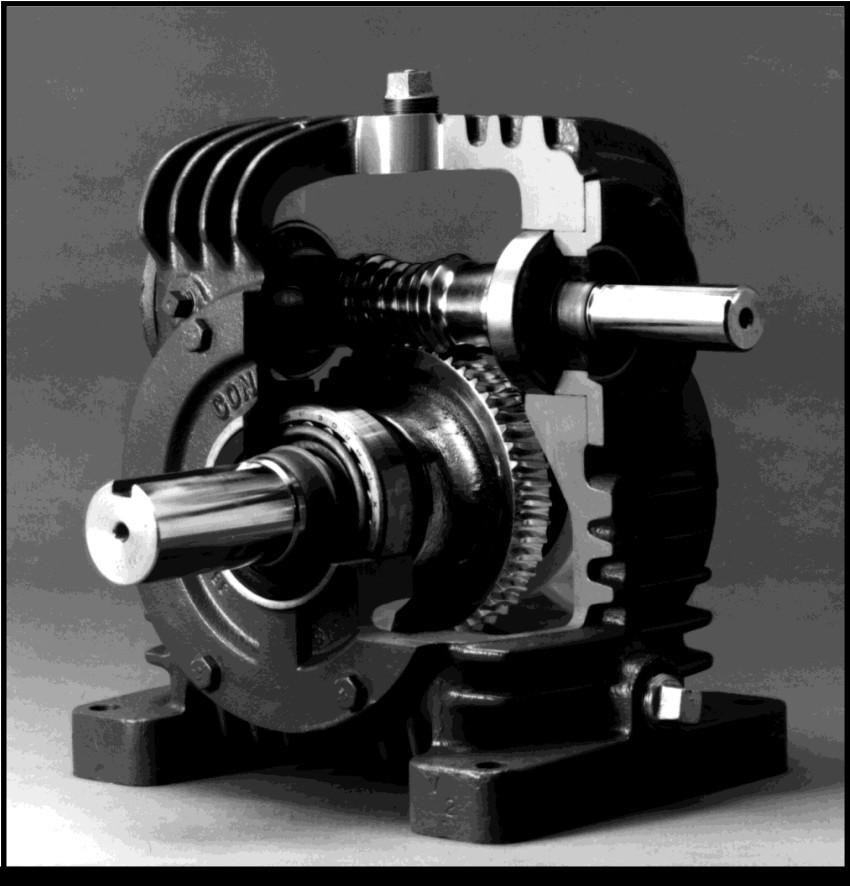


Sizes 15 - 80
Single Reduction Speed Reducer
Assembly Instructions



Cone Drive Double Enveloping Worm Gear Units



TEXTRON
Power Transmission



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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.

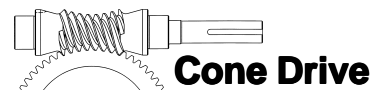
CALL CONE DRIVE TOLL FREE:

Sales Phone: 888-99-4 Cone

Sales Fax: 888-907-Cone

Parts & Service: 888-726-Cone

Parts Fax: 888-916-Cone



Cone Drive Parts & Service Options

Field Service

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.

Maintenance Workshops

Cone Drive's workshops are the most comprehensive technical educational program in the worm gear industry. We offer a variety of hands-on experience with double-enveloping worm gear speed reducers and gearsets, and teach valuable assembly, repair, and installation techniques.

At an advanced level, field simulation is balanced with classroom instruction at the

Cone Drive Training Center and Dynamometer Test Facility. We can provide intensive training and individual attention is provided by Cone Drive engineers, technicians, and field service personnel.

Our programs focus on assembly, repair and installation, lubrication, reducer selection and rating, bearing setting, trouble shooting, and failure analysis.

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 8"	.002

figure 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 caps and carriers. As spare or replacement 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 figure 2.

<i>color</i>	<i>thickness</i>	<i>color</i>	<i>thickness</i>
Yellow	.020"	Blue	.005"
Brown	.010"	Green	.003"

figure 2

Grease Packed Bearings

Bearings that are at 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 6. They should be greased with 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 figure 3.

Recommended Tapered Roller Bearing Settings

Single Reduction Reducer Worm Bearing Settings

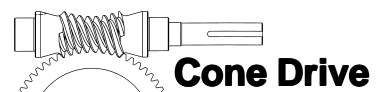
<i>Reducer Size (center distance)</i>	<i>Worm Speed (1,000 - 2,000 RPM)</i>	<i>Worm Speed (2,001 - 3,600 RPM)</i>
15 to 35 (1.500" to 3.500")	.003 +/- .001	.005 +/- .001
40 to 60 (4.000" to 6.000")	.004 +/- .001	.006 +/- .001
70 to 80 (7.000" to 8.000")	.006 +/- .001	.007 +/- .001

figure 3

Notes:

- a. Settings shown in figure 3 are axial looseness.
- b. All gear bearings up to and including 8.000" C.D. are set to a pre-load 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. 7.000" and 8.000" C.D. prior to 1980 have preset worm bearings.

- d. These bearing settings are for standard and special reducers unless otherwise specified on the assembly drawing.
- e. If low backlash is critical, some applications may require reduced settings. Contact Cone Drive Application Engineering for review.



"O" Markings

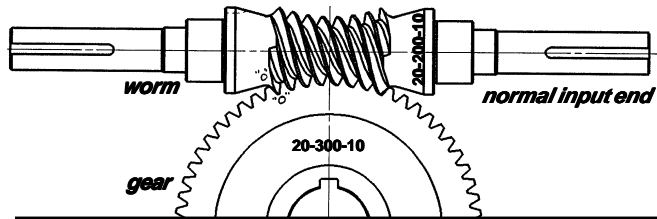
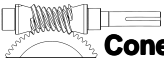



figure 4

"O" markings will appear on all multiple threaded worm gearsets that have been lapped and all multiple threaded worm gearsets with low backlash. When "O" markings are present, care should be taken during assembly to ensure that the "O" marks are properly aligned. As indicated in figure 4, when properly aligned, the "O" stamped worm thread will pass through the "O" stamped space between two gear teeth.

Preparation for 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		888-99-4-Cone	
Model	MSHO40-2				
Serial	99174461-100-1				
Cust. Pt. No.					
Ratio	10-1	Input RPM	2000		
Rating	10.50 HP	S.F.	1		
Assembled Backlash					
in Arc Minutes		Lube No.	AGMA 8		
	Caution: Before operation read all instructions.		Traverse City MI USA 231-946-8410		

Cone Drive Reducer Nameplate

Line #1 -Reducer Model Number
example: MSHO40-2.

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.

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Sales Fax: 888-907-Cone
Parts & Service: 888-726-Cone
Parts Fax: 888-916-Cone

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, WhisperDrive units and Model RG units are shipped with oil.

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.
 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 the carrier for determining the amount of new shims to use as a starting point when reassembling the reducer.

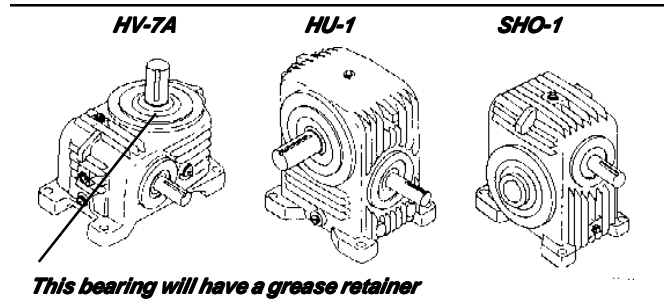


figure 5

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.
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 5), 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 6. When a grease retainer is used under a bearing, you must add .024" 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

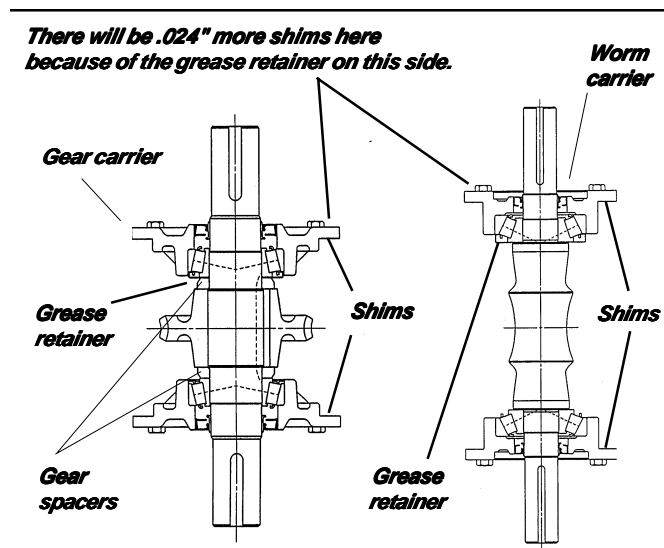
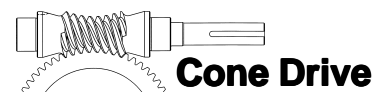


figure 6

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.



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 7. 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 figure 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 figure 3, paying attention to reducer size and worm speed. When finished with the bearing settings the worm should be left in the speed reducer.

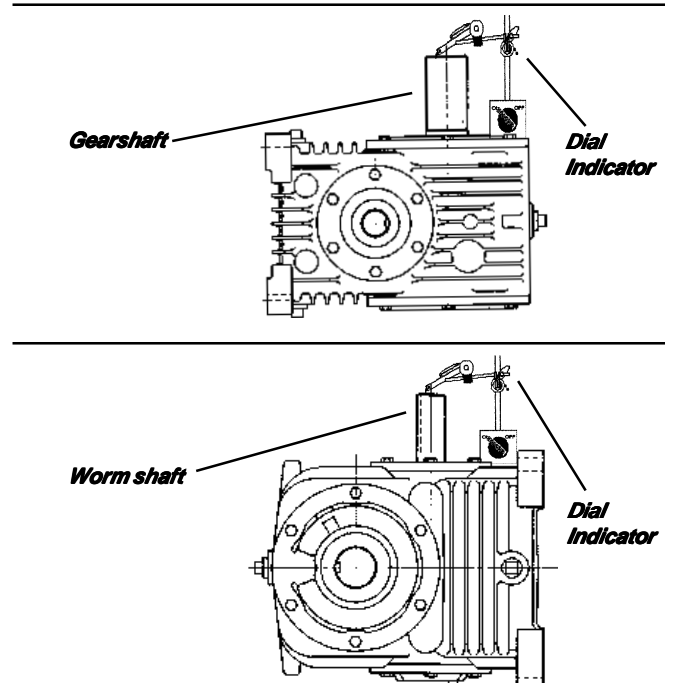


figure 7

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 4).

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 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 9 or 13, 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 9 and 10, and for ratios 30:1 to 70:1 see figures 13 and 14.

(discussion continues on page 10)

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

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

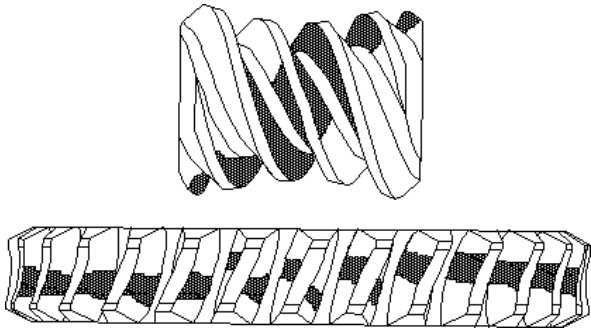


figure 9

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

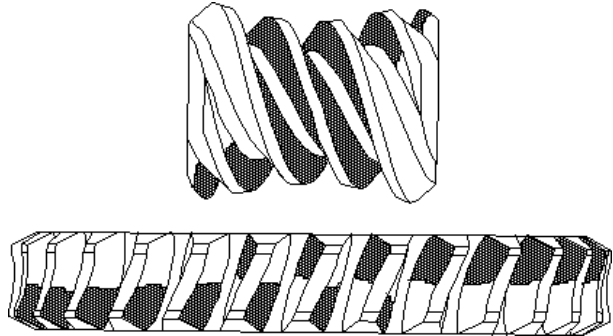


figure 10

**How to correct 5:1 - 25:1 ratio
for worm off end position.**

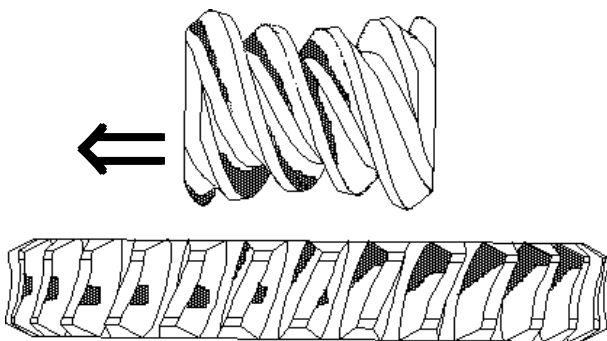


figure 11

**How to correct 5:1 - 25:1 ratio
for gear off side position.**

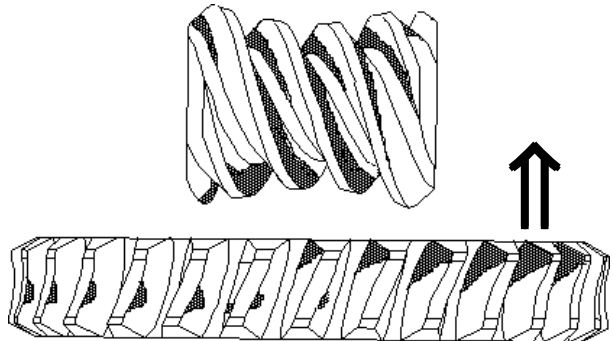
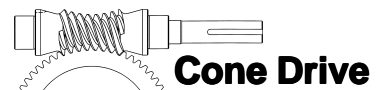


figure 12



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

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

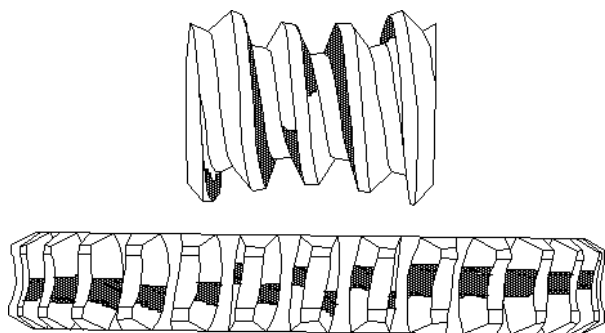


figure 13

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

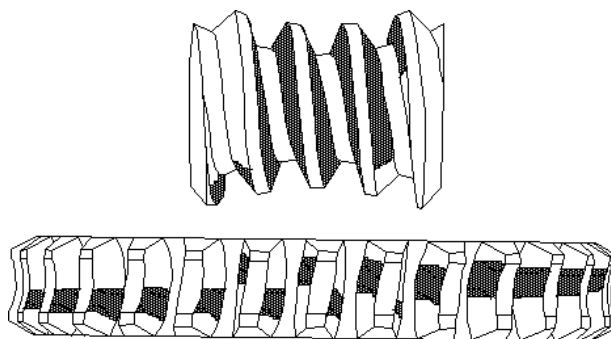


figure 14

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

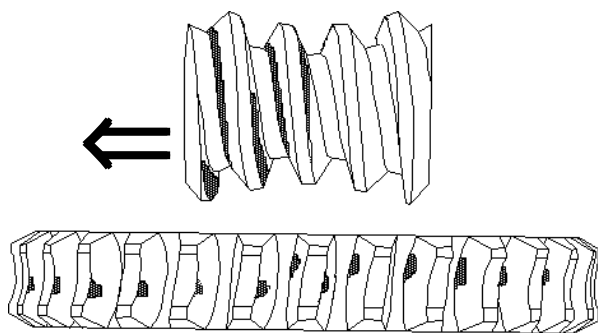


figure 15

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

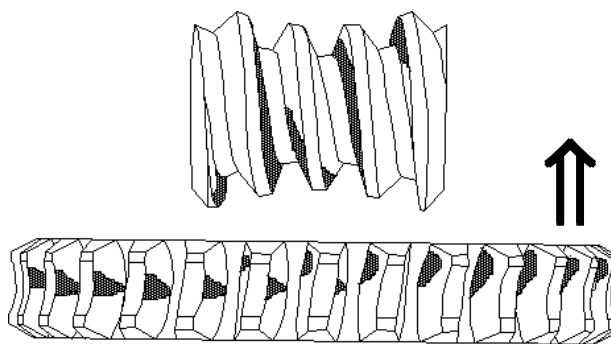


figure 16

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Contact Pattern (continued)

5. All of the illustrations, figures 11, 12, 15, and 16, 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 6.

7. If contact is similar to figures 11 or 15, 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 12 or 16, 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 8, 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.

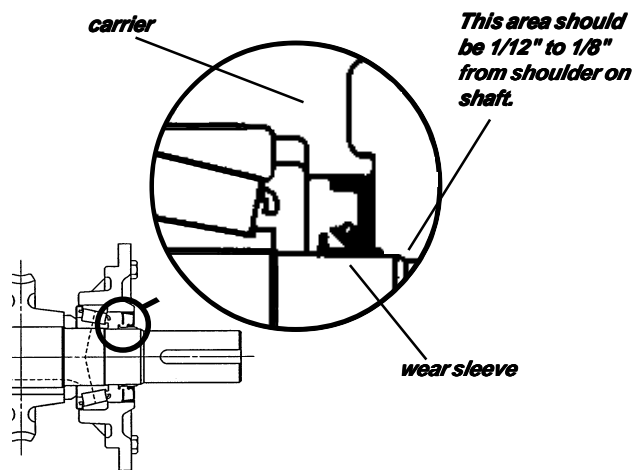
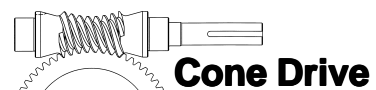


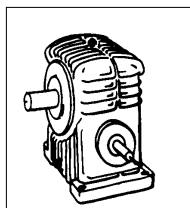
figure 8

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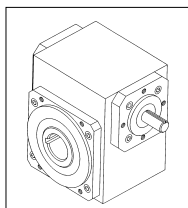


Trouble Shooting Guide

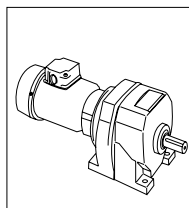
PROBLEM	EFFECT	CAUSE	SOLUTION
Decrease in efficiency	Wear & scoring of worm threads and gear teeth	Improper lubricant	Replace gearset, bearings and oil seals. Select correct lubricant from approved lube list.
Decrease in efficiency	Wear & scoring of worm threads and gear teeth	External torque overload	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 gearset and bearings, replace if necessary. Replace oil seals.
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 reducer, if necessary, with same size or 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.

**Cone Drive**

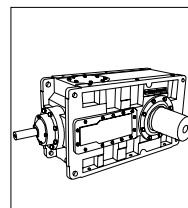
Double Enveloping design in single, double, and triple reduction types.

**WhisperDrive**

Servo Precision Gearhead in three precision levels.

**Series M**

In Line Helical Geared Motors and Reducers.

**Series G**

Helical parallel shaft and Bevel Helical right angle drive gear units.

Model RG

Right Angle Gearhead in two precision levels.

AccuDrive

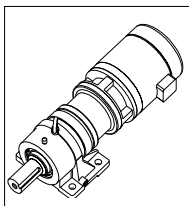
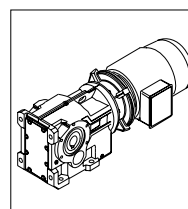
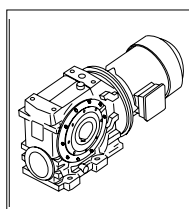
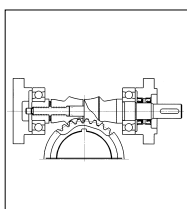
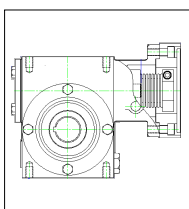
Zero Backlash Gearing for positive rotational positioning.

Series C

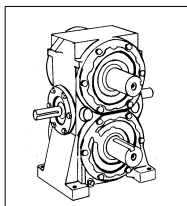
Right angle drive Helical Worm Geared Motors and Reducers.

Series K

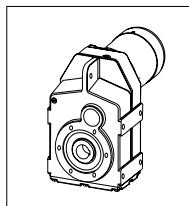
Right angle Bevel Helical Geared Motors and Reducers.

**Series Q**

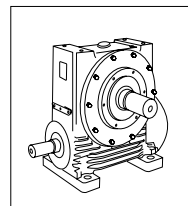
In Line Planetary Geared Motors and Reducers.

**DuoDrive**

Dual Gears on parallel output shafts.

**Series F**

Parallel Helical shaft mounted geared motors and reducers.

**Series A**

Worm Gear units and geared motors in single and double reduction types.

Extruder Drive

Rugged duty reducer takes high screw pressure.

Remanufacturing Center

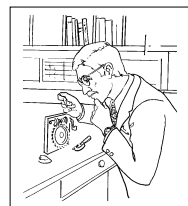
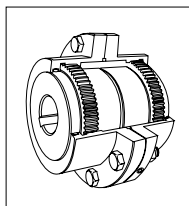
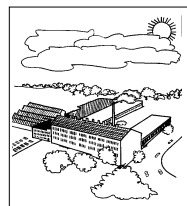
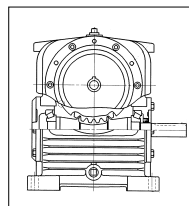
Fast turnarounds on rebuilds or preventative maintenance, warranted service.

Series X

Nylicon and Cone Ring Type flexible coupling, Gear Type rigid and flexible couplings.

Gear Institute

Gearing's most comprehensive technical educational programs.



TEXTRON
Power Transmission

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 975 Dillingham Road, Pickering ON L1W 3B2 Canada, 905-420-4141 -Phone, 905-420-9513 -Fax
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