

Parts & Service Manual

Foremost Industries
Model 306430ES
(Extended Service)
Floating Cushion Sub

Table of Contents

Page 3	Overview
Page 5	Schematic and Parts List
Page 7	Maintenance Schedules
Page 9	Maintenance Indicators
Page 13	Assembly & Disassembly Procedures
Page 17	Rig Installation

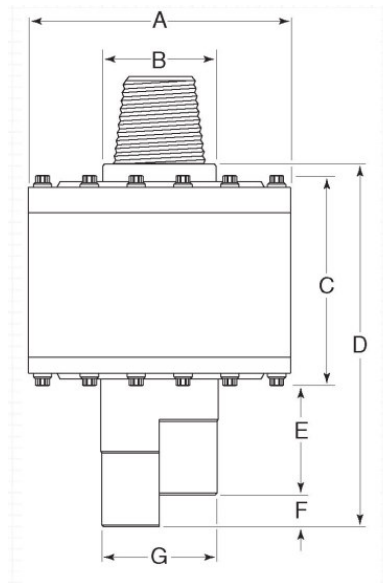
Overview - Model 306430-ES Floating Cushion Sub

General Specification

Hoist	200,000 lbs. Proof Load
Pulldown	200,000 lbs. Std. Cushion
Torque	30,000 lbs. / ft.
Extension	S-S Length extended 28.50 inches*
Retracted	S-S Length retracted 26.00 inches*
Stroke	2.5" with standard lower cushion with optional lower cushion
Weight	1100 lbs.

*Note: these lengths are typical – custom lengths are available.

A (max.)	18.00"
B	9.00"
C	16.37"
D	29.50"
E	8.00"
F (ext.)	2.50"
G (max.)	9.00"



The 306430-ES (Extended Service) FCS is a modified version of the well proven 306430. Design enhancements greatly improve the retention of lubricating grease which allows for a reduction in routine greasing intervals in addition to longer running periods between major service intervals. The 306430 and 306430ES retain many of the same components with overall dimensions being unchanged therefore, interchangeability between the models is easily achieved. Designed specifically to fit all mid-range and large blast hole rotary drills which are utilized to drill in soft to medium hard rock formations. When mounted into the drive spindle of the gear box it will provide a minimum 2 ½" (63.5 mm) of free travel between the top of the drill string and the rotary drive. The extended travel capacity built into the cushion sub enables drill operators to quickly and easily make-up and breakout connections on the drill pipe with minimal thread damage. When the rotary drive is lowered to pick up on the threads of the drill pipe, the piston component in the cushion sub will move

up into the housing of the sub when the threads come in contact which will considerably lessen the impact not only on the threads of the drill pipe but also the bearings and gears retained within the rotary drive.

The unique configuration of the housing assembly will not only provide direct drive forces from the rotary drive to the drill string but due to its design also absorb torsional vibration from the rotary bit or DTH hammer assembly through the use of polymers incorporated in the drive system. Whether using pull-down or hold back methods of drilling, urethane cushions located on both the top and bottom ends of the piston stroke as well as some hydraulic dampening from within the housing cavity, the shock and vibration from the rock bit will be greatly reduced and therefore enhance the drills performance and decrease maintenance.

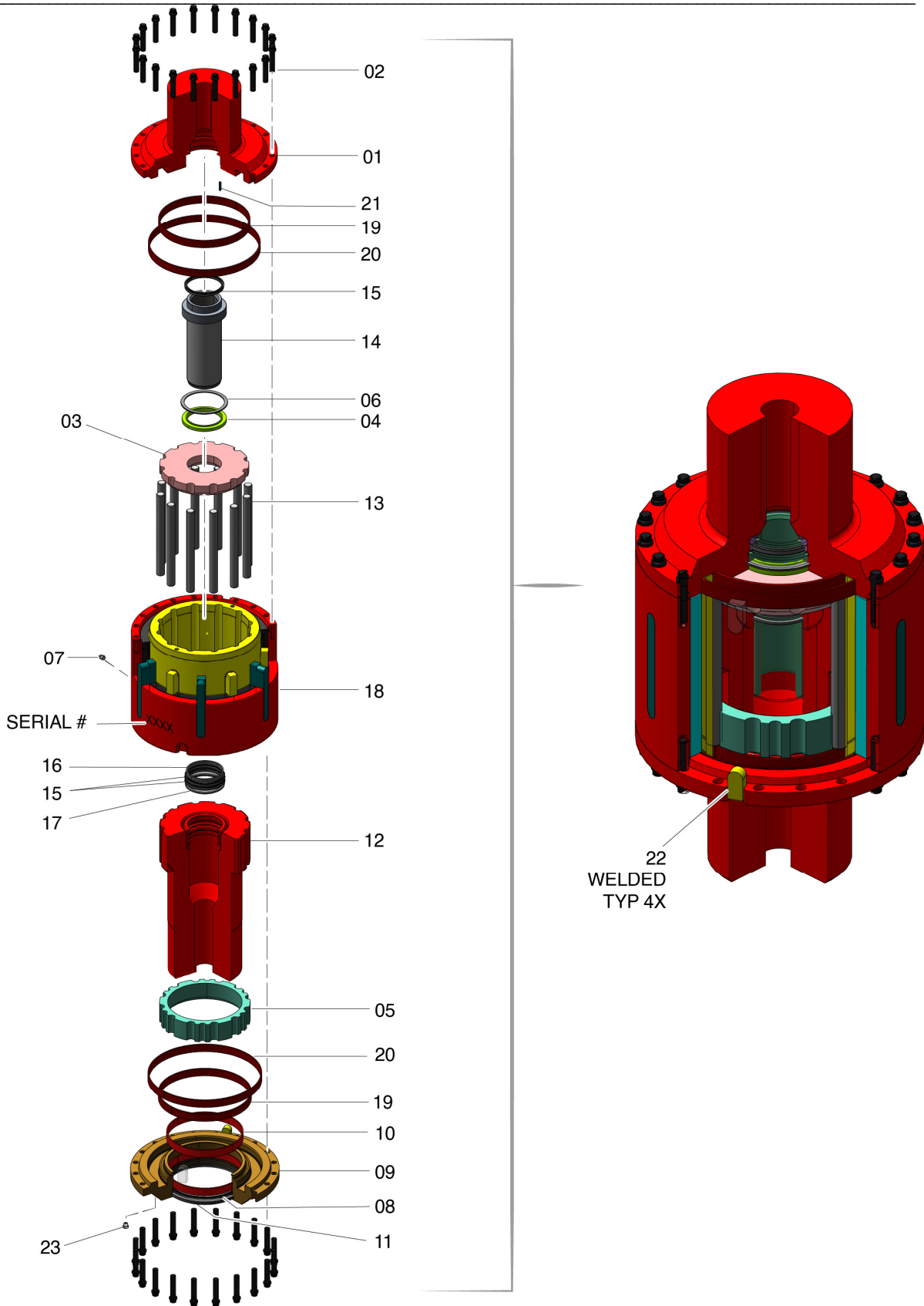
The FCS will accommodate drill strings up to and including 9 ¼" (235 mm) in diameter. Typically, the assembly is supplied with a pin up / box down thread combination cut to customer specifications as per the drill application. The FCS is designed as not to interfere with the operation of other drill rig components typically needing no modifications to the drill. In most cases, there will be room in the mast to install a short saver sub below the cushion sub to make up the required length as per the original extended sub supplied by the drill manufacturer. Seals, cushions and other wear parts can be easily replaced as no special tools or equipment are necessary for dismantling and rebuilding the complete assembly. Lubrication of internal components to reduce wear and prevent corrosion within the housing is accomplished by means of a grease fitting conveniently located on the bottom surface of the lower cover plate.

Features

1. Sliding spindle with 2 ½" inches of extension.
2. Standard seals, wipers and wear rings are utilized to isolate drilling fluids and air.
3. Unique drive system to transfer rotary torque to the drill string.
4. Precision machined components manufactured from high strength alloy steel.
5. Manufactured to suit O.E.M. drill specifications.
6. Large through bore in a stationary Wash Pipe assembly.
7. Heavy duty urethane upper and lower cushions.

Benefits

1. Sliding spindle reduces thread damage to drill pipe and allows drill operators to quickly and easily make-up and breakout connections.
2. Reduced maintenance to rotary drive bearings and gears.
3. Repairs and rebuilds can be accomplished with common tools.
4. Axial and torsional vibration are drastically reduced.
5. No modifications to the backup wrench or drill are required.
6. No restriction of air flow to the bit.
7. Maintenance costs on the drill and drilling tools are greatly reduced.



Model 306430-ES Floating Cushion Sub Parts List

Item No.	Part No.	No. Req'd	Description
1	414757	1	Upper Cap (Blank)
2	310422	40	Cap Screws Modified
Ref	9138-00-3535	40	Cap Screws Unmodified (used with High Capacity lockwashers)
Ref	416498	40	Lockwashers (High Capacity)
3	307000	1	Upper Cushion
4	307208	1	Spacer Ring
5	409325	1	Lower Cushion
6	16-38-289797	1	Retaining Ring
7	9285-00-0610	1	Grease Fitting
8	310364	1	Seal
9	409326	1	Lower Cap
10	307390	1	Wear Ring
11	307244	1	Wiper Ring
12	307021	1	Piston (Blank)
13	307337	12	Drive Pins
14	414758	1	Washpipe
15	307249	3	Seals
16	307245	1	Wear Ring
17	307246	1	Wiper Ring
18	310309	1	Housing Assembly
19	307247	2	Wear Ring
20	307248	2	Wear Ring
21	414894	1	Locating Pin
22	307354	4	Torque Key
23	5680	1	Valve Relief
Pt. No.	306430-ES-30	1	Seal Kit (4,6,8,10,11,15,16,19,20,21)
Pt. No.	306430-ES-31	1	Seal & Cushion Kit (3,4,5,6,8,10,11,15,16,19,20,21)

Note: The list above is for the standard configuration assembled with blank upper cap and piston (no threads cut). Please contact Foremost and provide Serial # to determine any assembly options and thread configuration.

Maintenance Schedules

Routine Service Intervals:

During factory assembly 1400* grams of grease has been installed into the housing for lubrication of the internal components. For optimal life between major service intervals, under average operating conditions, add 15** grams of grease (10 – 15 pumps from a typical handheld grease gun**) every 7-10 days or approximately every 150-200 operating hours. Pending the parameters of the drilling application and conditions it may be necessary to increase or decrease greasing intervals. Failure to maintain sufficient levels of grease will void warranty.

*1000 grams for FCS with Qty 2 upper cushions installed – reduces stroke to 1”.

**For reference a typical lever-style grease gun disperses 1.28 grams of grease per pump while the hand-grip style disperses 0.86 grams per pump.

A synthetic grease that meets standard NLGI #2 GC-LB should be used.

As an alternative it is acceptable to use an EP lithium grease meeting NLGI Grade 2 standard.

When high operating temperatures are present, it may be necessary to grease the cushion sub on a more frequent basis or utilize a higher temp grease.

The grease fitting is located in the approximate center position of the main body. Grease should be installed when the sliding spindle is in the retracted or up position.

It is possible to over grease the FCS. One indicator of excess grease is reduced float of the piston. Ideally there should be approximately 2 ¼” to 2 ½” (55-65 mm) of up and down travel of the piston when the assembly is operating.

If at any time the piston will not retract or extend from the housing, there could be too much grease in the body cavity. If this happens, remove the grease fitting and cycle the spindle up and down several times to remove excess grease and then re-install the fitting into the body. Use extreme caution when cycling the spindle up and down with the grease fitting removed as grease may be expelled under pressure. Wait one service interval before beginning the lubrication cycle again and adjust the amount and or the frequency of grease being added. The specific drilling application and conditions will determine the optimal quantity and frequency of routine service.

Major Service Intervals:

Periodically it will be necessary to replace seals and other wear items in the assembly. The frequency of this maintenance will depend upon the drilling application and the amount of lubrication the unit receives during its operating cycle. If at any time during the drilling operation, air or fluids are being blown past the piston seal on the lower end of the body, the cushion sub should be removed immediately from the drill to have a new seal kit installed.

Operators or maintenance personnel should perform an initial inspection based on the drilling conditions below and adjust ongoing service intervals accordingly.

	Formation Type		
Foremost Model 306430ES	Soft - Medium	Med - Hard	Hard - Extreme
Rotating Hours	3000	2500	1500

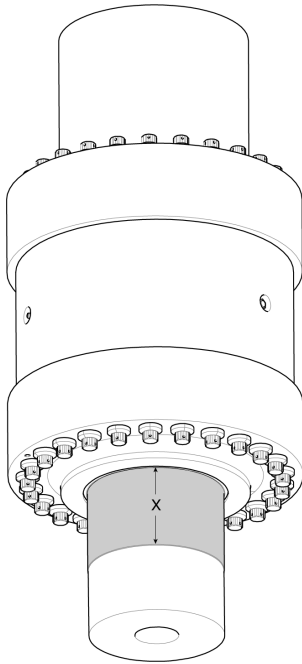
To insure optimal performance and product life, maintenance personnel over time should establish a routine whereas the FCS is rotated in and out of service at intervals established by the specific drilling application and conditions.

Maintenance Indicators

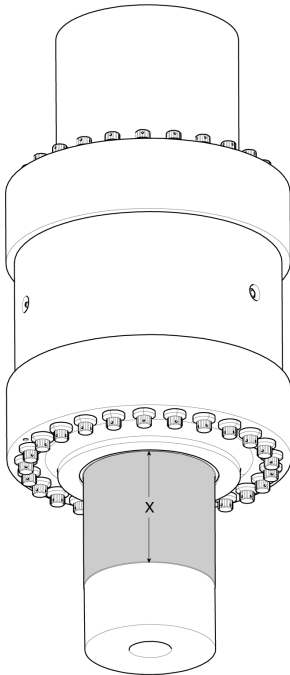
A spline drive system transfers the torque from the rotary spindle to the drill string and the bit by means of drive pins located between the housing cavity and piston. Upper and lower cushions are used to absorb the shock displaced into the piston from the drill string when the piston is either at the upper or lower limits of its stroke within the housing. Drilling fluids/air are isolated from the housing by means of a washpipe and seal arrangement preventing corrosion from taking place on the internal components.

The severity of the drilling application will determine the cycle time in which the cushion sub may require having some internal components replaced. The following are some visual indicators as to when the cushion sub should be removed from service and a rebuild performed:

1. If air or drilling fluid is being blown out around the wiper seal at the lower end of the assembly around the piston. (cause - leaking seal at the washpipe)
2. If the piston seems to have more extension than when the cushion sub was originally installed on the drill.
3. If backlash in the piston and housing is excessive (the time between when the rotary spindle starts to rotate and the drill steel starts to rotate).
4. If piston runout in relation to the housing is greater than 1/8" (3mm) the lower wear ring should be replaced.



When new, the chrome section on the piston when fully extended, will protrude $X = 2.90''$ (7.4cm) below the lower cap.

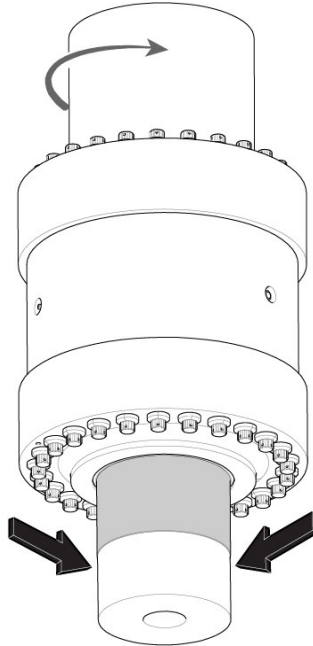


If the chrome section on the piston when fully extended exceeds $X = 3.90''$ (9.9cm) below the lower cap, the lower cushion should be replaced as soon as possible.

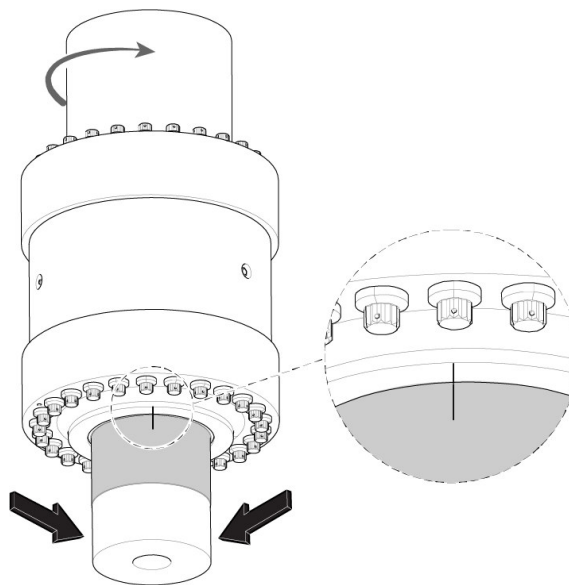
Note: Some models have been assembled with Qty 2 upper cushions reducing stroke to 1" (2.5cm). The chrome section on the piston when fully extended will initially protrude 2.90" (7.4cm) below the lower cap. When the chrome section exceeds 3.90" (9.9cm) below the lower cap the lower cushion should be replaced as soon as possible.

The splines in the piston and the housing will eventually start to wear due to the torsional pressure being applied during the drilling process from the bit and also from making up and breaking out of threads creating excessive free play (backlash).

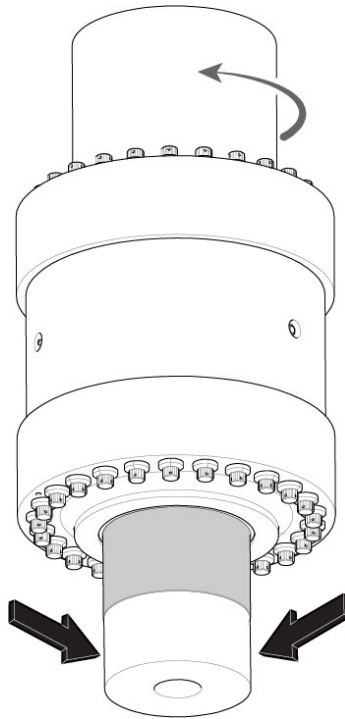
To check the amount of free play, restrain the lower connection (piston) and rotate the upper connection with a force of 10 - 20 ft/lb until rotation stops.



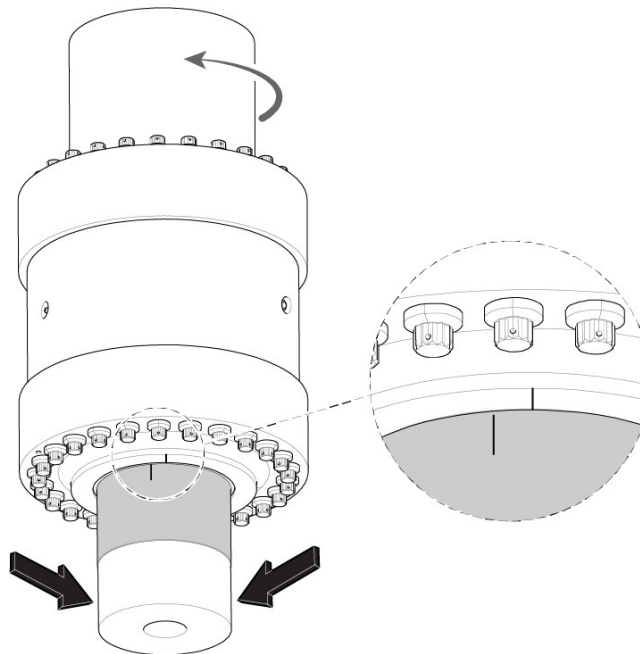
Mark a position on the piston and the lower cap parallel with each other.



Restrain the lower connection (piston) and rotate the upper connection in the opposite direction with a force of 10 - 20 ft/lb until rotation stops.



Measure the distance between the lines. When the free play exceeds 1/2" (1.27cm) - the piston and or body may need to be replaced.



Assembly and Disassembly Procedures

Disassembly:

1. Secure the body of the FCS in the vertical position - piston up
2. Remove Cap Screws (2) from the Lower Cap (Item 09)
3. Install a lift nubbin into the thread of the Piston (Item 12)
4. Lift the Piston out the housing assembly
5. Slide the lower cap off the end of the piston
6. Slide the Lower Cushion (Item 05) off the end of the piston
7. Remove the Drive Pins (Item 13) from the housing
8. Remove the Cap Screws (2) and Lock Washers from the Upper Cap
9. Separate the Upper Cap from the Housing
10. Remove the Upper Cushion from around the Wash pipe
11. Remove the Spacer Ring (Item 04), Retaining Ring (Item 06) & Wear Rings (Item 19, 20)
12. Remove the Wash Pipe (Item 14) and Seal (Item 15)
13. Remove Wiper Ring (Item 11), Seal (Item 08), Wear Rings (Item 10) from the lower cap
14. Remove Wiper Ring (Item 17), Seals (Item 15), Wear Ring (Item 16) from the piston
15. Clean all parts with cleaning fluid and inspect for wear - deburr any parts and remove sharp edges - any corrosion must be removed.

Assembly:

1. Replace one Seal (Item 15) in the seal fit of the Upper Cap (Item 1)
The O-ring of the seal against the shoulder of the location fit
2. Insert the Wash Pipe (Item 14) in the location fit
3. Install the Retaining Ring (Item 06) into the groove making sure to cover the Wash Pipe locating pin (tap the Retaining Ring to make sure it is properly seated in the groove)
4. Install the Spacer Ring over the Wash Pipe
5. Install the Upper Cushion over the Wash Pipe
6. Install the Wear Rings (Item 19, 20) into the Upper Cap location fits.
7. Locate the Upper Cap assembly on the Housing and install Cap Screws – **see notes below**
8. Install the new Seals, Wiper and Wear Ring into the Piston
9. Install drive pins into Housing Splines and Upper Cap. Apply a liberal amount of grease into the housing and spline area
10. Slide the Piston back into the Housing lining up the splines for the Drive Pins
11. Pump approximately 1400 grams of grease into the housing area in and around piston.
12. Install the Lower Cushion into the Housing line up the grease groove in the Cushion with the grease fitting in the Lower Cap

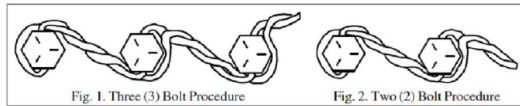
13. Install the new Wiper, Seal and Wear Rings (Item 8, 10, 11, 19, 20) into the Lower Cap
14. Install the Lower Cap over the Piston and into the Housing
15. Install Cap Screws - **see notes below**

Notes:

- Under no circumstances should any welding or wrenching be done on the chrome surface of the spindle.
- If cap screws are seized, heating maybe required to free thread locking compound. Do not exceed 200 degrees F in any portion or components of the assembly.
- There are optional methods used when installing the Capscrews

Standard Method – Capscrew with thread locking compound:

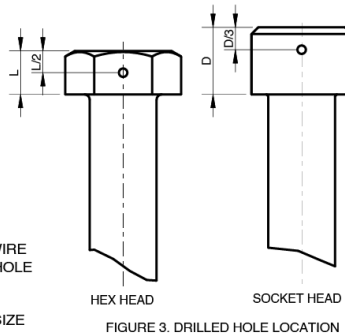
- Cap screws are coated with thread locker
https://www.henkel-adhesives.com/ca/en/product/threadlockers/loctite_2630.html
- Torque capscrew to 210 ft/lbs – alternating across the bolt circle
- Secure with lock wire. Follow Foremost Lock Wire Procedure document # 387100



THE FOLLOWING PROCEDURE IS TO BE USED WHEN DRILLING BOLT HEADS OR SECURING BOLTS WITH LOCK WIRE. (REF MACHINERY'S HANDBOOK 26TH ED) THIS APPLIES TO GRADE 5 AND 8 HEX HEAD OR SOCKET HEAD BOLTS OF EITHER UNC OR UNF THREADNG

THE USE OF SAFETY WIRE TIES IS ILLUSTRATED IN FIG. 1 & 2. THE ILLUSTRATIONS ASSUME THE USE OF RIGHT-HAND THREADED FASTENERS AND THE FOLLOWING ADDITIONAL RULES APPLY:

1. NO MORE THEN THREE (3) BOLTS MAY BE TIED TOGETHER
2. BOLTS HEADS MAY BE TIED AS SHOWN ONLY WHEN THE FEMALE THREAD RECIEVER IS CAPTIVE
3. PRE-DRILLED NUTS MAY BE TIED IN A FASHION SIMILAR TO THAT ILLUSTRATED WITH THE FOLLOWING CONDITIONS.
 - A. NUTS MUST BE HEAT-TREATED AND
 - B. NUTS ARE TO BE FACTORY DRILLED FOR USE WITH LOCK WIRE
4. LOCK WIRE MUST FILL A MINIMUM OF 75% OF THE DRILLED HOLE PROVIDED FOR THE USE OF LOCK WIRE
5. LOCK WIRE MUST BE AIRCRAFT QUALITY STAINLESS STEEL. DIAMETER OF LOCK WIRE IS DETERMINED BY THE THREAD SIZE OF FASTENER; SEE TABLE 1
6. THE LARGER WIRE MAY BE USED IN SMALLER BOLTS IN CASES OF CONVENIENCE, BUT SMALLER WIRE MUST NOT BE USED IN LARGER FASTENER SIZES.
7. DRILLED HOLE IS TO BE LOCATED ON THE AXIS OF THE BOLT AT A DISTANCE FROM THE TOP OF THE HEAD OF THE BOLT EQUAL THAT ILLUSTRATED IN FIG. 3



FASTENER SIZE	WIRE DIA.	DRILL BIT
< \varnothing 1/4"	0.020"	#72
\varnothing 1/4" - \varnothing 1/2"	0.032"	#60
> \varnothing 1/2"	0.042"	1/8

TABLE 1: WIRE AND DRILL SIZE GUIDELINE

Optional Method #1– Cap screw & High Capacity lockwasher:

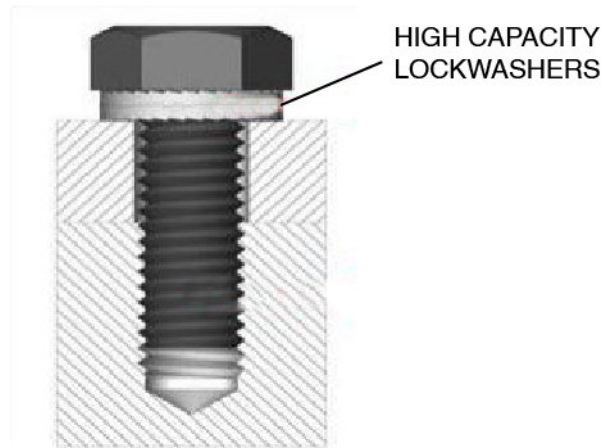
- Cap screws are coated with thread locker

https://www.henkel-adhesives.com/ca/en/product/threadlockers/loctite_2630.html

- Install high capacity lockwashers

https://www.heico-group.com/en/heico-lock/products/ring-lock-washers/?file=files/hc/pdf/pdf_en/HEICO-LOCK-Assembly-Instructions-EN_012018.pdf&cid=2798

- Torque capscrew to 250 ft/lbs – alternating across the bolt circle



Rig Installation

In most applications when installing the FCS making up the threaded connection to the specified torque requirements of the particular thread is sufficient to prevent backing off when breaking away from the drill string. However, in some cases additional means of retention are desired. There are several options available to assist further retaining the treaded connections.

Thread Locking Compounds

<https://bakerlok.com/>

<https://forumlok.com/>

<https://www.jetlube.com/product/jet-lok-iii-threadlocker-two-part-epoxy>

Mechanical Locking Systems

<https://www.foremost.ca/foremost-mobile-equipment/mining-drill-tooling/variable-range-tool-joint-clamp/>

Description

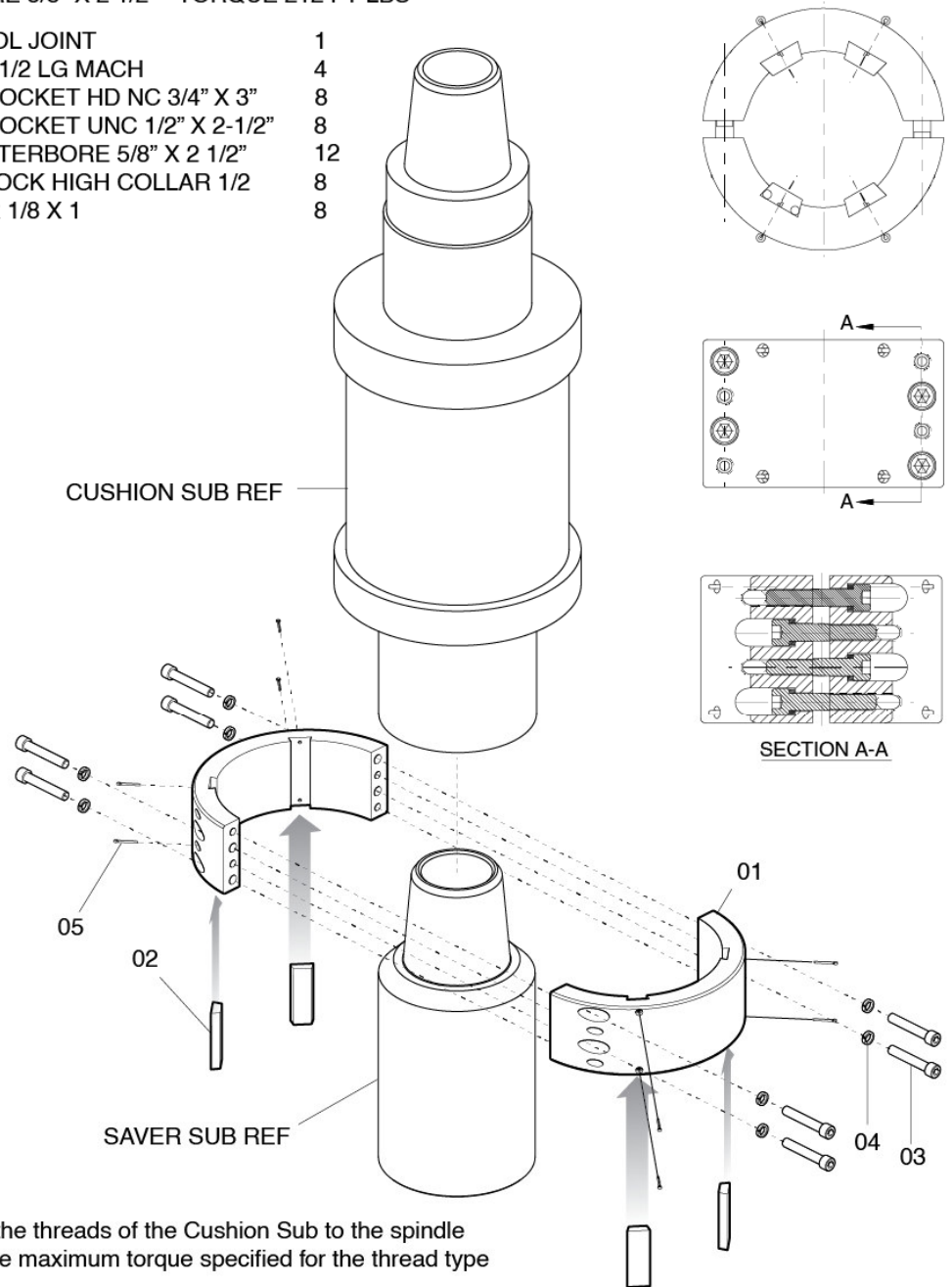
The Tool Joint Clamp consists of a split hub, tong dies and cap screws all of which are manufactured from alloy steel, heat-treated for maximum strength and gripping ability. Each assembly is machined to incorporate tong dies held in a dove tail groove machined the entire length of the hub. Cotter pins at each end of the tong die prevent the die from falling out of the assembly. The high strength cap screws equally spaced vertically along each side of the hub are tightened to displace the clamp force evenly along the entire length of the tong die. The gripping pressure of the clamp will prevent the threaded tool joints from backing off.

Installation

Apply the proper thread compound to the tool joints and make up the threads to the suggested API torque. Remove the cap screws from the assembly and separate the two halves of the clamp. Position the two halves to centralize the assembly vertically around the shafts at the point where the tool joints shouldered together. Begin to tighten the cap screws alternating at 180 degrees to maintain even pressure on each side of the clamp applying force against the outside circumference of each shaft as the cap screws are tightened.

Note: Apply specified torque and Locktite 242 to all Capscrews
CAPS HEX SOCKET UNC 3/4" X 3" - TORQUE 376 FT LBS
CAPS HEX SOCKET UNC 1/2" X 2-1/2" - TORQUE 103-105 FT LBS
CAPS COUNTERBORE 5/8" X 2 1/2" - TORQUE 212 FT LBS

01	CLAMP - TOOL JOINT	1
02	DIE-TONG 3 1/2 LG MACH	4
03	CAPS HEX SOCKET HD NC 3/4" X 3"	8
03	CAPS HEX SOCKET UNC 1/2" X 2-1/2"	8
03	CAPS COUNTERBORE 5/8" X 2 1/2"	12
04	WASHER - LOCK HIGH COLLAR 1/2	8
05	PIN-COTTER 1/8 X 1	8



Engage and make up the threads of the Cushion Sub to the spindle and or Saver Sub to the maximum torque specified for the thread type

Clamp Installation

- 1: Align clamp so as to straddle the tool joints to be secured
- 2: Apply Locktight 242 to cap screws or threaded holes in the clamp
- 3: Install the lock washers over the cap screws, insert and engage all of the cap screws in the corresponding threaded holes of the split clamp
- 4: Alternate tightening the cap screws until each of the threads are fully engaged
- 5: Once all cap screws are fully engaged, torque the cap screws to the recommended value for the screw size

Warning and Disclaimer Foremost urges adherence to the function, maintenance, operation and rebuild of the Floating Cushion Sub outlined herein. Foremost recommends taking your product to an experienced, qualified service center for maintenance and repair. Failure to follow the information herein may result in damage to the product or facility, unsafe conditions, injury to user and/or any warranties being voided. Foremost has no control over the end use of the product or the environment into which the product is placed or operated in.

Foremost encourages the safe use of its products. To help avoid personal injury or damage to the product:

1. Wear approved personal protection equipment, including eye, ear, head, and foot protection.
2. Inspect the product before each use. If the product is cracked, burred, bent, or damaged in any way, **DO NOT USE IT**.
3. Use the product within the operating parameters.
4. Stand clear of the product while in use and make sure protective guards are in place.
5. Maintain product in accordance with the maintenance schedule herein.
6. Exercise care when disassembling and assembling the product.

THE INFORMATION INCLUDED IN THIS DOCUMENT HEREIN IS ONLY ADVISORY IN NATURE AND DOES NOT CONSTITUTE ANY REPRESENTATION OR WARRANTY ON BEHALF OF FOREMOST.