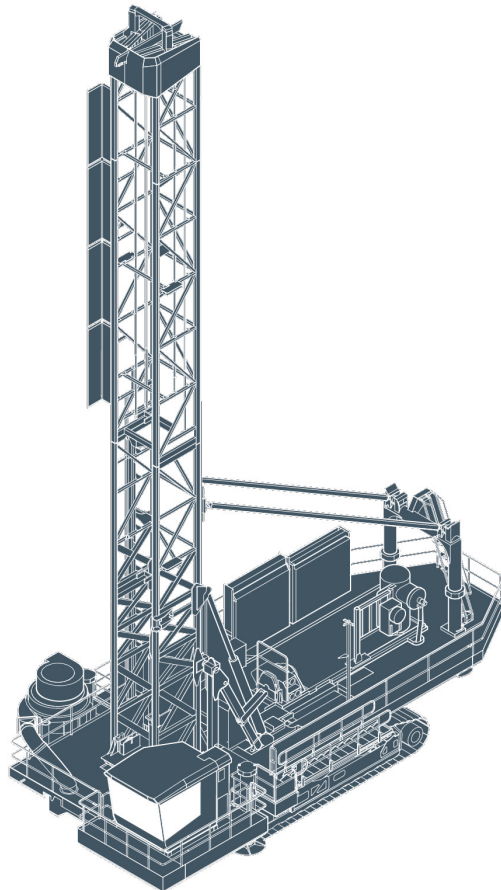


Service

PV-351 Rotary Head Rebuild

PV-351E, PV-351D



Original Instructions

2021-05-03 | No: TIS0001684.002 en-US

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Revision History

Revision No.	Date	Revision
001	March 2021	Original release
002	May 2021	Corrected error that resulted in missing chapters.

1 Introduction

This manual provides the necessary information that is required by site maintenance personnel for the correct disassembly and assembly of the spur gear rotary head.

All information, illustrations, and specifications in this manual are based on the latest information at the time of publication. Product improvement is a continuous goal at Epiroc. Design and specifications are subject to change without notice or obligation of notice.

If any part of this manual cannot be understood, contact your supervisor or local Epiroc distributor.

NOTICE

Component Damage

The use of repair parts other than those included within the Epiroc approved parts list can create hazardous conditions over which Epiroc has no control.

- ▶ Do not use non-approved repair parts. Epiroc cannot be held responsible for equipment in which non-approved repair parts are installed.
- ▶ When the life of the equipment is expired, it is recommended that the equipment be disassembled, degreased, and parts be separated by materials so that they can be recycled.

NOTICE

Safety Precautions

Failure to obey the safety instructions and warnings can cause product damage, personal injury, or death.

- ▶ Safety is always the primary concern for the protection of both personnel and the equipment during assembly and disassembly. All personnel must understand all safety precautions and procedures before doing any maintenance work on the spur gear rotary head.
- ▶ Safety is an integral part of every individual job responsibility. Every employee must be committed to these beliefs and must work in a manner that demonstrates that commitment.

1.1 Design Features

The spur gear rotary head provides the rotation speed and the rotary torque that is necessary for drilling with Epiroc drilling machines. The rotary head is a simple, compact, and efficient unit featuring dual axial piston hydraulic motors mounted at the top of the gear case for easy access. The rotation motors, which are powered by hydraulic oil from the main pumps, drive the spindle through a series of spur gears. Rotation motors are used to rotate the drill bit and to add and remove the drill pipe from the drill string which is connected to the rotary head.

The rotation speed is determined by the output of the main pumps. The output is variable through speed controls on the operator's panel at a maximum working pressure of 345 bar (5,000 psi). There is a motor control valve located on one of the motors on the rotary head, which changes the stroke of the motor producing a wide range of outputs. This arrangement enables the head to provide an option of either high torque [25,761 Nm (19,000 ft-lb @ 95 rpm)] or high speed [170 rpm @ 14,236 Nm (10,500 ft-lb)] or a desired torque and speed range within these parameters.

The internal bearings, pinions, and gears in the rotary head are cooled and lubricated with EP 80W90 gear oil. Approximately 208 liters (55 gallons) of oil are necessary to bring the oil to its correct level in the gear case. Make sure that the oil level is correct using the sight gauge on the front side of the gear case.

A special drill pipe adapter serves as a spindle sub. This sub is screwed tightly into the spindle and held in position by welded locking tabs. When the spindle sub break or the threads become damaged, the sub can be removed, thus eliminating the need for replacement of the more costly spindle.

1.1.1 Bearing Design and Gear Maintenance



NOTE: Use only new bearings. Do not reuse bearings.



NOTE: Refer to Table Rebuild Kit List for item numbers.

Items 6 and 12 are single-row, tapered roller bearings, and are the most widely used throughout the industry. They are especially applicable for carrying radial and axial loads, acting simultaneously when the radial loading is greater than the axial.

Items 8 and 105 are single-row, medium-type, and deep-groove ball bearings. They will sustain radial load and substantial thrust load in either direction, even at high speed. This advantage results from intimate contact between the balls and the deep continuous groove in each ring. For this type of bearing, careful alignment between shaft and housing is essential. These bearings are supplied with two red shields for roller protection from dirt and other contaminants.

Item 9 is a spherical roller bearing with cylindrical bore, narrow width and medium type design. It has excellent radial load carrying capacity due to the number, size and shape of the rollers and the accuracy with which they are guided.

Being inherently self-aligning, angular mis-alignment between the shaft and the housing has no detrimental effect and full bearing capacity is always available for loading. Considerable thrust loading may be carried in either direction.

1.1.2 Recommended Lubrication Oil

EP oils contain additives with the following properties:

- Increases load-carry properties
- Highly resistant to oxidation
- Non-corrosive to metals
- Highly resistant to foaming

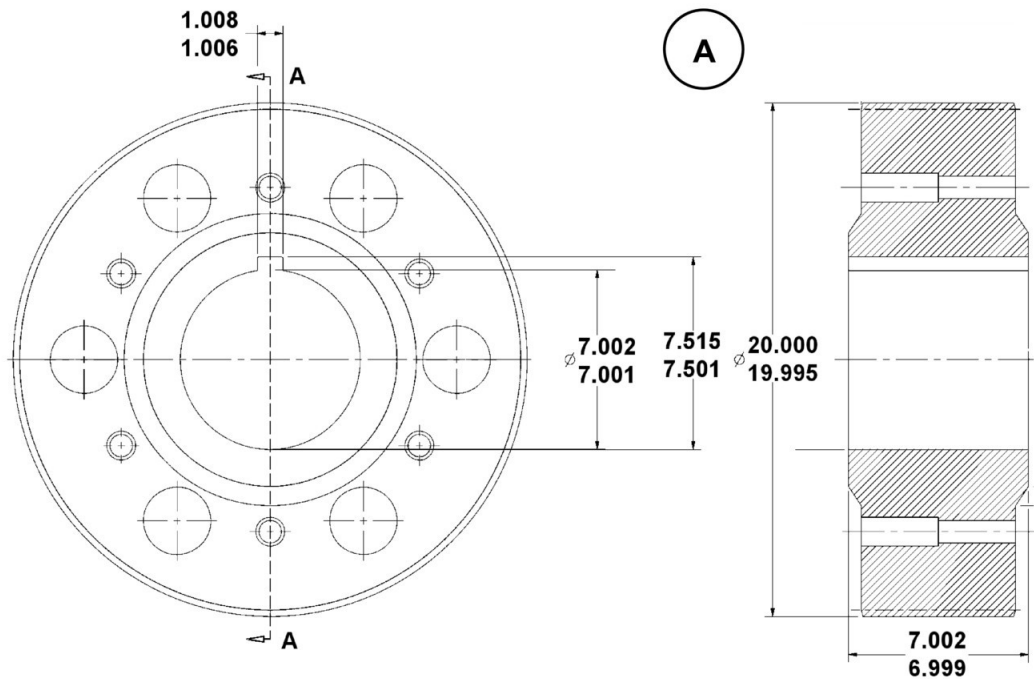
80W90 gear oil is added at the factory.

1.2 Weights and Tolerances

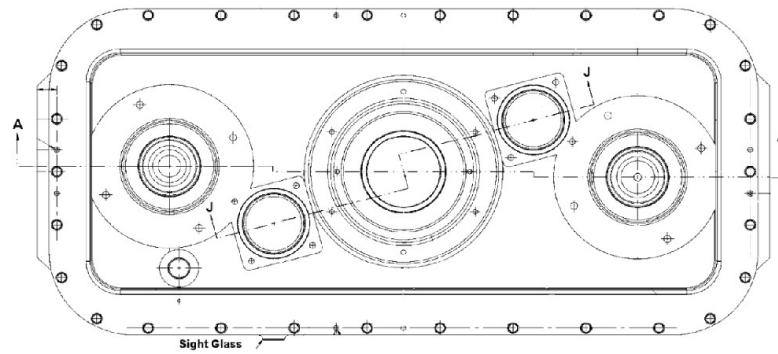
Component and Assembly Weights

Component	Part Weight	Assembly Weight
Spindle	159.7 kg (351.4 lb)	With bearing 215.1 kg (473.2 lb)
	123.2 kg (271 lb)	With bearing - 178.5 kg (392.8 lb)
Intermediate gear	68.9 kg (151.6 lb)	With shaft and bearing 109 kg (239.7 lb)
Input pinion	22.2 kg (48.8 lb)	With bearings 30.4 kg (66.8 lb)
Rotary head	1,534.5 kg (3,376 lb)	4,037.3 kg (8,882 lb)
Output gear	176.4 kg (388 lb)	-

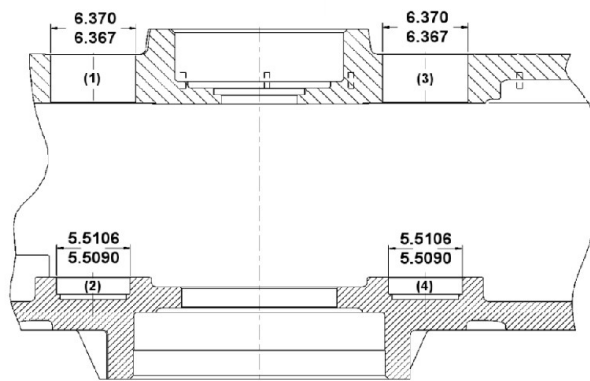
! *NOTE: Tolerances on the Output Gear Tolerances and the Housing Tolerances drawings are in inches.*



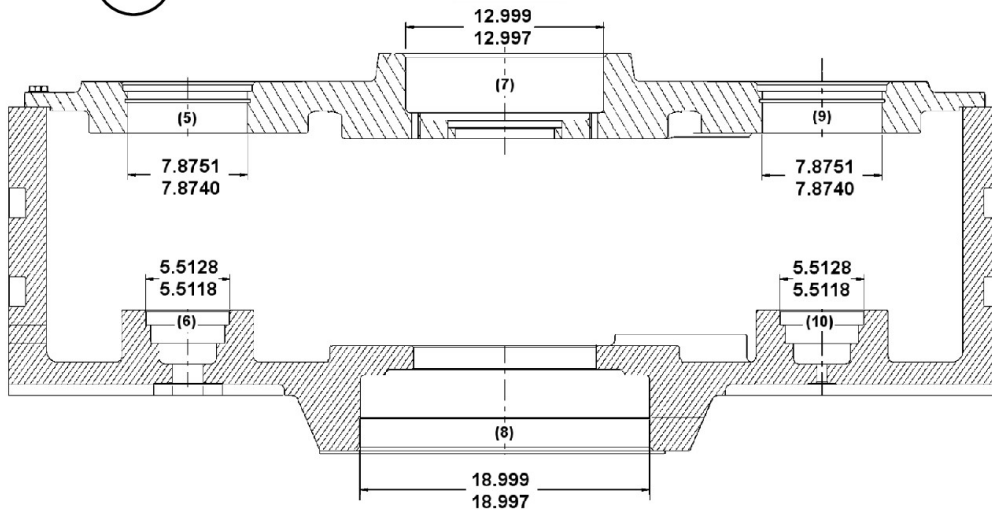
Output Gear Tolerances



B



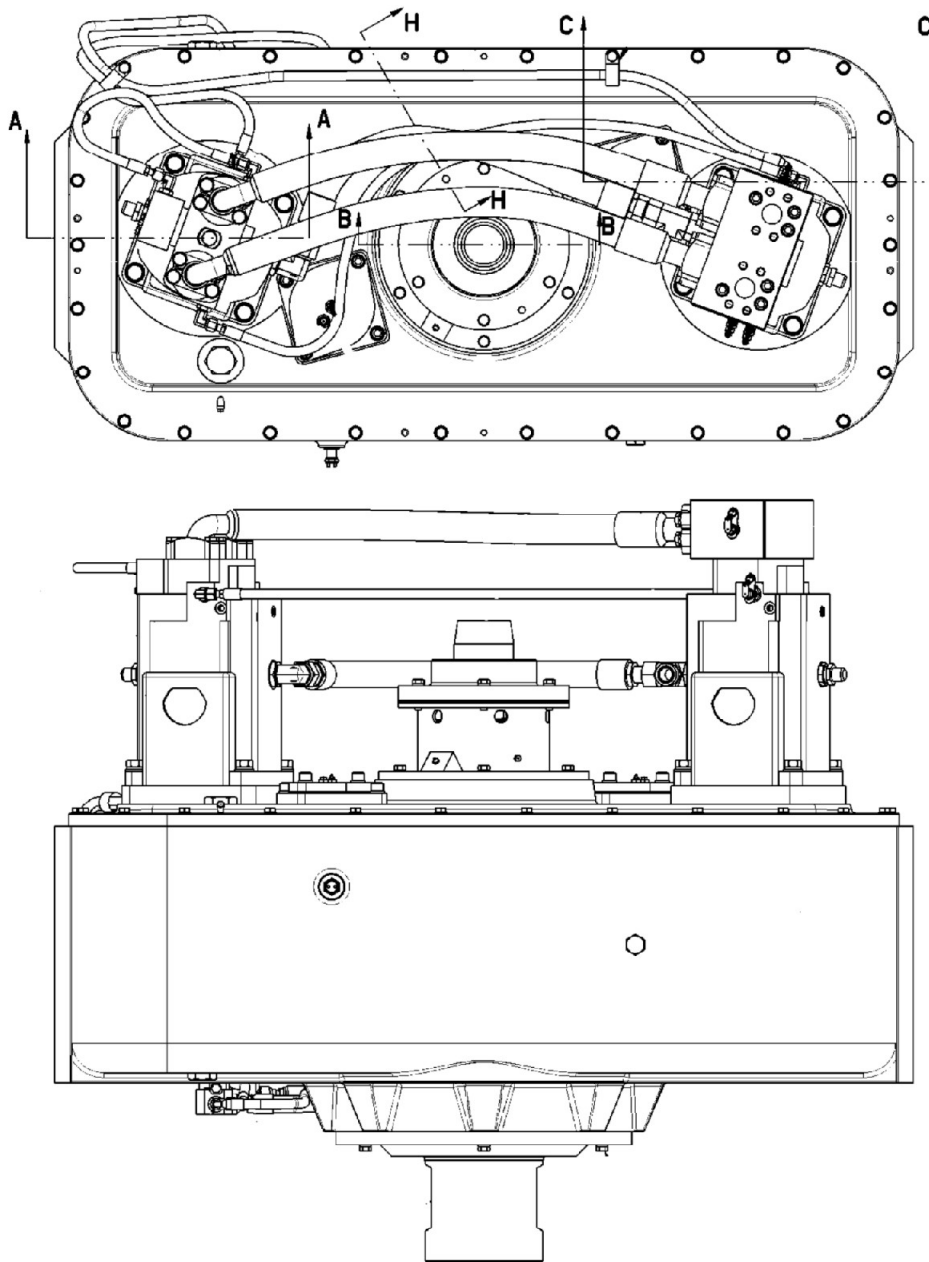
C



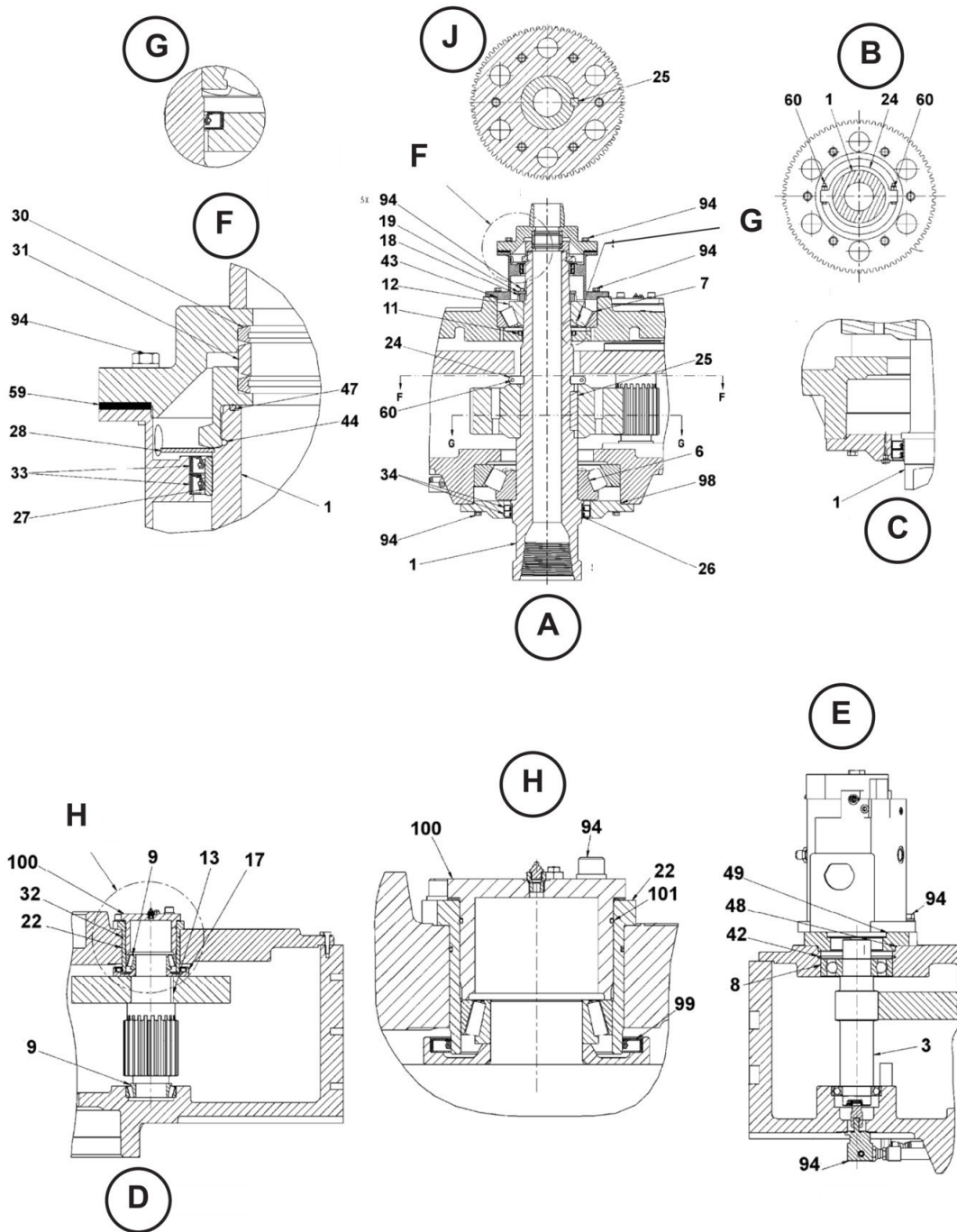
Housing Tolerances

A	Section A-A
B	Section J-J
C	Section A-A

1.3 Rotary Head Rebuild Kit



Rotary Head Kit List Reference Drawing



Rotary Head Kit List Reference Drawing (cont.)

A	Section B-B
B	Section F-F
C	Section H-H
D	Section C-C

E	Section A-A	
J	Section G-G	
Item	Quantity	Description
1	1 EA	Spindle
3	2 EA	Pinion input
6	1 EA	Bearing, pull down
-	1 EA	Cone
-	1 EA	Cup
7	1 EA	CUF
8	2 EA	Bearing, ball
9	4 EA	Bearing, intermediate shaft
-	1 EA	Cone
-	1 EA	Cup
11	1 EA	Seal, oil
12	1 EA	Cone
13	2 EA	Key, intermediate
17	2 EA	Spacer
18	1 EA	Nut, Adjusting
-	1 EA	Lock nut, bearing
19	1 EA	Tongued washer, bearing
22	2 EA	Holder, bearing
24	1 EA	Collar
25	1 EA	Key
26	1 EA	Sleeve, bottom
27	1 EA	Sleeve, wear
28	1 EA	Shield, drip
30	2 EA	Packing, swivel - 30XV
31	1 EA	Bushing, wear
32	2 EA	O- ring
33	2 EA	Seal, oil

Item	Quantity	Description
34	2 EA	Seal, oil
42	2 EA	Ring
43	1 EA	O-ring
44	1 EA	Ring, lock
47	1 EA	O-ring
48	2 EA	O-ring
49	2 EA	O-ring
59	2 EA	Shim kit
60	2 EA	Nut, elastic lock-3/8-16
94	1 EA	Adhesive
95	1 EA	Component, silicone
98	1 EA	O-ring
99	2 EA	Seal, oil
100	2 EA	Adjusting, bearing
101	2 EA	O-ring
105	2 EA	Bearing, ball

1.4 Assembly Checklist

Initial	Date	Step Number	Procedural Steps
3.1 Set-Up and Preparation			
		1	Correctly mount the housing into the rotary head working stand.
		2	Remove the cover. Clean and put it aside.
		3	Clean the housing.
		4	Reposition the housing.
		5	Heat the lower spindle bearing cone.
		6	Freeze the upper and the lower bearing cups.
		7-8	Make sure that there is no damage to the threads on the spindle.
3.2 Shrink Fit the Spindle Bearing Cone			
		1	Lower the spindle bearing cone over the spindle.

Initial	Date	Step Number	Procedural Steps
		2	Apply a layer of grease to the bearing cone.
		3	Correctly position the oil seals into the lower spindle retainer.
		4	Apply a layer of grease to the seal lips and in between the oil seals.

3.3 Expansion Fit the Lower Housing Bearing Cup

		1	Install the lower housing bearing cup into the housing and seat it fully.
		2	Apply a thin layer of grease to the bearing cup surface.
		3-4	Install the spindle into the housing.
		5	Heat the oil seal wear sleeve.
		6	Put the wear sleeve over the spindle and seat it fully.
		7	Heat the output gear.
		8	Heat the both intermediate gears.
		9	Lubricate the O-ring and position on the lower spindle retainer.
		10	Put the lower spindle retainer around the spindle.
		11	Install the plug into dedicated place in the side of the lower spindle retainer.
		12	install the bottom and side housing plugs, sight glass, and strainer.
		13	Reposition the housing.
		14	Use a jack to support the spindle from the bottom so that both the lower spindle bearing cup and cone are pressed tightly together.
		15	Insert the key into the keyway of the spindle.
		16	Make sure that the bearing cups are seated tightly against the mounting surfaces in the housing.
		17	Apply a thin layer of grease to both bearing cup running surfaces.

3.4 Shrink the Fit Output Gear

		1-2	Install the output gear over the spindle.
		3	Put the retaining collar around the spindle to keep the output gear in place.
		4	Secure the retainer collar with bolts and elastic stop nuts.

3.5 Shrink Fit the Intermediate Upper Bearing Cone and the Gear Assembly

		1	Heat the two lower intermediate bearings cones.
		2	Slide the lower intermediate bearing cones over the intermediate shafts.

Initial	Date	Step Number	Procedural Steps
		3-4	Put the keys in keyways of the intermediate shafts. Slide the each hot output gear over the intermediate shaft and seat it fully.

3.6 Shrink Fit the Spacers and the Lower Intermediate Bearing Cones

		1	Heat the spacers.
		2-3	Put the spacers onto the intermediate shafts.
		4	Heat the lower intermediate shaft bearing cones. Slide each intermediate shaft bearing cone over the end of its respective intermediate shaft.
		5	Insert the oil seal into the spacer.
		6	Lower the intermediate shaft subassembly carefully into the intermediate bearing cup.
		7	Install the upper and the lower ball bearings onto the input pinions.
		8	Install a drive key and a snap ring onto the one input pinion shaft sub-assembly.
		9	Make sure that the lubrication pump drive adapter fits correctly into the input pinion subassembly.
		10	Apply a thin layer of grease to the housing bores and the outer races on the lower input pinion bearings.
		11	Make sure that the intermediate shafts are seated fully.
		12	Apply a layer grease to the intermediate shaft seal lips, the rollers on the upper intermediate bearings, and the outer races of the input pinion.
		13	Apply a bead of silicone to the mounting surface of the housing.
		14-15	Install the cover on the housing and secure it with bolts.
		16	Insert the snap-rings inside the housing cover.
		17	Fill a small amount of silicone in the threaded bolt holes in the upper spindle bearing cavity area.
		18	Apply oil seal lip with a layer of grease and install the oil seal over the spindle and into the housing cover.
		19	Lubricate the O-ring with a thin layer of grease and put it over the bearing holder into the O-ring groove.
		20	Apply a thin layer of grease to the upper intermediate bearing rollers and to the inside surfaces of the intermediate bearing cavities.
		21	Slide the bearing holders into position in the housing cover and then fully seat them.

Initial	Date	Step Number	Procedural Steps
		22-23	Apply a thin layer of grease to the roller mounting surface and the outside diameter of the upper intermediate bearing cup. Install the bearing cups into the bearing holders.
		24	Apply a thin layer of grease to the outside diameter of intermediate bearing adjusters and insert them into the bearing holders.
		25	Install adapters, grease fittings, and relief fittings.
		26-27	Install bolts and washers on the bearing holders and the bearing adjusters. Tighten the bolts.

3.7 Set the Intermediate Bearing Pre-load

		1	Make sure that the intermediate bearings rollers are seated fully.
		2-5	Measure the shim thickness required on the bearing adjuster.
		6	Install the correct shim sets over the bearing adjuster and install the O-rings.
		7	Apply the outside diameters of both bearing adjusters with a thin layer of grease and install into the bearing holders.
		8	Install an elbow with a relief fitting into the housing cover.

3.8 Expansion Fit the Upper Spindle Bearing Cup

		1-2	Press the upper spindle bearing cup into the housing cover and seat it fully.
--	--	-----	---

3.9 Shrink Fit the Upper Spindle Bearing Cone

		1	Heat the upper spindle bearing cone.
		2	Apply a thin layer of grease to the bearing cup running surface.
		3	Put the upper spindle bearing cone onto the spindle.

3.10 Setting the Spindle Bearing Preload Rolling Torque

		1	Install the adjusting nut on the spindle and seat it fully.
		2-9	Adjust the preload torque.
		10	Put tongued washer over the spindle and secure it with bolts.

3.11 Shrink the Fit Wear Sleeve

		1	Heat the wear sleeve.
		2	Insert both grease fitting and relief fitting into the swivel housing.
		3	Apply grease to swivel housing, O-ring, upper spindle bearing cavity, and bearing rollers.

Initial	Date	Step Number	Procedural Steps
		4	Correctly orient the swivel housing with the lubrication fitting.
		5	Insert and torque the bolts on the swivel housing.
		6-7	Apply a layer of grease to the oil seals and install them into the swivel housing
		8	Put a drip shield and a plastic locking ring around the spindle.
		9	Apply a thin layer of grease to the spindle threads. Put the O-ring into groove at the top of the spindle. Apply grease to the O-ring.
		10-12	Put the spindle cap over the spindle and tighten it.
		13-15	Insert swivel packing into the spindle cap and swivel cover. Apply Loctite to the swivel packing.
		16	Insert the wear bushing inside of the spindle cap.
		17	Install the shims.
		18	Secure the swivel cover in place with bolts.
		19	Insert the adapters into the housing cover for both motors.
		20	Apply grease to the motor adapter. Put the O-ring. Align the motor adapters to the lubrication pump housing.
		21	Apply grease to the motor covers and install the O-rings. Install the covers and secure them with bolts.
		22-23	Install lubrication pump below the housing.
		24	Insert the bolts. Connect the suction hose. Attach the fittings.
		25	Secure the hoses to the housing with a clamp.
		26	Insert the rotation tachometer sensor.
		27	Fill the gear oil until the sight glass is at least half full.

1.5 Spur Gear Rotary Head Specifications and Lubricants

Specifications

Design	Two stages, spur gear
Speed range	Variable, 0 to 160 rpm
Maximum torque	25,760 Nm (19,000 ft/lb) @ 95 rpm - 100% efficiency 14,236 Nm (10,500 ft/lb) @ 170 rpm - 100% efficiency
Rotary head motor	Quantity-two, 229 cm ³ / rev (14 in ³ / rev)

Reduction	14.8:1
Main gear face width	152 mm (6 in)
Head guides	Replaceable, Nylatron (moly - disulfide) @ 1,626 mm (64 in) contact length each side.
Rotary head weight (bare)	1,179 kg (3,376 lb)
Function	Rotate the drill bit

Lubricants

Item	Type	Capacity
Rotary head grease	Ronex Extra HD Moly 2	Add grease until the relief valve pops out
Rotary head oil	SAE 80W90 gear oil	208 L (55 gal)
	SHC 634 is optional	Fill to mark on the sight level gauge

The SSU viscosity at 37 °C (100 °F) must be at a minimum of 2,060, and at 99 °C (210 °F), 189. Maximum pour point is -40 °C (-40 °F).

1.6 Torque Values

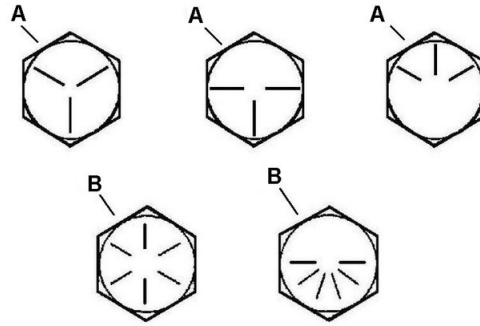
1.6.1 Standard Bolt Torque Values



NOTE: Use only the proper tools (inch or metric) on hardware. Other tools cannot fit properly and can slip and cause injury.

Fasteners must be replaced with the same grade or a higher grade. If higher grade fasteners are used, then tighten them only to the strength of the original grade fastener.

- Do not use the values from recommended torque tables if a different torque value or tightening procedure is listed for a specific application. Torque values listed are for general use only. All values are suggested maximum with dry plated hardware.
- Make sure that fastener threads are clean. Properly start thread engagement to prevent the fastener from failing when tightening.
- Always use proper torque specifications.
- The head of a Grade 5 fastener is marked with three short lines. The head of a Grade 8 is marked with six short lines.
- In the following tables, Dry means clean dry threads and Lube means a light film of oil. Excess oil in a threaded dead end hole can create a hydraulic lock, giving a false torque reading.



Standard Head Markings

A	Grade 5 capscrew head marking
B	Grade 8 capscrew head marking

Recommended Torques of Standard Bolts in Foot-Pounds

This table lists the recommended tightening torques in foot/pounds (ft·lb) for the various size bolts and nuts that are used. The suggested assembly torque values are per engineering specifications.

Recommended Torques of Standard Bolts in Foot-Pounds

Size	SAE Grade 5		SAE Grade 8	
	Dry	Lube	Dry	Lube
5/16 - 18 NC	16 - 17	12 - 13	23 - 25	17 - 18
5/16 - 24 NF	18 - 19	13 - 14	-	19 - 20
3/8 - 16 NC	28 - 30	21 - 23	42 - 45	33 - 35
3/8 - 24 NF	33 - 35	23 - 25	47 - 50	-
7/16 - 14 NC	47 - 50	33 - 35	65 - 70	51 - 55
7/16 - 20 NF	51 - 55	37 - 40	74 - 80	56 - 60
1/2 - 13 NC	70 - 75	51 - 55	102 - 110	74 - 80
1/2 - 20 NF	84 - 90	61 - 65	112 - 120	84 - 90
9/16 - 11 NC	102 - 110	74 - 80	140 - 150	102 - 110
9/16 - 18 NF	112 - 120	84 - 90	158 - 170	121 - 130
5/8 - 11 NC	140 - 150	102 - 110	205 - 220	158 - 170
5/8 - 19 NF	158 - 170	121 - 130	223 - 240	167 - 180
3/4 - 10 NC	242 - 260	186 - 200	353 - 380	260 - 280
3/4 - 16 NF	279 - 300	205 - 220	391 - 420	298 - 320
7/8 - 9 NC	400 - 430	298 - 320	558 - 600	428 - 460
7/8 - 14 NF	437 - 470	326 - 350	614 - 660	465 - 500

Size	SAE Grade 5		SAE Grade 8	
	Dry	Lube	Dry	Lube
1 - 8 NC	595 - 640	446 - 480	837 - 900	632 - 680
1 - 12 NF	651 - 700	493 - 530	930 - 1000	688 - 740
1-1/8 - 7 NC	744 - 800	558 - 600	1190 - 1280	893 - 960
1-1/8 - 12 NF	818 - 880	614 - 660	1339 - 1440	1004 - 1080
1-1/4 - 7 NC	1042 - 1120	781 - 840	1693 - 1820	1255 - 1360
1-1/4 - 12 NF	1153 - 1240	856 - 920	1860 - 2000	1395 - 1500
1-3/8 - 6 NC	1358 - 1460	1023 - 1100	2213 - 2380	1655 - 1780
1-3/8 - 12 NF	1562 - 1680	1172 - 1260	2530 - 2720	1897 - 2040
1-1/2 - 6 NC	1804 - 1940	1358 - 1460	2939 - 3160	2195 - 2360

Recommended Torques of Standard Bolts in Newton-Meters

This table lists the recommended tightening torques in Newton-meters (N·m) for the various size bolts and nuts that are used. The suggested assembly torque values are per engineering specifications.

Recommended Torques of Standard Bolts in Newton-Meters

Size	SAE Grade 5		SAE Grade 8	
	Dry	Lube	Dry	Lube
5/16 - 18 NC	22 - 27	16 - 17	31 - 33	23 - 24
5/16 - 24 NF	24 - 26	17 - 19	-	26 - 27
3/8 - 16 NC	37 - 40	28 - 31	56 - 60	44 - 47
3/8 - 24 NF	44 - 47	31 - 33	63 - 67	-
7/16 - 14 NC	63 - 67	44 - 47	87 - 93	68 - 73
7/16 - 20 NF	68 - 73	49 - 53	97 - 107	75 - 80
1/2 - 13 NC	93 - 100	68 - 73	136 - 147	99 - 107
1/2 - 20 NF	112 - 120	81 - 87	149 - 160	112 - 120
9/16 - 12 NC	136 - 147	99 - 107	187 - 200	136 - 147
9/16 - 18 NF	149 - 160	112 - 120	211 - 227	161 - 173
5/8 - 11 NC	187 - 200	136 - 147	273 - 293	281 - 227
5/8 - 18 NF	211 - 277	161 - 173	297 - 320	223 - 240
3/4 - 10 NC	323 - 347	248 - 267	471 - 507	347 - 373
3/4 - 16 NF	372 - 400	273 - 293	521 - 560	397 - 427
7/8 - 9 NC	533 - 573	397 - 427	744 - 800	571 - 613

Size	SAE Grade 5		SAE Grade 8	
	Dry	Lube	Dry	Lube
7/8 - 14 NF	583 - 627	435 - 467	819 - 880	620 - 667
1 - 8 NC	793 - 853	595 - 640	1116 - 1200	843 - 907
1 - 12 NF	868 - 933	657 - 707	1240 - 1333	917 - 987
1-1/8 - 7 NC	992 - 1067	774 - 800	1587 - 1707	1191 - 1280
1-1/8 -12 NF	1090 - 1173	819 - 880	1785 - 1920	1339 - 1440
1-1/4 - 7 NC	1389 - 1493	1041 - 1120	2257 - 2427	1687 - 1813
1-1/4 - 12 NF	1537 - 1653	1141 - 1227	2480 - 2667	1860 - 2000
1-3/8 - 6 NC	1811 - 1947	1364 - 1467	2951 - 3173	2207 - 2373
1-3/8 - 12 NF	2083 - 2240	1563 - 1680	3373 - 3627	2529 - 2720
1-1/2 - 6 NC	2405 - 2587	1811 - 1947	3917 - 4213	2927 - 3147

1.7 Servicing Time Tables

!

NOTE: Duty Guidelines / Definitions:

- Light - Sand and gravel, rotary drilling
- Normal - Soft rock, rotary drilling
- Heavy - Hard rock, hammer drilling

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NOTE: Life cycle calculation is based on the average expected life of the part. It does not imply that the part is covered under any warranty for that period.

Mean Time Between Service (MTBS)

Rotary Head Oil Level Check and Upper Bearing Greasing

Light duty	Normal duty	Heavy duty
8–10 hours or daily	8–10 hours or daily	8–10 hours or daily

Mean Time Between Maintenance (MTBM)

Change Rotary Head Oil

Light duty	Normal duty	Heavy duty
1,200 hours	1,000 hours	800 hours

Mean Time Between Failure (MTBF)

Average Time Between Recommended Rotary Head Rebuilds

Light duty	Normal duty	Heavy duty
12,000 hours	10,000 hours	8,000 hours


Mean Time To Repair (MTTR)

Average To Remove From Machine | **Average To Rebuild Rotary Head**

8–10 hours	16–20 hours
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
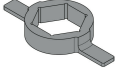


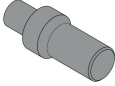
1.8 Required Tools and Special Equipment

Before starting the rotary head rebuild, certain special tools are necessary and available from Epiroc. Many of these tools are in a Rotary Head Rebuild Tools Kit. See table Rotary Head Rebuild Tools Kit.



NOTE: Refer to Rotary Head Rebuild Tools Kit drawing.

Rotary Head Rebuild Tools Kit

	Spindle seal tool
	Spindle nut tool
	Lock nut adjustment tool
	Spindle rotation tool
	Rotary head rebuild stand
	Input pinion tool

	Puller rod tool
	Puller plate tool
	Spindle nut stop tool, assembly
	Puller cap plate tool
	Stop angle tool
	Bolt, jacking
	Bolt, jacking
	Hex-heavy nut, 1-8

Some additional tools are necessary for this rotary head model that are not included with the Rotary Head Rebuild Tools Kit, but are necessary for a successful rebuild. These tools include:

- Round plate with holes
- Tee rod hook
- Lock-ring tool
- Various size threaded eye bolts
- Torque wrenches
- Shackle
- Insulated gloves
- Claw type bearing puller
- Lifting straps
- 25-ton long stroke bottle jack
- Induction heater or oil bath heater capable to 232 °C (450 °F)

- Hoist with a minimum of 9,072 kg (20,000 lb) capacity
- Hydraulic press
- Large and small snap ring pliers

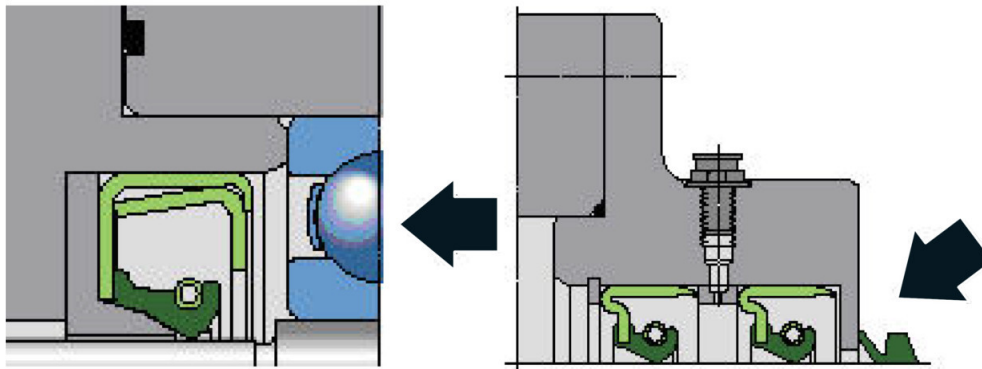
1.9 Rotary Head Rebuild Reference Numbers

Rotary Head Rebuild Kit Number / Bare Part Number

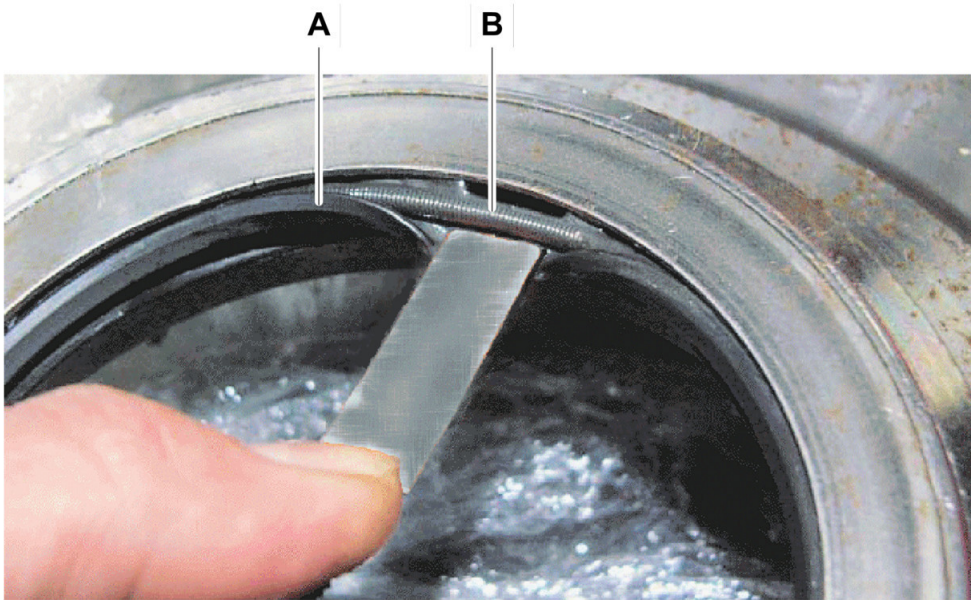
Rebuild Parts Kit	Rebuild Tool Kit	Rotary Head Part
2657817488	2657618142	2657653693 bare housing

1.10 Correct Bearing Oil Seal Orientation

The lip of the seal points to the highest pressure side (see arrow). Seals can be doubled.



For oil retention, the seal lip must be mounted with the lip pointing inwards toward the bearing and oil cavity to seal in the oil. The bearing seal has a spring retention design system. The spring must be towards the inside of the cavity.



A	Seal lip
B	Spring

1.11 Safety Messages in Publications

Safety messages in publications declare hazards and the related measures to avoid the hazards in that particular situation. Safety messages contain signal words (Danger, Warning, Caution, and Notice) that relate to the consequences of those specific hazards. The information in safety messages must be obeyed.

Safety messages consist of:

- A signal word to determine the degree of the hazard.
- A type of hazard states the potential source of a hazard. For example: Moving parts, Hot surface, and so on.
- The consequence of the hazard, if not avoided.
- A method to avoid the hazard.

The following are examples of safety message structures.

DANGER

Hazard

The signal word "DANGER" indicates a hazardous situation which will result in death or serious injury if not avoided.

- ▶ The method to avoid the hazard is written here.

WARNING

Hazard

The signal word "WARNING" indicates a hazardous situation which could result in death or serious injury if not avoided.

- ▶ The method to avoid the hazard is written here.

CAUTION

Hazard

The signal word "CAUTION" indicates a hazardous situation which could result in minor or moderate injury if not avoided.

- ▶ The method to avoid the hazard is written here.

NOTICE

Hazard

The signal word "NOTICE" contains information that is not related to bodily injury yet considered important. In a "NOTICE" the damage is related to machines, components, or systems.

- ▶ The method to avoid the hazard is written here.

1.12 Preventive Maintenance Inspections

NOTICE

Rotary Head Damage

Incorrect preload on the Main Bearing Assembly reduces the service life of the rotary head.

Repeated problems with the Swivel Head Packing Assembly, such as water leaks and missing packing rings, could be an indication of loss of preload on the Main Bearing Assembly.

Insufficient preload lets the upper spindle bearing inner-race spin below the lock nut during drilling and breakout operations. The spinning of the race quickly wears away the bottom of the lock nut and any existing preload is lost, resulting in endplay. The endplay in the Spindle Assembly is harmful to bearings and other components.

Excessive preload overloads the bottom spindle bearing, which leads to loss of preload and early failure.

Reapplying preload to spindle bearing causes early bearing failure.

- ▶ Apply correct preload on the Main Bearing Assembly.

In addition to the rotary head service recommendations in the Maintenance manual, the following is suggested:

1. Test oil samples every 500 hours.
 - a. Create a chart to track any changes in the content of dissolved metals or contaminants.
 - b. Changes must be fairly linear. Any sudden or dramatic changes in oil samples could be an indication that there has been a loss of preload on the main bearing, or problems elsewhere.
 - c. Any major changes are noted in the metal content of the oil. If a dramatic loss of preload or other serious problem is discovered or observed, consult Epiroc Technical Services.
2. Change the rotary head oil every 1,000 hours. For more information, see table Mean Time Between Service.
 - Examine the magnetic drain plug, strainer, and oil for evidence of ground-up metal shavings.



NOTE: Excessive amounts of metal shavings could be an indication of a problem.

3. Examine the preload every 2,000 hours.
 - a. Use a machinist's magnetic base with an adjustable arm and a dial-gauge attached to the end.
 - b. Put the dial-gauge on top of the spindle.
 - c. Examine vertical movement of the spindle and track the reading.
 - d. Measure horizontal runout by placing the dial-gauge on the side of the spindle and using the motor to rotate the spindle.

1.13 Safety Precaution

The following safety, cleanliness and maintenance guidelines are to be used throughout the assembly and disassembly process for the rotary head:

- Clean the exterior of the rotary head before disassembling it.
- Use applicable personal protective equipment.
- Disassemble the rotary head in a clean area.
- Pay close attention to the identities of the parts during disassembly; this makes reassembly much easier.
- Use a soft-faced hammer and soft drifts to remove heavier parts.
- Handle parts carefully. Hardened parts can chip or break if they are dropped on a hard surface.
- Clean all parts thoroughly in an approved cleaning solvent and blow dry with compressed air. Do this in a well-ventilated area.

- Inspect all bearings, gears, and shafts for wear, cracks, discoloration, and/or looseness. Examine all new parts for damage that can have occurred in shipment and replace all un-serviceable parts.
- Remove all nicks, burrs, or any foreign matter from the rotary head housing, inside, and out.
- Do not let dirt, cuttings, or brass shavings enter the rotary head during assembly.
- Keep hands and tools clean.
- Wipe a film of oil over all working parts such as bearings, shafts, seals, and O-rings as they are assembled, except where specified otherwise.
- Except for press-fit bearings and bushings, parts must fit together easily. If force is necessary, a part is either out of tolerance or alignment, and must be corrected to prevent binding and possible damage.

2 Disassembly Procedure

2.1 Preparation and Breakdown

1. Lift the rotary head (Figure 1, item A) and mount the rotary power head to the work stand (item B).



Figure 1

⚠ CAUTION

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Use an oil drip container and grease rags for potential overflow when motor adapters are removed.
- ▶ Comply with work area cleanliness and safety.

- Put a container (Figure 2, item B) below the rotary power head housing (item A). Drain oil from housing. Correctly dispose the oil or recycle used oil.



Figure 2

- Remove the hydraulic motor covers (Figure 3, item A), motor adapters, and O-rings from the rotary head cover (item B).



NOTE: It is common for rotary heads that are sent for rebuilding to have the hydraulic motors and subsequent hosing removed and replaced with just motor covers before delivery to the rebuild shop.

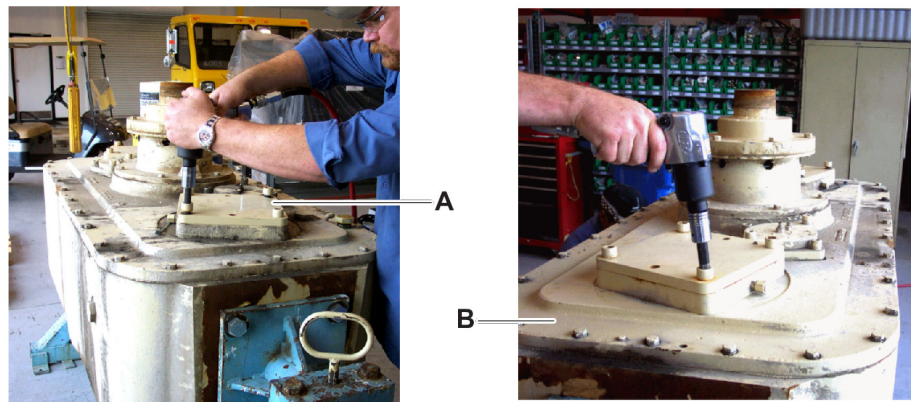


Figure 3

4. Remove spindle cover (Figure 4, item A), shims (item B), wear bushing (item C), and swivel 30-X packing from spindle cap (item D).

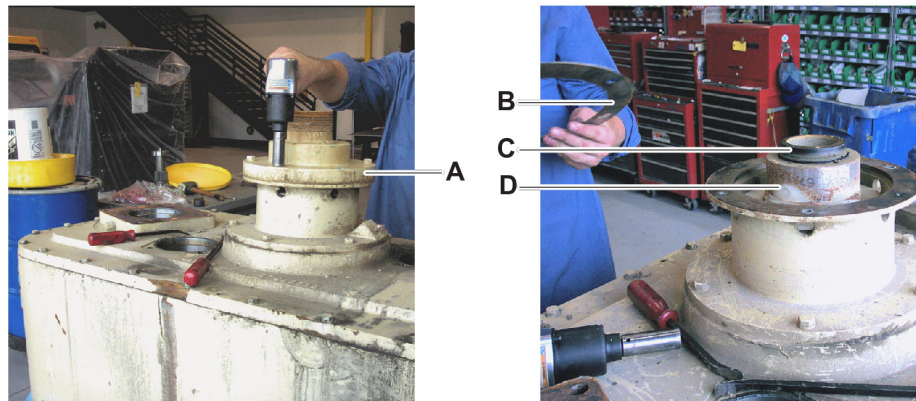


Figure 4

5. Remove the spindle cap (Figure 5, item A) with the spindle nut holding tool (item B), input pinion tool, and ratchet as shown. Rotate the input pinion tool (item C) counter-clockwise as viewed from the top of the housing.

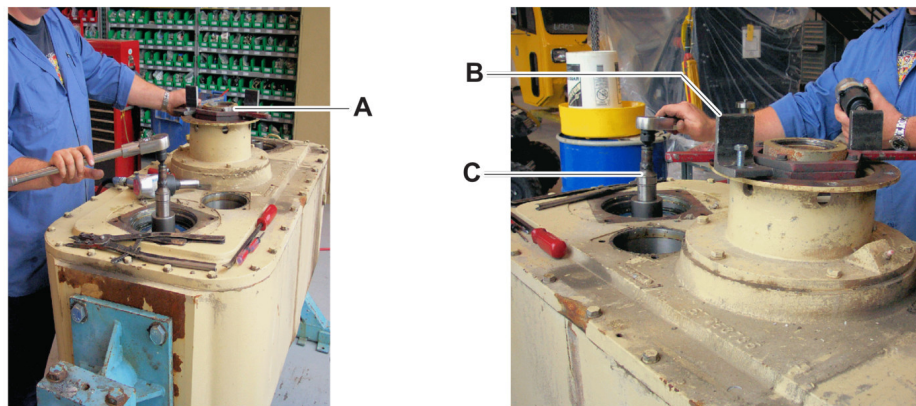


Figure 5

6. Remove the drip shield, O-ring, and locking ring (Figure 6, item A) from the spindle.



Figure 6

7. Remove the swivel housing (Figure 7, item A) from the rotary head cover.

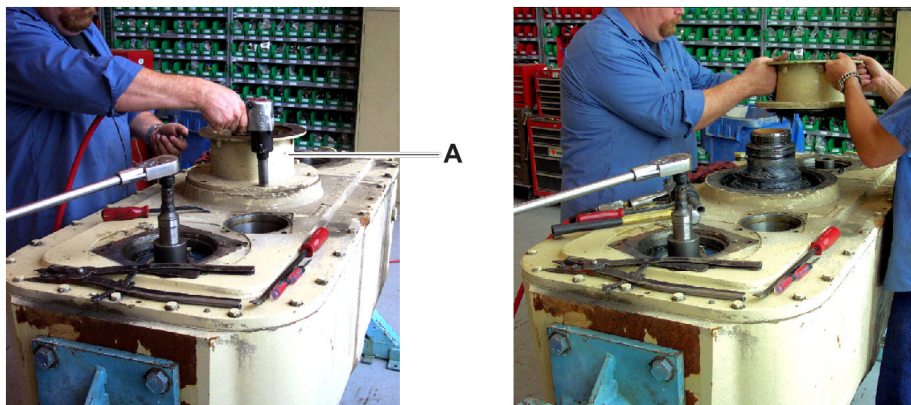


Figure 7

8. Remove the O-ring and the two oil seals from the swivel housing (Figure 8).



Figure 8

9. Remove the wear sleeve (Figure 9, item A) with a three-claw puller tool (item B).

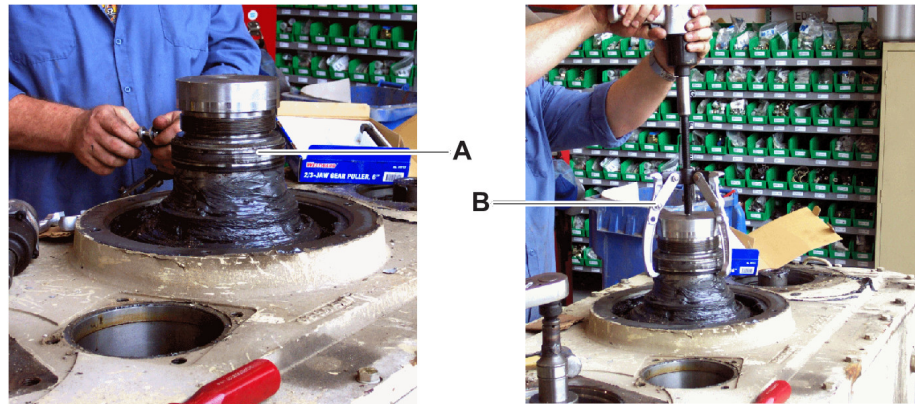


Figure 9

10. Remove the lock-tongued washer (Figure 10, item A).

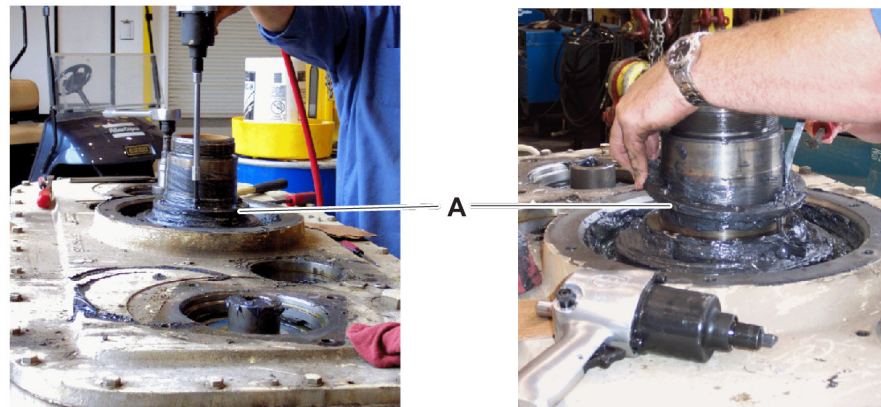


Figure 10

11. Use the lock nut adjustment tool (Figure 11, item A), input pinion tool, and ratchet to remove the upper bearing adjusting nut.

12. Rotate the input pinion tool (item C) with the ratchet (item B) clockwise as viewed from the top of the housing to remove the upper bearing adjusting nut.

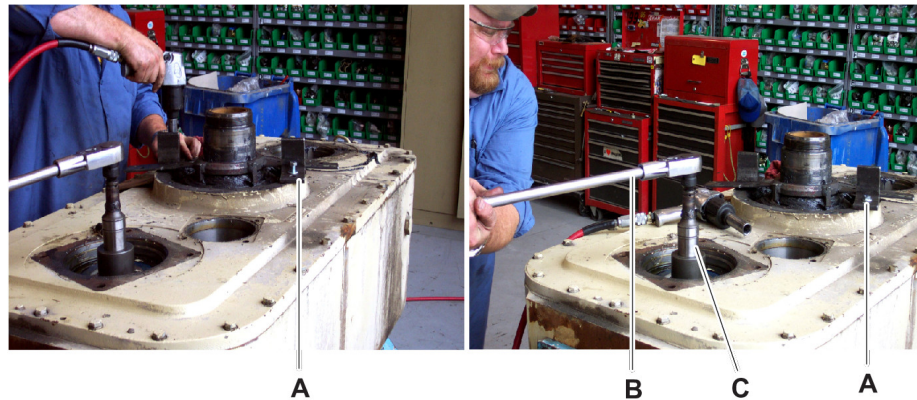


Figure 11

13. Before completely removing the upper bearing adjusting nut (Figure 12, item A), install a small floor jack or scissor jack below the spindle to lift and support it through Step 1, 2, and 3 in Remove the Output Gear from the Spindle. The upper spindle bearing cone and cup will be removed along with the cover shown in Steps 16 and 17.

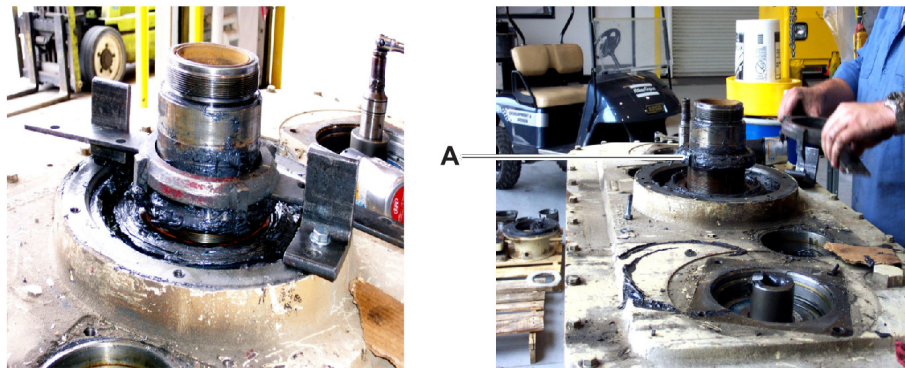


Figure 12

14. Remove the retainer bolts and release the vacuum manually by pulling up the pressure relief valve stem (Figure 13, item B) at the same time. Remove the intermediate bearing adjusters. Remove O-ring and shims. Remove the intermediate bearing holder (item A) and the O-ring.

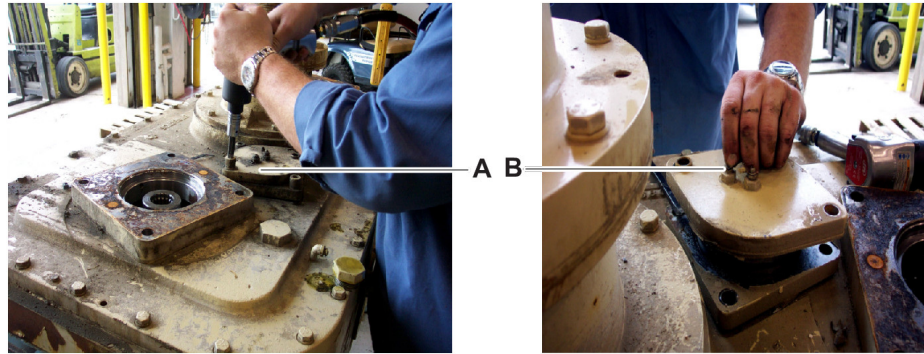


Figure 13

⚠ CAUTION

Risk of Injury

Incorrect handling of heavy sectioned snap rings can cause serious injury.

- ▶ Use extreme caution when you work with heavy sectioned snap rings.
- ▶ Use the applicable reteaching type snap ring pliers and wear gloves and face shield protection in case of an accidental flying snap ring.

15. Remove snap rings from above the input pinion bearings (Figure 14).

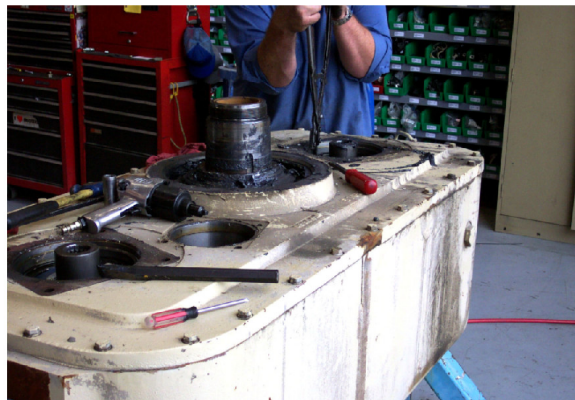


Figure 14

16. Remove all cover cap screws (Figure 15, item A). Install four jacking bolts (item C) in the threaded holes provided in the housing cover (item B) as shown. Slowly tighten the jacking bolts alternately to break the cover seal and partially lift the cover from the housing.

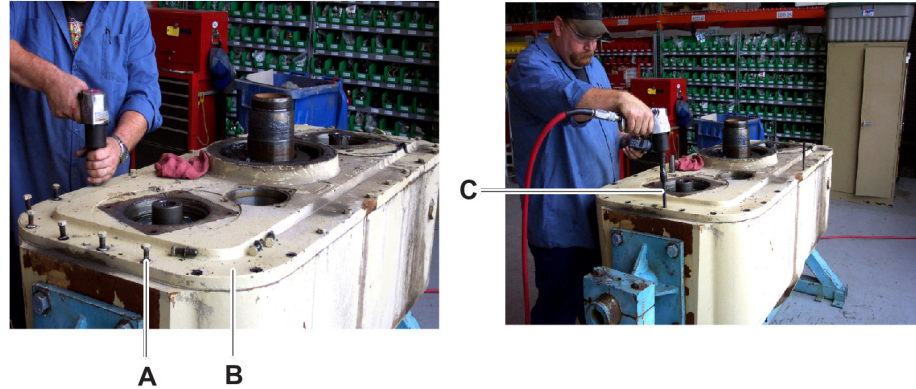


Figure 15

17. Insert lifting eyes (Figure 16, item A), attach them to the hoist with chains, and remove the cover (item B). Remove the oil seal from the cover. Using the same jacking bolts placed in threaded holes provided in housing cover below the upper spindle bearing cup, slowly tighten the jacking bolts alternately to push the bearing cup from the cover.

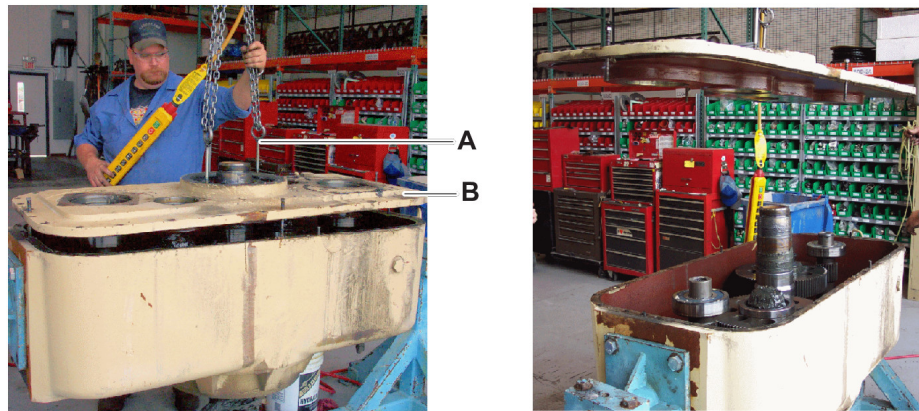


Figure 16

⚠ CAUTION

Component Damage

Can cause damage to the rotary housing.

- ▶ Do not distort the cavity in the rotary housing when removing the assemblies.
- ▶ Gently tap with a rawhide hammer to loosen if necessary.

- Using the hoist and lifting chains (Figure 17, item A) attached to input pinion assembly (item B), lightly tap the assembly with either a rawhide or rubber mallet (item C) to remove the input pinions with the attached bearings from the housing. Use a large stationary hydraulic press to push the bearing off of the pinions.

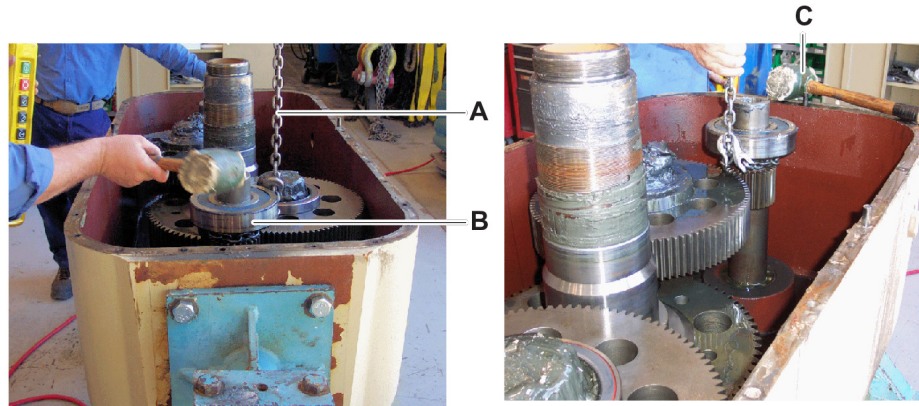


Figure 17

- Using the hoist and lifting chains attached to the intermediate gear (Figure 18, item A), lightly tap the gear shaft with either a rawhide or rubber mallet to remove the intermediate gear shafts with the attached bearings. Use a large stationary hydraulic press to push the gear off of the intermediate shafts.

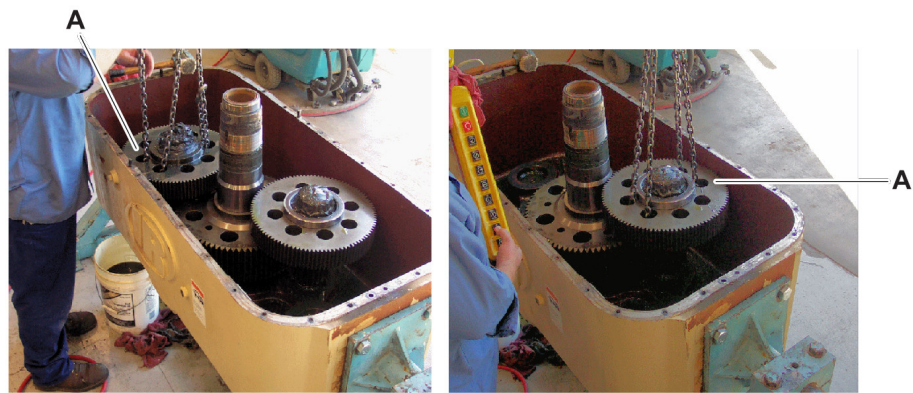


Figure 18

2.1.1 Remove the Output Gear from the Spindle

1. Remove the output gear collar (Figure 1, item A).

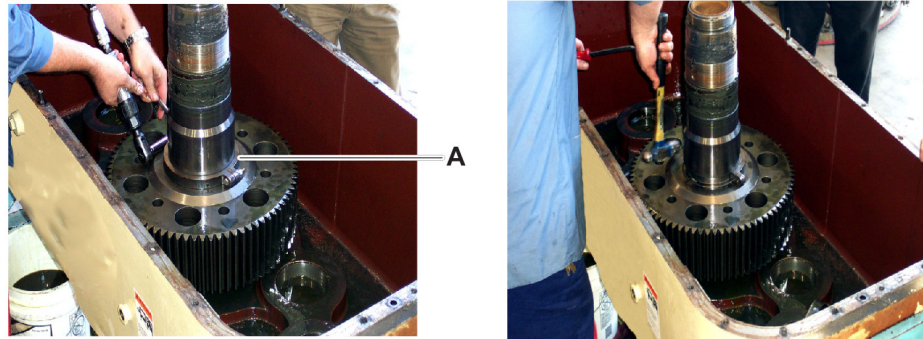


Figure 1

2. Use the applicable tools and a bottle jack or porto-power with a 25-ton minimum capacity as shown to remove the output gear from the spindle.
3. Use lifting chains and hoist to remove the output gear (Figure 2, item B) from the spindle (item A) as shown. Remove key from the spindle.
4. Remove both lower intermediate bearing cups from the housing with a three-claw puller.

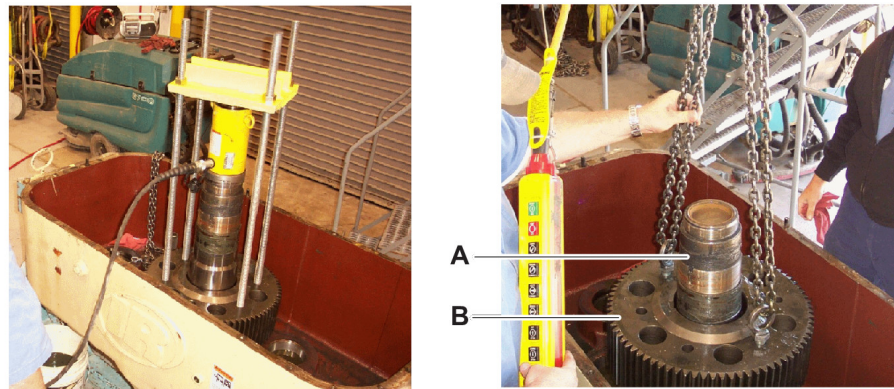


Figure 2

- Remove the floor or scissor jack used to support the spindle. Put a drip pan (Figure 3, item C) below the rotary head.

⚠ WARNING**Component damage**

Rotating the rotary head housing can cause damage to the components.

- ▶ Make sure that the pillow blocks are used with rotary head stand.
- ▶ Make sure that there is enough space when rotating the rotary head housing.

- Rotate the rotary head housing (item A) 180° within the work stand (item B) to remove the spindle.

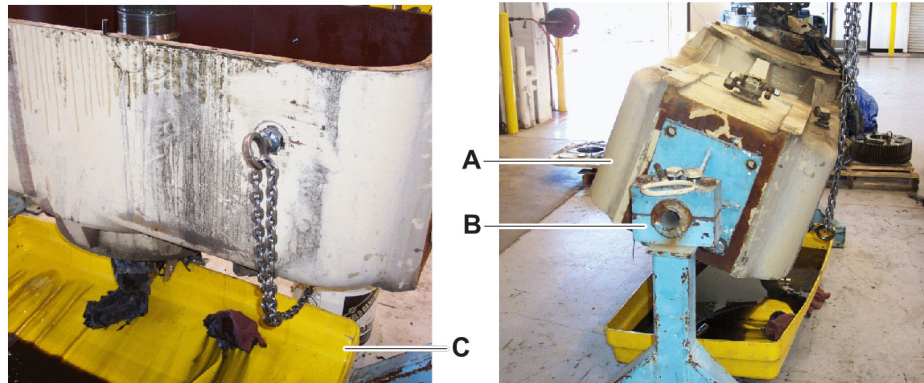


Figure 3

- Remove the lower spindle retainer (Figure 4, item A). Remove the O-ring and oil seals from the lower spindle retainer.

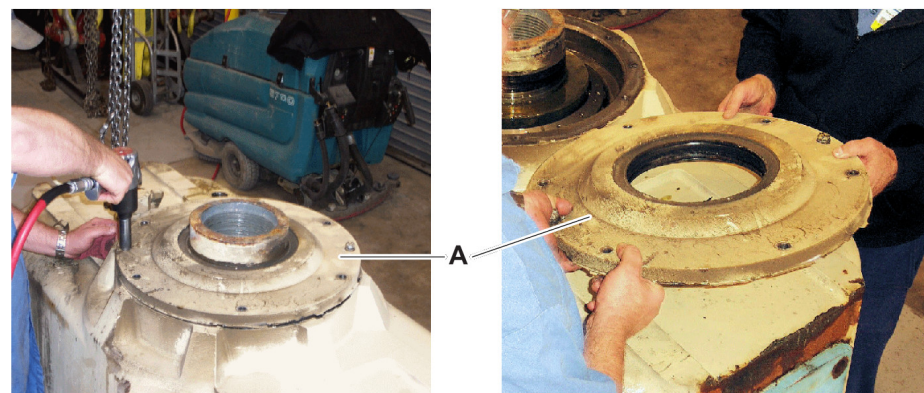


Figure 4

2.1.2 Remove the Spindle

1. Connect the chain to the hoist, insert the chain hook-end down through the spindle (Figure 1, item A), and attach lock-ring to hook (Figure 2, item B).



Figure 1

2. Remove the spindle (Figure 2, item A) with the lower spindle bearing cone and oil seal wear sleeve still attached.



Figure 2

3. Use a large stationary hydraulic press to push spindle bearing cone off of the spindle.
4. Use a three-claw puller or quick spot heating from a torch to remove the oil seal wear sleeve from the spindle.



NOTE: If spot heating is used to remove the oil seal wear sleeve, it can not be used again and must be thrown away and replaced with a new one.

- Remove the lubrication pump (Figure 3, item A), pump drive adapter, O-ring, strainer, and all miscellaneous plugs from the housing.



Figure 3

- Use the jacking bolts placed in the threaded holes provided within the housing above the lower spindle bearing cup. Slowly tighten the jacking bolts alternately to push the bearing cup from the housing (Figure 4, item A).



Figure 4



NOTE: Older housings do not have these threaded holes provided. If the housing is still reusable, these jacking holes can be drilled and tapped before reassembly.



NOTE: For field installation, the Product Support Department can provide details for the location and size of the tapped holes from the latest revision of the housing machining drawing.

3 Assembly Procedure

3.1 Set-Up and Preparation

1. Lift the machined housing and position it in the rotary head working stand (Figure 1, item A) with the cover pointing upward.



Figure 1

2. Remove the cover (Figure 1, item B), clean, and put aside in a clean area.
3. Turn the housing on its side using a strap and a hoist as shown. Use compressed air (Figure 2, item A) to remove contaminants and clean inside of the housing (item B) with paint prep thinner (S910).

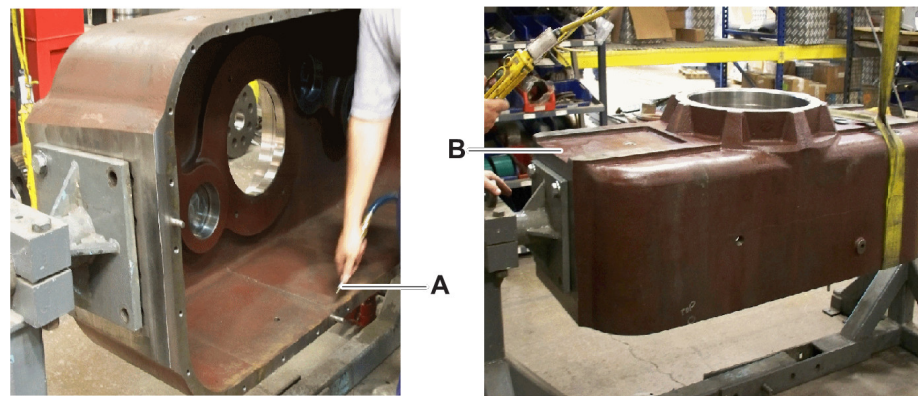


Figure 2

- Use a strap to rotate the housing upside down to prepare for the installation of the spindle.

NOTICE

Component Damage

Heating or freezing more than the specified limit can cause damage to the component.

- ▶ Do not heat the bearing cones hotter than 149 °C (300 °F) unless it is specified.
- ▶ Do not freeze the bearing cups colder than -30 °C (-20 °F).

- Heat the lower spindle bearing cone on an induction heater (or oil bath) to between 121 °C and 135 °C (250 °F and 275 °F).
- While the bearing cone (Figure 3, item B) is heating in the induction heater (item A), begin freezing the lower spindle bearing cup (item C) to between -18 °C and -23°C (0 °F and -10 °F). Additionally, begin freezing the upper spindle bearing cup and both lower intermediate shaft bearing cups to the same temperature.

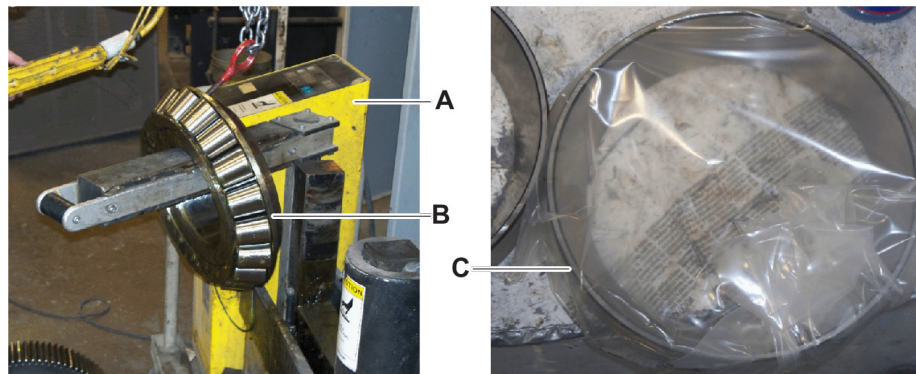


Figure 3

7. Make sure of correct thread match between the bearing adjusting nut (Figure 4, item A) and the spindle (item B).

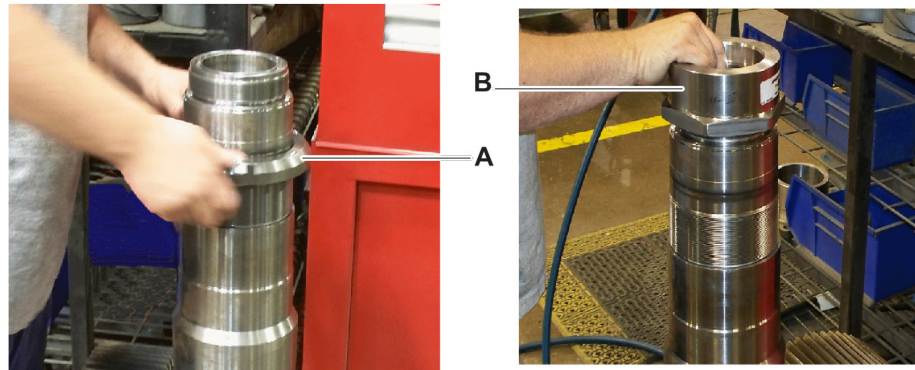


Figure 4

8. Move the spindle cap to the bottom of the threads to confirm that there is no damage to the threads on the spindle.



NOTE: The threads on the spindle cap are left-handed.

3.2 Shrink Fit the Spindle Bearing Cone

WARNING

Burn Hazard

Hot components can cause serious injury.

- ▶ Use approved safety gloves when handling hot components.



1. Remove the hot spindle bearing cone (Figure 1, item B) from the induction heater with safety gloves (item A). Lower the spindle bearing cone carefully over the spindle (item C) until it rests against the spindle shoulder.

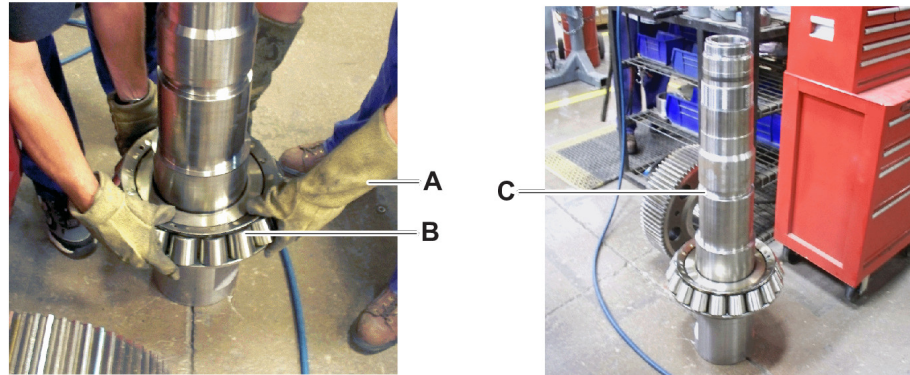


Figure 1

2. Let the bearing cone cool and shrink-fit onto the spindle. Once cooled, apply a layer of Ronex-HD grease to the bearing cone.
3. Carefully press both oil seals into the lower spindle retainer. The seals must be correctly oriented.



NOTE: The oil seal has a two lip seal design. The primary seal lip is for oil retention, and the secondary lip is for preventing contamination from reaching the primary seal lip. The primary lips on both oil seals must be towards the inside of the rotary housing.

4. Make sure that the spindle retainer (Figure 2, item B) is flipped over to place it on the housing. Apply a layer of Ronex-HD grease to the seal lips and in between the oil seals (item A).



Figure 2

3.3 Expansion Fit the Lower Housing Bearing Cup

1. Remove the bearing cup (Figure 1, item A) from the freezer and press the frozen lower spindle bearing cup into the housing. Make sure that the bearing cup is seated tightly against the mounting surface in the housing.

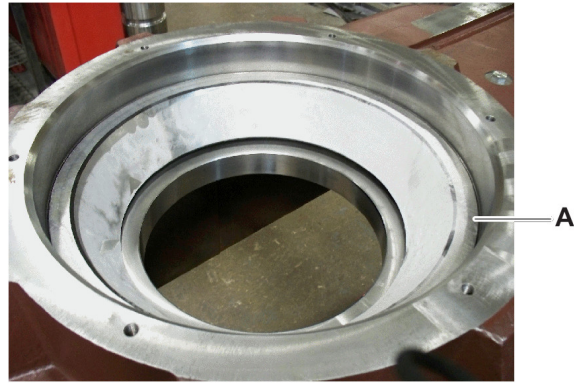


Figure 1

2. After correct seating, let the bearing cup warm to ambient temperature. Apply a thin layer of Ronex-HD grease to the bearing cup running surface.
3. Carefully flip the spindle (Figure 2, item A) with the bearing cone sub-assembly as shown.

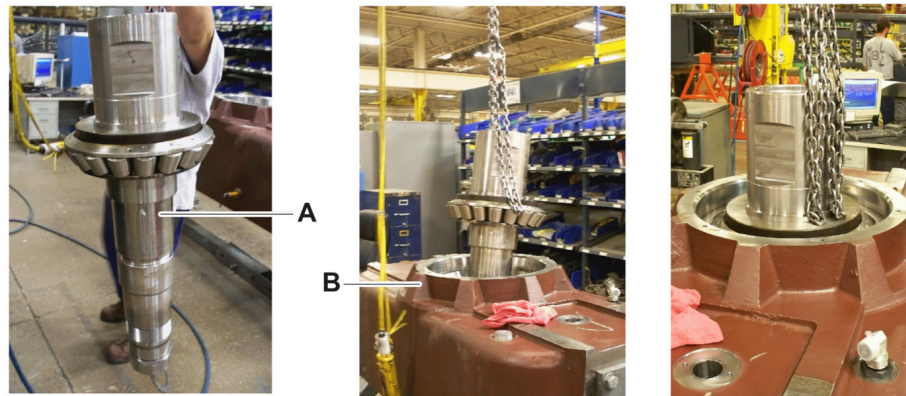


Figure 2

4. Attach the spindle to the hoist with a lifting chain. Lower the spindle slowly into the rotary head housing until the bearing cone rests against its mounting cup race (item B).
5. Heat the oil seal wear sleeve (Figure 3, item A) to between 177 °C and 191 °C (350 °F and 375 °F).



NOTE: Oil seal wear sleeve heats quickly, rotate it for even expansion to eliminate binding when it is installed.

6. Use approved safety gloves and put the wear sleeve (item A) over the spindle and seat it firmly on the shoulder of the spindle.



NOTE: Make sure that the wear sleeve is seated evenly.

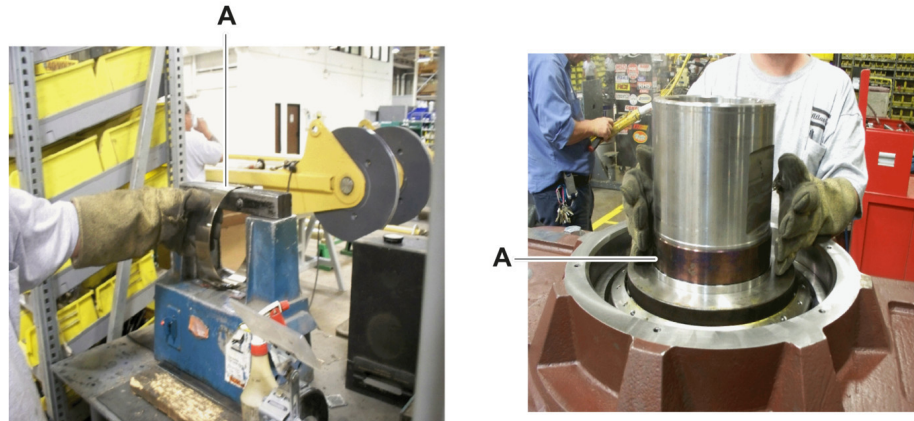


Figure 3

7. Heat the output gear (Figure 4, item A) to between 107 °C and 121 °C (225 °F and 250 °F). When correct temperature is reached, refer to Shrink Fit the Output Gear to install the output gear.
8. After the output gear is installed, start heating the both intermediate gears to between 149°C and 163°C (300°F and 325°F) in preparation for building up the intermediate shaft sub-assemblies needed soon after the output gear is installed.

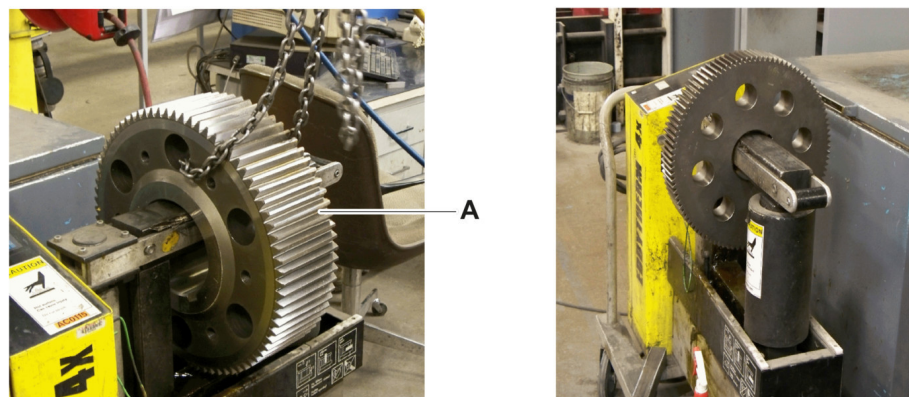


Figure 4

9. Lubricate the O-ring (Figure 5, item A) and position on the mounting shoulder of the lower spindle retainer (item B).
10. Put the lower spindle retainer around the spindle. Do not to damage the seal lips
Tighten the lower spindle retainer in position.

11. Install the plug into dedicated place in the side of the lower spindle retainer.

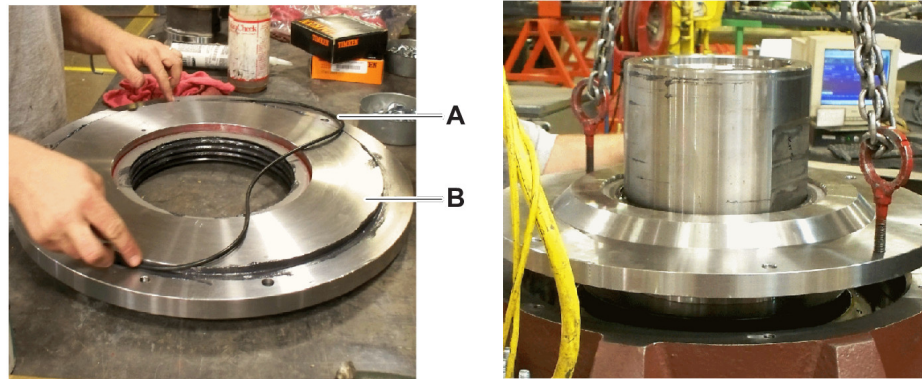


Figure 5

12. Before rotating housing to the upright position, install the bottom and side housing plugs (Figure 6, item B), sight glass (item A), and strainer into their dedicated places in the housing.

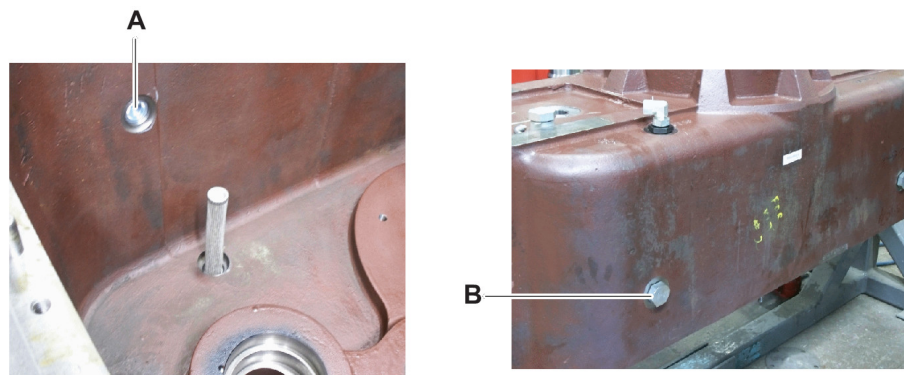


Figure 6

⚠ WARNING

Component damage

Rotating the rotary head housing can cause damage to the components.

- ▶ Make sure that the pillow blocks are used with rotary head stand.
- ▶ Make sure that there is enough space when rotating the rotary head housing.

13. Use a strap and the hoist to rotate the housing (Figure 7, item A) carefully to the upright position.

14. Use a round plate and a small bottle jack (item C) (or scissor jack with a piece of wood) to support the spindle (item B) from the bottom so that both the lower spindle bearing cup and cone are pressed tightly together.



NOTE: The spindle must be supported tightly to make sure that correct placement of the output gear and to start the critical pre-loading of the spindle bearings explained later in this document.

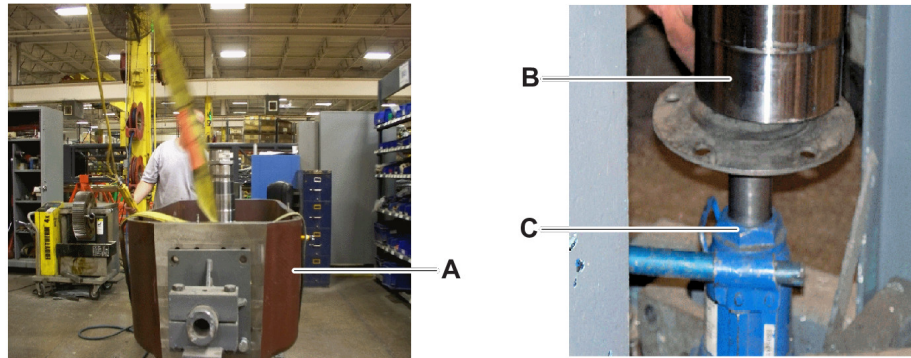


Figure 7

15. Insert key (Figure 8, item A) into the keyway of the spindle (item B). Retrieve both frozen lower intermediate bearing cups (item C) and quickly insert them into the housing.
16. Use a steel hammer and a brass drift to make sure that the bearing cups are seated tightly against the mounting surfaces in the housing (Do not to strike the bearing surface).

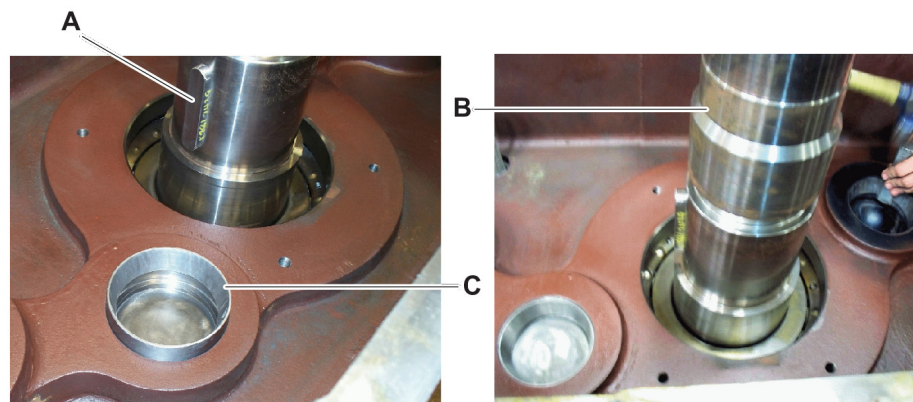


Figure 8

17. After correct seating, let the bearing cups warm to ambient temperature. Apply a thin layer of clean grease to both bearing cup running surfaces.

3.4 Shrink the Fit Output Gear

1. Remove the hot output gear from the induction heater with the shackle.
2. Slide the output gear (Figure 1, item A) over the spindle with the keyway flush using protective gloves as shown.



NOTE: Make sure that the output gear is seated correctly on the shoulder of the spindle and the retaining collar groove is fully visible.

3. Put the retaining collar (item B) around the spindle to keep the output gear in place.

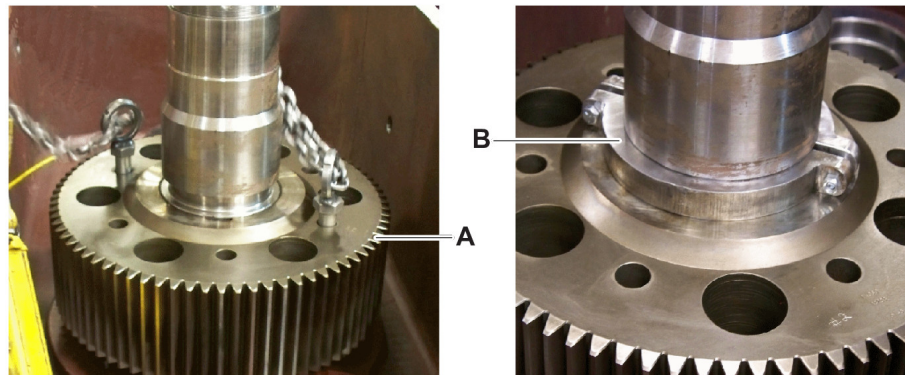


Figure 1

4. Secure the retainer collar with bolts and elastic stop nuts. Use a hammer and small tipped drift pin to stake the bolt threads as close as possible to the nuts.
5. Let the output gear cool.

3.5 Shrink Fit the Intermediate Upper Bearing Cone and the Gear Assembly

WARNING

Burn Hazard

Hot components can cause serious injury.

- ▶ Use approved safety gloves when handling hot components.

1. Heat the two lower intermediate bearings cones (Figure 1, item A) to between 135 °C and 149 °C (275 °F and 300 °F) on the induction heater (item B).



NOTE: Do not let the bearing cones or gears to soak at temperatures above 149 °C (300 °F) for extended periods of time.

- Use safety gloves and slide the heated lower intermediate bearing cone over the end until it rests against the shoulder of intermediate shaft (item C). Repeat for the other intermediate shaft.

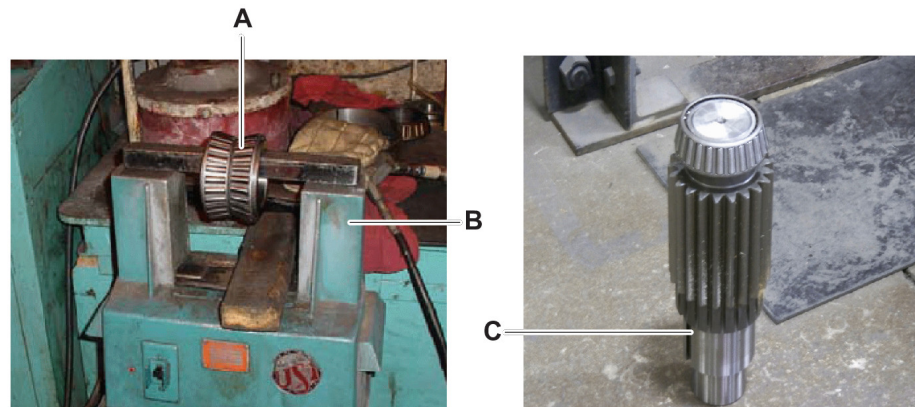


Figure 1

- Put the keys in keyways of the intermediate shafts. Use safety gloves and slide the each hot output gear (Figure 2, item A) carefully over the intermediate shaft until they rest on the shoulders.
- Make sure that the keys (item B) are correctly installed into the slots and flush with gear.

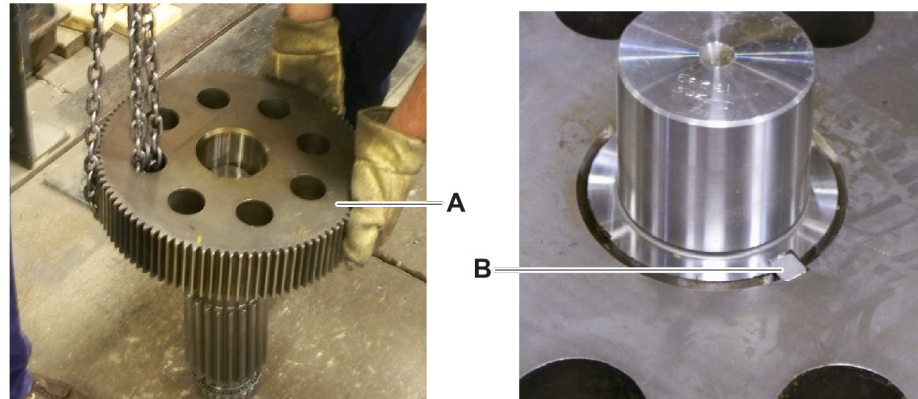


Figure 2

3.6 Shrink Fit the Spacers and the Lower Intermediate Bearing Cones

⚠ WARNING

Burn Hazard

Hot components can cause serious injury.

- ▶ Use approved safety gloves when handling hot components.

1. Heat the spacers to between 163 °C and 177 °C (325 °F and 350 °F).
2. Put the spacers (Figure 1, item A) onto the intermediate shafts. Let the spacers to rest against the top of the intermediate gears.
3. Let the spacers shrink-fit onto the intermediate shafts.
4. Heat the lower intermediate shaft bearing cones to between 135 °C and 149 °C (275 °F and 300 °F). Slide each intermediate shaft bearing cone over the end of its respective intermediate shaft, until it rests against the shoulder of the spacer.



Figure 1

5. Insert the oil seal (Figure 2, item A) into the spacer. Pay close attention to proper orientation. The primary lips on the oil seals must be toward the inside the space.

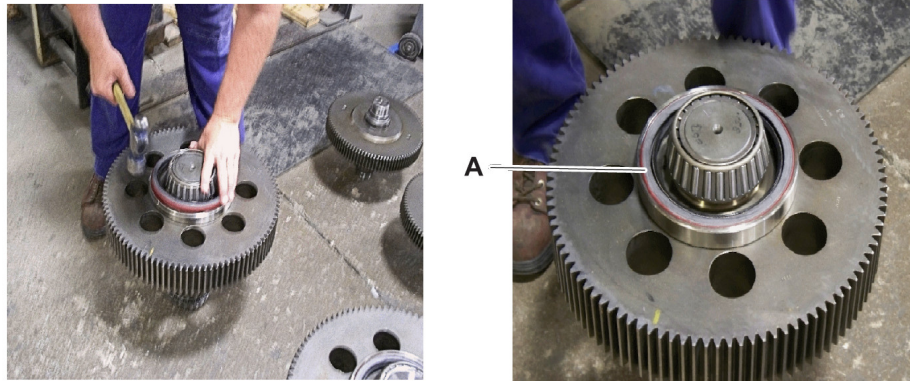


Figure 2

6. Attach the intermediate shaft subassembly (Figure 3, item A) to the hoist with the lift chains. Lower the intermediate shaft subassembly carefully down into the pre-greased lower intermediate bearing cup (item B). Repeat for the other subassembly.

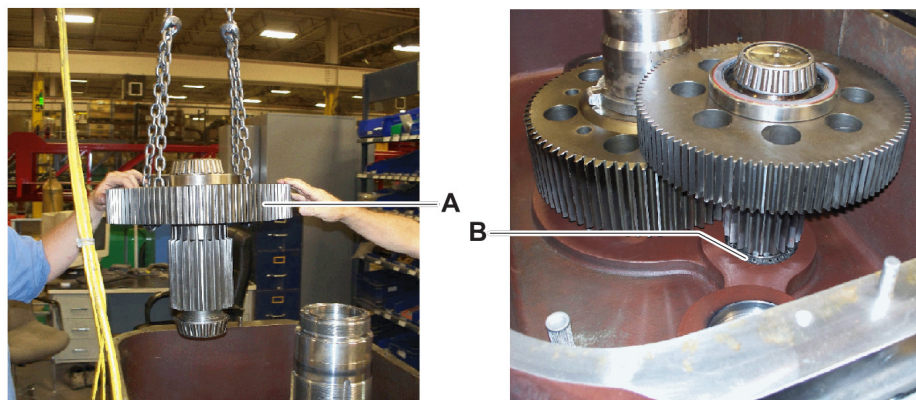


Figure 3

7. Install the upper and the lower ball bearings (Figure 4, items B and D) onto the input pinions (item C) with a hydraulic press (item A).

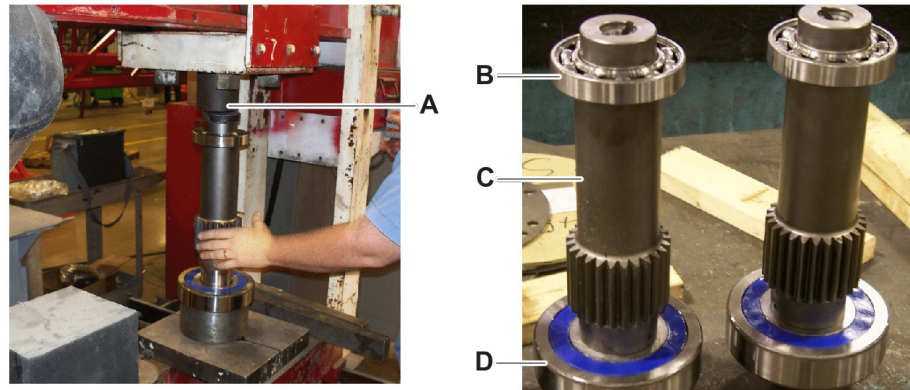


Figure 4

8. In the lower end of one input pinion shaft subassembly (Figure 5, item A), install a drive key (item A) followed by a snap ring to hold the key in place.
9. Make sure that the lubrication pump drive adapter fits correctly into input pinion sub-assembly (to be installed later).

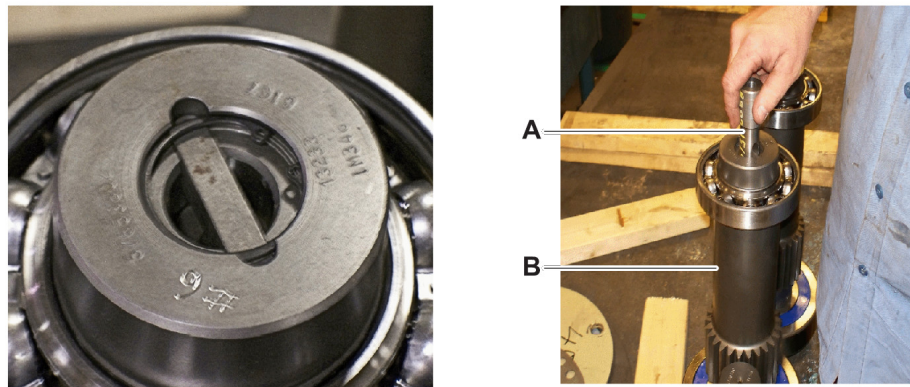


Figure 5



NOTE: This input pinion shaft sub-assembly with the drive key installed must be placed directly over the location provided in the housing where the lubrication pump is installed. If not, the lubrication pump does not circulate oil.

10. Apply a thin layer of Ronex-HD grease to the housing bores and the outer races on the lower input pinion bearings to help the input pinion shaft subassemblies (Figure 6, item A) slide easily into position.

11. Tap the intermediate shaft with a rawhide mallet (item A) to fully seat the bearing. Make sure of correct gear teeth engagement. Repeat for second subassembly as shown.

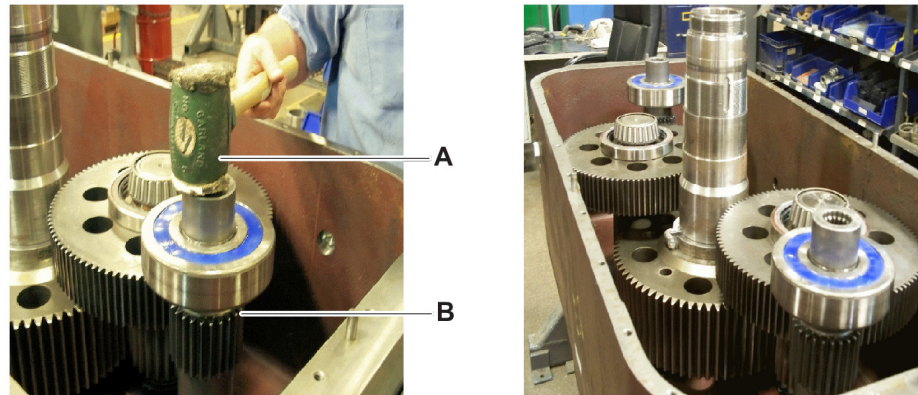


Figure 6

12. Apply a layer Ronex-HD grease to the intermediate shaft seal lips (Figure 7, item A), the rollers on the upper intermediate bearings (item B), and the outer races of the input pinion.

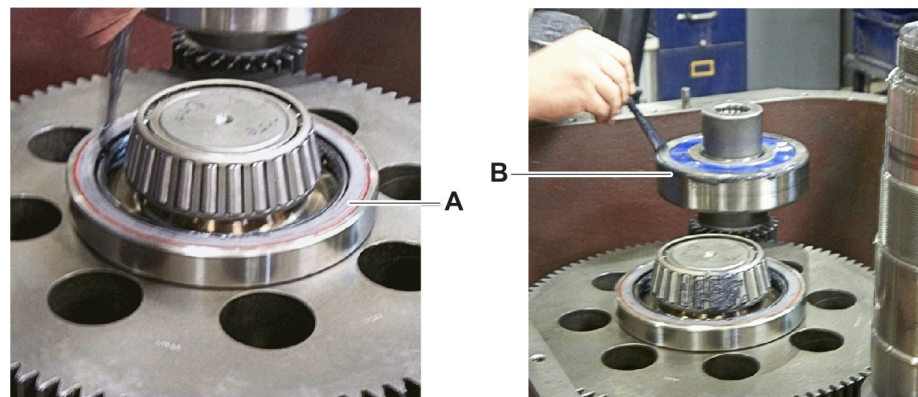


Figure 7

13. Make sure that the mounting surfaces on the housing and cover are free of oil and grease. Apply a bead of silicone to the mounting surface of the housing.
14. Use applicable lifting eye bolts, chains, and hoist to put the cover (Figure 8, item B) carefully on the housing.



NOTE: Make sure that the dowel pin in the housing matches with the pattern of holes in the cover.

15. Install bolts on the cover and torque the bolts to 102 Newton meters (75 foot-pounds). Wipe-off any excess silicone (item A) from the outside of the rotary head.

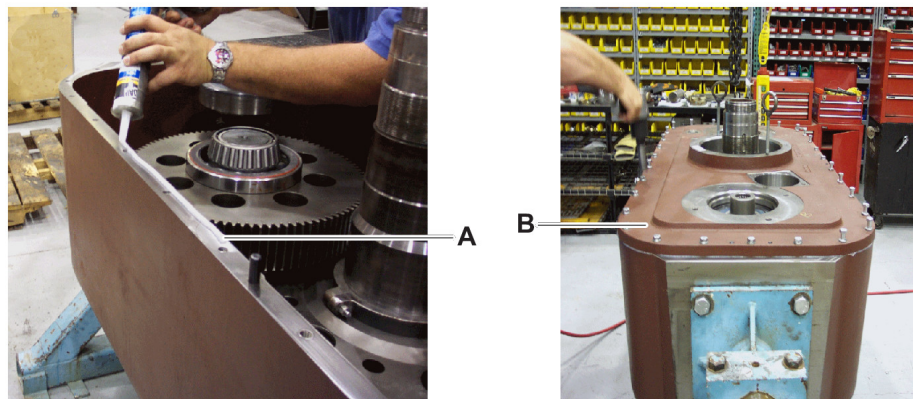


Figure 8

⚠ CAUTION

Risk of Injury

Incorrect handling of heavy sectioned snap rings can cause serious injury.

- ▶ Use extreme caution when you work with heavy sectioned snap rings.
- ▶ Use the applicable reteaching type snap ring pliers and wear gloves and face shield protection in case of an accidental flying snap ring.

16. Insert snap-rings (Figure 9, item A) inside the housing cover to secure input pinion shaft subassemblies in place.

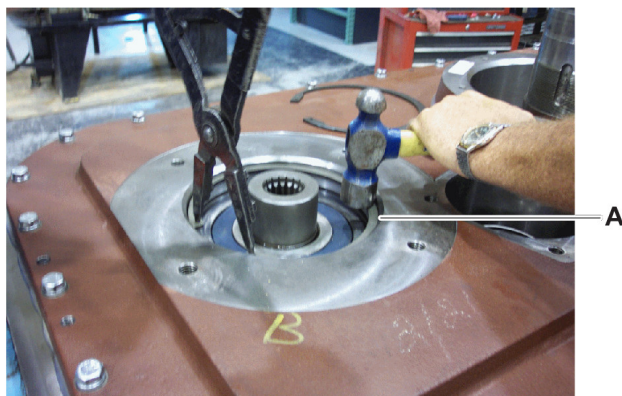


Figure 9

17. Fill a small amount of silicone in the threaded bolt holes in the upper spindle bearing cavity area of the housing cover.



NOTE: Make sure that the silicone is flush with the top of the surface to prevent the upper spindle bearing cup from not seating correctly. The silicone keeps the gear oil in the housing from flushing out or contaminating the grease in the upper spindle bearing cavity.

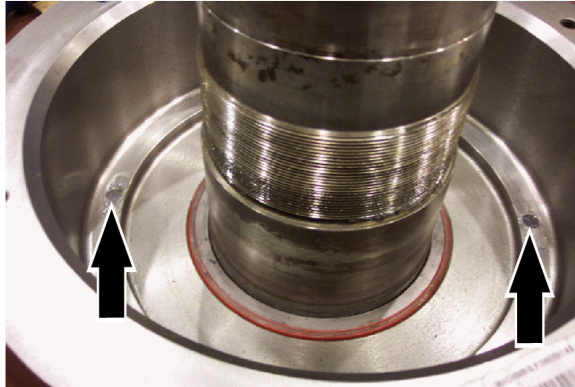


Figure 10

18. Apply oil seal lip with a layer of Ronex-HD grease and install the oil seal over the spindle (Figure 11, item A) and into the housing cover. Make sure for the correct seal orientation.



NOTE: The primary lip on the oil seal must be toward the inside of the upper spindle bearing cavity for grease retention in the cavity. Use a drift to seat it.

19. Lubricate the O-ring with a thin layer of Ronex-HD grease (item A) and slip over the bearing holder into the O-ring groove.

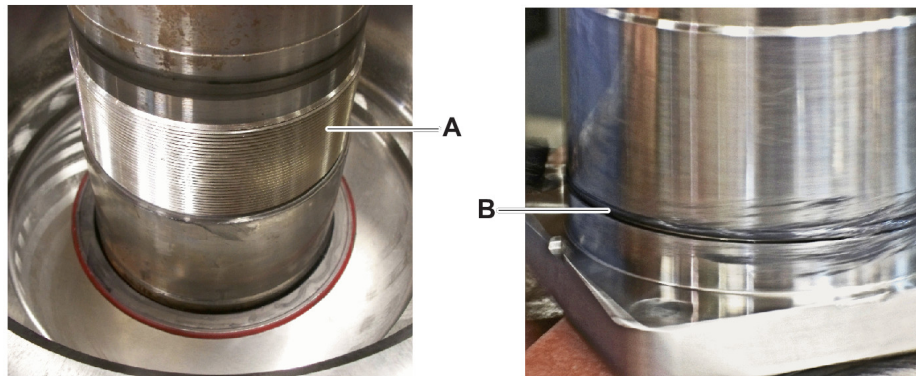


Figure 11

20. Apply a thin layer of Ronex-HD grease (Figure 12, item A) to the upper intermediate bearing rollers and to the inside surfaces of the intermediate bearing cavities. Also apply to the outside and the inside diameters of the bearing holder.

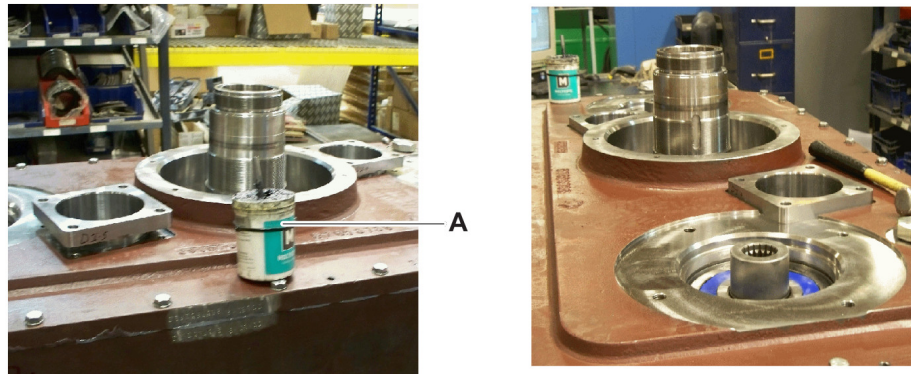


Figure 12

21. Slide the bearing holders into position in the housing cover and then fully seat them.
22. Apply a thin layer of Ronex-HD grease to the roller mounting surface and the outside diameter of the upper intermediate bearing cup. Install the bearing cups into the bearing holders.
23. Slide the intermediate bearing cup (Figure 13, item A) down to engage the bearing cones. Make sure that the upper intermediate bearing assemblies are fully seated together using a drift to seat them.

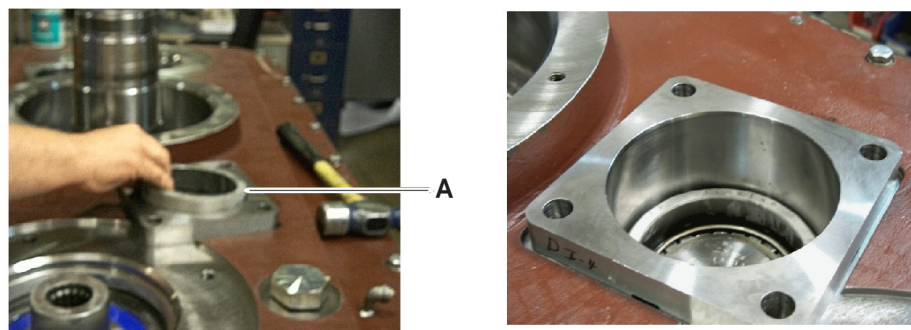


Figure 13

24. Apply a thin layer of Ronex-HD grease to the outside diameter of intermediate bearing adjusters and insert them into the bearing holders.

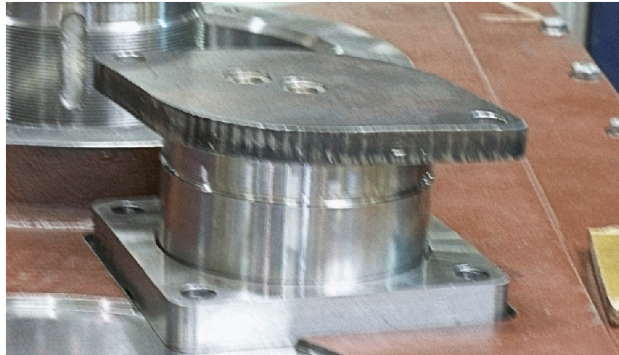


Figure 14

25. Install adapters, grease fittings, and relief fittings.



Figure 15

26. Install bolts and washers in the two opposite corners of the bearing holders (Figure 16, item A) and the bearing adjusters.
27. Tighten the bolts with the impact wrench (item B) for the bearing holders, but only snug the bolts for the bearing adjusters.

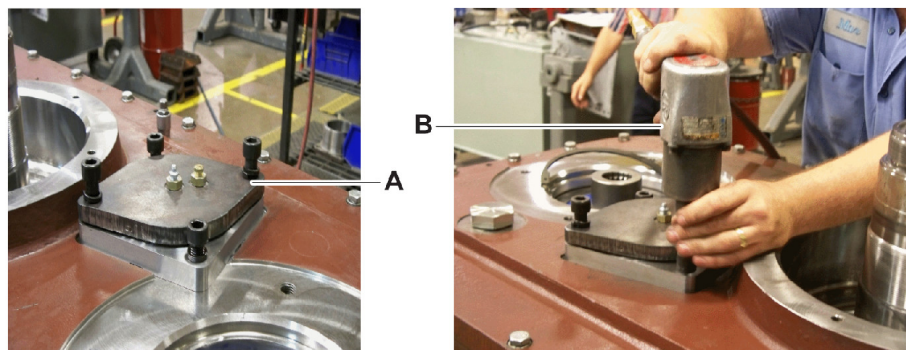


Figure 16

3.7 Set the Intermediate Bearing Pre-load



NOTE: The following steps are important to set the bearing preload correctly.

1. Make sure that the intermediate bearings rollers are seated using a ratchet with tool inserted into the splines of the pinion to rotate the input pinion shaft.
2. Torque the two bolts that holds the bearing adjuster to have a final torque that stabilizes at 20 newton meters (15 foot pounds). This torque value is achieved in three or four graduated steps followed alternately with a required turning of the input pinion shaft in both directions between each graduated torque step. This action determines the correct shim thickness to achieve 0.1 mm (0.004 in) preload.

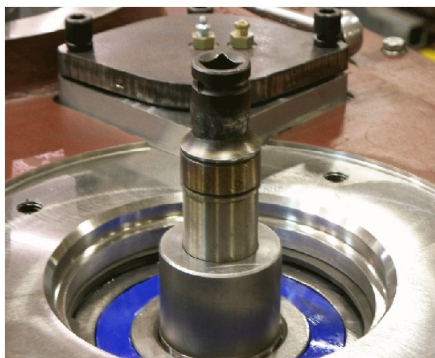


Figure 1

3. With the bolts from the previous step tightened to a consistent 20 Newton meters (15 foot-pounds), measure individually the gaps between the surfaces of each bearing adjuster and the holder. Select the correct thickness of the shims from the shim pack for each gap.
4. Test each shim set in its applicable gap for a tight fit to make sure that a 0.00127-centimeter (0.0005-inch) feeler gage can not be slipped between the shim in the gap and bearing adjuster.
5. Remove torqued bolts and bearing adjuster from the bearing holders.

6. Install correct shim sets (Figure 2, item A) over the corresponding bearing adjuster and slip the O-rings into grooves on the bearing adjusters.

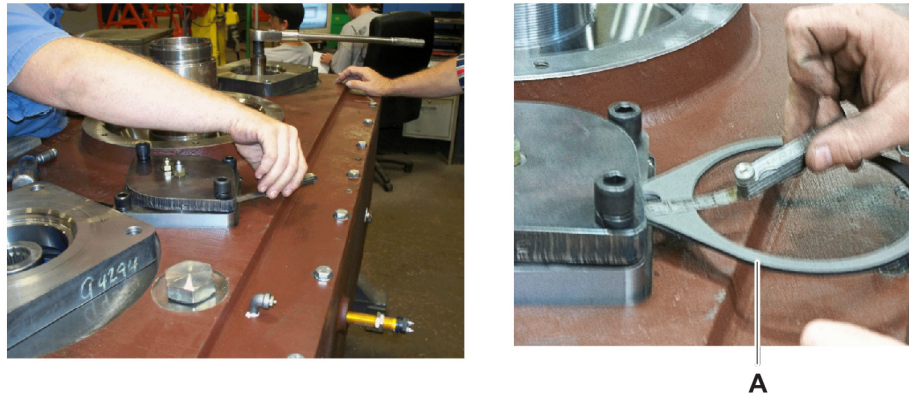


Figure 2

7. Apply the outside diameters of both bearing adjusters with a thin layer of Ronex-HD grease and reinstall into the bearing holders. Torque the bolts for both bearing holders and both bearing adjusters to 203 Newton meters (150 foot-pounds).

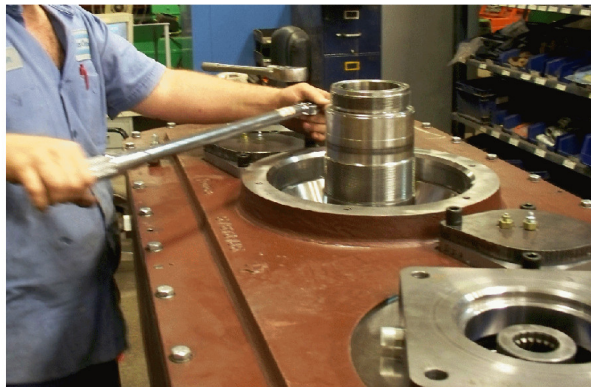


Figure 3

8. Install an elbow with a relief fitting (Figure 4, item A) into the housing cover. Loosely fit the oil filler plug with the O-ring into position.

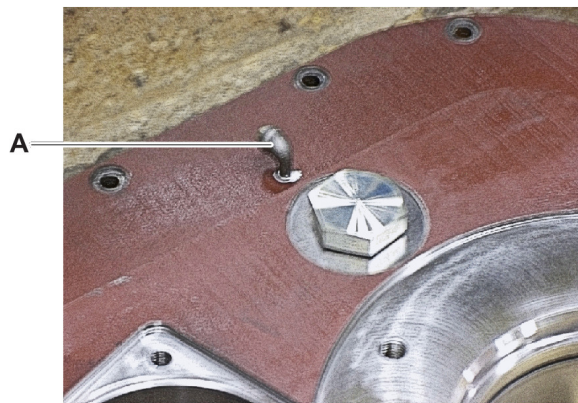


Figure 4

3.8 Expansion Fit the Upper Spindle Bearing Cup

1. Press the frozen upper spindle bearing cup (Figure 1, item A) into the housing cover. Make sure that the bearing cup is seated tightly against the mounting surface in the housing cover.
2. If necessary, use a steel hammer and a bronze drift to make sure that the cup is fully seated.

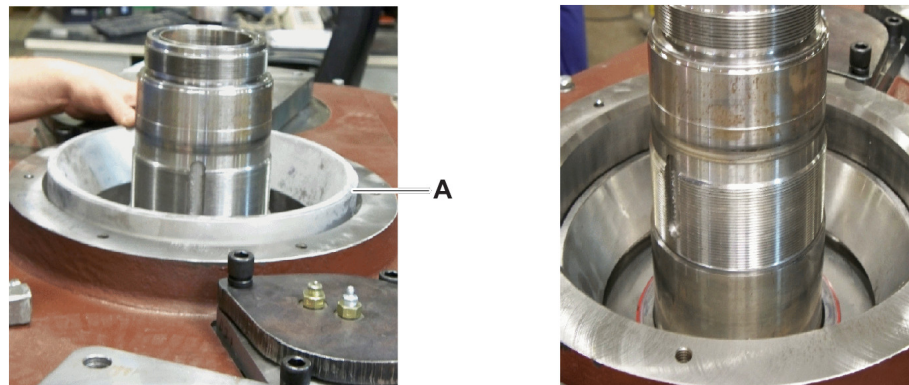


Figure 1

3.9 Shrink Fit the Upper Spindle Bearing Cone

⚠ WARNING

Burn Hazard

Hot components can cause serious injury.

- ▶ Use approved safety gloves when handling hot components.



NOTE: Do not let the bearing cones soak at temperatures above 149 °C (300 °F) for an extended period of time.

1. Heat the upper spindle bearing cone (Figure 1, item A) to between 135 °C and 149 °C (275 °F and 300 °F). Install the bearing cone immediately upon reaching the desired temperature.
2. Apply a thin layer of Ronex-HD grease (item B) to the bearing cup running surface.

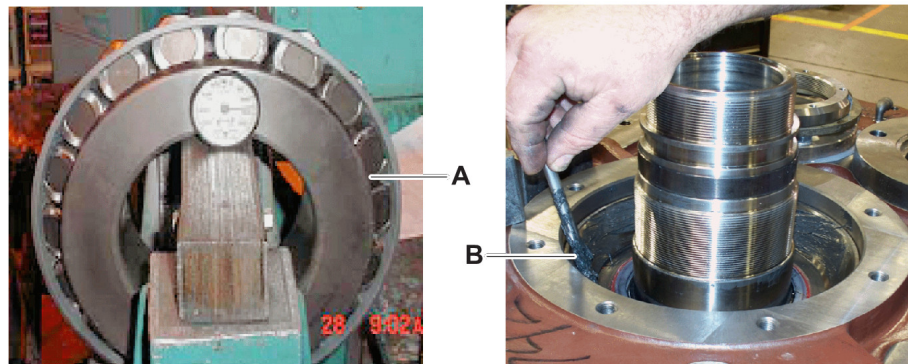


Figure 1

- Before installing the upper spindle bearing cone (Figure 2, item B), make sure that the small floor or scissor jack is still fully supporting the spindle subassembly (item A). Put the heated upper spindle bearing cone onto the spindle using protective gloves.



Figure 2

3.10 Setting the Spindle Bearing Preload Rolling Torque

NOTICE

Rotary Head Damage

Incorrect preload on the Main Bearing Assembly reduces the service life of the rotary head.

Repeated problems with the Swivel Head Packing Assembly, such as water leaks and missing packing rings, could be an indication of loss of preload on the Main Bearing Assembly.

Insufficient preload lets the upper spindle bearing inner race spin below the lock nut during drilling and breakout operations. The spinning of the race quickly wears away the bottom of the lock nut, and any existing preload lost results in endplay. The endplay in the Spindle Assembly is harmful to bearings and other components.

Excessive preload overloads the bottom spindle bearing, which leads to loss of preload and early failure.

Reapplying preload to the spindle bearing causes early bearing failure.

- ▶ Apply correct preload on the Main Bearing Assembly.
- ▶ Make sure not to reapply the preload on the spindle bearing after the rotary head is operated for any period of time.



NOTE: Repeated problems with the Swivel Packing Assembly, such as water leaks, missing packing rings, and the like, can be an indication of loss of preload of the Main Bearing and Spindle Assembly.

With the bearing properly seated, proceed quickly to the next step while the bearing is still warm, the next steps of setting preload torque have to be completed before the bearing has a chance to shrink-fit to spindle.

Special tools necessary for this setting are from the Rotary Head Rebuild Tools Kit list and used in the following steps:

1. Install the adjusting nut (Figure 1, item A) on the spindle and use the spindle rotation tool attached to a ratchet to tighten the adjust nut so that it firmly contacts the surface of the upper spindle bearing cone.
2. Remove the support (item B) from the bottom of the spindle.

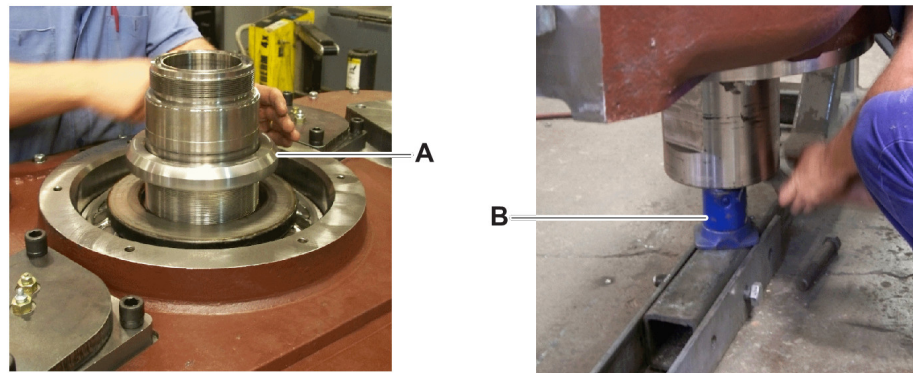


Figure 1

3. Insert the input pinion tool (Figure 2, item A) into the motor adapter spline (item B).

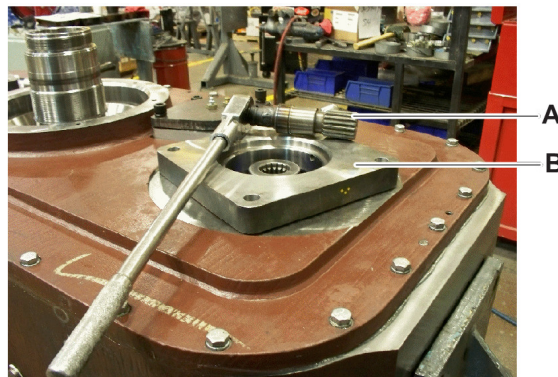


Figure 2

4. Install two angles (Figure 3, item A) 180 degrees apart on the rotary head housing with two cap screws and flat washers. Tighten the two cap screws after alignment to the wings on the adjustment locking ring tool (item B).
5. Make sure that the adjustment locking ring tool in place engaging notches in the adjusting nut (item C).



NOTE: Make sure that the additional adjusting nut to hold the locking ring tool in place.

With the adjustment locking ring tool that is installed in the notches on the adjusting nut, the wings on the tool contact the surfaces of the angles to prevent the adjusting nut from turning during spindle rotation. Thereby tightening the adjusting nut and increasing preload on the spindle bearing when the input pinion tool is rotated. Using the overall gear reduction makes tightening the adjusting nut easier.

Spindle bearings must have the correct preload. The method used measures the difference in rolling torque necessary to turn the spindle from the initial condition to the final condition. Rolling torque increases incrementally as the bearing adjusting nut is tightened.

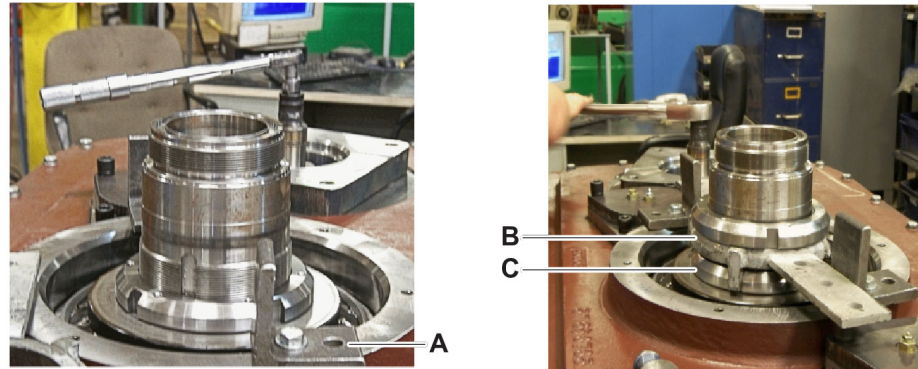


Figure 3



NOTE: Do not strike or otherwise impact a bearing assembly. This can cause damage which cannot be visible, but which leads to failure of the bearing.

6. Before tightening the adjusting nut, put a mark on the nut and corresponding mark on the spindle. With a torque wrench attached and lock nut adjustment tool temporarily removed, insert the input pinion tool (Figure 4, item A) into the spline of the pinion shaft. Carefully measure and record the initial torque necessary to rotate the pinion counter-clockwise.

7. With a torque wrench attached, engage the spindle rotation tool on the adjusting nut on the spindle, carefully measure and record the initial torque necessary to rotate the spindle clockwise (turning the spindle counterclockwise at this stage may loosen the adjusting nut).

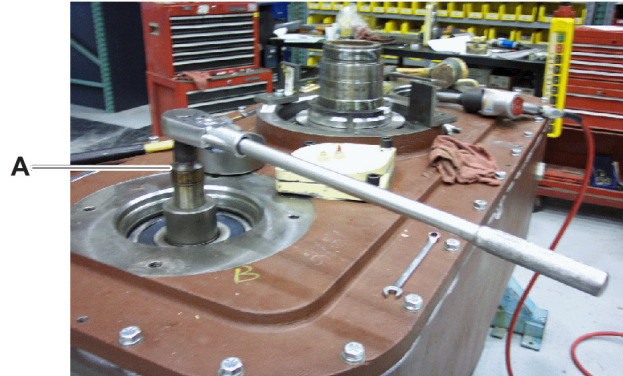


Figure 4

8. Ideally, the preload on the spindle bearings is 0.2 millimeter to 0.25 millimeter (0.008 inch to 0.010 inch). Turning the input pinion counterclockwise approximately 1.75 to 2.00 complete revolutions incrementally, while the adjusting nut is locked preventing its rotation, equates to 0.2 millimeter (0.010 inch) preload. This equates to a 43° to 48° shift between the original marks made on the nut and the spindle.
9. After each incremental turn of the input pinion tool, the lock nut adjustment tool must be removed temporarily to let the spindle bearings roll back and forth several times to seat the rollers. Before reinstalling the lock nut adjustment tool for further adjustment, measure and record rolling torque at the pinion and the spindle itself as described in the steps above.



NOTE: The preload is correct when the slow rolling torque necessary to turn the spindle itself has risen 386 Newton meters to 441 Newton meters (285 foot-pounds to 325 foot-pounds) above its initial reading. The slow rolling torque measured at the input pinion must be about 26 Newton meters to 30 Newton meters (19 foot-pounds to 22 foot-pounds) above its initial reading.

10. Once the adjusting nut is tightened to reach the final slow rolling torque requirement, remove the locknut adjustment tool. Put tongued washer over the spindle and engage the tongue into slot in the spindle. If the holes do not align correctly, reinstall locknut

adjustment tool and continue to tighten adjusting nut enough to align holes for bolts (never loosen to align). When aligned, install the lock bolts and torque to 23 Newton-meters (17 foot-pounds)

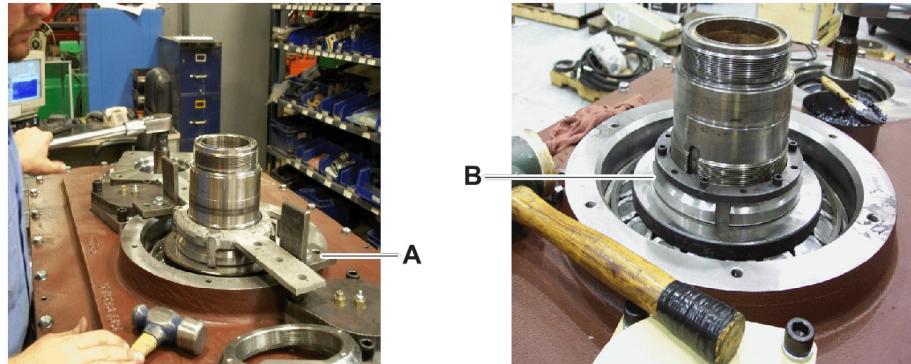


Figure 5

3.11 Shrink the Fit Wear Sleeve

⚠ WARNING

Burn Hazard

Hot components can cause serious injury.

- ▶ Use approved safety gloves when handling hot components.

1. Heat the wear sleeve (Figure 1, item A) to between 121 °C and 135 °C (250 °F and 275 °F) on the heater (item B). Use protective gloves and put the heated sleeve (item C) over the spindle. Let the sleeve cool and shrink fit onto the spindle. Apply a thin layer of clean grease to the outer surface of the sleeve.

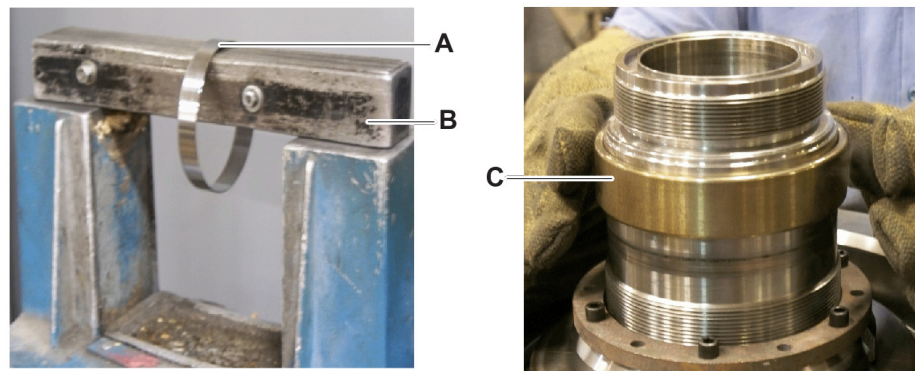


Figure 1

2. Insert both grease fitting and relief fitting into the swivel housing.

3. Apply the shoulder area of the swivel housing (Figure 2, item A) with a layer of Ronex-HD grease (item A). Lubricate the O-ring heavily and position over mounting shoulder of the swivel housing. Fill the upper spindle bearing cavity with Ronex-HD grease. Make sure to get the grease in between and around the bearing rollers.

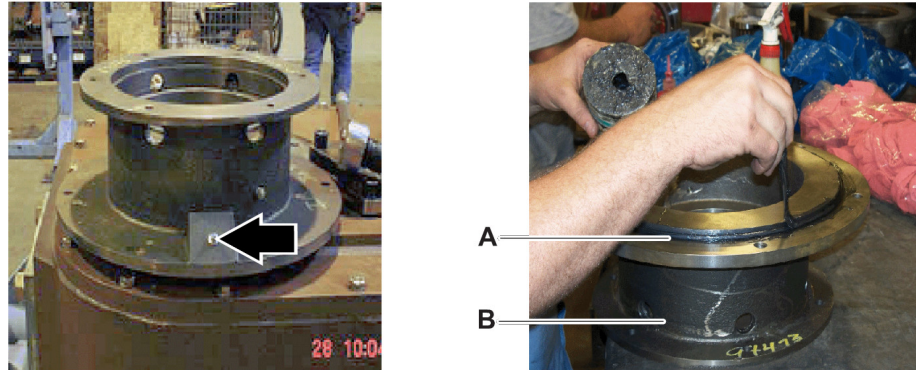


Figure 2

4. Orient the swivel housing (Figure 3, item A) with the lubrication fitting facing the front of the rotary head housing (item B) for easy field lubrication access.
5. While taking care not to damage the O-ring seal, insert and torque the bolts on the swivel housing.

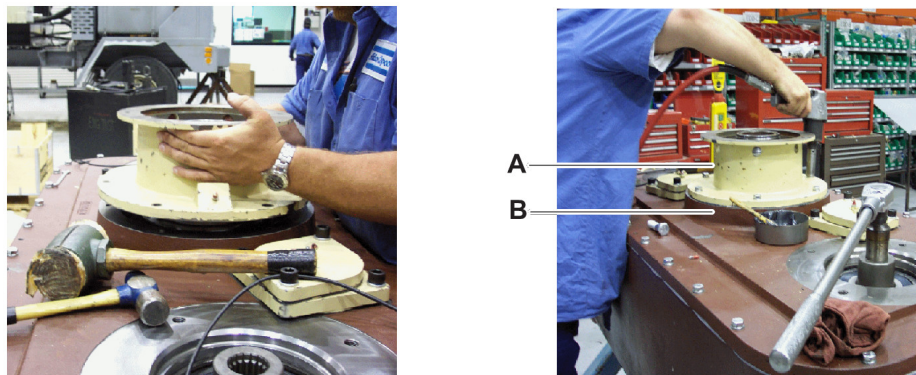


Figure 3

6. Lubricate the oil seals (Figure 4, item A) with a generous layer of Ronex-HD grease. Correctly orient the oil seal to hold the grease inside the housing cavity. Use a piece of very thin greased shim material wrapped around the upper end of the spindle and in-

stall first oil seal into the swivel housing using extreme care to not damage the seal lips. Use a small steel hammer and bronze flat bar (item B) to seat the seal into bore. Do not damage or deform the seals during installation.

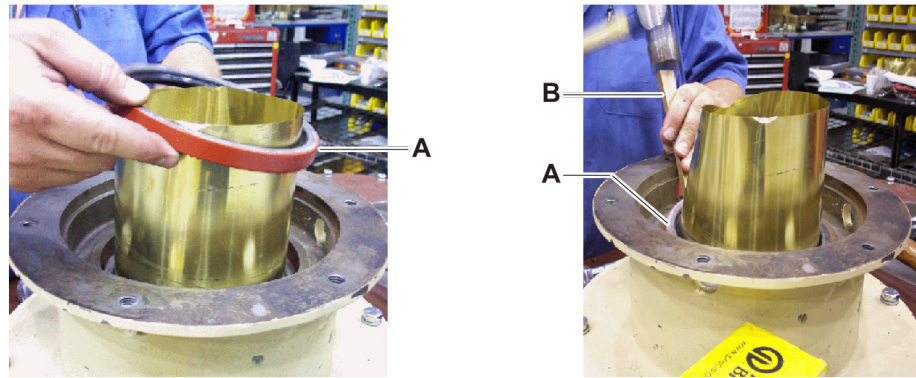


Figure 4

7. Insert the second seal (Figure 5, item A) on the spindle (Figure 5, item B) and orient it to hold the grease inside the cavity. Use a small steel hammer and bronze flat bar to seat the seal into bore. The seal must be flush with top of bore as shown.

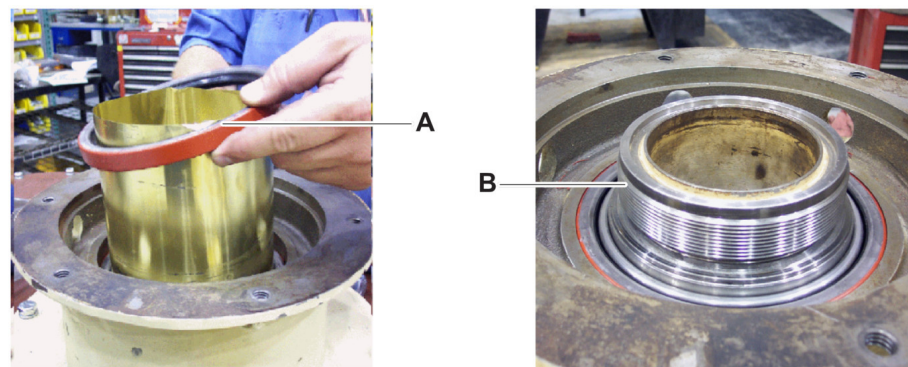


Figure 5

8. Put a drip shield (Figure 6, item A) around the spindle. Put the plastic locking ring (item B) into the groove at the base of the spindle threads.

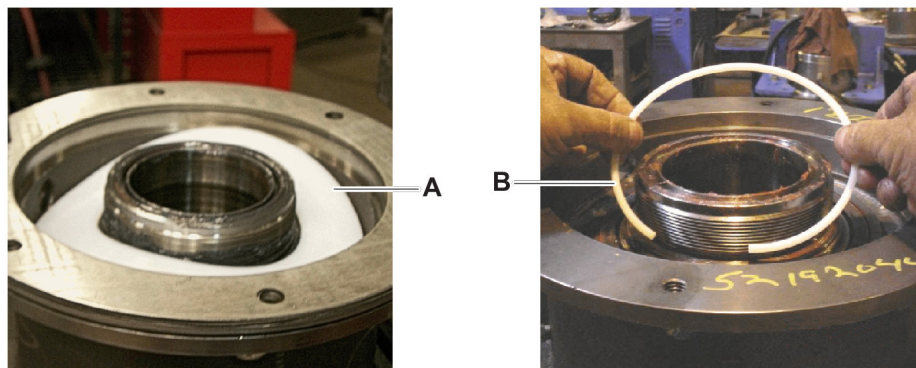


Figure 6

9. Lubricate the spindle threads with a very thin layer of clean grease. Put the O-ring (Figure 7, item A) into groove at the top of the spindle (item B) to help seal the spindle cap. Apply the O-ring with grease after installation.

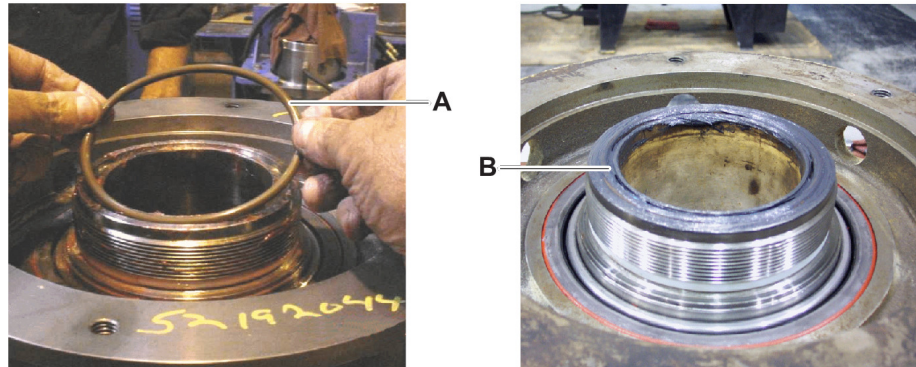


Figure 7

10. Put the spindle cap (Figure 8, item A) over the spindle and hand thread as far as possible.

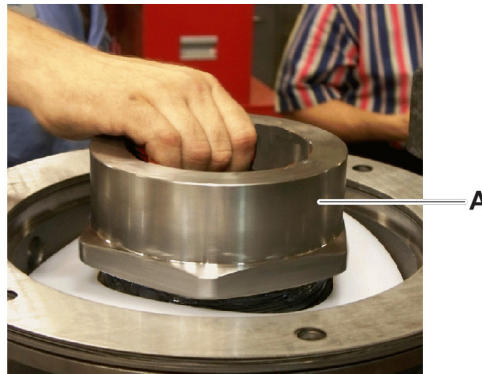


Figure 8

11. Install and tighten the spindle nut stop tool assembly to the top of the housing, contacting one of the arm extensions of the spindle nut holding tool. This prevents the spindle cap from turning as the spindle is turned with the input pinion, tightening the spindle cap.
12. Use the input pinion tool with an attached ratchet to turn the input pinion shaft, using the overall gear reduction to tighten the spindle cap. Turn the input pinion clockwise while the spindle cap is still locked preventing its rotation. While verifying the plastic

lock ring remains in its assigned groove, tighten spindle cap until it makes good firm contact with the spindle and compresses the top O-ring. Remove all rotary head assembly tools.

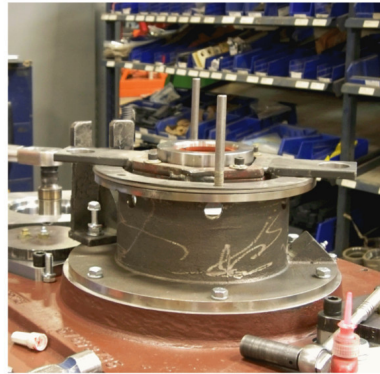


Figure 9

13. To determine the appropriate amount of shims from the shim kit needed between the mounting surfaces of the spindle cover and swivel housing to give the correct amount of squeeze on the air seal packing, install the spindle seal tool into the spindle cap. With the tool in position, temporarily install the spindle cover (Figure 10, item A) on top of the tool. Measure with a feeler gage the gap between the mounting surfaces of the swivel housing and the swivel cover for the correct shim required. When this is determined, remove the spindle cover and tool.

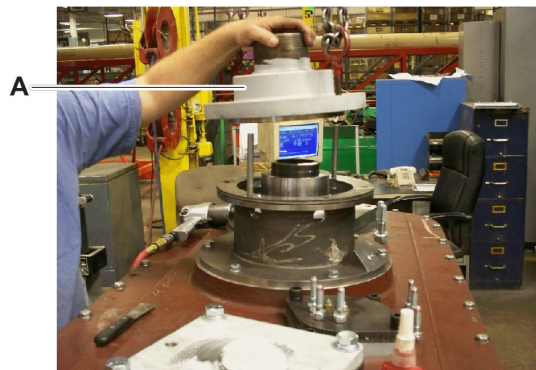


Figure 10

14. Insert one swivel 30-X packing (Figure 11, item A) into the spindle cap and one into the swivel cover (item B).

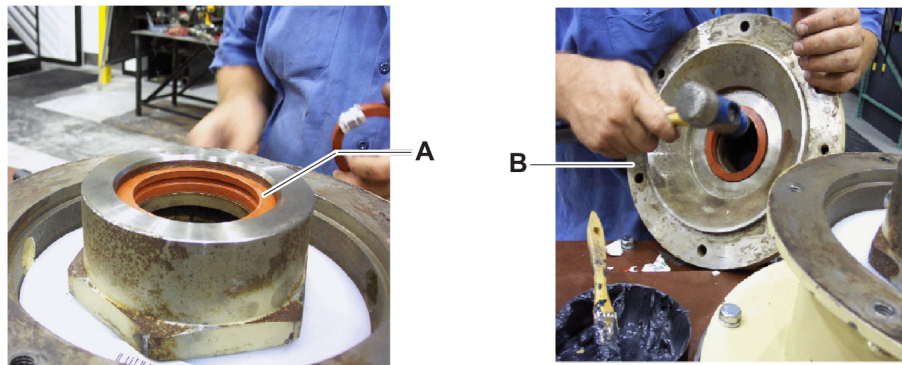


Figure 11

15. Apply Loctite C5-A anti-seize lubricant to the exposed edge of the packing inside of the spindle cap and both contact surfaces on the wear bushing.
16. Insert the wear bushing (Figure 12, item B) inside of the spindle cap (item A). (When the swivel cover is mounted, the wear bushing is between the two swivel packings.)

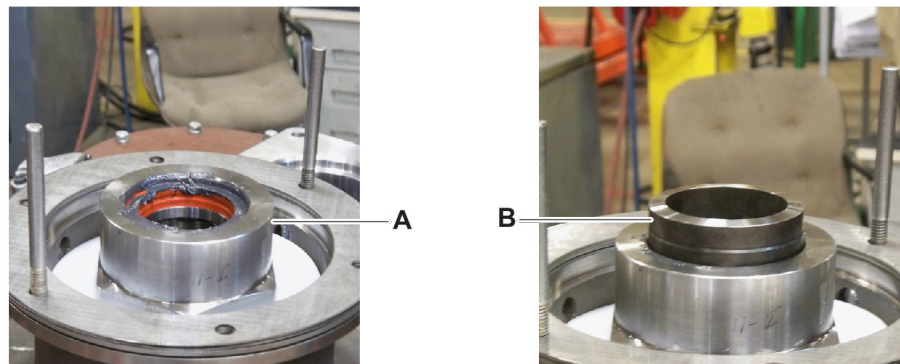


Figure 12

17. Install the correct thickness of shims (Figure 13, item A) from the shim kit between the spindle cover and the swivel housing. Use long threaded dowel rods to help align the spindle cover.

18. Secure the swivel cover (item B) in place with bolts. When shimmed and tightened correctly, the air seal packing will be squeezed by $7/32$ inch.

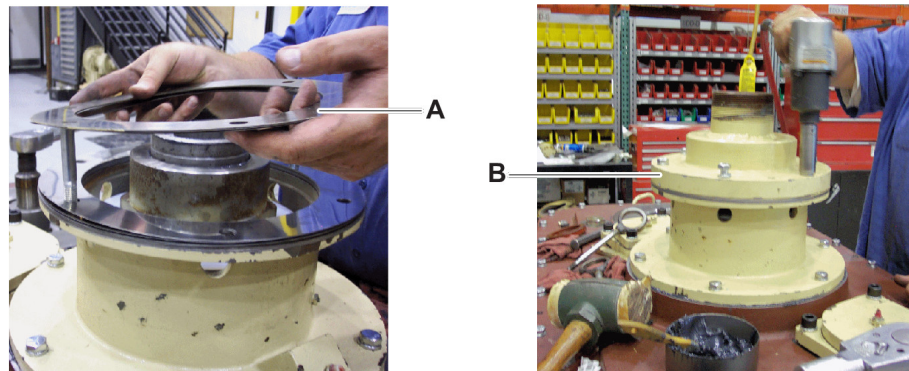


Figure 13

19. Insert the adapters into the housing cover for both motors.
20. Lubricate the shoulder area of the motor adapter (Figure 14, item B) with a thin layer of Ronex-HD grease. Put the O-ring into the shoulder area and apply with grease heavily. Align the motor adapters with the SAE port (item A) for the lubrication pump hosing toward the back of the rotary head housing for the best hose routing.

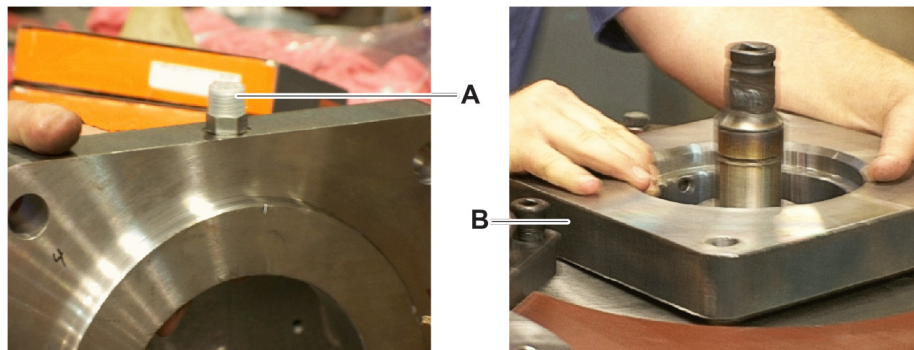


Figure 14

21. Apply Ronex-HD grease (Figure 15, item A) lightly to the mounting shoulder on the motor covers and install the O-rings. Install the covers and insert the bolts. Torque the bolts.

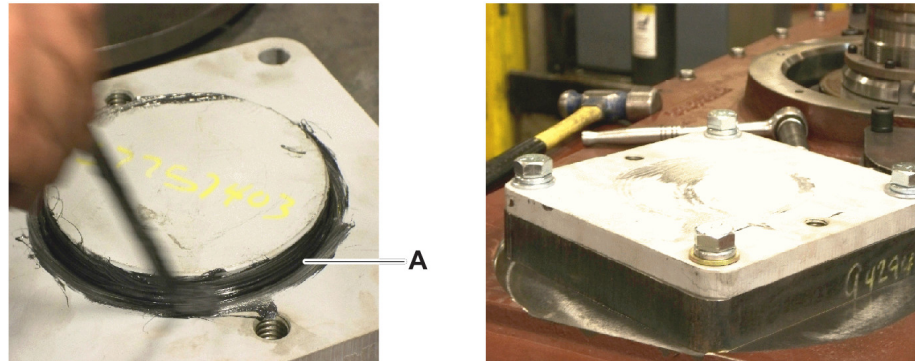


Figure 15

22. Install the lubrication pump (Figure 16, item A) drive adapter onto the keyed shaft of the lubrication pump and make sure that the shaft key is correctly installed. Lightly grease the O-ring groove on the housing and install the O-ring.

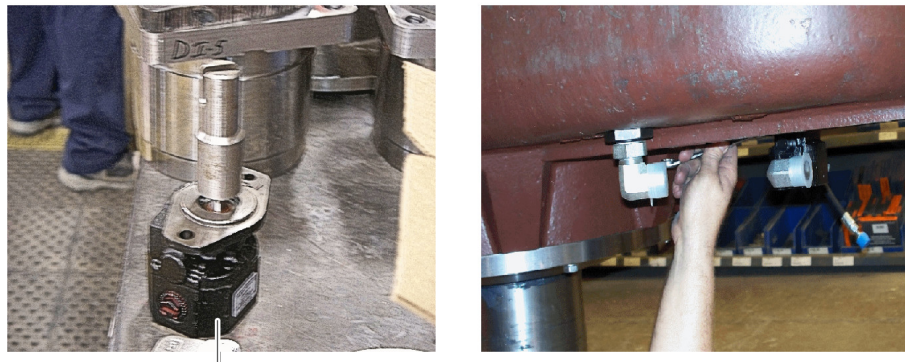


Figure 16

23. Install lubrication pump (Figure 17, item B) below the housing.
24. Insert the bolts and torque together. Attach the suction hose (item A) from the strainer to the pump with fittings. Attach the fitting to the charge side of the lubrication pump, and attach the hoses to the motor adapter fittings).

25. Secure the hoses to the housing with a clamp as shown.

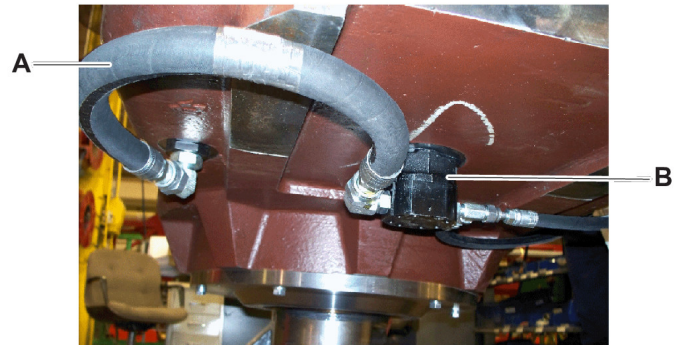


Figure 17



Figure 18

26. Insert the rotation tachometer sensor (Figure 19, item A) into the side of the casing. Thread the sensor into the housing until it contacts the intermediate gear teeth. Unthread the sensor two turns and lock it into position using a jam nut.

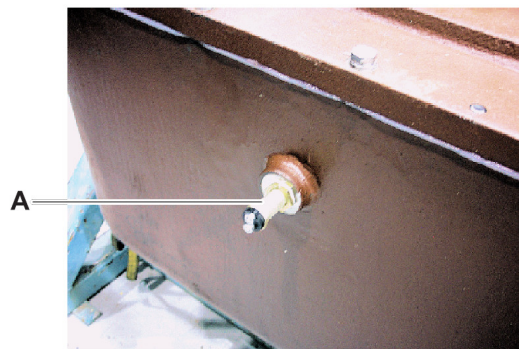


Figure 19

27. Remove the filler cap and fill the housing (Figure 20, item A) with new, filtered 80/90W gear oil until the sight glass is at least half full. Reinstall and tighten the filler cap. Examine for leaks. Hand-grease both the intermediate bearing cavities and the upper spindle bearing cavity until the grease is observed exiting out of the relief fittings.

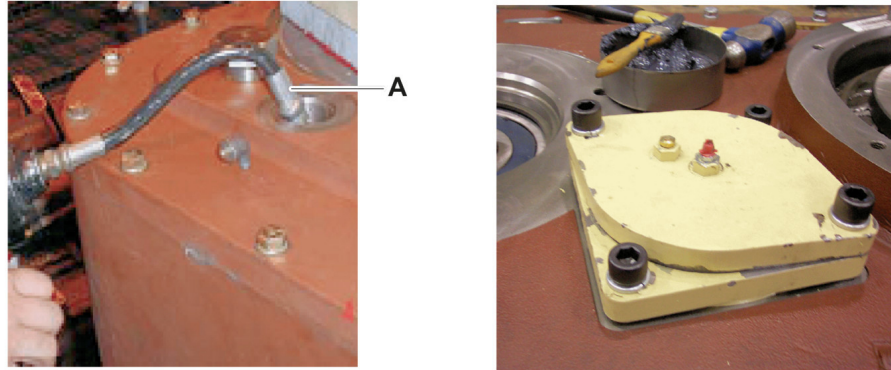
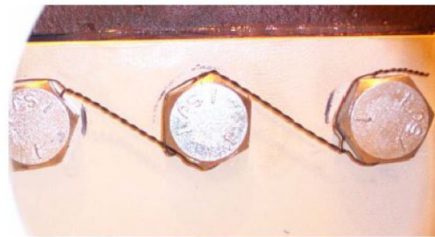
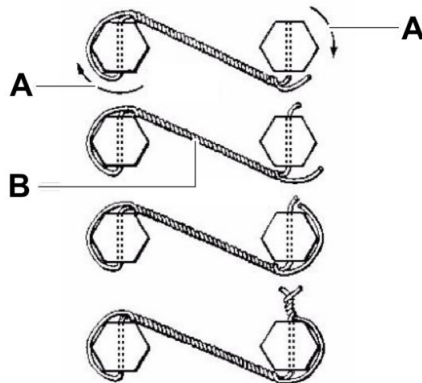


Figure 20

4 Safety Wire Installation Instructions and Examples



A	Tighten direction
B	Twisted safety wire

