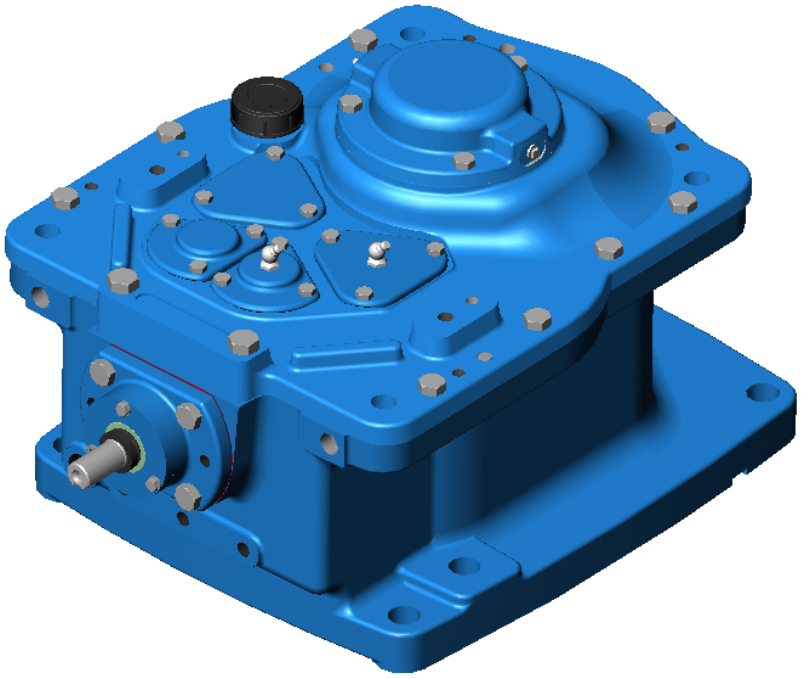
Manual No. 703

Maintenance Manual

Model 20 HT (Case Size 21, 22) Gear Drive



For service and information contact:

Chemineer, Inc.
5870 Poe Ave,
Dayton, OH 45414

Phone: 1 (937) 454 3200
Toll Free: 1-800-643-0641
Fax: 1 (937) 454 3379

E-mail: reachus@chemineer.com
Web: http://www.chemineer.com

Chemineer, Ltd.
7 Cranmer Road
West Meadows
Derby, UK
DE21 6XT

Phone: 00 +44 (0) 1332 363175
Fax: 00 +44 (0) 1332 290323

E-mail:
sales@chemineer.co.uk
engineering@chemineer.co.uk
spares@chemineer.co.uk

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1. INTRODUCTION

This manual contains instructions for 'Model 20 'HT' gear drive disassembly, assembly and an item list. Refer to the agitator manual for all other information relative to the agitator.

Periodic lubrication of gear drive as defined in the *Lubrication* section of the Agitator Manual is required.

To assure the longest life from your gear drive, annual inspections corresponding to plant shutdowns should be planned. Bolting and the condition of all seals should be checked. Worn parts should be replaced; and any areas of general concern should be brought to the attention of your **local Chemineer office.**

DISASSEMBLY

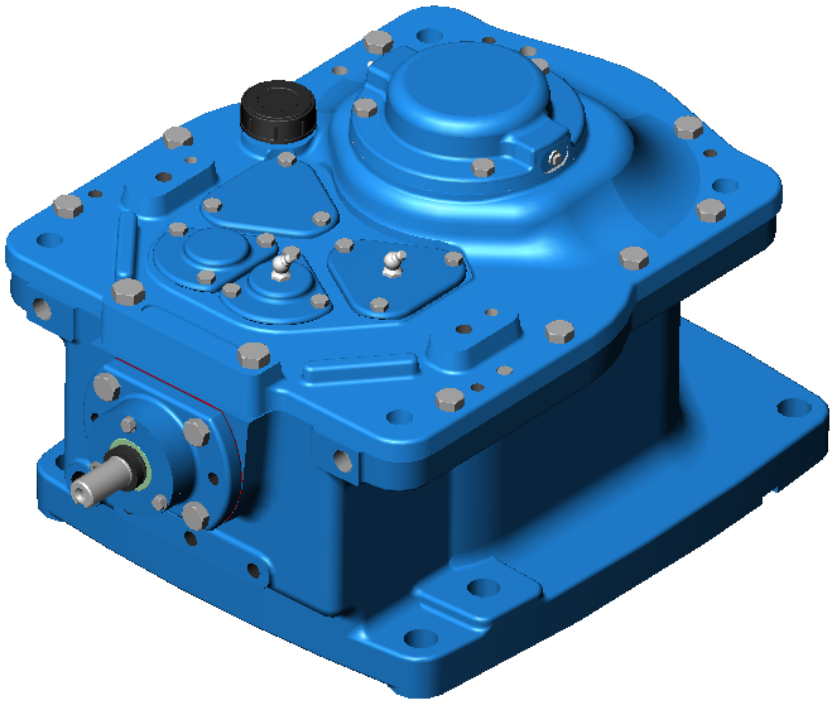

Figure 1 – Model 20 HT

2. DISASSEMBLY

A. Drain oil from the gear drive.

B. At input shaft, remove the following items (refer Figure 2):

- Bolts **[381]**
- Spiral Bevel cartridge assembly **[370]** (insert 2 of the bolts in the 2 center holes of the cartridge to push out the cartridge
- Shim set **[382]**

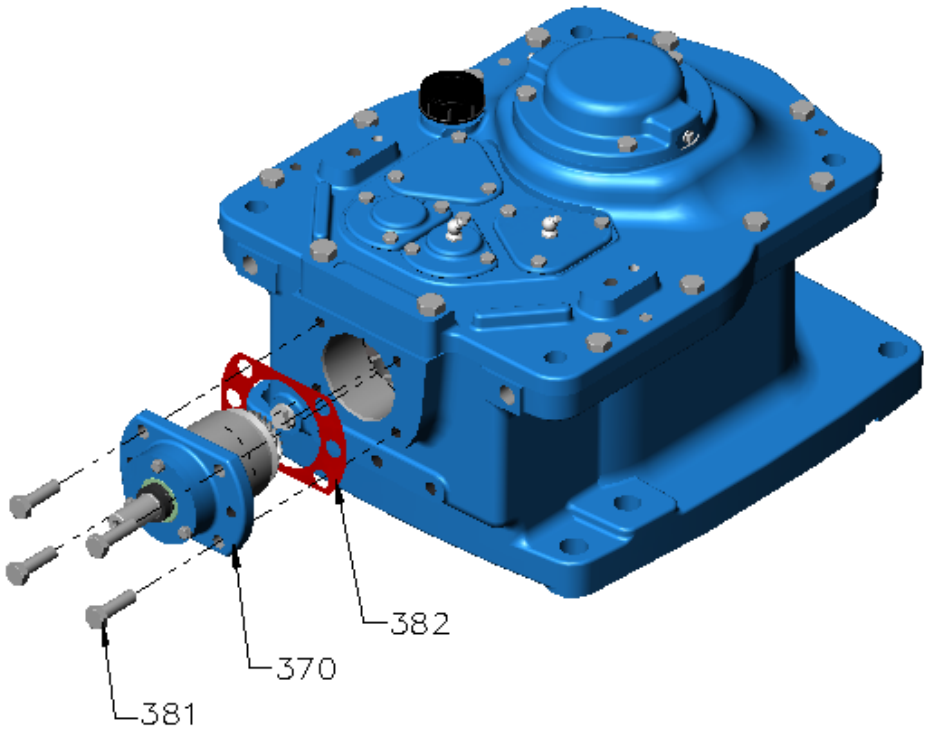

Figure 2 – Spiral Bevel Cartridge

C. Bevel Cartridge disassembly, remove following items (refer Figure 3):

- Bolts **[370-1]**
- Washers **[370-2]**
- V-Ring **[370-3]**
- Lip Seal **[370-4]**
- Cap **[370-5]**
- Use a shortened Allen wrench to loosen the locknut set screw and remove locknut **[370-6]**
- Press out bevel pinion **[370-13]** from the housing **[370-11]**
- Bearing cone **[370-9]** and bearing cup **[370-10]**
- Bearing cup **[370-8]**
- O-Ring **[370-12]**

D. Use a bearing puller to remove bearing cone **[370-7]** off bevel pinion **[370-13]**. Or if necessary, do following steps (refer Figure 3):

(1) Cut roller cage and remove rollers.

(2) Hold the pinion shaft from large end.

CAUTION: BE CAREFUL TO HEAT THE BEARING RACE ONLY. USE A SMALL FLAME TO AVOID DAMAGE TO THE SHAFT

(3) Turn the pinion and carefully apply heat with an acetylene torch to the bearing.

E. The bearing will move off the pinion when it is hot enough, use a heat resistant tool to push the bearing off the pinion if it stops.

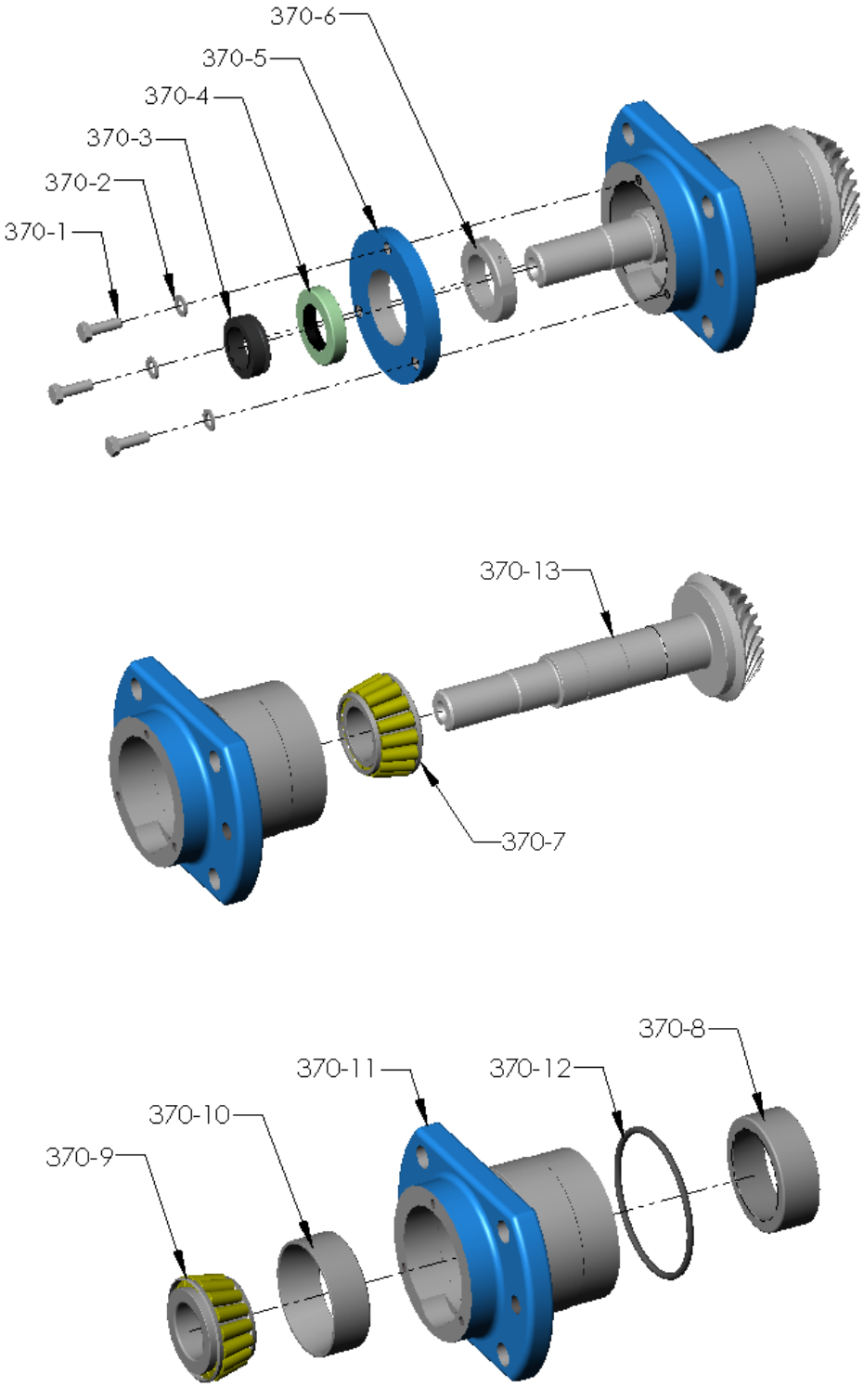

Figure 3 – Spiral bevel cartridge

F. At first intermediate shaft, remove the following items (refer Figure 4):

- Bolts **[213]**
- Intermediate cap **[383]**
- Grease fitting **[384]** from cap **(only if necessary)**
- O-ring **[206]**
- Shim set **[207]**

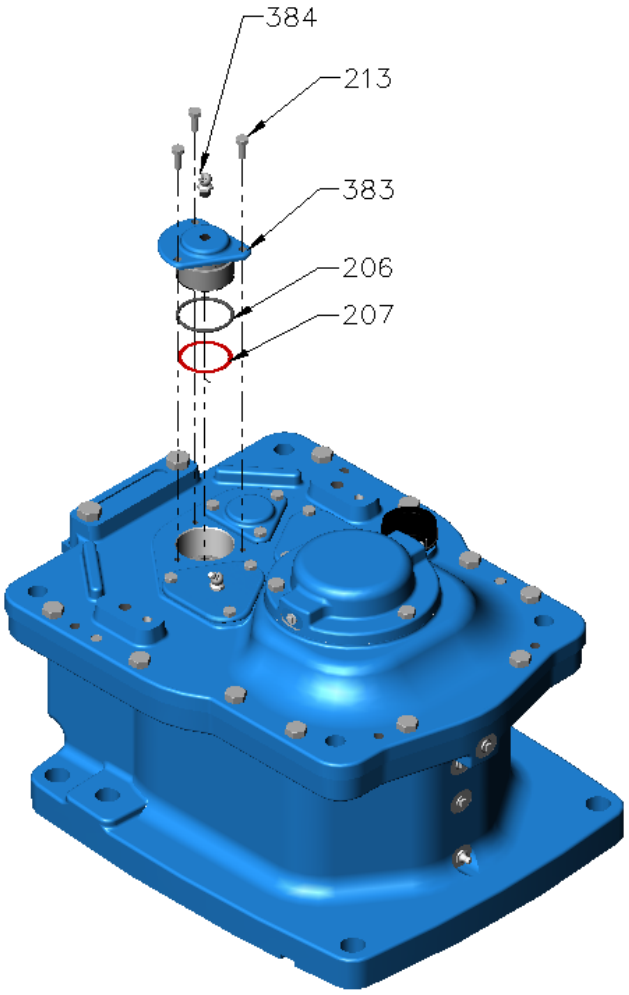

Figure 4 – First Intermediate Cap

G. At second intermediate shaft, remove the following items (refer Figure 5):

- Bolts **[225]**
- Intermediate cap **[386]**
- Grease fitting **[385]** from cap **(only if necessary)**
- O-ring **[222]**

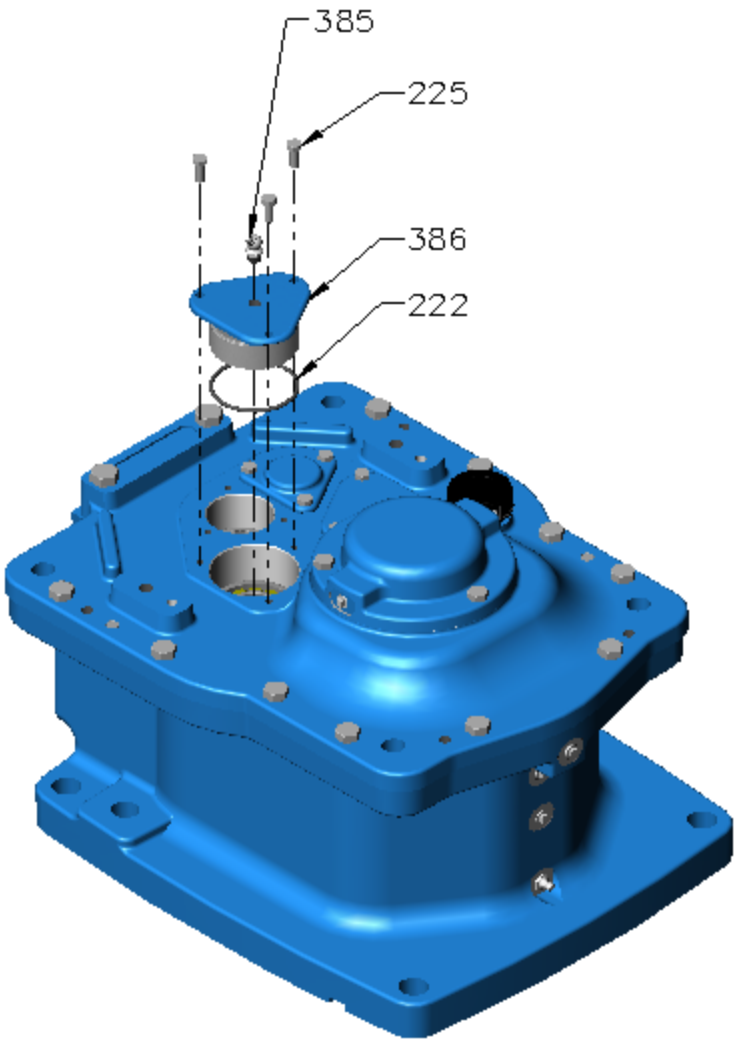

Figure 5 – Second Intermediate Cap

H. At output shaft, remove the following items (refer Figure 6):

- Bolts **[255]**
- Output cap **[254]** and only remove grease nipples **[260 and 261]** ***if necessary***
- O-ring **[253]**
- Bolts **[230]** and spring washers **[231]**
- Thrust washer **[228]**
- Shim set **[229]**

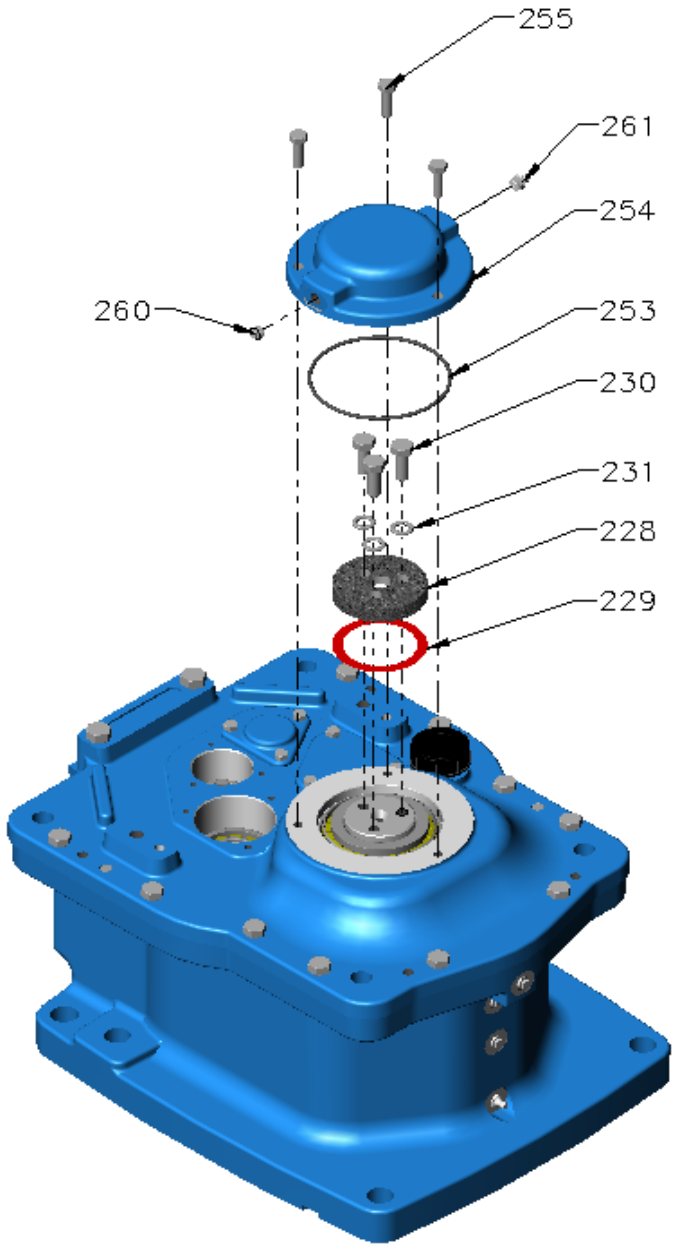

Figure 6 – Output Cap

I. Remove case lid **[247-1]** (refer Figure 7).

(1) Remove dipstick/breather **[258]**.

(2) Remove bolts **[250]**.

(3) Install jacking screws [Local supply].

(4) Tighten jacking screws [Local supply] until bearing **[233-2]** clears output shaft, then remove case lid **[247-1]**.

(5) Remove dowel pins **[252]**.

J. Remove from case lid **[247-1]** (refer Figure 7):

- Bearing cone **[233-2]**
- Bearing cup **[233-1]**
- Nilos ring **[235]**

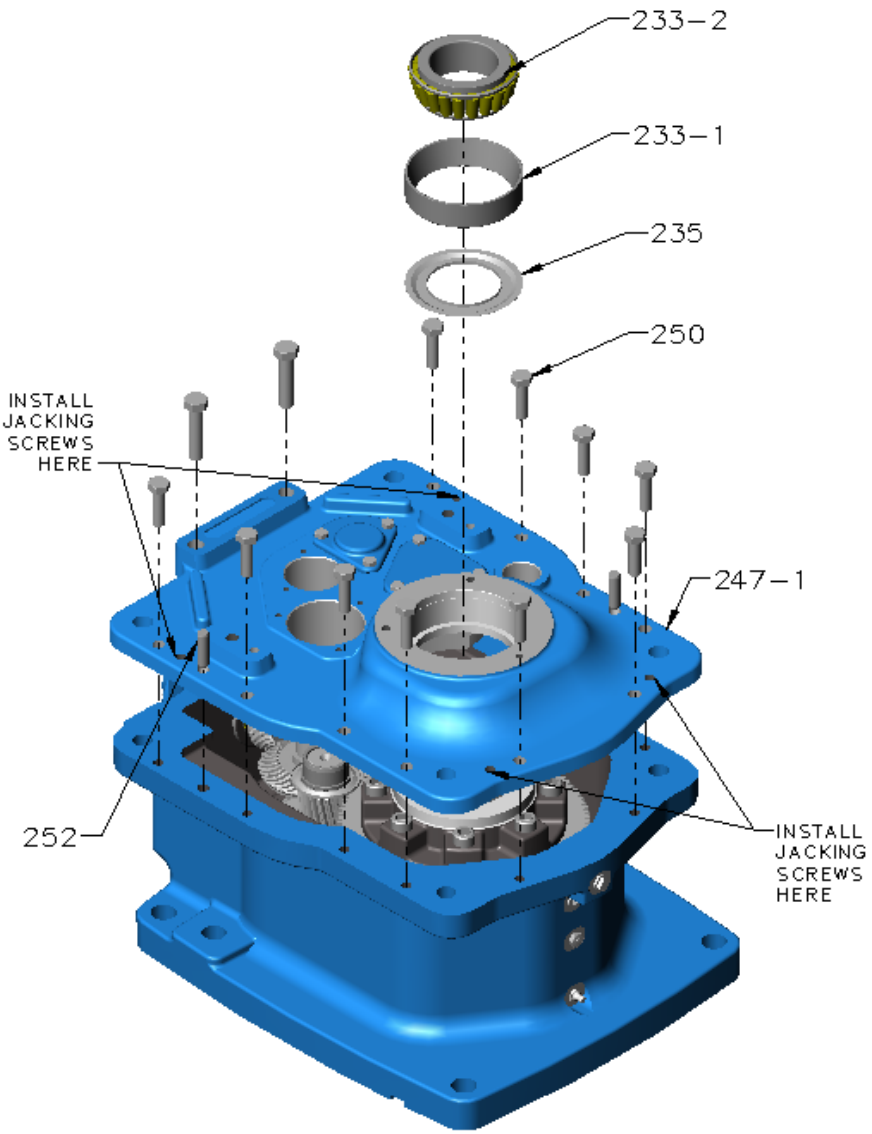

Figure 7 – Case Lid

K. Remove first intermediate shaft assembly (refer Figure 8)

L. First intermediate shaft disassembly (refer Figure 8):

- Press off the spiral bevel gear **[389]** from the shaft **[390]** in order to remove the bearing cone **[203-2]**, nilos ring **[387]**, bearing spacer **[388]** and key **[391]** at the same time.
- Remove bearing cone **[205-2]**

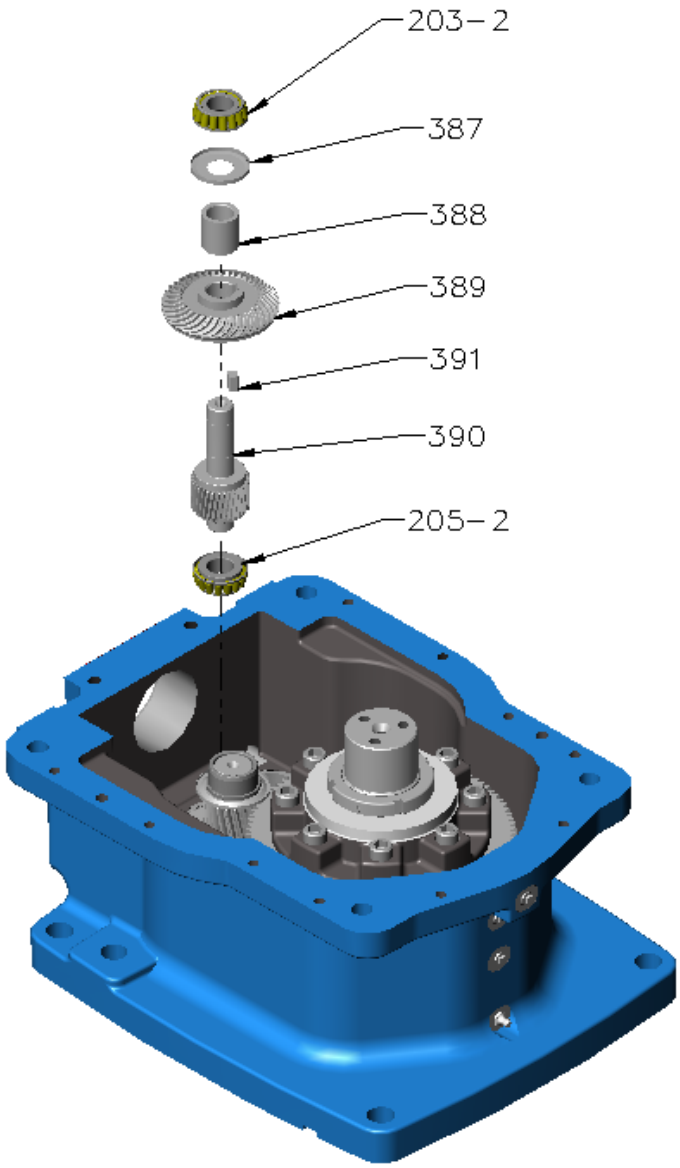

Figure 8 – First intermediate shaft

M. At output shaft **[244]**, remove the following items (refer Figure 9):

- Loosen the locknut set screw then remove gear flange locknut **[236]**
- Press output shaft **[244]** out of gear flange **[237]**
- Key **[238]**
- Bolts **[240]**
- Gear flange **[237]**
- V-ring **[242]**
- Gear **[239]**

N. Output shaft **[244]** disassembly (refer Figure 9)

Use a bearing puller to remove bearing cone **[245-2]** off output shaft **[244]**. Or if necessary, do following steps:

(a) Cut roller cage and remove rollers.

(b) Hold output shaft from large end.

CAUTION: BE CAREFUL TO HEAT THE BEARING RACE ONLY. USE A SMALL FLAME TO AVOID DAMAGE TO THE SHAFT.

(c) Turn the shaft and carefully apply heat with an acetylene torch to the bearing.

(d) The bearing will move off the shaft when it is hot enough. Use a heat resistant tool to push the bearing off the shaft if it stops.

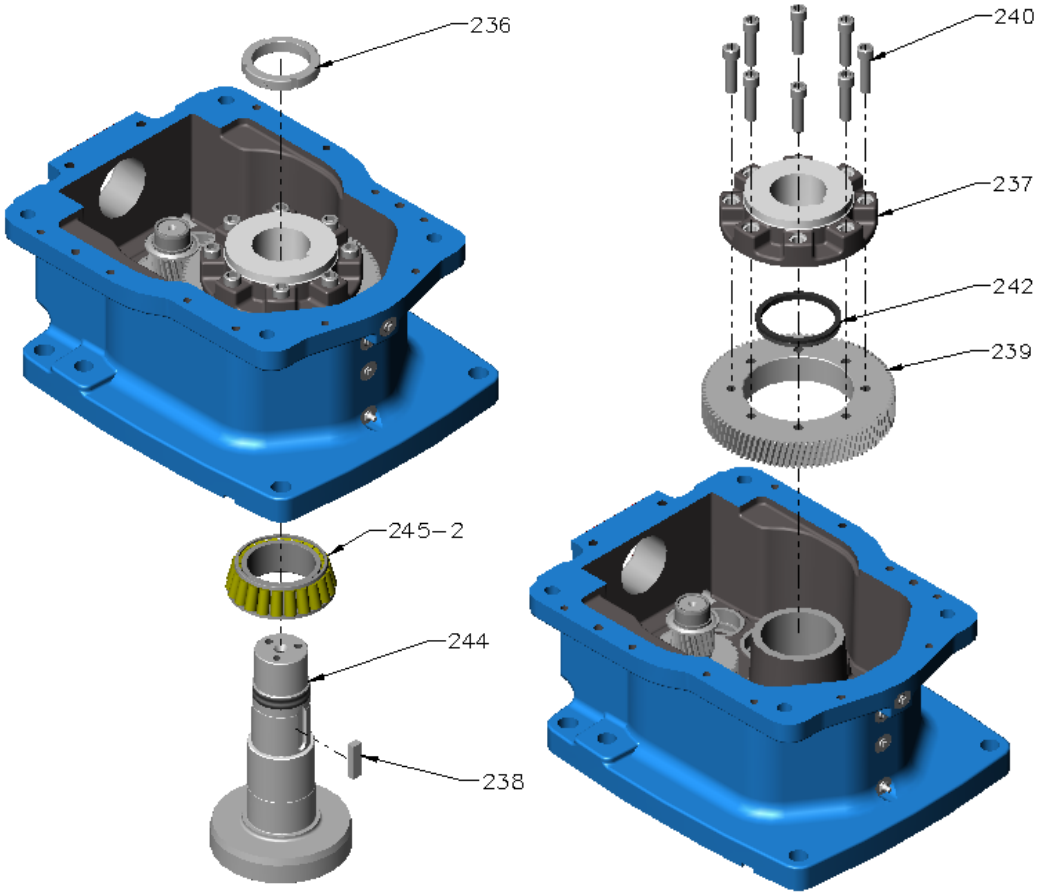

Figure 9 – Output Shaft

O. Remove second intermediate shaft assembly (refer Figure 10).

P. Second intermediate shaft disassembly (refer Figure 10)):

- Press bearing inner race **[217-2]** and nilos ring **[392]** off the shaft **[218]**
- Press bearing inner race **[221-2]** and gear **[219]** off the shaft **[218]**
- Remove key **[220]**

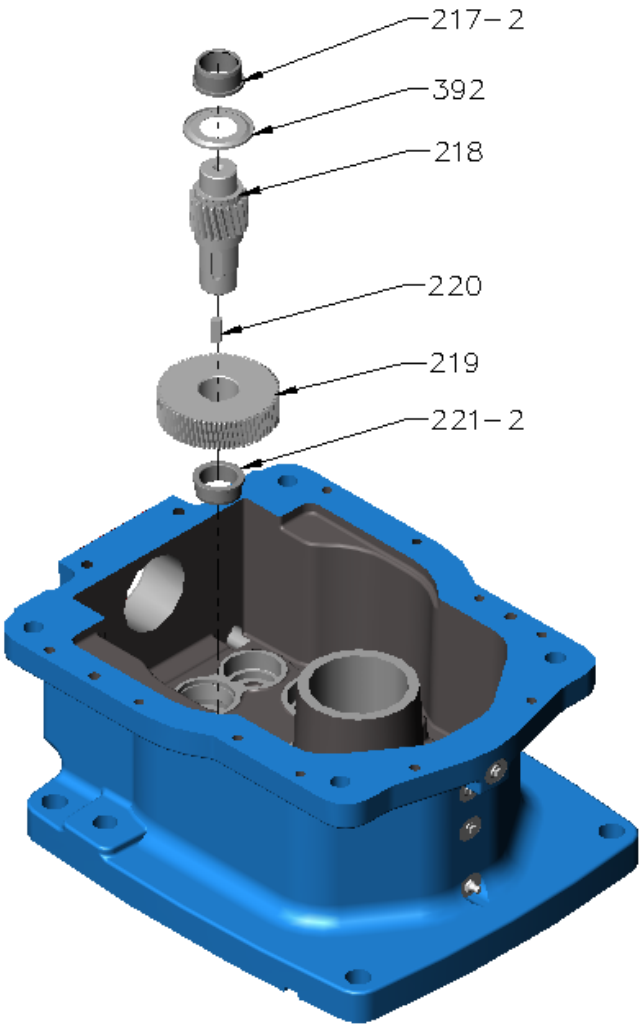

Figure 10 – Second Intermediate Shaft

Q. At bottom case **[248-1]**, remove following items (refer Figure 11):

- Lip seal **[249]**
- Bearing cup **[245-1]**
- Bearing cup (1st Intermediate) **[205-1]**
- Bearing outer race **[221-1]**

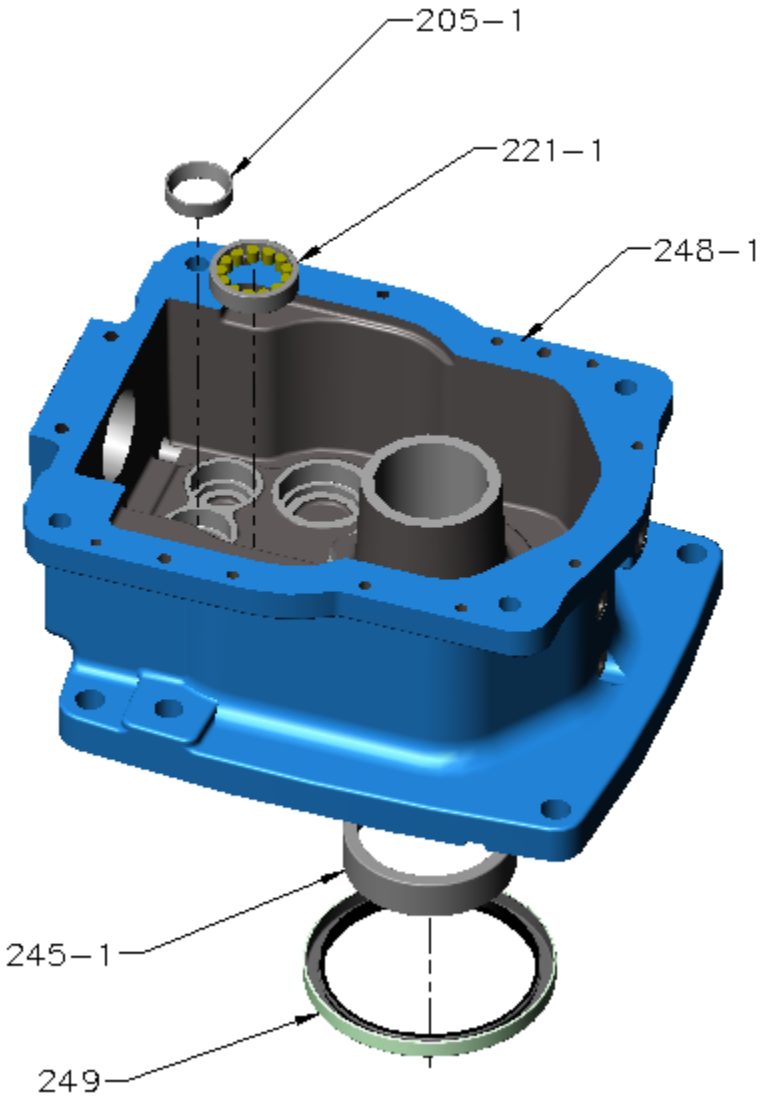

Figure 11 – Bottom Case

R. At case lid remove following items (refer Figure 12):

- Bearing cup **[203-1]**
- Bearing outer race **[217-1]**

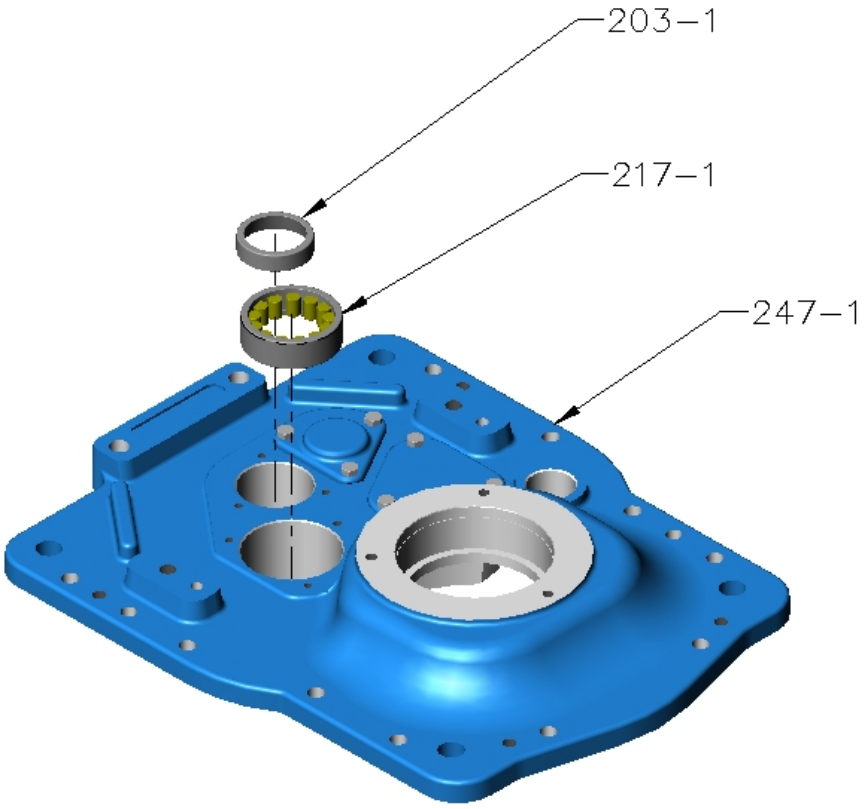

Figure 12 – Bearing races in case lid

S. Standard Procedures

- Clean all parts and inspect for wear. Replace worn parts as necessary.
- Replace all bearings, lip seals and shims.
- Always replace both inner and outer bearing races (cup and cone).
- Always replace gears in complete gear pair sets.

ASSEMBLY

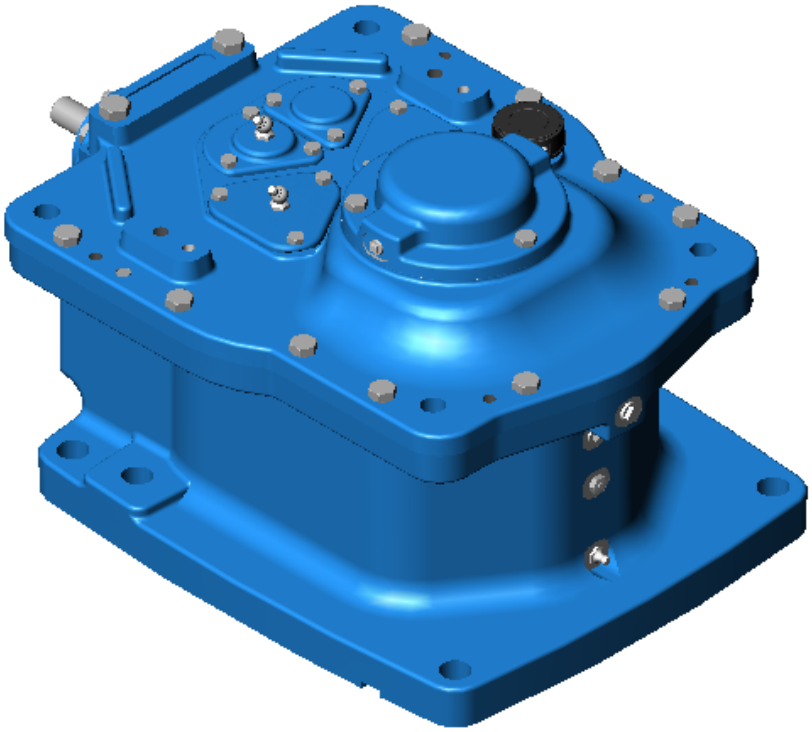

Figure 13 – Model 20 HT

3. ASSEMBLY

A. Standard Procedures

(1) Inspect threads, shank and head of all bolts and setscrews for damage after cleaning. If replacement is required, replace with equivalent type and strength.

(2) Inspect and clean all tapped holes. If threads are damaged, use the correct tap to repair.

(3) Use a torque wrench for the following assembly procedures. Table 1 gives the correct torque values as a function of thread size.

Table 1 - Bolt Tightening Torque for Carbon Steel

	Grade 8.8		**Grade 10.9**	
Bolt Size	**Nm**	**Ft-lb**	**Nm**	**Ft-lb**
M6 x 1	9.4	6.9	15.1	11.1
M8 x 1.25	22.9	16.9	36.8	27.1
M10 x 1.5	45.4	33.5	72.8	53.7
M12 x 1.75	79.2	58.4	127	93.7
M16 x 2.00	196.4	144.8	315	232.3
M20 x 2.50	383.2	282.4	615	453.5
M24 x 3.00	663.6	489.1	1065	785.4

(4) On assembly, lubricate all fasteners with grease, oil or an anti-seize material. Lubricate threads and contact surfaces of bolt heads and nuts. If fasteners cannot be lubricated, increase torque values given in Table 1 by a factor of 1.33.

(5) Bearing cones are installed with interference fits, heat cones and press on to the shaft. Heat bearings in oven or oil bath:

- Do not heat above 120°C (248° F)
- Do not apply direct flame
- Do not allow parts to touch bottom or sides of oven or oil bath

(6) Bearing cups are installed with interference fits.

(7) Install lip seals with the seal lip towards the bearing. Coat the seal lip with bearing grease before installing the shaft.

NOTE: New V-rings and lip seals must be used when rebuilding the gearbox.

B. At case bottom **[248-1]**, install following items (refer Figure 14):

- Bearing cup **[245-1]**. Use feeler gauge and make sure bearing cup **[245-1]** is seated against case shoulder
- Lip seal **[249]**
- Bearing outer race **[221-1]**

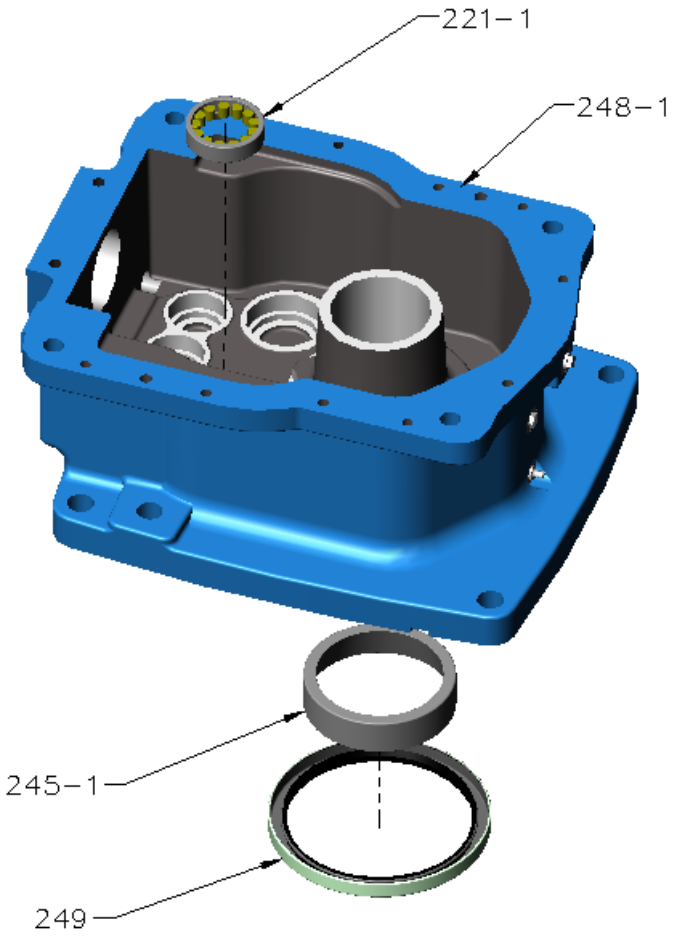

Figure 14 – Bottom Case

C. Output shaft assembly (refer Figure 15).

- Heat bearing cone **[245-2]** and press it on to the output shaft **[244]**.
- Use feeler gauge and make sure bearing cone **[245-2]** is seated against the shaft shoulder.
- Install key **[238]** on to the output shaft **[244]** (glue in if necessary)

D. Lift the case bottom and align with output shaft assembly **[244]** (refer Figure 15).

E. Carefully lower bottom case until bearing **[245-2]** is seated (refer Figure 15). Take care not to damager the lip seal.

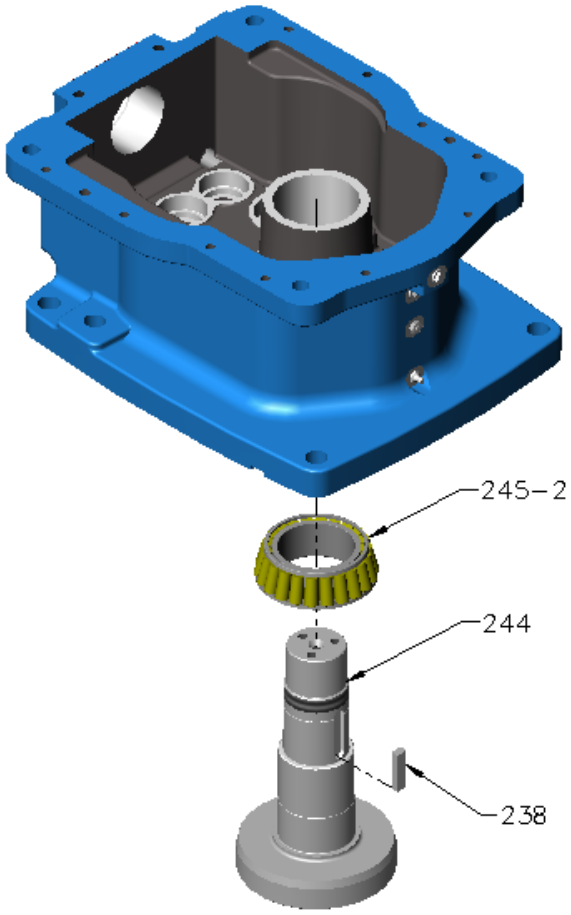

Figure 15 –Output shaft

F. Second intermediate shaft assembly (refer Figure 16)

- Press gear **[219]** with the key **[220]** and bearing inner race **[221-2]** on to the shaft **[218]**
- Install the nilos ring **[392]** on to the shaft **[218]**
- Press bearing inner race **[217-2]** on to the shaft **[218]**

G. Install second intermediate shaft **[218]** assembly in the bearing outer race **[221-1]** in the case bottom (refer Figure 16).

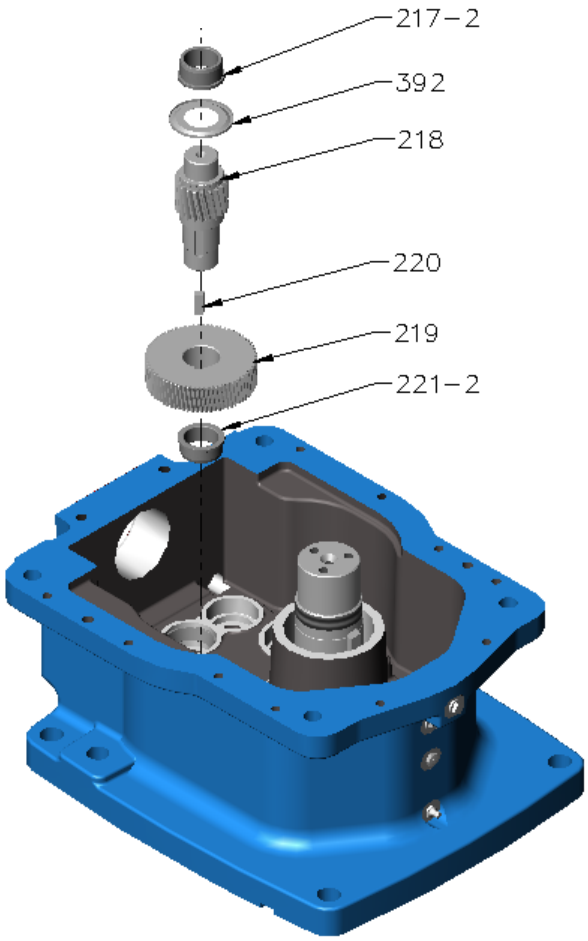

Figure 16 – Second Intermediate shaft

H. Install V-ring **[242]** in gear flange **[237]** and heat flange to 120° C (248° F) (refer Figure 17).

I. At output shaft **[244]**, install the following items: (refer Figure 17).

- Gear **[239]**
- Pre-heated gear flange **[237]**
- Gear flange locknut **[236]** and tighten locking set screws
    - Re-tighten the locknut after the gear flange cools down

J. Lift gear **[239]** to engage tenon on the flange and install bolts **[240]** (refer Figure 17). Make sure the gear is sitting flat on the gear flange. Use feeler gage to check

K. Torque-tighten bolts **[240]** to value given in Table 1 (refer Figure 17).

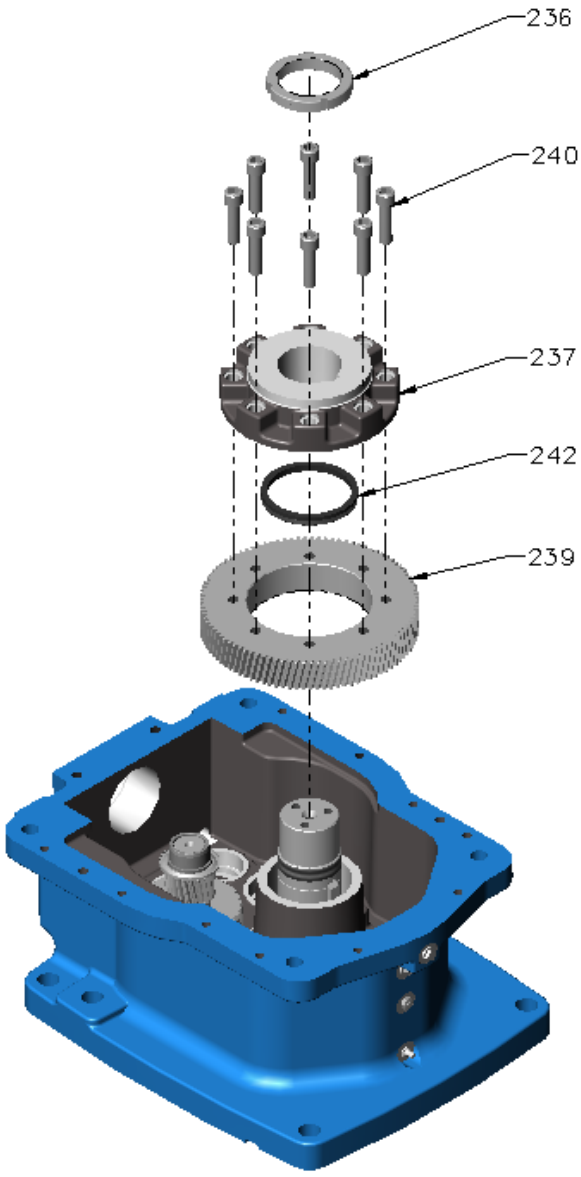

Figure 17 – Gear Flange

L. First intermediate shaft assembly (refer Figure 18)

(1) Install bearing cone **[205-2]**

(2) Press spiral bevel gear **[389]** with key **[391]** and the following items on to the shaft **[390]**:

- Bearing spacer **[388]**
- Nilos ring **[387]**
- Bearing cone **[203-2]**

(3) Install bearing cup **[205-1]**

M. To calculate number of shims

(4) Measure distance 'C' from bottom of the bevel gear **[389]** to bottom surface of the bearing cup **[205-1]**.

(5) **Number of shims required = Z – (C + MD)**

Where, 'Z' is the distance specified on the gear case lid in mm and 'MD' if the mounting distance scribed on the gear in mm (as shown in Figure 19)

N. Install the bearing cup **[205-1]** along with the appropriate number of shims in the gear case **[248-1]**

O. Install first intermediate shaft assembly in the bearing cup **[205-1]**

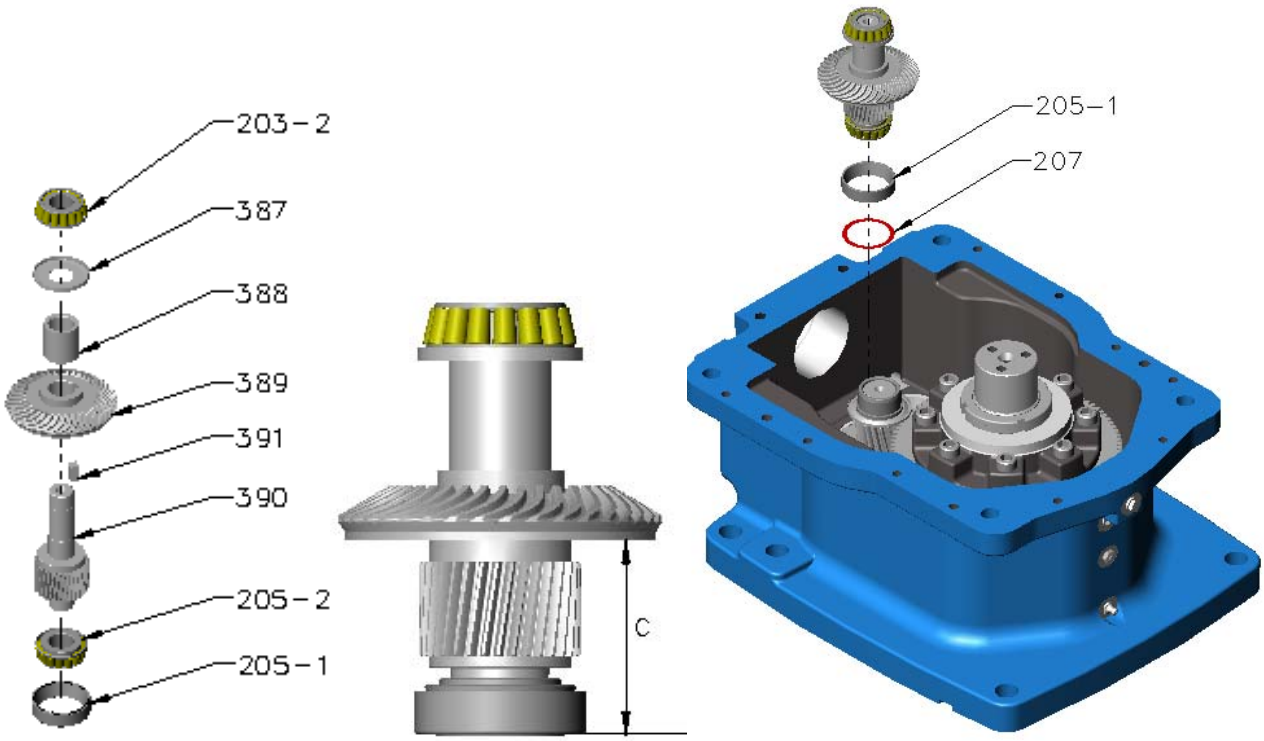

Figure 18 – First intermediate shaft

P. Assemble the spiral bevel cartridge **[370]** (refer Figure 20)

(1) Wash the cartridge **[370-11]** and the spiral bevel pinion **[370-13]**

(2) Measure length 'Y' on the spiral bevel input shaft **[370-13]** before any assembly is started

(3) Heat bearing cone **[370-7]** to 120ºC [248ºF] and press it on to the shaft **[370-13]**

(4) Spray the cartridge ID with Zepreserve or light machine oil and press bearing cups **[370-10]** and **[370-8]** into the cartridge **[370-11]**

(5) Assemble the shaft **[370-13]** into the cartridge **[370-11]**. Heat second bearing cone **[370-9]** to 120ºC [248ºF] and install it on to the shaft

(6) Insert locknut **[370-6]**, with setscrew in place but loose

(7) Spray bearings with Zepreserve or light machine oil and tighten locknut **[370-6]** to obtain shaft turning preload torque of:

(a) 1.5 in.lbs (plus 0, minus 1 in.lbs) – For 21HT

(b) 6.5 in.lbs (plus 0, minus 2 in.lbs) – For 22HT

(8) Rotate shaft one full turn to check for binding. Torque reading is to be taken through ¼ turn of shaft, requiring 5 seconds to complete the ¼ turn

(9) Tighten locknut setscrew using a shortened allen wrench

(10) Install lip seal **[370-4]** into the end cap **[370-5]**. Apply three-bond sealant (or any other suitable sealing compund) to the end cap **[370-5]** on the area that will be contacting the housing **[370-11]**.

(11) Apply a small amount of grease to the ID of the lip seal **[370-4]** and slip it over the input shaft. Screw cap on to the housing using three screws **[370-1]** (and washers **[370-2],** on 21 HT).

(12) Torque-tighten bolts **[370-1]** to value given in Table 1. Wipe off any excess sealant that squeezed out while tightening the bolts.

(13) Install V-ring **[370-3]** on to the shaft at a height of 9 mm for 21HT / 7.5 mm for 22HT measured from the lip seal's metal surface to the back of the V-ring.

(14) Install O-ring **[370-12]** on to the housing **[370-11]**

Q. To calculate number of shims **[382]** required at the spiral bevel cartridge **[370]**

(1) Measure distance 'X'

(2) Compute 'A': **A = Y - X**

(3) **Number of shims required = (A + MD) - B**

Where, 'B' is the distance in mm specified on the gear case lid (as shown in Figure 19) and 'MD' is the mounting distance in mm scribed on the gear (as shown in Figure 22)

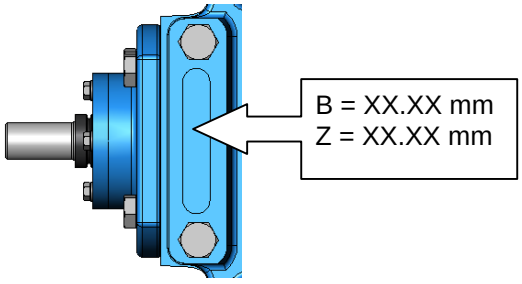

Figure 19 – Cartridge Setting Measurements

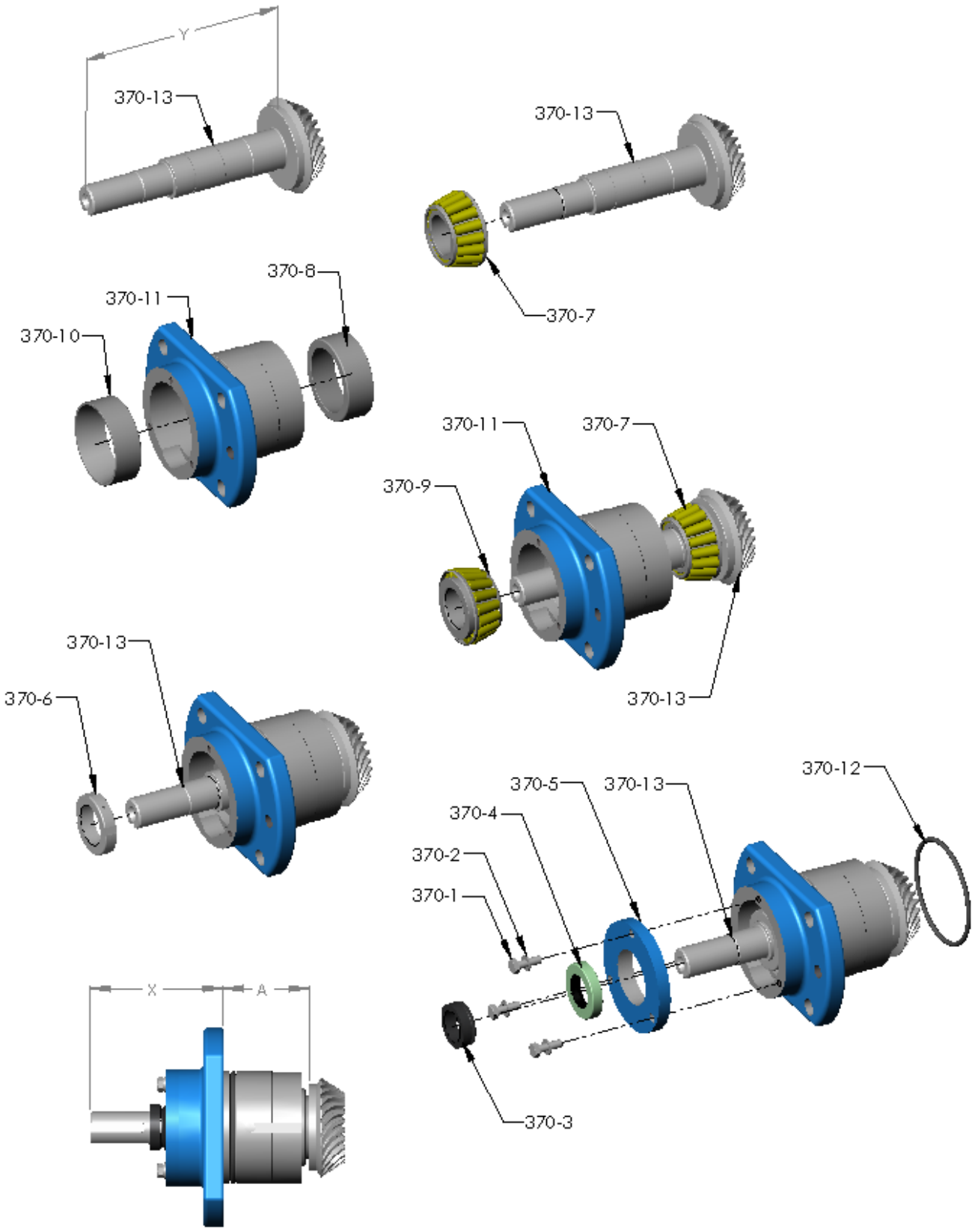

Figure 20 – Spiral Bevel Cartridge Assembly

R. Insert spiral bevel cartridge **[370]** along with appropriate number of shims **[382]** in the bore. Make sure that the 'X' marks on the bevel pinion and gear teeth match (as shown in Figure 22).

S. Install bolts **[381]**. Torque-tighten bolts **[381]** to value given in Table 1 (refer Figure 21).

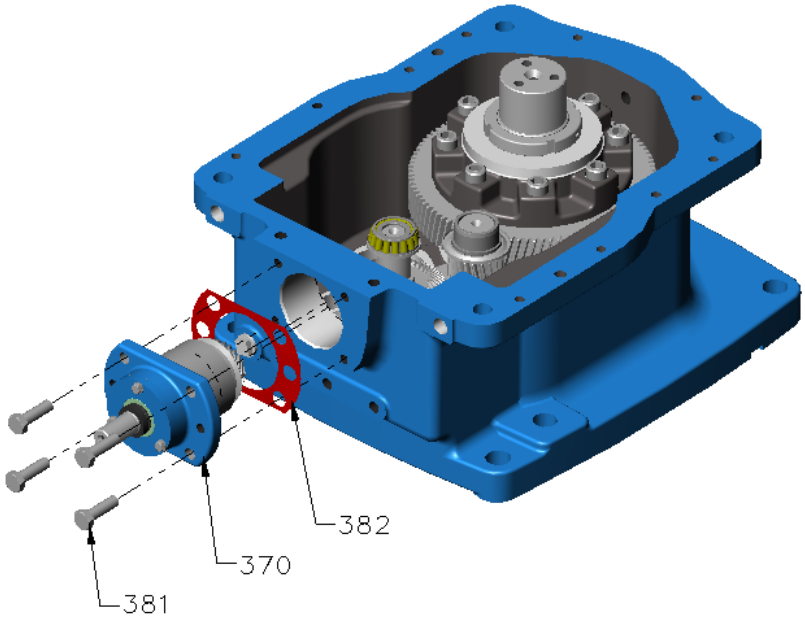

Figure 21 – Spiral bevel cartridge

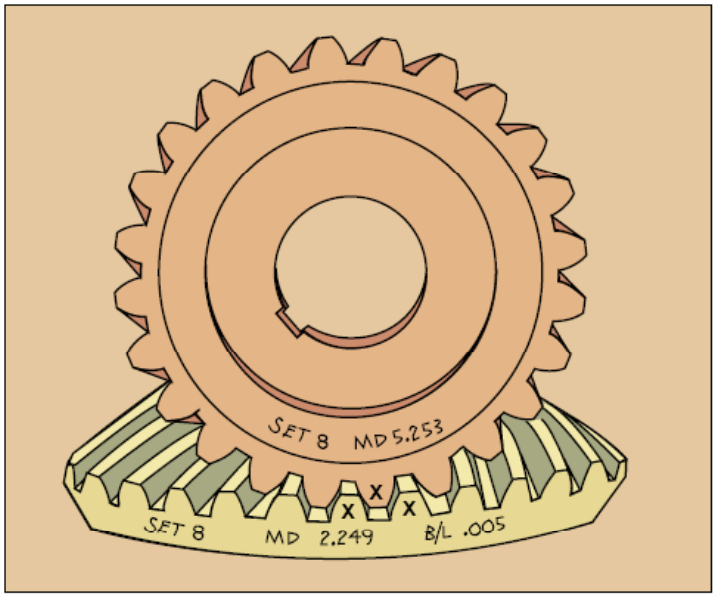

Figure 2 — Typical markings on bevel gears include (left to right) the gearset number, mounting distance (MD) in inches for each gear, x's on mating teeth, and the backlash dimension (B/L) in inches.

Figure 22 – Spiral Bevel Markings

(Source: "How to install bevel gears for peak performance" by Robert F. Wasilewski, Arrow Gear Company, "Power Transmission Design" Magazine, March 1994)

T. To check backlash:

(1) Install case lid **[247-1]** with dowel pins **[252]** and two bolts **[250]**. DO NOT APPLY SEALANT.

(2) Insert bearing cup **[203-1]**

(3) To check backlash at the input bevel shaft:

(a) Insert the backlash tool in the threaded end of the input bevel shaft, as shown in Figure 24

(b) Position a Dial Test Indicator (DTI) at the marking etched on the backlash tool.

(c) Restrain the output shaft from turning and rotate the spiral bevel pinion shaft back and forth to measure the free movement. The backlash setting is etched on the spiral bevel gear.

(d) Take five consecutive readings. Rotate the spiral bevel pinion shaft one-revolution counter clockwise after each reading.

(e) Turn the pinion shaft back to the position of the lowest reading.

(f) Add shimming **either** between the bevel cartridge **[370]** and housing **or** below the bottom bearing of first intermediate shaft **[390]** assembly, in order to achieve the desired backlash.

(4) Remove the case lid **[247-1]**, bolts **[250]**, and dowel pins **[252]**

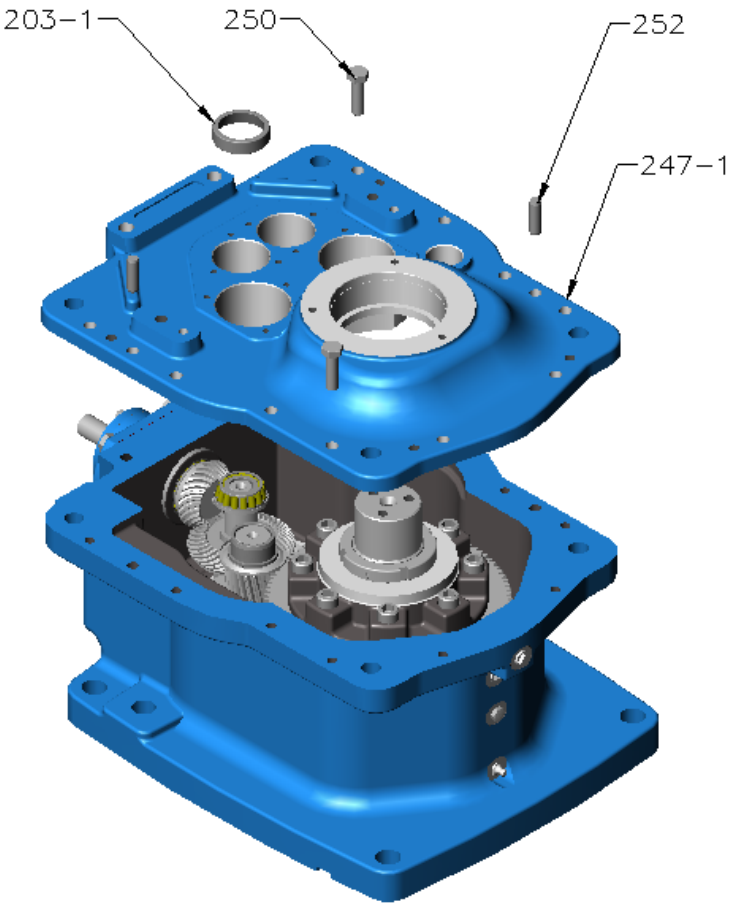

Figure 23 – Case lid Install

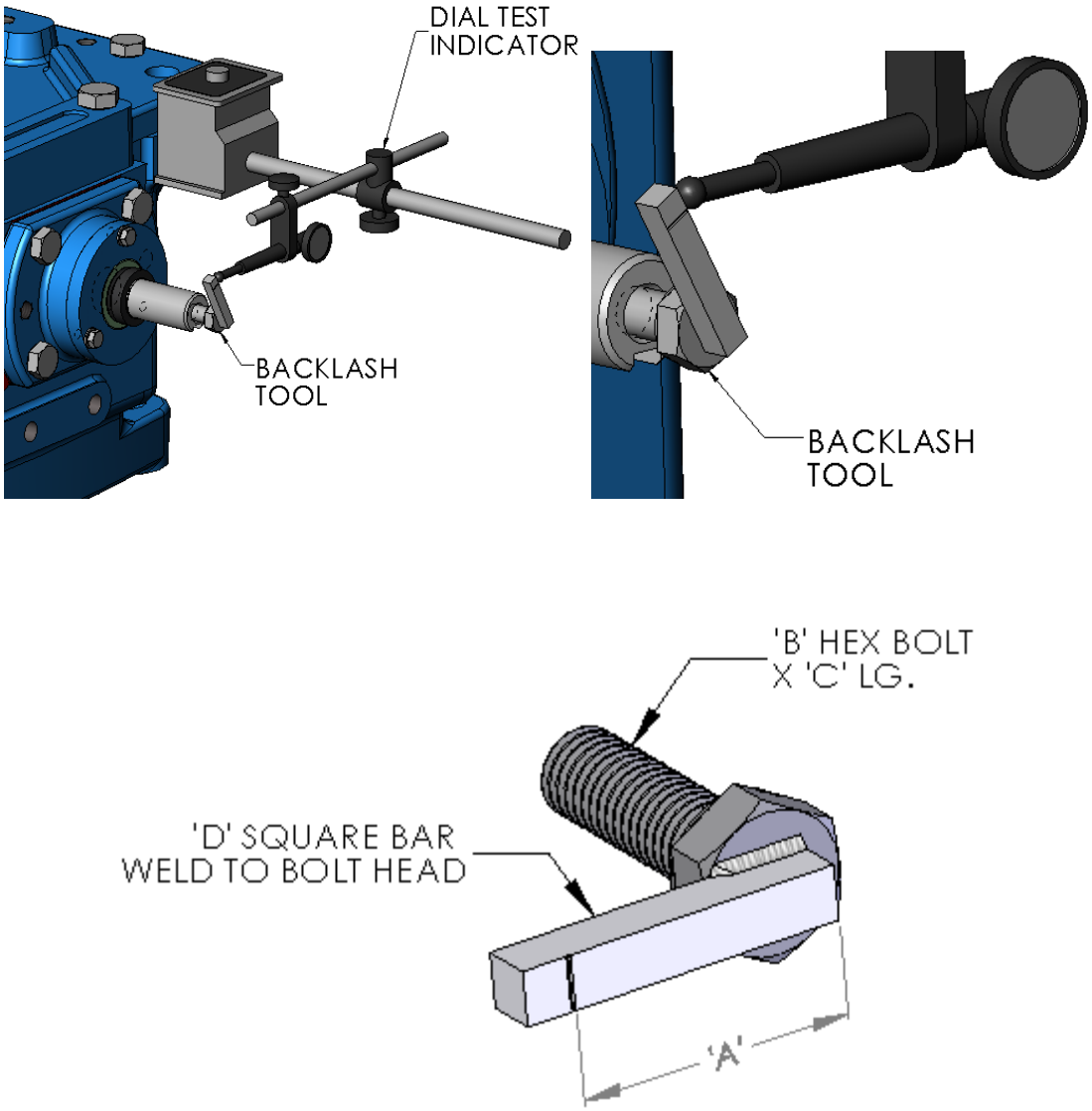

Figure 24 –Check Backlash

Table 2 – Backlash Setting

MODEL	A	B	C	D
21 HT	0.772" (19.6 mm)	5/16"-18	1" (25.4 mm)	1/4" (6.4 mm)
22 HT	0.908" (23 mm)	5/16"-18	1" (25.4 mm)	1/4" (6.4 mm)

U. Install case lid **[247-1]** (refer Figure 25).

(1) Apply Three Bond Sealant 1215AA or equivalent to case bottom flange.

(2) Put case lid **[247-1]** on case bottom.

(3) Install dowel pins **[252]**.

(4) Install bolts **[250]** and torque-tighten to value given in Table 1.

V. Install at output shaft (refer Figure 25):

- Nilos ring **[235]**
- Bearing cup **[233-1]**
- Heat bearing cone **[233-2]** at 120ºC (248ºF)
- Press the heated bearing cone **[233-2]** onto output shaft

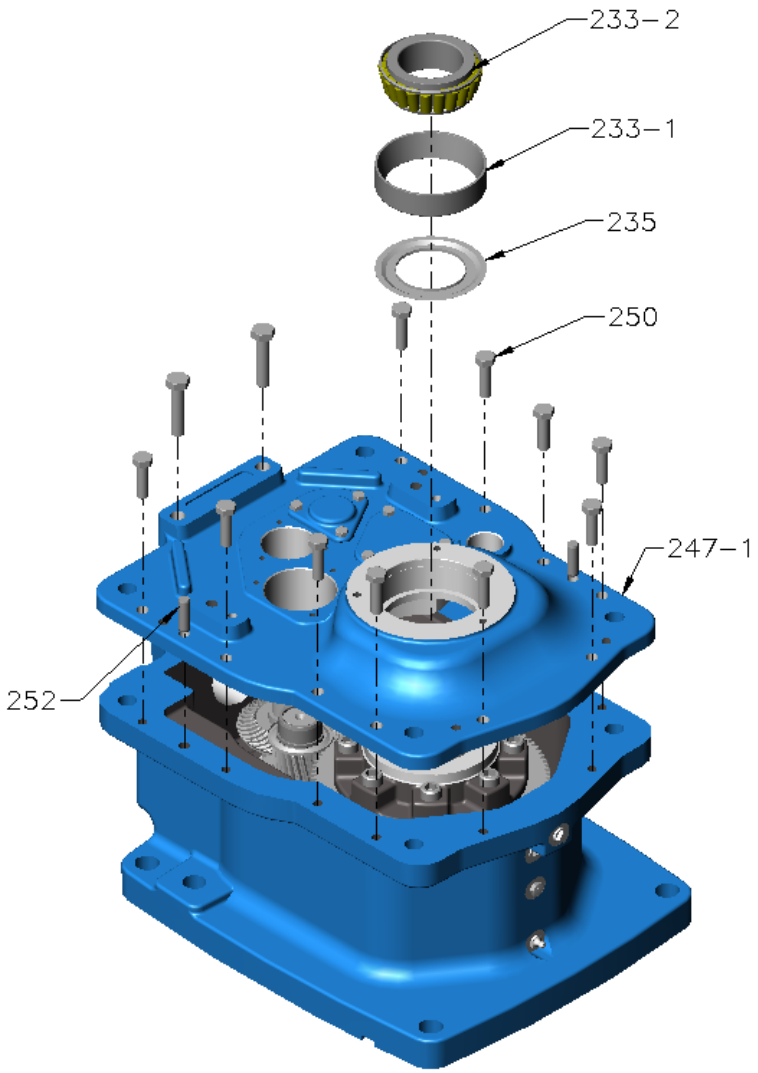

Figure 25 – Case Lid

W. First intermediate cap shim selection (refer Figure 26).

(1) Measure the distance 'D_C' from the seating surface of the cap to its bottom.

(2) Measure the depth of the bore 'D_b' from the seating surface of the cap to the bearing.

(3) **Number of shims required = (D_b - D_C) – 0.002"**. Select appropriate shims set **[207]**.

X. At first intermediate shaft, install following items (refer Figure 26):

- Shim set **[207]**
- First intermediate cap **[373]** with O-ring **[206]**
- Replace grease fitting **[384]** if it was removed before
- Bolts **[213]**, torque-tighten bolts **[213]** to value given in Table 1

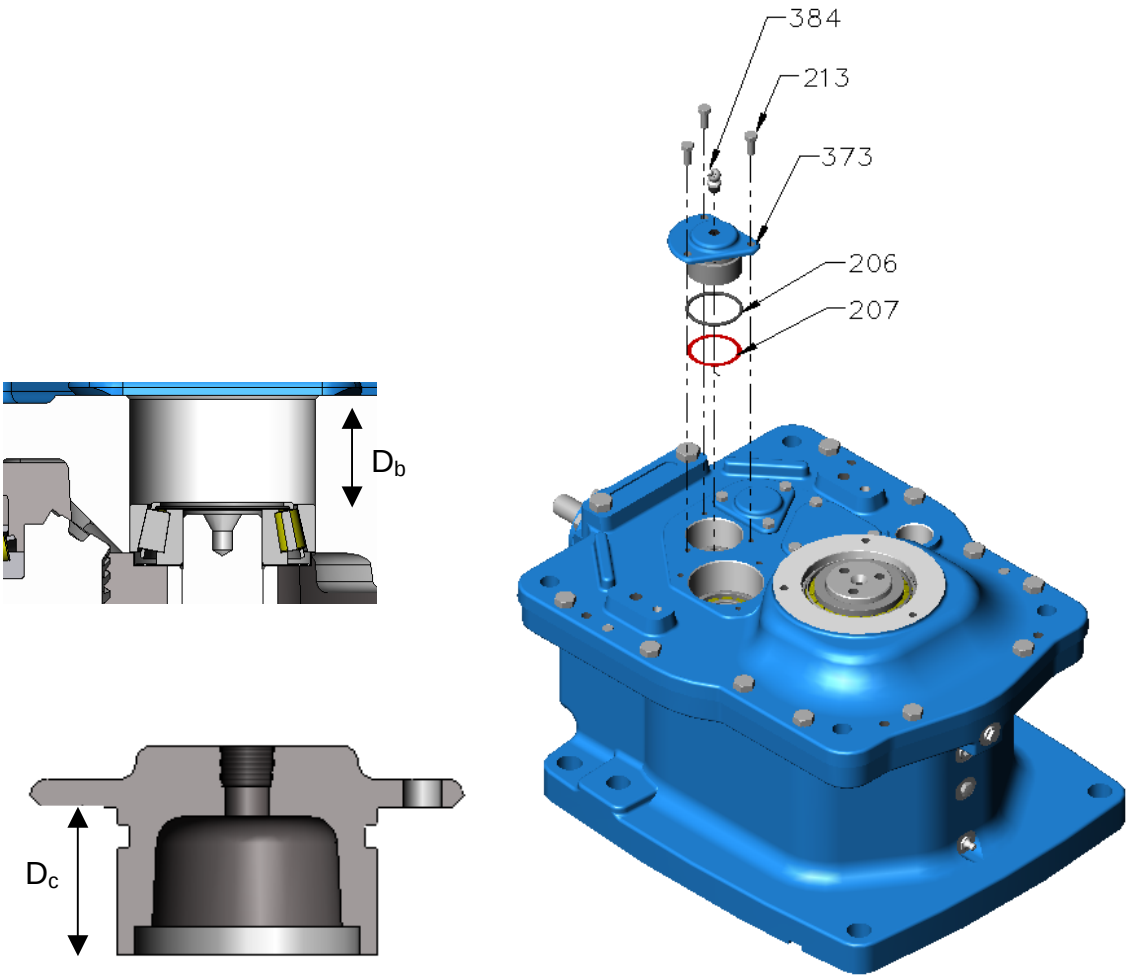

Figure 26 – First Intermediate Cap

Y. At second intermediate shaft, install following items (refer Figure 27):

- Bearing outer race **[217-1]**
- O-ring **[222]**
- Intermediate cap **[386]** with grease fitting **[385]**
- Bolts **[225]**, torque-tighten bolts **[225]** to value given in Table 1

NOTE: No shimming required

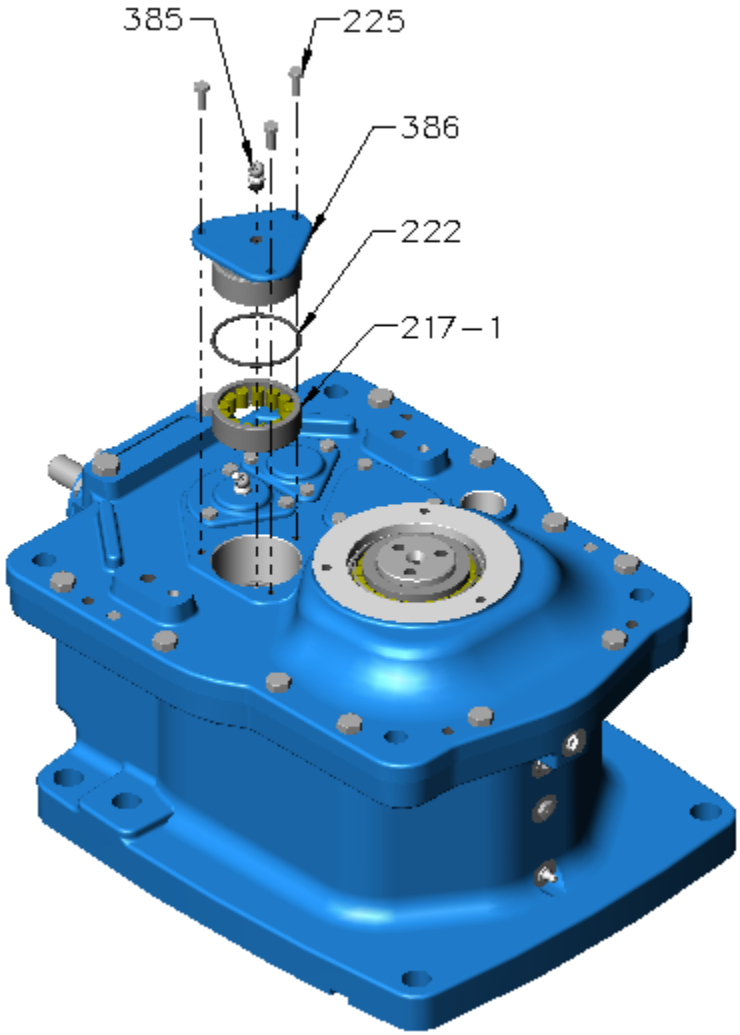

Figure 27 – Second Intermediate Cap

Z. Output shaft shim selection (refer Figure 28).

(1) Make sure any fixture or arrangement to prevent the output shaft **[244]** from rotating is removed before shimming.

(2) Install thrust washer **[228]** and bolts **[230]**. Torque-tighten bolts **[230]** to value given in Table 1.

(3) Use a Dial Test Indicator (DTI) to measure end float of output shaft.

(a) Carefully tap shaft down with a mallet.

(b) Install eye bolt to end of shaft.

(c) Lift shaft up with a pry bar on the eye bolt and measure the end float with the DTI. Record this as measurement 'A'.

(d) Required shim thickness = A – 0.002". Select shim set **[229]** accordingly.

(e) Remove bolts **[230]** and thrust washer **[228]**.

AA. At output shaft, install following items (refer Figure 28):

- Shim set **[229]**
- Thrust washer **[228]**
- Bolts **[230]** with spring washers **[231]**, torque-tighten to value given in Table 1
- O-ring **[253]**
- Output cap **[254]**
- Grease fittings **[260]** and **[261]**, if removed
- Bolts **[255]**, torque-tighten to value given in Table 1
- Check the end float (0.001"– 0.003" is acceptable)

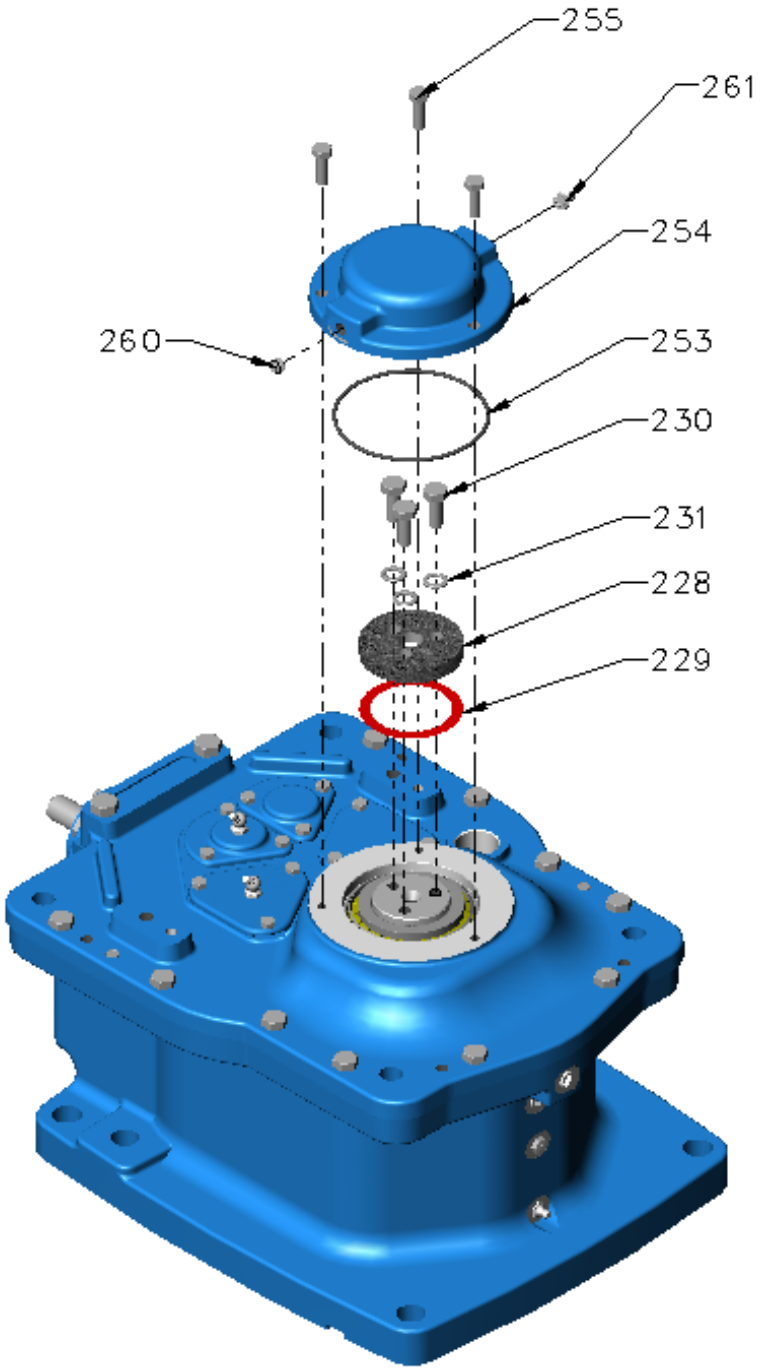

Figure 28 – Output Cap

- Replace any fittings/nipples that were removed.
- Replace oil drain plug, if removed.
- Apply grease to the bearings as necessary and fill the gear drive housing with oil (Refer to related Agitator IOM, Lubrication Section).

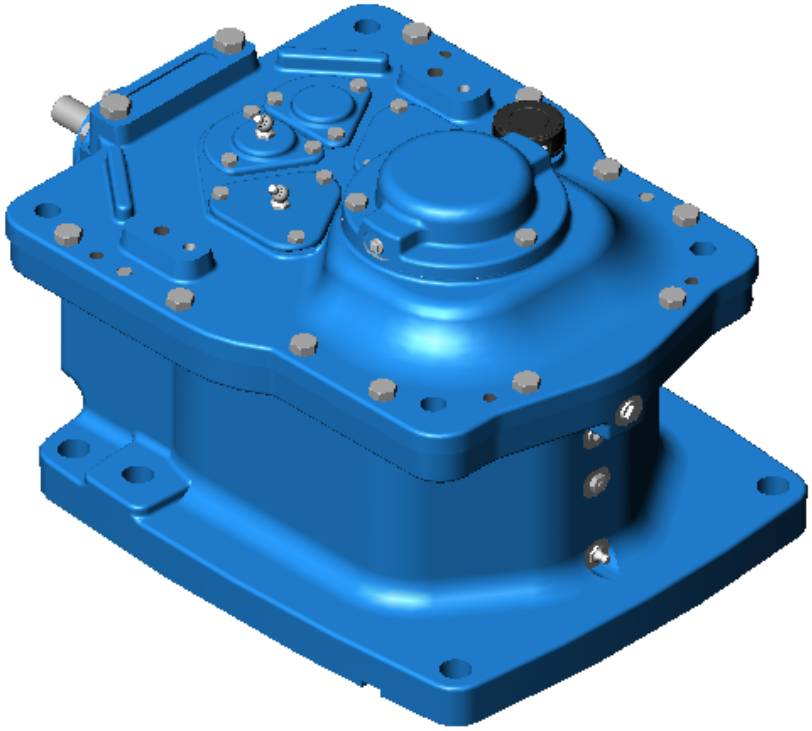

Figure 29 – Model 20 HT

4. ITEM LIST

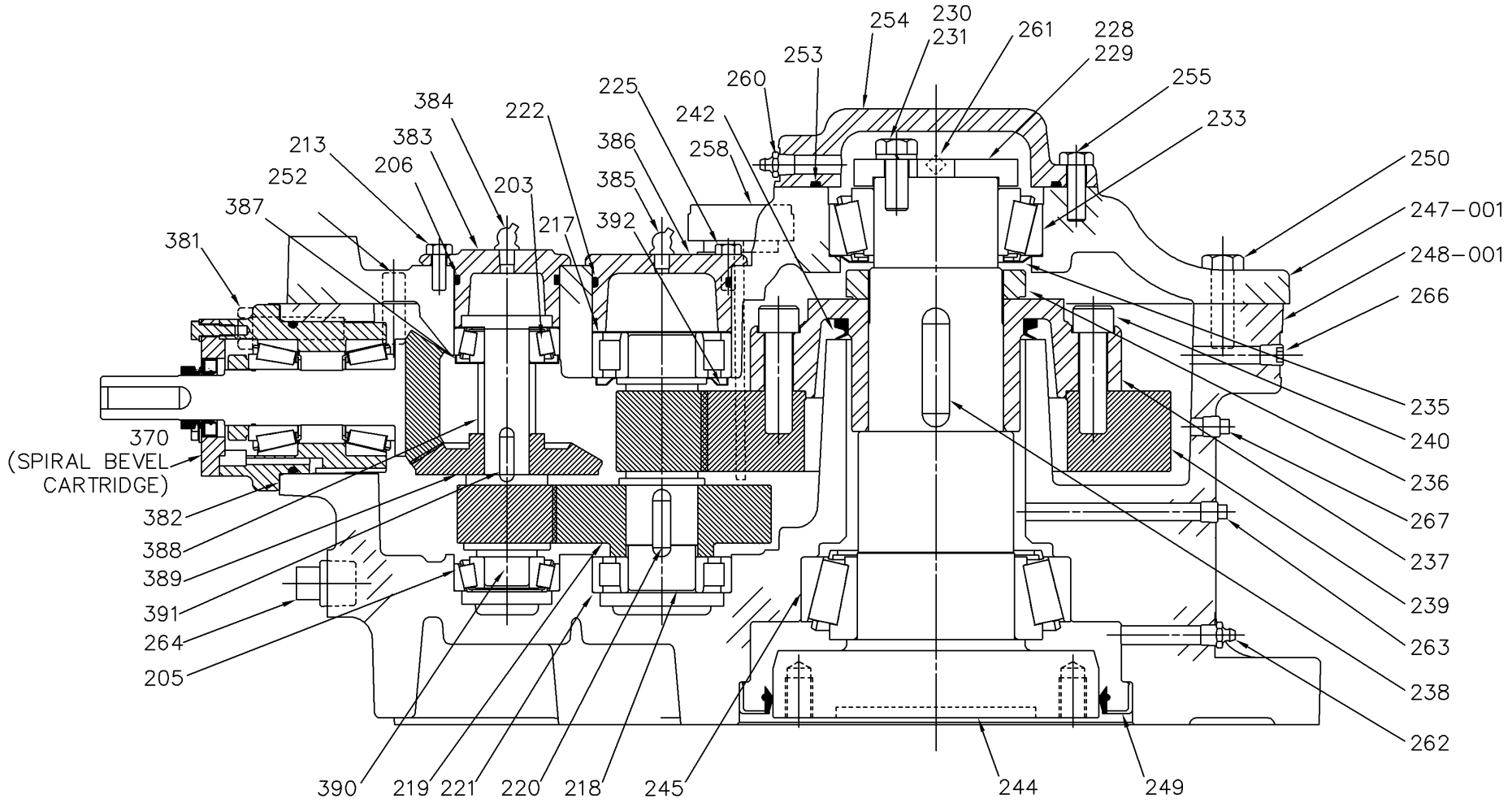

Figure 30 – Sectional View of Model 20 HT

Table 3 – Item List for Model 20 HT Gear Drive

Item #	Description	Qty.	Item #	Description	Qty.	Item #	Description	Qty.
200	**Gear drive assembly**	**1**	229	shim set	1	254	output cover	1
			230	bolt	3	255	bolt	3
203	bearing (taper roller)	1	231	lockwasher	3	258	breather/dipstick	1
203-1	bearing cup	1	233	bearing (taper roller)	1	260	grease fitting	1
203-2	bearing cone	1	233-1	bearing cup	1	261	pipe plug, NPT	1
205	bearing (taper roller)	1	233-2	bearing cone	1	262	grease fitting	1
205-1	bearing cup	1	235	nilos ring	1	263	pipe plug, NPT	1
205-2	bearing cone	1	236	lock nut	1	264	magnetic drain plug, NPT	1
206	O-ring	1	237	gear flange	1	266	set screw plug, NPT	1
207	shim set	1	238	key	1	267	pipe plug, NPT	1
213	bolt	3	239	gear	1	370	spiral bevel cartridge assembly	1
217	bearing (Cylindrical Roller)	1	240	bolt	8	381	bolts	4
217-1	bearing outer race	1	242	V-ring	1	382	shim set	1
217-2	bearing inner race	1	244	output shaft	1	383	bearing cap	1
218	pinion shaft	1	245	bearing (taper roller)	1	384	grease fitting	1
219	gear	1	245-1	bearing cup	1	385	grease fitting	1
220	key	1	245-2	bearing cone	1	386	bearing cap	1
221	bearing (Cylindrical Roller)		247-1	gear drive lid	1	387	nilos ring	1
221-1	bearing outer race	1	248-1	gear drive housing	1	388	bearing spacer	1
221-2	bearing inner race	1	249	lip seal	1	389	spiral bevel gear	1
222	O-ring	1	250	bolt	10	390	pinion shaft	1
225	bolt	3	252	dowel pin	2	391	key	1
228	output shaft washer	1	253	o-ring	1	392	nilos ring	1

Table 4 – Item List for Model 20 HT Gear Drive

Item #	Description	Qty.
370	**spiral bevel cartridge assembly**	**1**
370-1	bolts	3
370-2	washers	3
370-3	V-ring	1
370-4	lip seal	1
370-5	spiral bevel seal cap	1
370-6	lock nut	1
370-7	bearing cone (taper roller -inboard)	1
370-8	bearing cup (taper roller -inboard))	1
370-9	bearing cone (taper roller -outboard)	1
370-10	bearing cup (taper roller -outboard)	1
370-11	cartridge housing	1
370-12	o-ring	1
370-13	spiral bevel input shaft	1

P.O. Box 1123
Dayton, Ohio 45401
Phone: (937) 454-3200
FAX: (937) 454-3379

www.chemineer.com