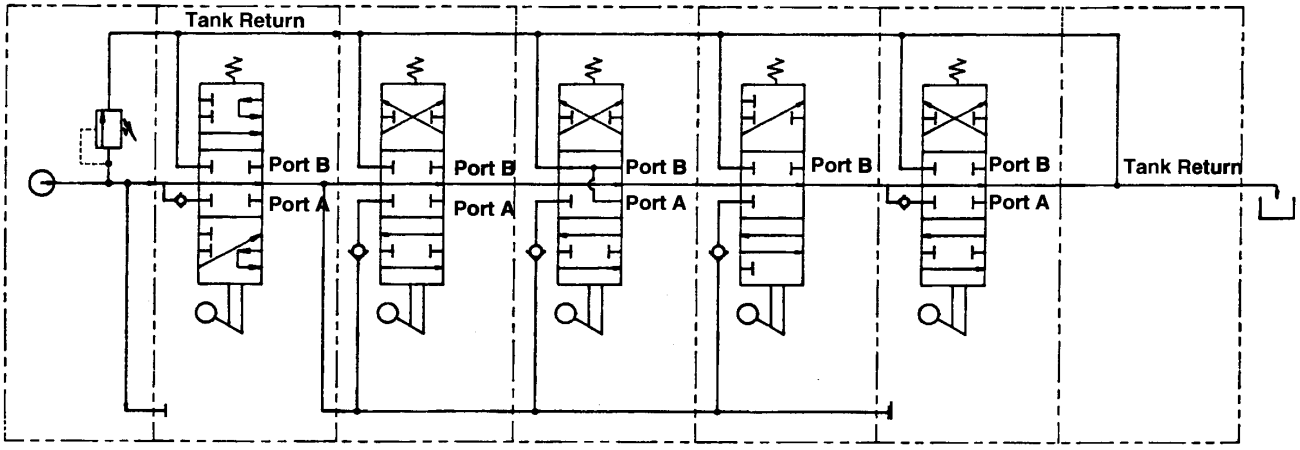
## Tandem Circuits

(Not available in the program)

Tandem circuits are sometimes called priority or standard circuits by other manufacturers. Tandem sections feed from the open center passage like series sections but the return flow is directed to the tank return passage and is not available downstream.

If a tandem section is followed by a series or tandem section, operating the tandem section nearest the inlet will assert priority and downstream sections will not function.

# Typical Work Section Schematics



# Lo-Boy Work Sections -- Parallel Circuits

| Code | 4-Way 3-Position Hold In Neutral | 3-Way 3-Position Hold In Neutral | 4-Way 3-Position Float In Neutral | 4-Way 4-Position Float Position Detented | Port Size | Work Port NOT Machined | Spring Return | 3-Position Detent | Metered Hydraulic Remote Control | Solenoid Operated | Air Shift | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DVA35-DAO | • | | | | | • | • | | | | | | |
| DVA35-DA4 | • | | | | 1"NPT | | • | | | | | | |
| DVA35-DA8 | • | | | | SAE-16 | | • | | | | | | |
| DVA35-SAO | | • | | | | • | • | | | | | | |
| DVA35-SA4 | | • | | | 1" NPT | | • | | | | | | |
| DVA35-SA8 | | • | | | SAE-16 | | • | | | | | | |
| DVA35-MA0 | | | • | | | • | • | | | | | | |
| DVA35-MA4 | | | • | | 1" NPT | | • | | | | | | |
| DVA35-MA8 | | | • | | SAE-16 | | • | | | | | | |
| DVA35-DK8-12V | • | | | | SAE-16 | | | | | • 12 VDC | | | |
| DVA35-DK8-24V | • | | | | SAE-16 | | | | | • 24 VDC | | | |
| DVA35-DX4 | • | | | | 1" NPT | | | | • | | | | |
| DVA35-DX8 | • | | | | SAE-16 | | | | • | | | | |
| DVA35-DV4 | • | | | | 1" NPT | | | | | | • | | |
| DVA35-DV8 | • | | | | SAE-16 | | | | | | • | | |
| DVA35-MX4 | | | • | | 1" NPT | | | | • | | | | |
| DVA35-MX8 | | | • | | SAE-16 | | | | • | | | | |
| DVA35-DB4 | • | | | | 1" NPT | | | • | | | | | |
| DVA35-DB8 | • | | | | SAE-16 | | | • | | | | | |
| DVA35-SB4 | | • | | | 1"NPT | | | • | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

Note: See Section G, Page 33 for section seal kits.
Codes outside of the shaded area may require increased lead time.
Most codes outside the shaded area can be made from codes inside the area and kits on page 33.
Solenoids are furnished with spade connectors
Machining instructions for standard housings are included in solenoid kits.

# VA™/VG™ Valve Service Instructions

## INTRODUCTION

This manual has been prepared to assist you in the proper maintenance of the VA20™/VA35™ and VG20™/VG35™/VG80™ directional control valves. Before any work is done, we suggest that you read the assembly and disassembly instructions completely.

The first rule of good maintenance is cleanliness, which includes a clean environment. MAKE SURE YOU DISASSEMBLE AND ASSEMBLE YOUR HYDRAULIC EQUIPMENT IN A CLEAN AREA. Dirt is the natural enemy of any hydraulic system.

## GENERAL INFORMATION

The VA and VG model valves are updated versions of our proven A20™ and A35™ units. The VG models are cast from compacted graphite, a high strength iron alloy, which allows the valve to be rated to 3500 psi. VA models are cast from gray iron and are rated at 2500 psi. These open-center, directional-control valves are available in parallel, tandem, and series circuitry. As needed, the sectional, stack-type construction provides flexibility for the addition of subtraction of work sections to an existing valve bank. This design also permits the combination of parallel, tandem, and series circuitry in a single bank. The internal coring of each valve section determines its circuitry and the number of gasket seals required.

All sections with optional features, such as port relief valves, crossover relief valves, and anti-cavitation checks, are dimensionally larger when measured from the top of the port to the bottom of the housing. These are referred to as "hi-boy" sections. Those without work-port options can use the low-profile castings, which are called "lo-boy" sections.

## REPLACEMENT PARTS

The illustrations and instructions in this manual apply only to the VA/VG series assemblies, subassemblies, and components. All valve components, except for spools and housings, are available as replacement parts or subassemblies. Spools are hone-fitted to their individual housings, so damage to either of these components means the entire section must be replaced.

We recommend that you use only genuine VA/VG series replacement parts in your service program. Manufactured to the same exacting tolerances and quality controls as the original equipment, genuine VA/VG replacement parts may help prevent premature, component failure and costly downtime. Service parts and assemblies are available through your original equipment dealer or any authorized distributor.

## MAINTENANCE

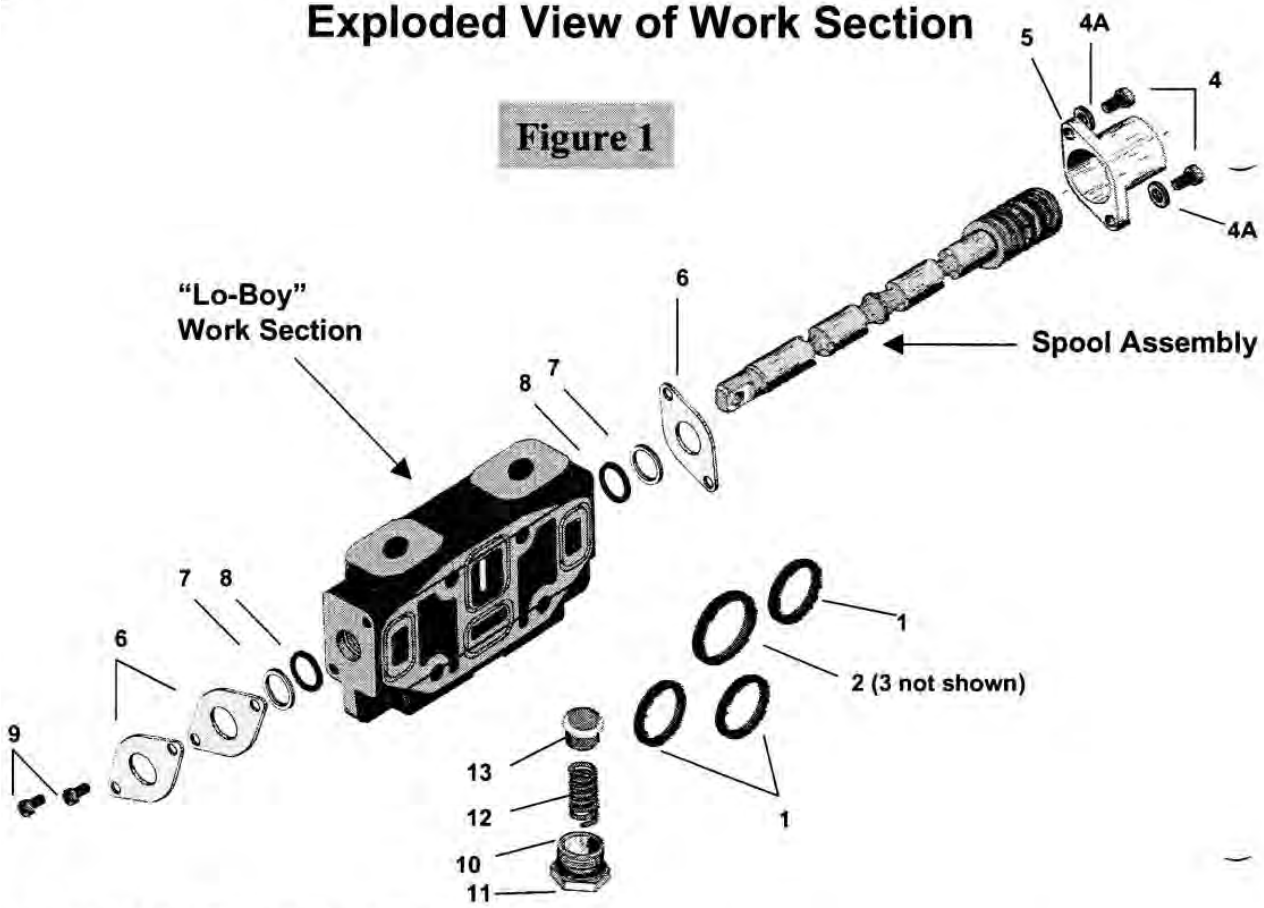
Valves are often used in hazardous environments. Inspect them frequently for damage due to improper use, corrosion or normal wear. If needed, repairs should be made immediately.

**Always refer to the machine manual for the proper procedure to remove the valve from the machine.**

Remove the valve bank from the equipment, disconnecting all hoses, fittings, control handles and linkage connectors that might be attached to the valve. Plug all ports and thoroughly clean the exterior of the valve bank, then the port plugs can be removed.

# Exploded View of Work Section

Figure 1



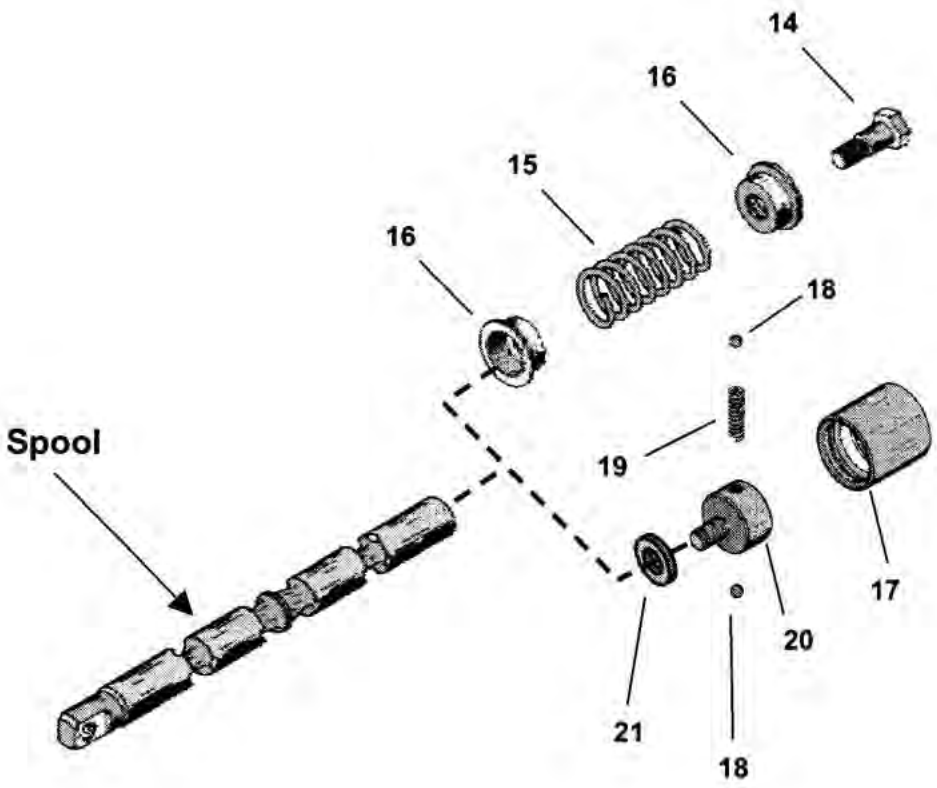

## Parts List For Work Section

| Item | Description | Qty. | VA/VG20 Part No. | VA/VG35 Part No. | VG80 Part No. |
|---|---|---|---|---|---|
| **Parallel Section Seals* See Figure 1** | | | | | |
| 1. | Square Seals | 3 | 391-2881-206 | 391-2881-200 | 391-2881-433 |
| 2. | Square Seal | 1 | 391-2881-200 | 391-2881-403 | 391-2881-670 |
| **Series Section Seals** | | | | | |
| 1. | Square Seals | 2 | 391-2881-206 | 391-2881-200 | ..... |
| 3. | Square Seal | 1 | 391-2881-627 | 391-2881-628 | ..... |
| **Parallel and Series Section Component Parts. See Figure 1** | | | | | |
| 4. | Back Cap Screws | 2 | 391-1433-020 | 391-1433-009 | (4) 391-1402-068 |
| 4A. | Lock washers | 8 | ..... | ..... | 391-3783-039 |
| 5. | Back Cap | 1 | 341-6000-100 | 342-6000-100 | 341-0585-099 |
| 6. | Retainer Plates | 3 | 391-2183-001 | 391-2183-005 | 391-2183-157 |
| 7. | Back up Rings | 2 | 391-2681-378 | 391-2681-426 | 391-2681-285 |
| 8. | Spool Seals | 2 | 391-1985-014 | 391-2887-212 | 391-2881-096 |
| 9. | Retainer Plate Screws | 2 | 391-1433-015 | 391-1433-002 | (4) 391-1402-015 |
| 10. | Check Valve Cap | 1 | 391-0581-044 | 391-0581-044 | 391-0585-099 |
| | Or Valve Cap (F.I.N.) | 1 | 391-2281-015 | 391-2281-015 | ..... |
| 11. | O Ring Seal ** | 1 | 391-2881-204 | 391-2881-204 | 391-2881-249 |
| 12. | Check Spring ** | 1 | 391-3581-713 | 391-3581-713 | 391-3581-778 |
| 13. | Check Valve Poppet ** | 1 | 391-2481-069 | 391-2481-069 | 391-2383-091 |

*Parallel Sealing Face includes inlets and mid-inlets.

**Not required in Float-in-neutral Sections.

## Figure 2



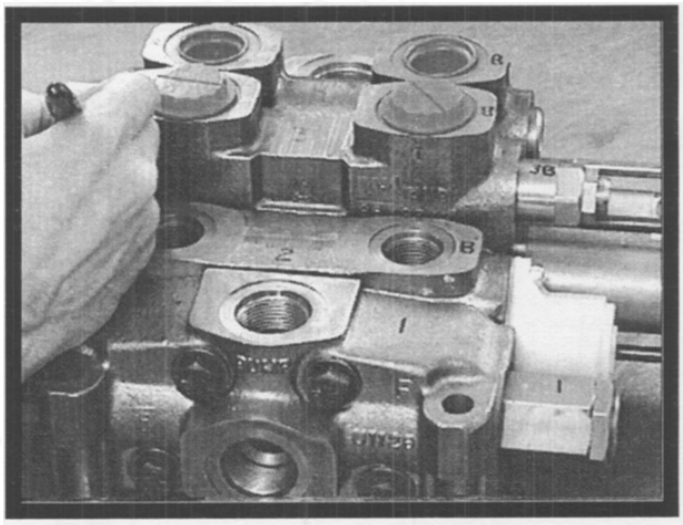

### Spring Centered and Detent Spool Operators. See Figure 2

| | | | | |
|---|---|---|---|---|
| 14.Stripper Bolt | 1 | 391-1432-022 | 391-1432-021 | 391-1402-452 |
| 15.Centering Spring | 1 | 391-3581-608 | 391-3581-633 | 391-3581-330 |
| 16.Spring Guides | 2 | 391-1642-045 | 391-1642-013 | 391-1642-161 |
| 17.Detent Sleeve | 1 | 391-3283-015 | 391-3283-008 | 391-3384-310 |
| 18.Detent Balls | 2 | 391-0282-010 | 391-0282-009 | 391-0282-011 |
| 19.Detent Spring | 1 | 391-3581-130 | 391-3581-015 | 391-3581-316 |
| 20.Detent Poppet Retainer | 1 | 391-2583-008 | 391-2583-006 | 391-3384-311 |
| 21.Detent Spacer | 1 | ..... | ..... | 391-3782-208 |

4

# Valve Disassembly Instructions

**Reference exploded view and parts list on page 2 and 3 for work section detail.**



## Step 1 - Valve Bank

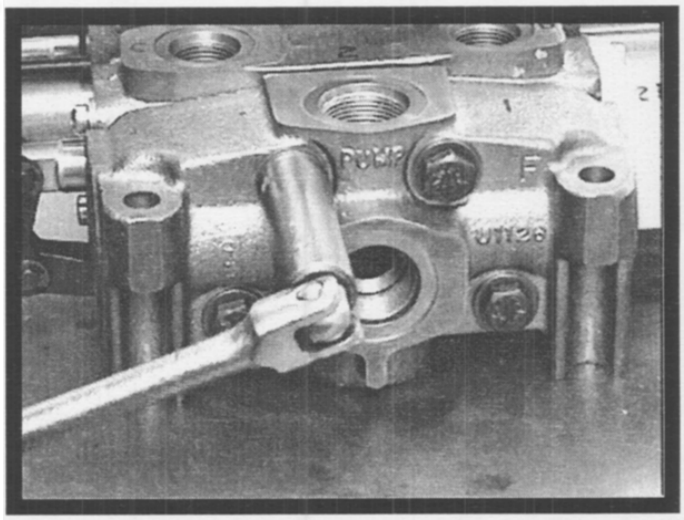
This step is the most critical in the disassembly procedure. It should be followed closely to ensure that the valve bank is properly reassembled after repairs have been made.

With a waterproof, quick-drying marker, mark each casting with a sequential number. Start by marking the inlet casting with the #1 and finish by marking the outlet with the highest number.

Next, mark the port boss closest to the back cap on each work section with a "B" (for back cap end).

Then, mark the port boss closest to the spool clevis on each work section with a "C" (for clevis end).

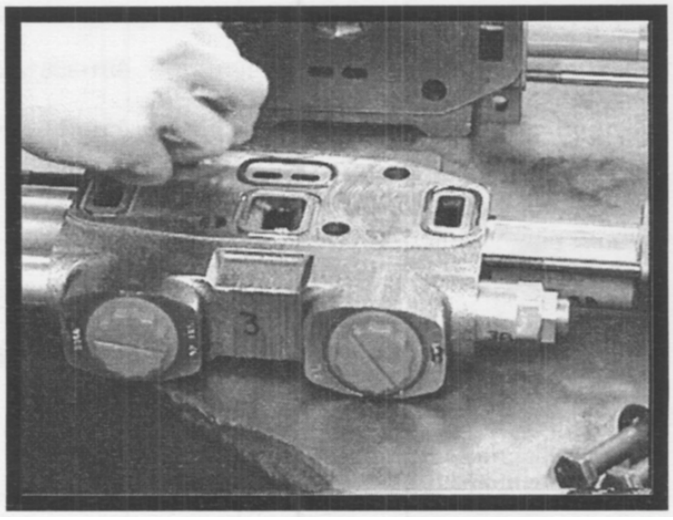
Finally, if relief valves are removed from the valve bank they must be marked with the corresponding number of the casting and port location (B or C) from which they were removed. Inlet and mid-inlet relief valves are marked with a casting number only.



## Step 2 - Tie Bolts

Remove the four, tie bolts that hold the bank together and separate the sections.

**NOTE: VA valve tie bolts thread into the outlet casting. VG valve tie bolts pass through the entire bank, requiring washers and hex nuts to be fastened at both ends of the bolt.**



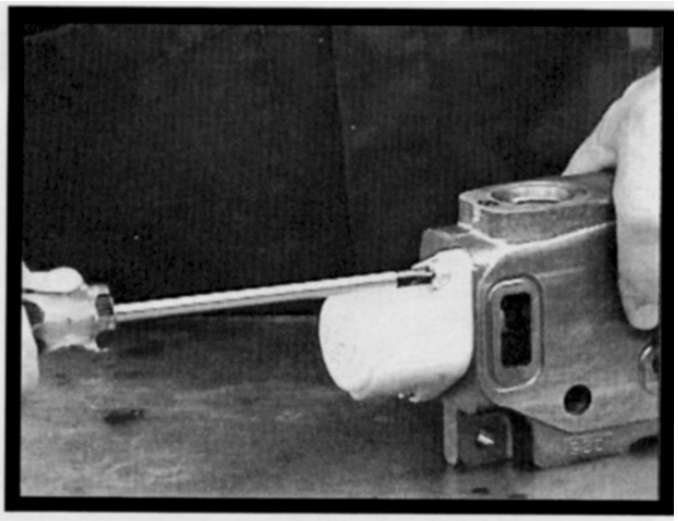
## Step 3 - Section Seals

The inlet, mid-inlet and each parallel work section have four, section seals, (Fig. 1, items 1 & 2) on the downstream, mating face. Series work sections and the VA/VG35 split flow mid inlets have three section seals on the downstream mating face, (Fig. 1, items 1 & 3.) These section seals should be removed and discarded.

**REMINDER: ALL WORK MUST BE PERFORMED IN A CLEAN AREA.**

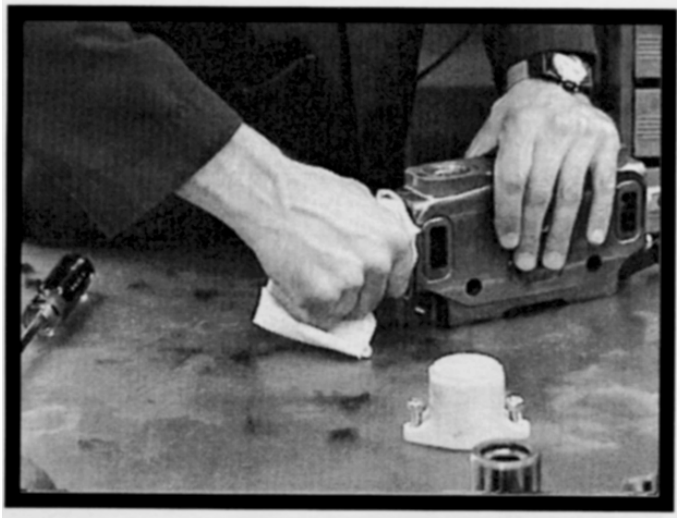
# Valve Disassembly Instructions





## Step 4 - Valve Back Cap

Using a large, Phillips-head screwdriver, remove the two, cap screws (Fig. 1, item 4) which fasten the back cap to the work section. Lightly tap the end of the screwdriver handle with a hammer to break adhesive. Remove the back cap (Fig. 1, item 5).

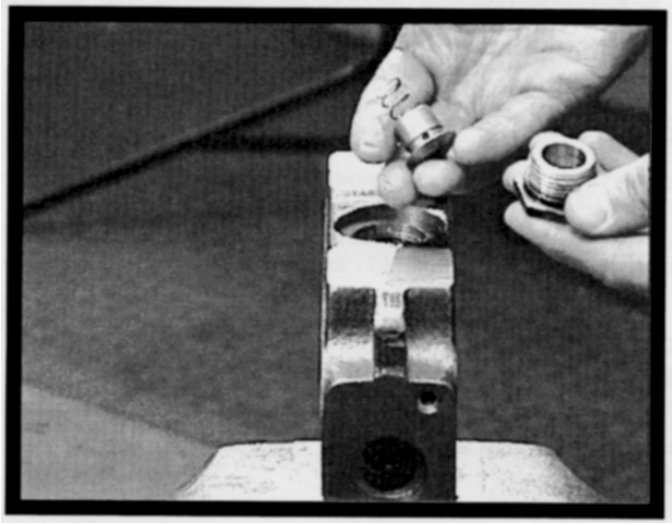


## Step 5 - Control Spool and Seals

Grasp the spring end of the spool with a clean, lint-free cloth and pull the spool out of the housing using a twisting motion. Generally, the rear, retainer plate (Fig. 1, item 6 ) back-up ring (Fig. 1, item 7) and spool seal (Fig. 1, item 8) will come out with the spool.

**CAUTION: For detented spool models, be careful not to remove the detent poppet sleeve (Fig. 2, item 17) unless it is to be serviced.**

Using a large, Phillips-head screwdriver, remove the two, retainer-plate screws (Fig. 1, item 9) from the spool clevis end of the work section. Lightly tap the end of the screwdriver handle with a hammer to break the adhesive. Remove the two, retainer plates (Fig. 1, item 6) the back-up ring (Fig. 1, item 7) and the spool seal (Fig. 1, item 8). Tag or mark with the appropriate, work section identification number. (See Step 1.) Spool seals (Fig. 1, item 8) and back-up rings (Fig. 1, item 7) should be discarded.



## Step 6 - Transition Check

The transition check is located in the bottom center of the work section housing. Carefully clamp the work section in a vise with ports down. Do not clamp on the machined surface. Remove the check-valve cap (Fig. 1, item 10) and its O-ring seal (Fig. 1, item 11). Discard the seal. Remove the check spring (Fig. 1, item 12,) and the check-valve poppet (Fig. 1, item 13).

**NOTE: Only cylinder work sections (ports blocked in neutral) have a transition check. Motor sections have only a cap plug.**

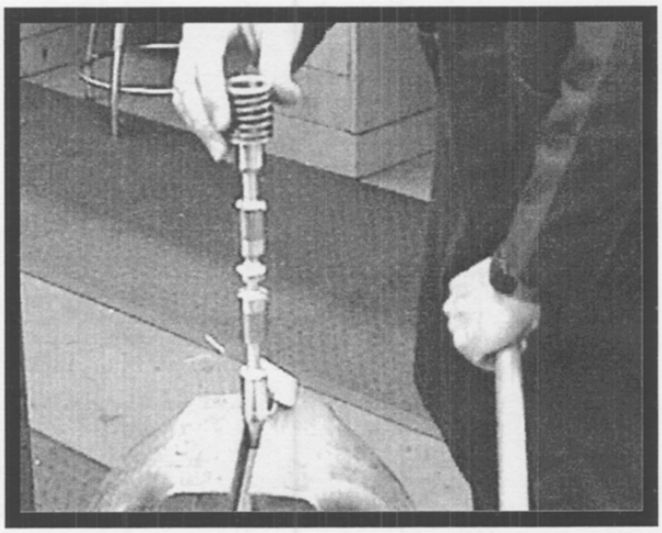
6

# Valve Disassembly Instructions

## Spool Disassembly

### Spring Centered Spool

The spring assembly should not be removed from the spool unless these parts need to be replaced. Once the spool is free of the work section housing, it must be handled carefully to avoid damage. Place the spool vertically in a soft-jawed vise, clamping on the flat, spool clevis, and remove the stripper bolt (Fig. 1, item 14) with a wrench.



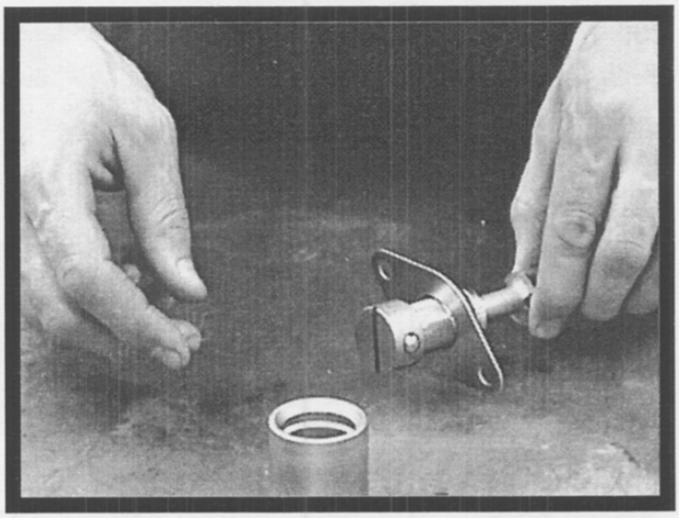
Lightly tap the stripper bolt with a hammer and a punch to help break the adhesive. Cautious application of heat may be required to free the stripper bolt, since an anaerobic thread adhesive was used during its assembly.

**CAUTION: Too much heat may distort the spool.**

As the stripper-bolt threads disengage, the spring (Fig. 2, item 15) and spring guides (Fig. 2, item 16) will release abruptly from the spool.

### Detent Spool

The detent assembly should not be removed from the spool unless these parts need to be replaced. Wrap the detent sleeve (Fig. 2, item 17) with a clean, lint-free cloth. Grip the cloth-covered sleeve and pull firmly. As the sleeve moves backwards, the detent balls (Fig. 2, item 18) and the detent spring (Fig. 2, item 19) will release abruptly. The cloth should capture these parts and prevent their loss.



Next, clamp the spool in a soft-jawed vise and remove the detent poppet retainer (Fig. 2, item 20). Place an undersized bar through the detent ball bore to serve as a wrench. Lightly tap the detent poppet retainer with a hammer and a punch to help break the adhesive. Cautious application of heat may be required again, since an anaerobic adhesive was also used in the detent retainer assembly.

**CAUTION: Too much heat may distort the spool!**

## CLEANING, INSPECTION, AND REPAIR

1. Inspect the spool bore, transition check seat and spool from each section for deep scratches, gouges or excessive wear. If any of these conditions exist, replace the section. Minor, surface damage on the control spool and check poppet can be carefully polished away with a very fine, crocus cloth.

2. Examine the machined surfaces of the valve housing for nicks and burrs that could cause leakage between sections. Lightly stone these surfaces to remove any rough spots.

**CAUTION: A shallow-milled relief area extends across the O-ring face of the valve housing. This should not be stoned or ground off!**

3. Wash all parts thoroughly in a cleaning solvent and blow dry before beginning reassembly. Pay special attention to the number and letters marked on the parts in Step 1. If any marks are removed during cleaning, re-mark immediately.

4. Clean adhesive from threads of spool, stripper bolt, housing, cap screws and hex nut with Loctite™ Chisel Gasket Remover.

# Valve Assembly Instructions

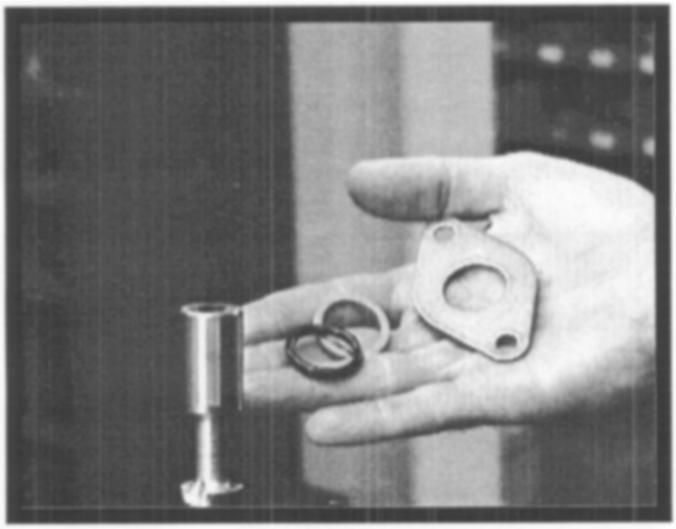


## Preparation of Parts

Spray the threads of the new stripper bolt (Fig. 2, item 14) tapped-threaded spool end, all screws and screw holes on both ends of the housing with LOCQUIC Primer Grade NF™ and let dry.

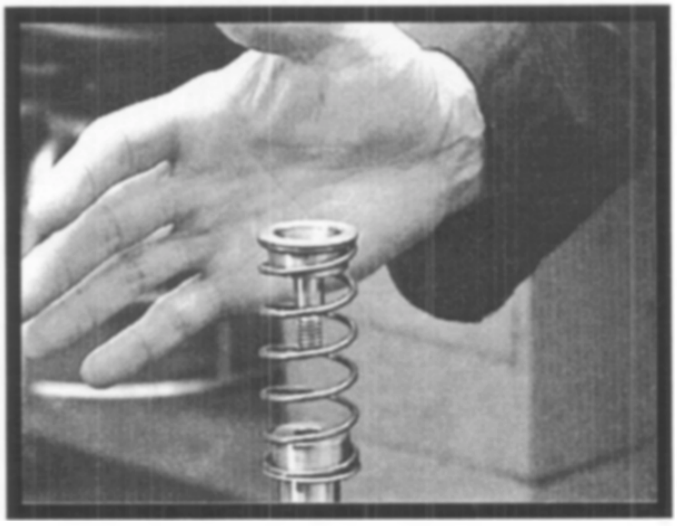
**CAUTION: Failure to follow the recommended assembly instructions can result in poor performance or product malfunction. Product should be thoroughly tested to ensure proper operation before the valve is placed back into service.**

## Spring Center Spool Assembly



### Step 1 - Spool Assembly-Spring Centered

Clamp the flat, clevis end of the control spool in a soft jawed vise. Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8 ) and slide it onto the end of the spool away from the clevis. Slide on the back-up ring (Fig. 1, item 7) and retainer plate (Fig. 1, item 6). Position these items onto the spool, so that they do not interfere with the spool operator mechanism during assembly. Do not allow the O-ring to come in contact with the sharp edge of the spool notches.



### Step 2 - Attach Spring Guides and Spring

Apply 2 - 3 drops of Loctite 262™ or equivalent anaerobic adhesive near the middle of the female threads in the spool. Assemble the spring guides (Fig. 2, item 16) centering spring (Fig. 2, item 15 ) and stripper bolt (Fig.2, item 14, ) onto the spool (Reverse of Step 7). Torque the stripper bolt to 175 in. lbs. +/-4 in. lbs.

**CAUTION: Care must be taken to ensure that the spring retainer is not pinched under the shoulder bolt during assembly. This can result in burrs that may cause spool binding. Check for binding by compressing the spring and guides or by rotating the spring guide nearest the housing.**

**CAUTION: Follow the adhesive manufacturer's instructions for proper cleaning and curing. Failure to clean and prepare parts properly may result in assembly failure!**

Lightly coat the centering spring with high- temperature grease to prevent rusting. Set the spool assembly aside and let it cure for a minimum of 1 hour. After curing, test the stripper bolt to make certain it can withstand 125 in. lbs. of breakaway torque.

8

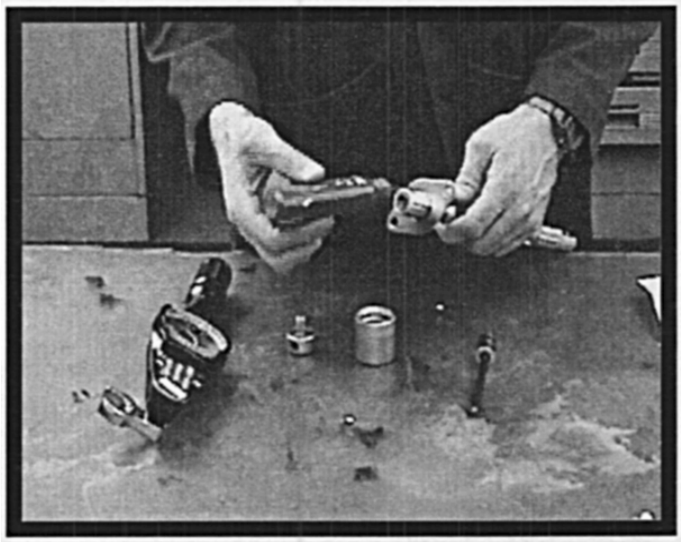
# Valve Assembly Instructions

## Detent Spool Assembly

### Step 1 - Spool Assembly-Detent

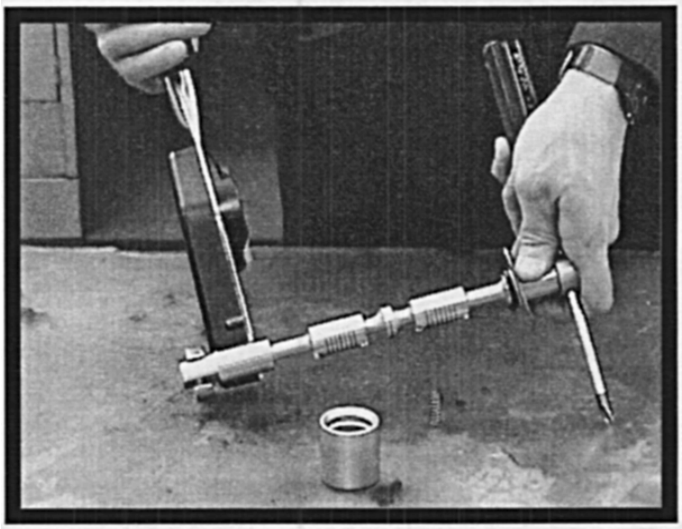
Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the spool. Slide the back-up ring (Fig. 1, item 7) and one, retainer plate (Fig. 1 item 6) onto the spool. Position these items onto the spool, so that they do not interfere with the spool operator mechanism during assembly. Do not allow the O-ring to come in contact with the sharp edge of the spool notches. Apply 2 - 3 drops of Loctite 262™ or an equivalent, anaerobic adhesive near the middle of the female threads in the spool.

**CAUTION: Follow the adhesive manufacturer's instructions for proper cleaning and curing. Failure to clean and prepare parts properly may result in assembly failure.**



### Step 2 - Spool Assembly-Detent

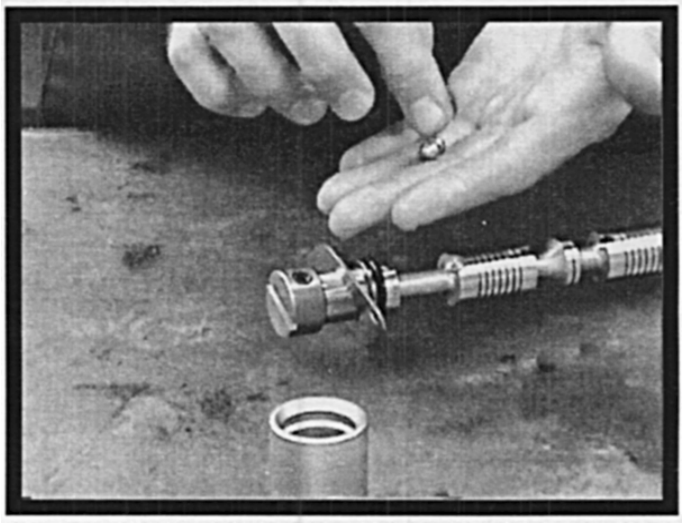
Thread the detent ball retainer (Fig. 2, item 20) into the spool end. Torque the detent ball retainer to 175 in. lbs. +/-4 in. lbs.. This can be accomplished by using a crows-foot socket on the flats of the clevis, and holding the spool by inserting a round, steel rod or screwdriver through the hole in the ball retainer.



### Step 3 - Detent Balls and Spring

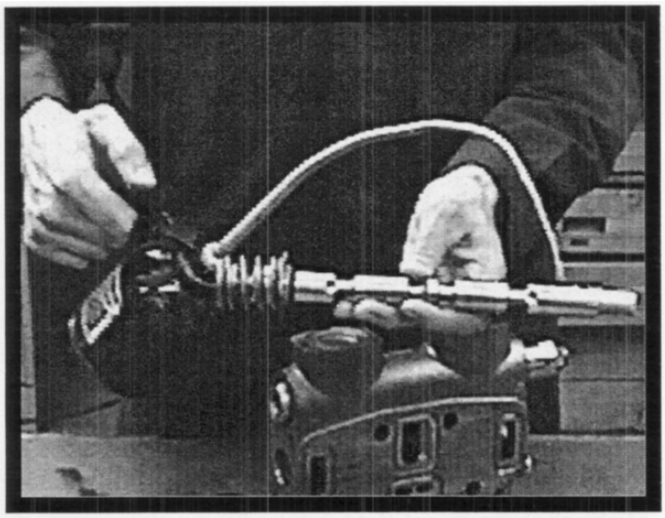
Next, lightly coat the detent balls (Fig. 2, item 18) detent spring (Fig. 2, item 19) and entire inside diameter of the detent sleeve (Fig. 2, item 17) with high-temperature grease.

Insert the detent spring into the through hole in the detent ball retainer. Place the steel balls on the ends of the spring. Compress the balls and spring, then slip on the detent sleeve. (Note: The detent sleeve is not symmetrical; one end of the sleeve has a lead-in chamfer. This chamfer must face the spool clevis when assembled.) Move the detent sleeve to the neutral or middle position to prevent the subassembly from separating during subsequent steps.



# Valve Assembly Instructions

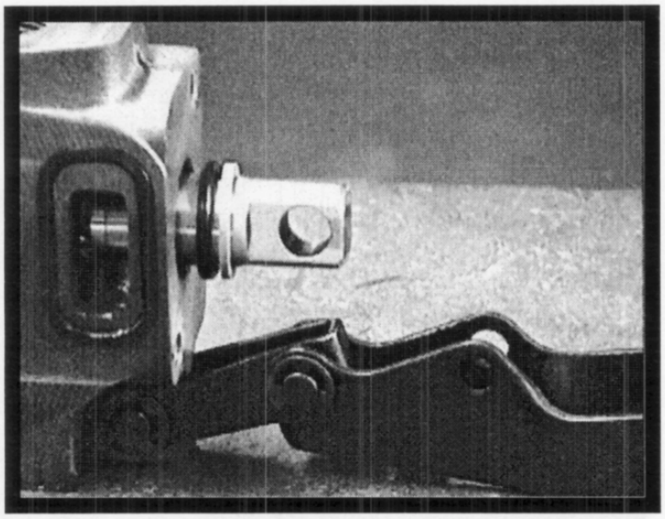




## Step 1 - Spool Subassembly

Apply 2 - 3 drops of Loctite 262™ or equivalent to the fillister screw holes on both ends of the housing.

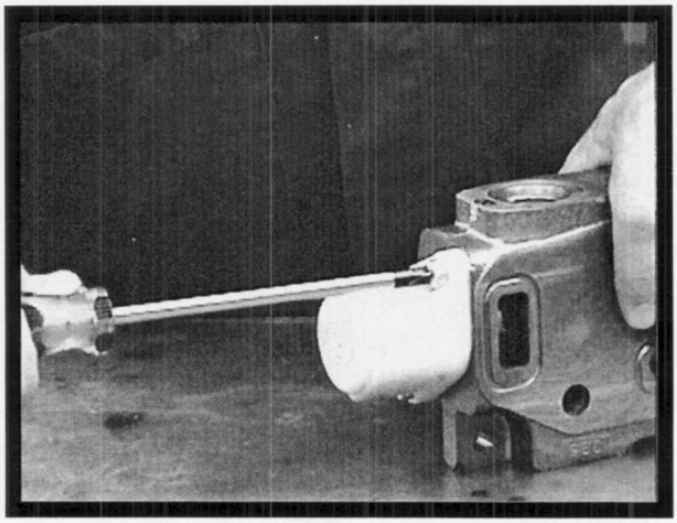
Apply a light coating of clean, hydraulic oil to the valve spool. Carefully insert the spool assembly into the housing. Use caution to avoid causing burrs. Be careful not to pinch, roll or damage the seals. Make sure that the spool and housing are in the proper orientation (see Step 1, page 6 disassembly).



## Step 2 - Spool Seal and Back up

Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the spool. Slide on the back-up ring (Fig. 1, item 7). Push both items into the counter-bore until they bottom out.

Assemble the two, front, retainer plates (Fig. 1, item 6) using the two short, fillister screws (Fig. 1, item 9). Check retainer plates for proper alignment. Tighten to a final torque of 34 in. lbs. +/- 2 in. lbs..



## Step 3 - Back cap

Install the back cap using the two, long, fillister screws (Fig. 1, item 4). Tighten to a final torque of 34 in. lbs. +/- 2 in. lbs.

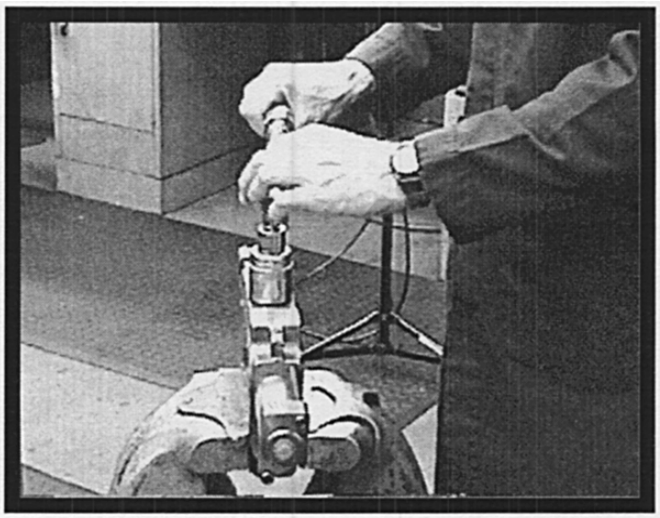
**Caution: Excessive torque will damage the back cap ears!**

10

# Valve Assembly Instructions

## Step 4 - Install Transition Check

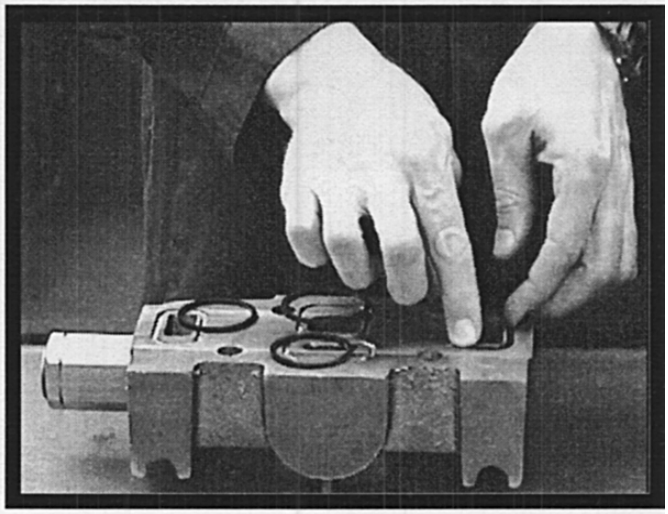
Inspect transition check components for cleanliness. Install check poppet (Fig. 1, item 13) into the transition check cavity. Align the check spring (Fig. 1, item 12) square to the poppet, then carefully place the check cap (Fig. 1, item 11) over the poppet and spring. Turning by hand, engage several threads. Tighten to a final torque of 75 ft. lbs. +/-4ft. lbs..



## Step 5 - Relief Valves

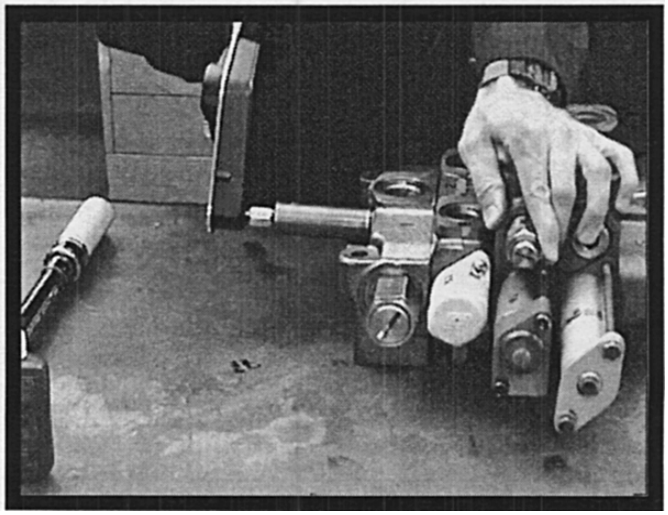
Return all relief valves to their proper positions and torque to 75 ft. lbs.

Install new, section seals. Place section seals (Fig. 1, items 1 & 2, or items 1 & 3) in the proper grooves. Make certain seals stay in their grooves during assembly.



## Step 6 - Install Tie Bolts

Slide the tie bolts through the inlet casting. If cap screws are used, place a washer on the cap screw prior to installation. Place the valve sections on the tie bolts in their proper sequence (see Step 1, page 4). Turning by hand, engage several threads in the outlet. If it is a VG series assembly, assemble nut and washer to either end of the stud and follow above instructions. Torque the tie bolts in a cross-corner pattern.



**Tie Bolt Torque Values**

**VA20 - 29 ft. lbs. (348 in. lbs.)**
**VG20 - 42 ft. lbs. (504 in. lbs.)**
**VA35 - 34 ft. lbs. (408 in. lbs.)**
**VG35 - 75 ft. lbs. (900 in. lbs.)**
**VG80 - 150 ft. lbs. (1800 in. lbs.)**

28

# Troubleshooting

| TROUBLE | PROBABLE CAUSE | REMEDY |
|---|---|---|
| Oil leaks between sections | Pinched, blown or missing section seal | Replace section seal |
| | Stud fasteners not correctly torqued | Replace section seals and re-torque |
| | Mounting plate not level | Loosen mounting bolts and shim as required |
| | Contamination/burrs on seal | Clean seal groove, replace section seal |
| Oil leaks at either end of spool | Over-pressurized tank core | Correct high, back-pressure condition |
| | Worn or damaged spool seals | Replace seals and seal retainers |
| Spring - centered spools do not return to neutral | Broken centering spring | Replace centering spring |
| | Misalignment of operating linkage | Check linkage for mechanical binding |
| | Foreign particles in system | Clean valve and system |
| Load will not hold | Cylinder leaking or worn | Check cylinder - repair |
| | Port relief valve not holding | Remove and clean or replace |
| | Spool or housing scored or worn excessively | Replace section |
| Load drops when spool moved from neutral | Dirt or foreign particles lodged between check-valve poppet and seat | Disassemble, clean & reassemble |
| | Scored or sticking check-valve poppet | Replace poppet |
| No motion, slow, or erratic system operation | Worn pump | Check flow & pressure |
| | Defective cylinder or motor | Repair or replace |
| | Low-reservoir oil level | Add oil to specifications |
| | Clogged suction strainer | Clean or replace |
| | Suction line restricted | Check lines |
| | Relief valve not properly set | Check pressure setting |
| | Relief valve poppet or seat scored & sticking open | Replace relief valve |
| | Valve spool not shifted to full stroke | Check spool linkage travel |

## Pilot-to-open, spring biased closed, unbalanced poppet logic element

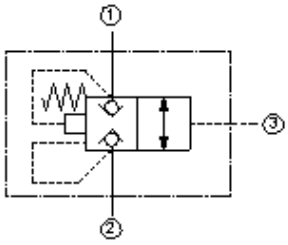
Capacity:
**60 gpm (240 L/min.)**

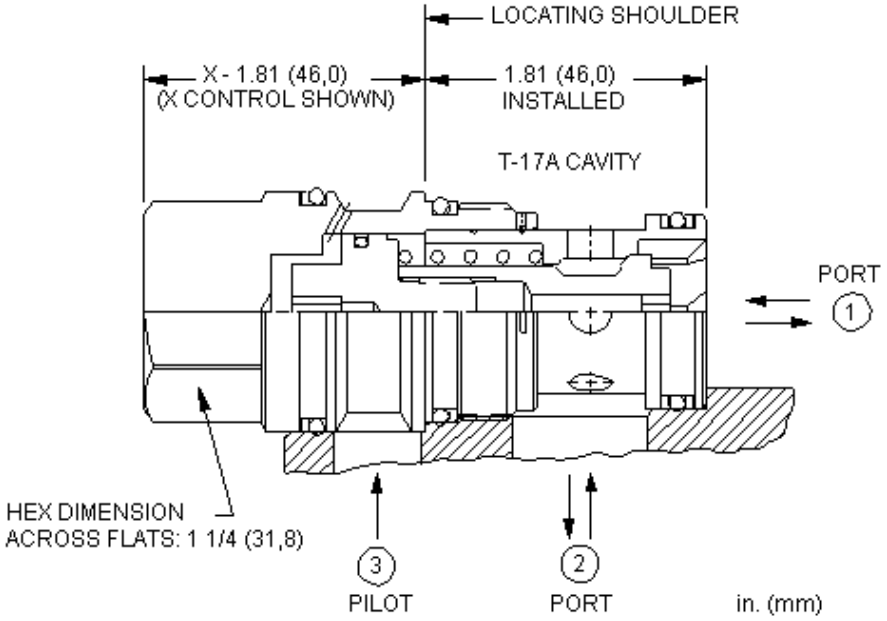
Functional Group:
**Products : Cartridges : Corrosion Resistant : Logic Element : Unbalanced Poppet, Pilot-to-open, Switching Element, Spring biased closed, External Pilot Port 3 pilot source**

Model:
**LKHC**

### Product Description

These unbalanced poppet, logic valves are 2-way switching elements that are spring-biased closed. Pressure at either work port 1 or 2 will further bias the valve to the closed position while pressure at port 3 will tend to open it. The force generated at port 3 must be greater than the sum of the forces acting at port 1 and port 2 plus the spring force for the valve to open. NOTE: The pilot area (port 3) is 1.8 times the area at port 1 and 2.25 times the area at port 2.



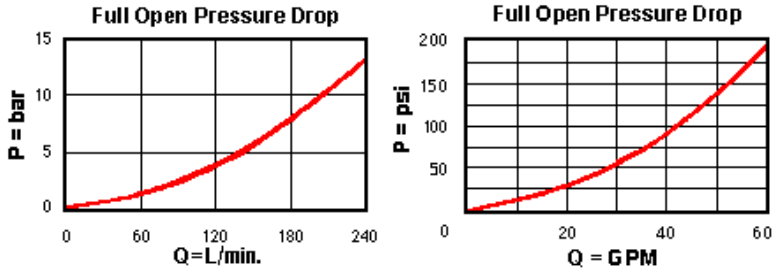

### Technical Features

- Because these valves are unbalanced, operation is pressure dependent. Opening and closing of the poppet are functions of the force balances on three areas: 1) Port 1 = 100%, Port 2 = 80%, and Port 3 = 180%.
- These valves are pressure responsive at all three ports, therefore it is essential to consider all aspects of system operation through a complete cycle. Pressure changes at any one port may cause a valve to switch from a closed to an open position, or vice versa. All possible pressure changes in the complete circuit must be considered to assure a safe, functional system design.

- These valves have positive seals between port 3 and port 2.
- Incorporates the Sun floating style construction to eliminate the effects of internal parts binding due to excessive installation torque and/or cavity/cartridge machining variations.
- Stainless steel cartridge options P or W are intended for use within corrosive environments with all external components manufactured in stainless steel or titanium. Internal working components remain the same as the standard valves.

## Technical Data

| | U.S. Units | Metric Units |
|---|---|---|
| | | |
| **Cavity** | T-17A | |
| **Capacity** | 60 | 240 L/min. |
| **Area Ratio, A3 to A1** | 1.8:1 | |
| **Area Ratio, A3 to A2** | 2.25:1 | |
| **Maximum Operating Pressure** | 5000 | 350 bar |
| **Maximum Valve Leakage at 110 SUS (24 cSt)** | 10 | 10 drops/min.@70 bar |
| **Pilot Volume Displacement** | .15 | 2,5 cc |
| **Series (from Cavity)** | 3 | |
| **U.S. Patent #** | 4,795,129 | |
| **Valve Hex Size** | 1 1/4 | 31,8 mm |
| **Valve Installation Torque** | 150 - 160 | 200 - 215 Nm |
| **Seal Kits** | Buna: 990-017-007 | |
| **Seal Kits** | Viton: 990-017-006 | |




## Option Selection

**LKHC-X D N**

### Preferred Options

| *Control* | *Cracking Pressure* | *External Material/Seal Material* |
|---|---|---|

### Standard Options

**X** Not Adjustable

**N** Buna-N
**V** Viton