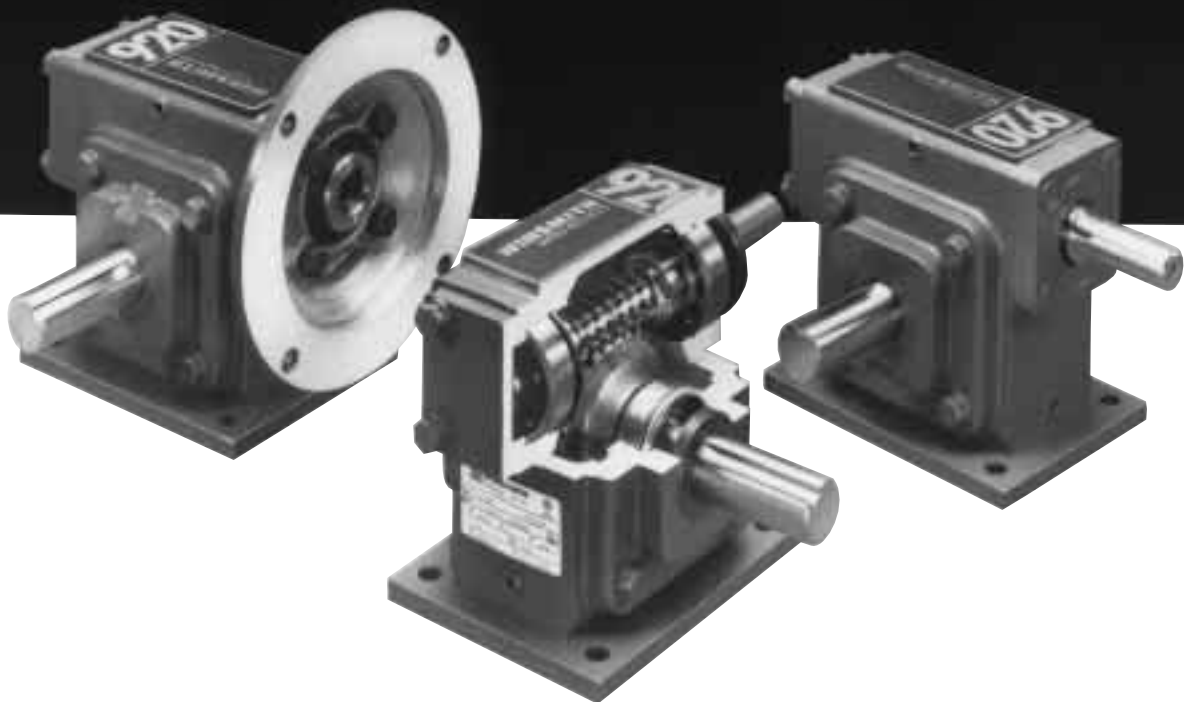




*D-90[®] TYPE
SE[®]
WORM GEAR
SPEED REDUCERS*



***Disassembly
and Reassembly Instructions***

DISASSEMBLY AND REASSEMBLY INSTRUCTIONS

D-90[®] TYPE SE[®]



The following describes the procedures for disassembling and reassembling WINSMITH[®] D-90[®] Type SE[®] speed reducers. These instructions can also be used for specific tasks such as changing assemblies or gearing (ratio) by referring to the appropriate sections, however, it is recommended that all instructions be reviewed before proceeding. They are combined to cover all units and, in those situations where models differ, will differentiate between specific models. Although the sequence may be determined by the task, it will be necessary to remove the slow speed shaft and gear assembly before removing the input (worm) shaft. If seals are going to be reused, such as with new units, they must be protected by covering the shaft keyways with smooth tape before disassembly. Figure 1 illustrates the location of the various parts (1-32) referenced throughout the text.

Prior to Disassembly

1. Remove motor and coupling (if applicable).
2. Remove keys and set screws (hollow shaft models). Check shafts for damage and remove any protruding nicks that may impede seal or bearing removal.
3. Clean the outside of the housing. Remove foreign material that may contaminate any components or lubricant being reused.
4. Drain the oil. The plugs adjacent to the worm should be avoided as the internal vent shield will impede oil flow. Drain both housings in double reduction models.

Disassembly

5. Disassemble the slow speed cover(s) (16) or cover and base (DV model) from the housing. Disassemble both covers (16 & 22) on hollow shaft models (DSF or DSR). With DL models, first disassemble the slow speed bearing cap (32) and then disassemble the cover and base (31) from the housing.
6. Remove the slow speed shaft and gear assembly from the housing. With single cover designs, tilt the slow speed gear away from the high speed worm. It may be necessary to apply a small amount of pressure to the shaft extension, using the inner bearing as a pivot point, to separate the gear from the worm. When disassembling units with double slow speed shaft extensions, it may be necessary to remove the seal opposite the slow speed cover prior to removing the slow speed gear assembly from the housing.

Steps 7 through 11 apply to the primary stage of double reduction models. If single reduction, proceed to step 12.

7. Remove attachment housing cover (28).
8. Remove fastener and washer (26 & 27) at end of exposed shaft.
9. If the primary gear (24) is being reused, mark the outer face for reference so the gear may be reinstalled in the same position (reference face out). Remove gear (24) and spacer (29) from shaft. This will be a sliding fit. If the gear does not easily disengage from the worm, remove the intermediate cap (2) and slide the intermediate worm (6) out the rear side of the main housing until the shaft extension clears the primary gear. On 935 and 943 models, it will only be necessary to loosen the intermediate cap, allowing the primary gear to tip away from the worm due to the tapered intermediate bearings.

10. Disassemble the motor adapter (8) (if applicable). Disassemble the high speed cap (2) from the attachment housing (25). Remove the high speed worm by tapping it toward the high speed cap end. With single bearing designs (hollow input), the worm (9) may be completely removed at this time. With two bearing designs (solid input), the snap ring (4) must be removed before sliding the worm (6) and front bearing (5) through this bore.
11. Disassemble the attachment housing (25) by removing the four fasteners (30) located behind the primary gear (24). The housing will also be supported by two dowel pins partially engaged in the main housing.

If this is a double reduction unit, steps 12-15 relate to the main housing components.

12. Disassemble the motor adapter (8) (if applicable). Disassemble the high speed bearing cap(s) (2, 11 & 12 or 14): For the Size 910, remove the high speed cap plug (2) (press fit in the housing) and outer retaining ring. Remove the worm by tapping it toward the high speed cap end. With single bearing designs (hollow input), the worm (9) may be completely removed at this time. With two bearing designs in sizes 913-930, (solid input), the snap ring (4) must be removed before sliding the worm (6) and front bearing (5) through this bore.
13. If seals are to be replaced, remove the worn seals from the housing and covers. If two seals are used at a particular location, it is important that both be replaced exactly as removed (i.e. tandem or opposed). Tandem seals provide extra protection against leakage while opposed seals assist in preventing outside contaminants from working their way into the unit.
14. If bearings are to be replaced, remove them from their respective shafts using a press. Note the position of these bearings on the shafts, so the unit can be rebuilt accordingly. Care must be taken not to damage the seal areas of either shaft. Remove the bearing races from the housing and cover using a soft metal drift. When driving them out, exercise caution not to damage the housing or cover bearing seat. The compression ring (18) behind the bearing cup in the cover will be reused in this location as a spacer.
15. Thoroughly clean all parts in preparation for reassembly. Remove all gasket material and sealant from mating surfaces. Inspect all parts for damage or wear and replace as necessary.
CAUTION: If a shaft seal area is cleaned with emery paper, the direction of the resulting finishing marks in the shaft must be perpendicular to the shaft axis. Any small lead inscribed in the shaft surface while cleaning, may create a path for oil seepage.

Reassembly—Single Reduction Models

16. Reassemble the high speed shaft bearings. Press the new high speed ball bearings (3 & 5) or tapered roller bearing cones (10) on the worm shaft until tight against the backing shoulders. To prevent damage to the bearing, press against the inner race only. Secure the rear bearing(s) with snap rings (1) or locknut (13) as dictated by the worm design.
17. Reassemble the slow speed shaft and bearing assembly. Press the slow speed gear (20) and key on the shaft (17) or

21) to its original position making sure the key is not extending beyond the gear hub. Add spacers (if applicable) and press the bearing cones (19) tight against the adjacent spacer or gear hub. Press against the inner cone race only, avoiding contact with the roller cage. When pressing the bearings or gear, be extremely careful not to damage the shaft seal surface.

18. Install the output shaft bearing races.

a. For single cover models (see item 18c for DL models), install one race in the housing making sure it is properly

seated. This should be a tight fit. Insert the compression ring (18) into the bearing seat of the slow speed cover (16) or DV cover and base followed by the bearing race. This should be a sliding fit.

b. For hollow shaft models, install bearing races in each of the slow speed covers (16) or cover and base (22) making sure they are properly seated. Each should be a tight fit.

c. For DL models, install one bearing race in the housing, making sure it is properly seated. This should be a tight fit.

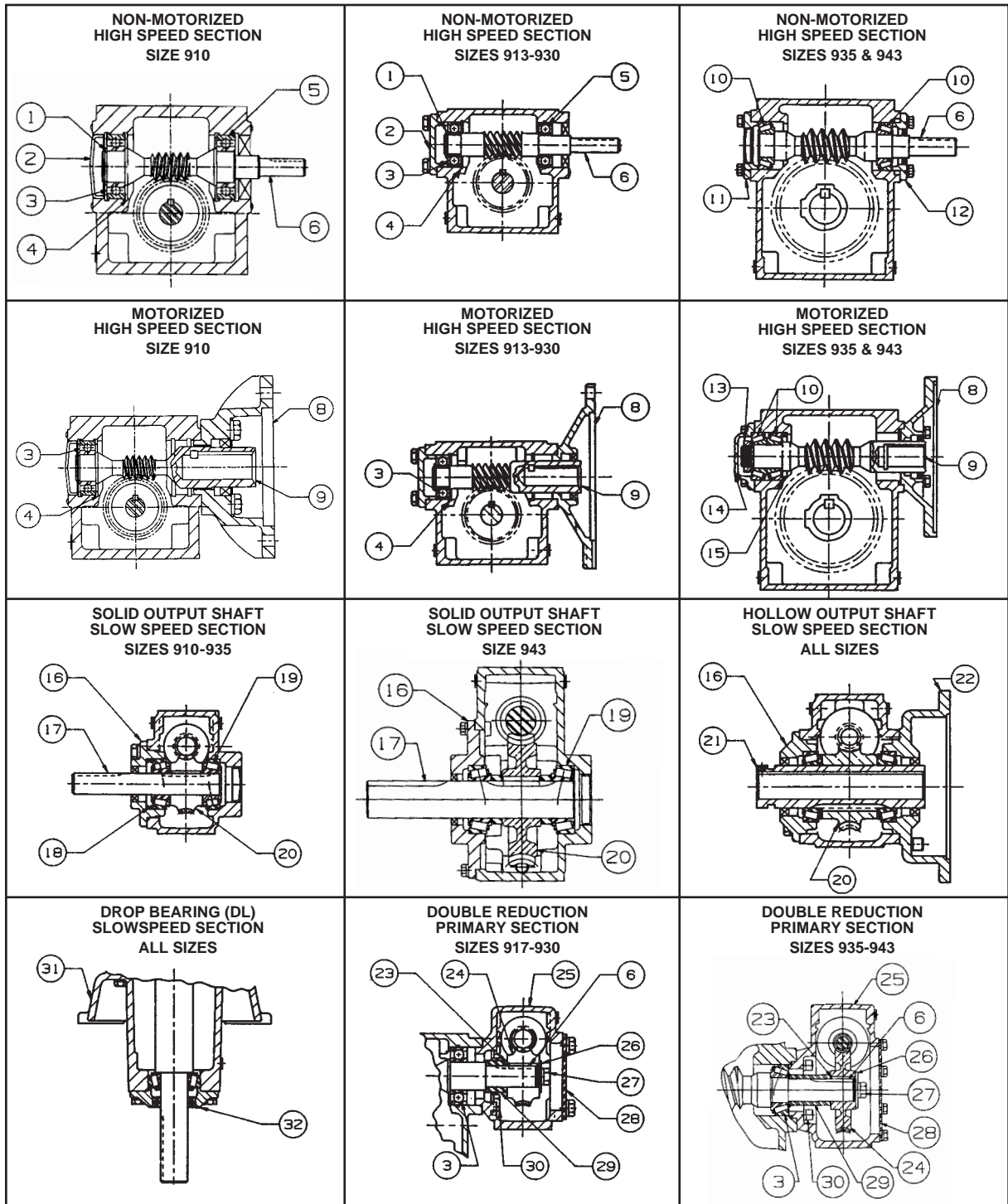


FIGURE 1

DISASSEMBLY AND REASSEMBLY INSTRUCTIONS

D-90® TYPE SE®



19. Assemble the high speed shaft (6) in the housing. For Sizes 935 and 943, see items 19b and 19c below.

a. Sizes 913 through 930. For models using two high speed ball bearings, insert the high speed shaft assembly into the rear (high speed cap) side of the housing and slide through until the front bearing (5) clears the rear snap ring groove. Install the snap ring (4) in the rear housing groove, making sure it is completely seated. Continue inserting the worm in the housing until the rear bearing shoulders against the snap ring. For single bearing assemblies, the snap ring (4) may be installed first. Attach the high speed cap (2) using the required thickness of gaskets that will take up the clearance between the cap and housing while trapping the bearing between the cap and snap ring. This will prevent the bearing from moving axially during load reversals. For the Size 910, install the outer snap ring to retain the bearing. Lightly coat the housing bore with sealing compound and press the high speed cap plug (2) in the housing. Proceed to step 20.

b. Sizes 935 and 943 with solid input shaft. Slide the front high speed bearing race into the housing for the proper assembly. Using one gasket (.010"), assemble the front high speed cap (12) or coupling style motor adapter. Insert the worm (6) from the opposite end of the housing and install second bearing race. Attach rear high speed cap (11) using the required thickness of gasket to provide .002-.004 inch endplay. Tap each end of the worm with a nonmetallic hammer to seat the bearings before checking endplay. Proceed to step 20.

c. Sizes 935 and 943 with hollow input shaft (motorized). Insert high speed spacer (15) and inner bearing race (10) into rear high speed side of housing. Insert worm (9) from the rear housing side until it rests against the inner bearing race. Install the outer race. Attach rear high speed cap (14) using the required thickness of gasket to provide .002-.004 inch endplay. Tap the end of the worm and the rear high speed cap with a non-metallic hammer to seat the bearings before checking endplay.

20. Assemble the slow speed shaft assembly in the housing. When attaching covers, apply a small amount of liquid sealant to the thread area of all fasteners to prevent leakage in this area. See instruction 20b for Size 943 and hollow shaft models.

a. With the output shaft (17) extension positioned for the proper assembly, rest the inside bearing cone in its mating cup (race) in the housing. Snap the gear into mesh by applying a small amount of pressure against the end of the slow speed shaft. At this point, the gear is automatically centered over the worm by means of component dimensional tolerances. If the unit is a DL Series, refer now to 20c. Attach the slow speed cover (16) (DV cover and base) using the proper thickness of gaskets that will provide up to .002 inches endplay while avoiding any bearing preload. Tap the end(s) of the shaft or opposite cover with a non-metallic hammer before checking endplay. If this cannot be achieved with at least one gasket, add about .010 inch shim stock in the slow speed cover bearing bore behind the compression ring (18) and reassemble per the above instructions. Proceed to step 21.

b. Assemble one slow speed cover (16) or cover and flange (22) without gaskets and insert the shaft and gear assembly. It may be helpful to position the gear in mesh with the worm before securing the first cover. Assemble the opposite cover using the proper thickness of gaskets that will provide up to

.002 inch endplay while avoiding any bearing preload. Tap each end of the shaft with a non-metallic hammer to seat the bearings before checking endplay. Once this is established, remove both covers, equally distribute the gaskets between the two covers and reassemble. Proceed to step 21.

c. Attach the slow speed cover and base (31) to the housing using one .010 inch gasket. Insert the outer slow speed bearing race. Attach the slow speed bearing cap (32) using the proper thickness of gaskets that will provide up to .002 inch endplay while avoiding any bearing preload. Tap the end of the shaft and opposite cover with a non-metallic hammer before checking endplay.

21. If motorized, attach the motor adapter (8) using one .010 inch gasket. If the unit uses a coupling style motor adapter, install the high speed seal in the housing (refer to step 22 for seal mounting instructions).

22. Install all seals using the following instructions. Lubricate the shaft seal areas with a light coat of oil. Apply a thin layer of liquid sealant to the housing or cover bore area that supports the seal. Protect the seal lips by covering all shaft keyways or other sharp corners with smooth tape. Slide seal up to bore, being careful not to displace the seal spring or roll the seal lip over. Tap into place using a blunt surface that will not deform the seal casing. When installed, the seal should be flush with the casting surface and perpendicular to the shaft axis. If two seals are installed, fill the cavity between them with grease. Use the outer seal to drive in the inner seal, leaving it extended about 1/16 from the casting surface.

23. If the ratio, assembly, or any other feature was changed, a new nameplate reflecting these changes should be used. This will insure proper parts or unit replacement in the future. Contact the factory for help in this regard.

24. Recheck all fasteners. Tighten to the torques (inch pounds) listed in the following table.

Size	Attachment Housing		Main Housing	
	Cap	Cover	Cap	Cover
913	N/A	N/A	100	200
917/920	100	200	200	200
924/926	200	200	330	200
930/935	200	200	330	330
943	330	200	330	330

25. Fill unit with oil. Refer to page 7 and note the plug locations for the appropriate model and mounting position. Using the fill and level plugs as shown, add oil (see page 6 for recommended oils) until it just begins to flow out the level plug location. For double reduction models, fill each housing individually. Install all plugs while making sure the vent is in its proper location and the vent opening is clear.

Reassembly—Double Reduction Models

26. Reassemble the main housing components per steps 16 through 19 but do not assemble the slow speed shaft into the housing yet.



- 27. Reassemble the attachment housing (25) using one .010 inch gasket, two dowel pins and four fasteners. If an intermediate seal is required (non-standard mountings), install at this time using the precautions outlined in step 22. See steps 44 and 45 if the primary housing is being repositioned for a change of assembly.
- 28. Reassemble the primary stage worm using steps 16 and 19.
- 29. Slide the spacer (29) on the intermediate shaft (6) extension up to the backing shoulder.
- 30. Slide the high speed gear (24) on the intermediate shaft and seat against the spacer. If the gear does not easily slide into mesh with the worm, proceed as follows:
 - a. Sizes 917-930: Remove the intermediate cap (2) and slide the worm (6) out of the main housing. Position the high speed gear (24) in mesh with the worm and reintroduce the intermediate worm in the housing with the extension end passing through the gear bore. Reattach the intermediate cap. Secure the gear with a fastener (27) and washer (26).
 - b. Sizes 935 and 943: Loosen the intermediate cap (11) enough to tip the intermediate worm allowing the primary gear to position itself in mesh with the primary worm. Retighten the intermediate cap and secure the gear with a fastener (27) and washer (26).

At this point it is necessary to center the primary gear over the worm to insure proper operation. This is accomplished by adding shims (23) between the gear (24) and spacer (29) as required. The initial shim pack can be estimated by measuring the distance between the gear hub face and machined surface of the attachment housing and referring to the following chart. Any distance greater than the reference dimension is made up with shims. Distances less than this (which normally should not occur) can be accommodated by decreasing the spacer width. The correct position can then be verified by blueing the worm and checking the resulting contact on the gear teeth.

Unit Size	Reference Dimension	Shim Part Numbers (.002, .005, .010)
917-920	.812	815007, 815008, 815009
924-935	.585	815507, 815508, 815509
943	1.312	817005, 817006, 817007

Once properly shimmed, install the gear key and apply Loctite 242 (or equal) to the fastener before final assembly.

- 31. Reassemble the balance of the unit using steps 20 through 25.

Assembly Conversions

I. Reverse the output shaft of a solid output shaft model:

- 32. Refer to steps 2 through 6 and proceed where applicable. Be sure to protect the seal from the keyway before disassembly.
- 33. Remove the slow speed seal and slow speed plug, being careful not to damage either in the process. Coat the housing or cover bore diameter where the seal had been located and reinstall the plug in this location.

- 34. Reassemble the slow speed shaft assembly using the same compression ring, if applicable and the same total thickness of gaskets. Refer to step 20a or b for additional instructions. If either the gear or bearings are changed in the process, it may be necessary to readjust the bearing endplay per the instructions in step 20.
- 35. Complete the reassembly using steps 22 through 25.

II. Reverse the output shaft of a hollow output shaft model:

- 36. Refer to steps 2 through 6 and proceed where applicable. Be sure to protect the seals from the set screw holes and puller groove.
- 37. Reverse the position of the slow speed shaft assembly and reassemble using the same total thickness of gaskets on each cover. Refer to step 20b for additional instructions. If either the gear or bearings are changed in the process, it may be necessary to readjust the bearing endplay per the instructions in step 20.
- 38. Complete the reassembly using steps 22 through 25.

III. Reverse the assembly of the high speed shaft (all models):

- 39. It will be necessary to remove the slow speed gear for this conversion. Refer to steps 1 through 6 and step 12 and proceed where applicable. Be sure to protect all seals from keyways or other surface discontinuities before disassembly.
- 40. Reverse the position of the high speed shaft (6) and snap ring (4) and reassemble using step 19.
- 41. Reassemble the slow speed shaft assembly using step 20.
- 42. Complete the assembly using steps 21 and 23 through 25.

IV. Rotate the attachment housing:

- 43. Refer to steps 1 through 4 and steps 7 through 11 and proceed where applicable. Be sure to protect the high speed or intermediate shaft seal from any keyways before disassembly.
- 44. Remove the two roll pins and reassemble the attachment housing in the desired position, aligning it as square as possible with the main housing. Replace the gasket between the housings if necessary.
- 45. Using the two roll pin holes as pilots, drill into the main housing about 1/4 inch using a 1/8 diameter drill. Insert the two roll pins.
- 46. Reassemble the high speed worm using step 19.
- 47. Reassemble the high speed gear using steps 29 and 30 where applicable. If none of the components were changed, the centering operation will not be necessary.
- 48. Reassemble the balance of the unit using steps 21 through 25.

DISASSEMBLY AND REASSEMBLY INSTRUCTIONS

D-90® TYPE SE®



Lubricants

Worm Gear Reducers

For special applications that involve severe ambient temperature extremes or a seasonal oil requirement, WINSMITH, based on extensive testing and field experience, recommends the use of Mobil SHC synthetic lubricants.

Ambient Temperature	-30 to 15°F	16 to 50°F	51 to 95°F	51 to 95°F	96 to 131°F	96 to 131°F
Final Stage Worm Speed*	up to 2000 FPM	up to 2000 FPM	up to 450 FPM	above 450 FPM	up to 450 FPM	above 450 FPM
ISO Viscosity Grade	220	460	680	460	680	460*
AGMA Lubricant No.	5S**	#7 Compounded***	#8 Compounded***	#7 Compounded***	8 S**	7S**

Mobil	SHC 630	600W Super Cylinder	Extra Hecla Super	600W Super Cylinder	SHC 636	SHC 634
American Lubricants	SHC-90W	AGMA #7 Gear Oil	AGMA #8 Gear Oil	AGMA #7 Gear Oil	N/A	N/A
Castrol	Tribol 800/220	Tribol 1105-7C	Tribol 1105-8C	Tribol 1105-7C	Tribol 800/680	Tribol 800/460
Chevron	Tegra 220	Cylinder Oil W460	Cylinder Oil W680	Cylinder Oil W460	Tregra 680	Tegra 460
Conoco	Syncon R & O 220	Inca Oil 460	Inca Oil 680	Inca Oil 460	N/A	Syncon R & O 460
Exxon (Esso)	Teresstic SHP 220	Spartan EP 460	Spartan EP 680	Spartan EP 460	Teresstic SHP 680	Teresstic SHP 460
Fiske Brothers	SPO-MG	SPO-277	SPO-288	SPO-277	N/A	N/A
Shell	Omala RL 220	Valvata J 460	Valvata J 680	Valvata J 460	Omala RL 680	Omala RL 460
Texaco	Pinnacle 220	Vanguard 460	Vanguard 680	Vanguard 460	Pinnacle 680	Pinnacle 460

**synthetic oil

***3% to 10% fatty or synthetic oils or mild EP additives

Lubricant selections are provided by the lubricant manufacturer based on AGMA recommended viscosity grades. Viscosity grades are based on Lubrication Standard ANSI/AGMA 9005-D94.

*The sliding velocity in feet per minute (FPM) for standard ratios is determined by multiplying the speed of the worm in RPM by the factor from the following table. For selecting the proper lubricant, use the speed of the worm in the final stage (input RPM divided by the first stage ratio).

SIZE	Nominal Ratio											
	5	7.5	10	15	20	25	30	40	50	60	80	100
910	0.153	—	0.137	0.133	0.122	0.116	0.132	0.121	0.115	—	—	—
913	0.231	0.189	0.183	0.179	0.171	0.165	0.178	0.169	0.164	0.161	—	—
917	0.303	0.229	0.201	0.193	0.180	0.172	0.189	0.176	0.170	0.166	0.161	0.133
920	0.347	0.263	0.225	0.216	0.202	0.191	0.215	0.200	0.188	0.182	0.164	0.161
924	0.412	0.312	0.261	0.256	0.236	0.223	0.249	0.231	0.216	0.210	0.201	0.196
926	0.455	0.345	0.283	0.276	0.254	0.238	0.269	0.249	0.234	0.225	0.215	0.210
930	0.520	0.395	0.327	0.317	0.291	0.273	0.307	0.285	0.269	0.258	0.246	0.241
935	0.607	0.461	0.427	0.412	0.373	0.349	0.403	0.367	0.345	0.330	0.311	0.299
943	0.633	0.588	0.568	0.553	0.507	0.558	0.544	0.501	0.475	0.457	0.435	0.422

BASIC MODEL	TRADITIONAL MOUNTING	INVERTED MOUNTING	ADDITIONAL MOUNTING POSITIONS			
			INPUT SHAFT HORIZONTAL		INPUT SHAFT VERTICAL	
DB DD DJ DN DT DU WB WT WU						
DV						
DL		SPECIAL Contact the Factory				
DSF			SPECIAL Contact the Factory			
DSN DSR DSU						

Note: Single Reduction 935 and 943 standard models are supplied with grease fittings on the input shaft to insure bearing lubrication for all mounting positions.

= Fill Plug

= Vent Plug

= Level Plug

= Drain Plug

= Grease Fitting

FIGURE 1. SINGLE REDUCTION MODELS

DOUBLE REDUCTION* WORM/WORM			DOUBLE REDUCTION* HELICAL/WORM		
OTHER ATTACHMENT HOUSING POSITIONS			OTHER ATTACHMENT HOUSING POSITIONS		

Plug locations apply to motorized units also.

Contact the factory when input speeds are less than 1160 RPM to insure proper lubrication.

*Double Reduction units are not universal mounting. Mountings other than standard require a special outline.

FIGURE 2. DOUBLE REDUCTION MODELS



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