

SINGLE REDUCTION GEARBOX ASSEMBLY INSTRUCTIONS



CONE DRIVE DOUBLE ENVELOPING WORM GEAR UNITS



Cone Drive
BY TIMKEN

Table of contents

Introduction -----	2
General Information-----	3
Bearing Settings -----	4
Preparation for Rebuild -----	5
Disassembly Instructions -----	6
Assembly Instructions -----	6
Double Row Thrust Bearing Assembly-----	7
Contact patterns -----	9
Trouble Shooting-----	13

Introduction

This specification covers the assembly and disassembly of Cone Drive standard worm gear speed reducers and gearsets. It applies to single reduction reducers and standard or low backlash gearsets.

This manual assumes the person performing the assembly and disassembly has experience with servicing transmission equipment. Always use lifting equipment with heavy

lifting capability. Standard tools used for the assembly and disassembly of reducers may be used to perform the instructions in this manual. A bearing press will also be necessary to install bearings and gears.

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Cone Drive Parts & Service Options

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Experienced Cone Drive personnel are available to make sure that your Cone Drive reducer is ready to give you the reliable duty for which it was designed.

To arrange for service, please call us toll free at 888-726-Cone, or ask for the field service extension.

Remanufacturing Center

Cone Drive's Remanufacturing Center at our Traverse City manufacturing facility is capable of any level of rebuild. For information, please call us toll free at 888-726-Cone, or ask for the rebuild service extension.

Technical Information

Assembly drawings of your reducer or technical assistance is available from Cone Drive.

The Controlling Dimensions

The controlling dimensions for the proper assembly of Cone Drive gearsets are: worm end position, gear side position and center distance. Since these dimensions are held during the manufacture of gearsets, these same dimensions should be maintained within the specified limits to properly locate the worm and gear in the housing at assembly.

Variations in housing flange face dimensions affect the end position of the worm and side position of the gear. We compensate for these variations by inserting shims between the bearing cap or carrier flange face and the housing bore face. The shims are adjusted to centralize the worm and gear in the housing.

Tolerances

The recommended tolerance limits for the controlling dimensions, (worm end position, gear side position, and center distance) are shown.

Center Distance	Tolerances (+/-)
up to 6"	.001
6" to 10"	.002
over 12"	.003

Table 1

Errors in Angularity

Errors in angularity between the worm and gearshaft, beyond permissible limits, cannot be corrected by altering any of the locating dimensions. Care should be taken that the housing bores for the worm shaft and gear shaft are machined square with each other within .004" per linear foot.

Shims and Shim Sets

Shims are used in Cone Drive gear units both to properly position the worm and gear within the gear housing (see “Assembly instructions”), and to set the desired bearing end-play or pre-load (see Recommended Tapered Roller Bearing Settings).

The shims also serve as gaskets for the bearing parts, the shims are packaged as “shim sets”.

Each shim set includes an assortment of shims which are color coded according to thickness as shown in Table 2.

Color	Thickness	Color	Thickness
Yellow	.020”	Blue	.005”
Brown	.010”	Green	.003”

Table 2

Grease Packed Bearings

Bearings that are least partially submerged in oil or oiled by internal oil scoops do not require special maintenance. However, bearings that are not lubricated as above require grease lubrication. Grease fittings and internal retainers are furnished when required, see figure 3. Apply a high quality lithium base NLGI #2 or NLGI #3 bearing grease at normal maintenance intervals depending on the duty cycle of the reducer.

Adjustment of Bearing Settings

Opposed mounted single row tapered roller bearings require adjustment for end play. Select proper worm bearing setting according to RPM from Table 3.

Double Row Bearing settings for the worm are described on page 7.

Recommended Tapered Roller Bearing Settings

Single Reduction Reducer Worm Bearing Settings		
Reducer Size (center distance)	Worm Speed (1,000 - 2,000 RPM)	Worm Speed (2,001 - 3600 RPM)
15 to 35 (1.500” to 3.500”)	.003 +/- .001	.005 +/- .001
40 to 60 (4.000” to 6.000”)	.004 +/- .001	.006 +/- .001
70 to 80 (7.000” to 8.000”)	.006 +/- .001	.007 +/- .001

Table 3

Notes:

- A. Settings shown in above chart are axial looseness.
- B. All gear bearings up to and including 12.000” C.D. are set to a preload of (-) .001 +/- .001 for output speeds of 350 RPM or less. Contact Application Engineering for gear bearing settings for speeds in excess of 350 RPM.
- C. For all double worm reducers, the secondary worm bearings are set to .001 +/- .001 (loose).
- D. 7.000” and 8.000” C.D. prior to 1980 have preset worm bearings.

- E. 10.000” C.D. and larger worm bearings and 15.000” C.D. and larger gear bearings are preset.
- F. These bearing settings are for standard and special reducers unless otherwise specified on the assembly drawing.
- G. If low backlash is critical, some applications may require reduced settings. Contact Cone Drive Application Engineering for review.
- H. If the reducer is to be operated at input speeds other than those indicated above, contact Application Engineering for review.

“O” Markings

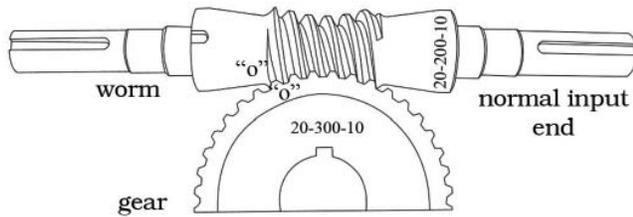


Figure 1

“O” markings will appear on many multiple threaded worm gearsets. When “O” markings are present, care should be taken during assembly to ensure that the “O” marks are properly aligned. As indicated in figure 1, when properly aligned, the “O” stamped worm thread will pass through the “O” stamped space between two gear teeth.

Preparation of Rebuild

Applies to 1.5” through 8.0” Center Distance Single Reduction Speed Reducers. When calling for parts, please reference reducer model number and serial number. To properly identify a Cone Drive speed reducer we must have the reducer model number and serial number.



Cone Drive Reducer Nameplate

Line #1 - Reducer Model Number

example: MSH040-2.

Line #2 - Serial Number

example: 99174461-100-1.

year manufactured (99)

Cone Drive order number (174461)

order item number (100)

item sequence number (1)

Line #3 - Customer Part Number when required.

Line #4 - Ratio and Input Speed

Line #5 - Reducer Rating and Service Factor

Line #6 - Assembled Backlash and Lubricant No.

Drawings and Parts Lists

Assembly drawings, detail drawings, and parts lists for all units are available from Cone Drive. An assembly drawing is required to rebuild the reducer. Note positions of input and output shafts, breather and oil level plug. A photograph of the reducer before disassembly will be helpful.

Lubrication

Contact Cone Drive for lubrication list.

Oil Level

Cone Drive reducers are furnished with a bronze colored hex head pipe plug to indicate oil level. An oil level tag is affixed to the unit near the oil level indicator. Oil level should always be checked with the unit stopped.

Cone Drive reducers are all shipped without oil. However, Series W, Model RG and Series S are shipped with oil.

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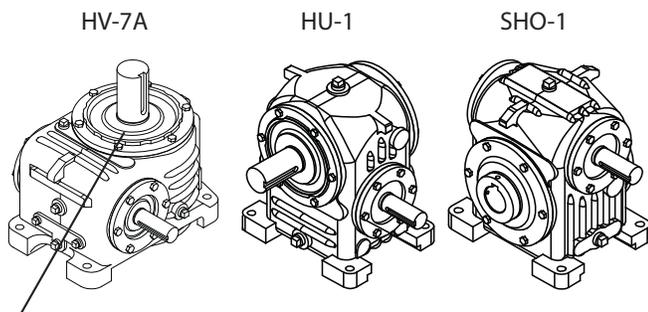
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Disassembly Instructions

1. Remove reducer from machine.
Caution: follow machine manufacturer's recommendations, making sure to remove all load from the reducer before removing reducer from machine.
2. Drain oil
3. Clean outside of housing
4. Position reducer on bench with gearshaft up.



This bearing will have a grease retainer

Figure 2

5. Remove one (1) Gear carrier making sure the shim packs stay with the carrier for determining the amount of new shims to use as a starting point when reassembling reducer.
6. Lift gearshaft assembly out of housing.
7. Wipe off excess oil.
8. Reposition housing so worm is pointing up.
9. Remove one (1) worm bearing carrier making sure shim pack stays with carrier for determining the amount of new shims to use as a starting point when reassembling the reducer.
10. Lift worm out of housing.
11. Remove remaining worm and gear carriers from housing making sure shims stay with carriers.
12. Remove bearing cups from all carriers.
13. Remove oil seals from open caps and carriers.
14. Clean inside of housing and carriers.
15. Discard old parts, i.e. bearings, seals, and gearset.

Assembly Instructions

Applies to 1.5" through 8.0" Center Distance Single Reduction Speed Reducers.

1. Refer to prints and parts lists for parts breakdown.
2. Check gearset for matched set numbers. The worm and gear must have the same set number.

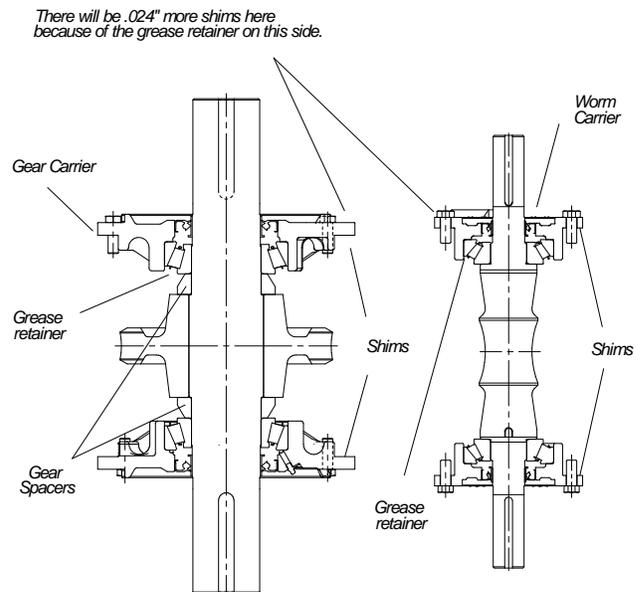


Figure 3

3. Determine the hand of assembly of the speed reducer which is the relationship between the input and output shaft. This can be found on the name tag as part of the model number (see figure 2), the assembly drawing or from the reducer to be rebuilt.
4. All speed reducers 3" C.D. and larger with a vertical worm or gearshaft will have a grease retainer under the upper bearing cone on the shaft. The grease retainer must be installed with the rim toward the bearing cone, as shown in figure 3. When a grease retainer is used under a bearing, you must add 0.24" shims to the carrier on that bearing.
5. A 10 ton press will be required for installing the bearings and gear for reducers as large as 3.5" C.D. and a 50 ton press for reducers as large as 8.0" C.D. Press the bearing cups into the worm and gear carriers. Press the grease retainer (if required) and bearing cones onto the worm. Press the gear, gear spacers (if required), grease retainer (if required), and bearing cones onto the gearshaft.

Double Row Thrust Bearings

General

The Worm is assembled into the housing before the gear on Model HV up to and including 10.000" C.D. and on all Model HU and HO reducers with split type housing. On Model HV 12.000" C.D. and larger the worm is assembled last using an eccentric thrust bearing carrier to bring the worm into mesh with the gear.

Worm

1. Make the required measurements as shown in sketch 1 and determine shim thickness E. If a grease retainer is required on the locating end, add the thickness of the retainer to Dimension A.
2. Press all worm bearings on the worm.
3. Assemble the worm into the housing using E shim thickness between the thrust bearing carrier and the housing. Lock the thrust bearing the place by installing K shim thickness between the bearing cap and the thrust bearing carrier. This should provide a .003 - .005 clamp on the bearing cups.

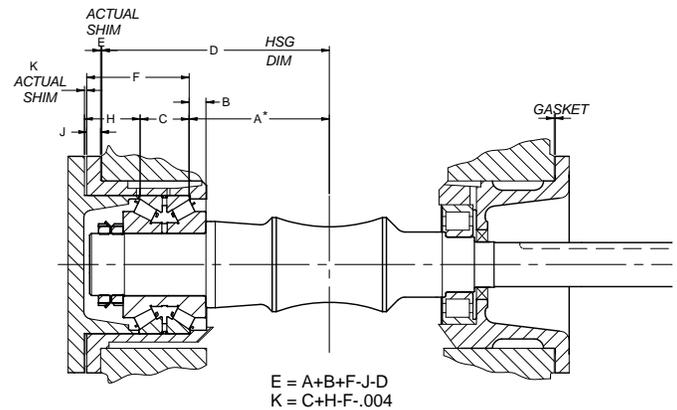
Gear

1. Make the required measurements as shown in sketch 2 and determine the spacer width J. If a grease retainer is required on the locating end, add the thickness of the retainer to Dimension A. Grind the thrust bearing spacer to J demenstion and assemble the spacer, grease retainer (if required), and the thrust bearing to the shaft.
2. Press the gear on the gearshaft being sure to observe the matching relationship discussed on page 3. Add the radial gear spacer and grease retainer (if required) and press the radial bearing into place. Assemble the locknuts and lock washers.

Check Contact

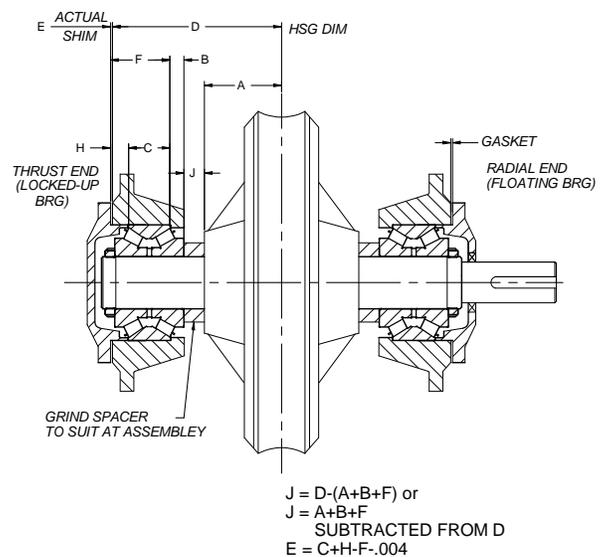
1. Apply a light coat of prussian blue or red lead to the worm.
2. Assemble the gearshaft sub-assembly into the housing and lock the thrust bearing in place by installing E shim thickness between the gear bearing cap and the housing. This

- should provide a .003 - .005 clamp on the bearing cups.
3. Check the gearset contact patterns as shown on pages 9 and 10 by rotating the worm in both directions.
4. No bearing adjustment is required on double row thrust bearings. The endplay is preset at the factory.



Sketch 1

*Dimension held exact in manufacturing



Sketch 2

Gear Bearing Settings

1. The first step for checking bearing settings is to assemble one (1) gear carrier starting with the same number of shims as with old reducer or the nominal shim thickness called for on the assembly drawing. Install the gearshaft assembly and bolt the remaining gear carrier and shims into the housing. Rotate the shaft while tapping on the end to seat the bearing rollers. Check the gear bearing setting with an indicator as shown in figure 4. With the dial indicator set at zero, pull up on the shaft while watching the dial indicator. Add or subtract shims as necessary to achieve the proper bearing setting shown in Table 3. The shims should be equal under both carriers so that the worm and gear are centered in the housing, unless there is a grease retainer being used.

2. Remove one (1) gear carrier and the gear shaft assembly from the housing. Note: keep track of the amount of shims needed under the carrier.

3. The next step is to install the worm assembly into the housing and check the bearing settings in the same manner as the gear assembly. The recommended bearing settings can be found in Table 3, paying attention to reducer size and worm speed. When finished with bearing settings the worm should be left in the speed reducer.

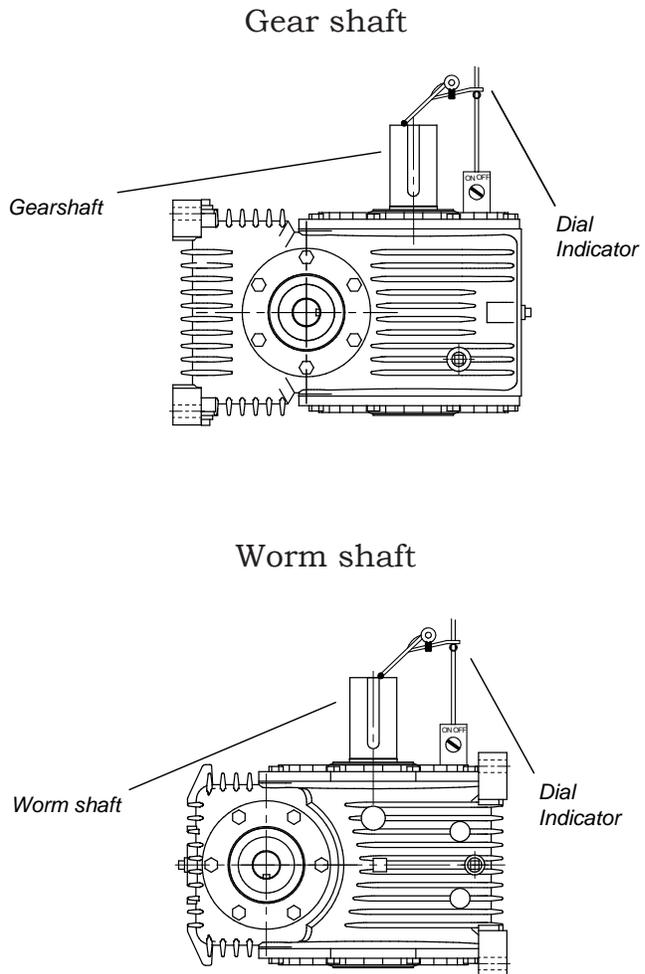


Figure 4

Contact Pattern

1. Coat gear teeth and worm threads with a nondrying contact paste. Caution: On some multiple threaded worms, a zero marking will be on the worm and gear. These must be matched during the assembly of the gear and the worm. (refer to “O” marking in figure 1).

2. Install gearshaft assembly into the housing. Replace gear carrier and shims.

3. Rotate the worm shaft by hand until the gear has made one or more revolutions in each direction. Remove gear shaft assembly from the housing to observe the pattern on both the worm and gear.

4. The gearset must be positioned properly at assembly to obtain the desired gear contact between the worm threads and gear teeth. If the gearset is properly aligned, contact will be approximately as shown by the shaded portions in figures 5 or 9, depending on ratio. The correct pattern is symmetrical with respect to the centerline of the worm and the gear but will vary with ratio. The correct pattern for ratios 5:1 to 25:1 are shown in figures 5 and 6, and for ratios 30:1 to 70:1 see figures 9 and 10.

(discussion continues on page 10)

Sample Contact Patterns for 5:1 - 25:1 Ratios

Correct contact pattern for 5:1 - 25:1 ratios
before running-in.

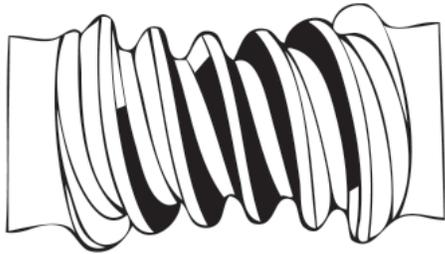


Figure 5

Correct contact pattern for 5:1 - 25:1 ratios
after running-in.

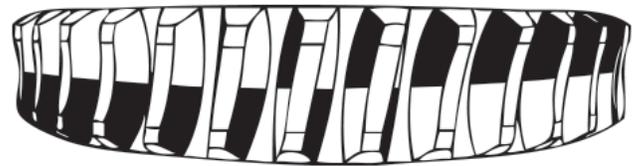


Figure 6

How to correct contact pattern for 5:1 - 25:1
ratios for worm off end position.



Figure 7

How to correct contact pattern for 5:1 - 25:1
ratios for gear off side position.

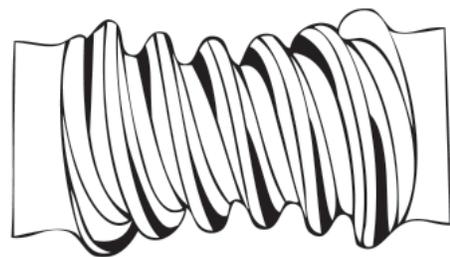


Figure 8

Sample Contact Patterns for 30:1 - 70:1 Ratios

Correct contact pattern for 30:1 - 70:1 ratios before running-in.

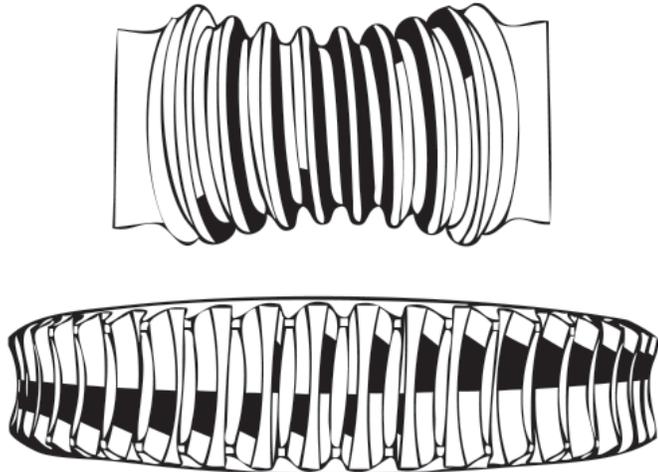


Figure 9

Correct contact pattern for 30:1 - 70:1 ratios after running-in.

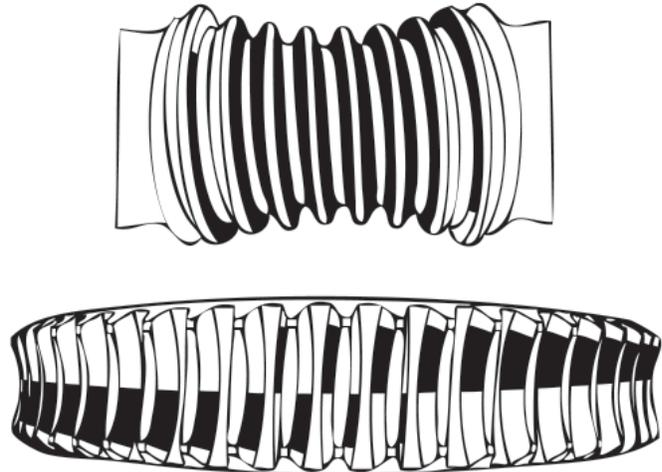


Figure 10

How to correct 30:1 - 70:1 ratio for worm off end position.

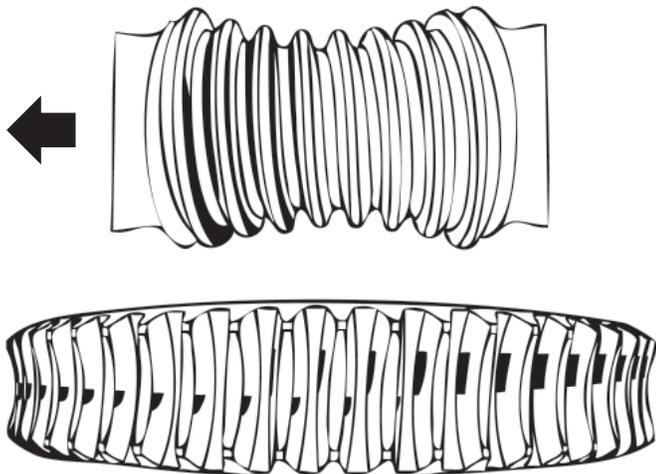


Figure 11

How to correct 30:1 - 70:1 ratio for gear off side position.

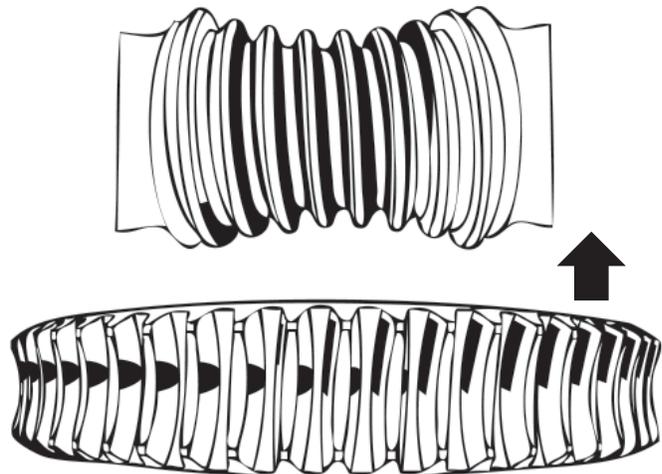


Figure 12

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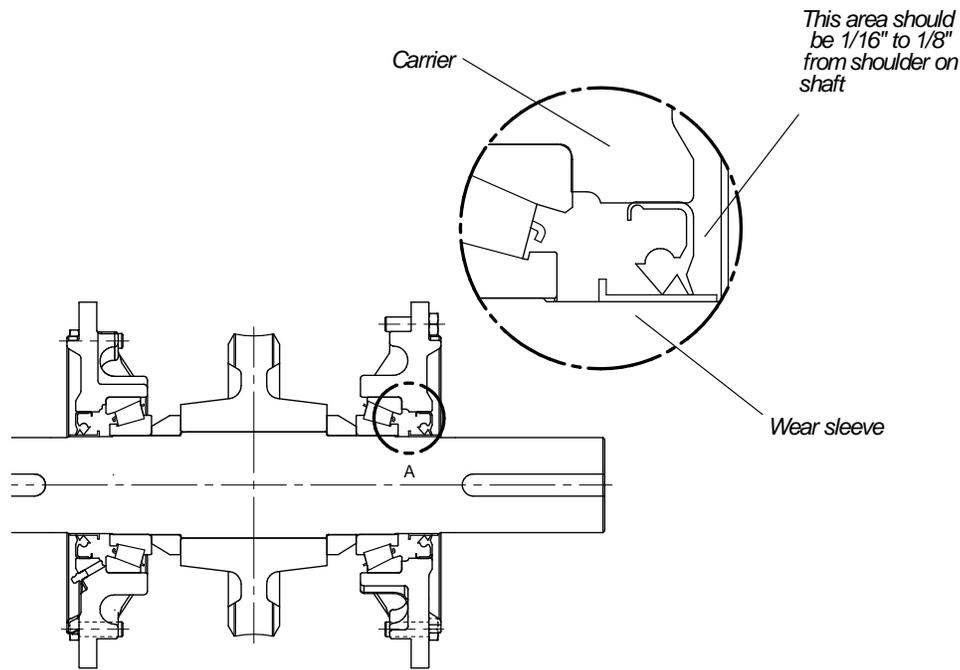


Figure 13

5. All of the illustrations, figures 7, 8, 11, and 12, show a misalignment of the gear set.

6. Correct any misalignment by removing shims from one bearing cap or carrier and adding an equal amount to the opposite cap or carrier. See figure 3.

7. If contact is similar to figures 7 or 11, the worm is out of position. Move the worm in the direction indicated by the arrow. If the contact pattern is opposite to that shown move the worm in the opposite direction.

8. If contact is similar to figures 8 or 12, the gear is off side position. Move the gear in the direction indicated by the arrow. If the contact pattern is opposite to that shown, move the gear in the opposite direction.

9. Install pipe plugs, oil level indicator, all bolts, and grease fittings if applicable. Bolt, torque settings can be found on the print or contact Cone Drive.

10. Install wear ring type oil seals. The Wear ring should be assembled onto the shaft by tapping against the flange. A piece of round tubing works well as an assembly tool. Note: Tubing must clear the sealing surface of the wear ring which will expand up to .007" when pressed onto the shaft. Tap the oil seal into the cap or carrier and thus onto the wear ring using a liberal amount of grease on the lip of the seal and the wear ring. Note: Be sure the outer lip of the seal is completely onto the sealing surface of the wear ring. See drawing, figure 13, for position of wear ring. The dimension for positioning the wear ring is indicated on the reducer assembly drawing.

11. Fill the speed reducer to the proper oil level with a recommended lubricant from the Cone Drive Approved List of Lubricants.

12. Special applications and older style speed reducers may use different assembly techniques.

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Lubrication Chart

LIMITATIONS

Gear drives operating in normal ambient temperatures, -10 °C (15 °F) to 40 °C (100 °F), and at or below their thermal horsepower ratings (continuous duty), should have a maximum sump temperature not exceeding 93°C (200°F). Those operating in ambient temperatures less than -10 °C (15 °F) or greater than 40 °C (100 °F), or those operating in extremely humid, chemical, or dust laden atmosphere, should be referred to Cone drive Application Engineering for recommendations.

Note: 200 °F max operating sump temperature

TYPE OF OIL

Lubricating oils for use in gear units should be high quality well refined petroleum oils. They must not be corrosive to gears, to ball, roller, or sleeve bearings; they must be neutral in reaction; free from grit or abrasives; and have good defoaming properties. They may be subject to high operating temperatures, so they must have good resistance to oxidation. Extreme Pressure (E.P) lubricants or cylinder oils with sulphur-phosphorus additives are not acceptable and should not be used with Cone Drive worm gearing.

Worm gears generally require steam cylinder oils with additions of 3 percent to 10 percent of acidless tallow or similar animal fats.

VISCOSITY

Oils recommended for AGMA 7 comp, 8 comp and 8A comp must have a minimum viscosity index of 90.

LUBRICATION RECOMMENDATIONS

Pour Point of the oil used should be less than the minimum ambient temperature expected.

BEARING GREASE RECOMMENDATIONS

Reducers supplied with grease fittings are to be greased with a high quality lithium base NLGI #2 or NLGI #3 grease.

SLUDGE

It is necessary that the oil be clean and free from sludge at all times to obtain long life from a gear unit.

Sludge in gear units may be caused by metallic particles ground off the gears, from dust and dirt and by the presence of moisture or chemical fumes. Therefore, every precaution should be taken to prevent water and foreign particles from entering the gear case.

OIL CHANGE

If an approved synthetic lubricant is used, it should be changed after 5,000 hours of operation or once per year, whichever occurs first.

If a recommended steam cylinder oil is used, the change interval should be after 2,500 hours of operation or every six months, whichever occurs first. This is recommended for units operating under favourable conditions. Where operating conditions are severe, such as a rapid rise and fall in temperature of the gear case with accompanied sweating of the inside walls and resulting formation of sludge, or where operation is in moist or dusty atmospheres, or in the presence of chemical fumes, or extended, or in the presence of chemical fumes, or extended running at sump temperatures in excess of 180 °F., it may be necessary to change the oil at intervals of one to three months.

VISCOSITY RANGE			
AGMA Lubricant Number	ASTM System		
	SUS @210°F	SUS @100°F	CST @ 40°C
7 COMP*	125 - 150	1919 - 2346	414 - 506
8 COMP*	150 - 190	2837 - 3467	612 - 748
8A COMP*	190 - 250	4171 - 5098	900 - 1100

Above oils are compounded with 3 to 10 percent of acidless tallow or other suitable animal fats.

Refer to Cone Drive **“Approved List of Lubricants”** for specific oils that meet the above specifications. Cone Drive recommends only those lubricants listed or any lubricant which meets all the requirements of AGMA 250 “Lubrication of Industrial Enclosed Gear Drives” as it applies to double enveloping worm gearing. Use of other lubricants can result in gearset failure which will not be covered under warranty.

DOUBLE-ENVELOPING WORMGEAR UNITS						
Center Distance	Worm Speed Up To Rpm	AMBIENT TEMP		Worm Speed Above Rpm	AMBIENT TEMP	
		-10°C to 10°C	10°C to 40°C		-10°C to 40°C	-15°F to 100°F
		-15°F to 50°F	50°F to 100°F		-15°F to 100°F	-15°F to 100°F
Up to 6 in. inclusive	0-700	8 comp.	8A comp.	700	8 comp.	
Over 6 in. to 12 in.	0-450	8 comp.	8A comp.	450	8 comp.	
Over 12 in. to 18 in.	0-300	8 comp.	8A comp.	300	8 comp.	
Over 18 in. to 24 in.	0-250	8 comp.	8A comp.	250	8 comp.	
Over 24 in.	0-200	8 comp.	8A comp.	200	8 comp.	

*Wormgears operating at speeds above 2400 rpm or 2000 to feet per minute rubbing speed may require force feed lubrication. In general, an AGMA #7 lubricant of lower viscosity than recommended in the above table may be used with a force feed system.

Trouble Shooting Guide

PROBLEM	EFFECT	CAUSE	SOLUTION
Decrease in efficiency	Wear & scoring of worm threads and gear teeth.	Improper lubricant	Replace gearset, bearings and oil seals. Select correct lubricant from approved lube list.
Decrease in efficiency	Wear & scoring of worm threads and gear teeth	External torque overload	Eliminate overload, replace gearset, bearings and oil seals or select larger reducer.
Reducer runs hot	Wear & scoring of worm threads and gear teeth	Improper or insufficient lubricant	Replace gearset, bearings and oil seals. Select correct lubricant from approved lube list.
Reducer runs hot	Wear & scoring of worm threads and gear teeth	Input power exceeds thermal rating	Replace gearset, bearings and oil seals. Add Auxillary cooling or select larger reducer.
Reducer seizes up	Gearset and/or bearings running hot	Oil seal leaks	Check condition of bearings, replace if needed. Shim bearings per bearing setting instructions.
Reducer seizes up	Bearings run hot	Tight bearings	Check condition of bearings, replace if needed. Shim bearings per bearing setting instructions.
Reducer seizes up	Bent worm or swedged gear teeth	External torque overload	Eliminate overload, replace gearset, bearings and oil seals or select larger reducer.
Loss of ratio	Broken worm threads or gear teeth	External torque overload	Eliminate overload, replace gearset, bearings and oil seals or select larger reducer.
Reducer comes loose from mounting	Broken reducer feet or foot bolts	External overload	Eliminate overload and replace bearings and oil seals or select larger reducer.
Knocking noise from reducer	Bent gear tooth	External torque overload	Eliminate overload, replace gearset, bearings and oil seals or select larger reducer.
Squealing noise from reducer	Damaged bearing	Improper installation or inadequate lube	Replace bearings and oil seals.

NOTES

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Universal metric housing featuring double enveloping gearing & drywell feature



Series B

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DuoDrive

Dual gears on parallel output shafts



Extruder Drive

Rugged duty reducer takes high screw pressure



Series G

Helical parallel shaft & bevel helical right angle drive gear units



Series W

Precision right angle servo gearboxes



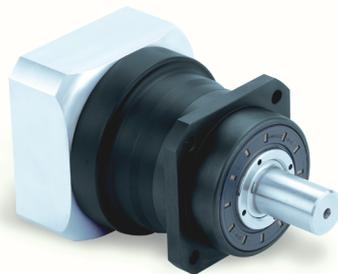
Model RG

Moderate precision right angle servo gearboxes



Series S

Value Engineered right angle servo gearboxes



Series P

Precision planetary servo gearboxes



Series E

Economical planetary servo gearboxes



Series LE

Economical planetary servo gearboxes

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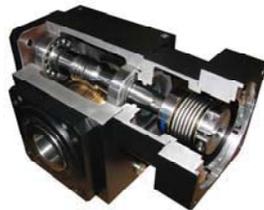
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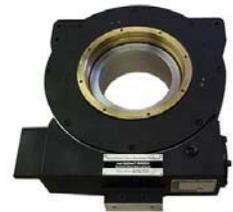
Model HP



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Gearsets



Specials

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