

Engineering Data

Formulas

$$\begin{array}{l} \text{(Linear)} \\ \text{HORSEPOWER} = \end{array} \frac{\text{Load in Pounds X Feet Per Minute}}{33,000}$$

$$\begin{array}{l} \text{(In. - lbs.)} \\ \text{TORQUE} = \end{array} \frac{63025 \times \text{HP}}{\text{RPM}}$$

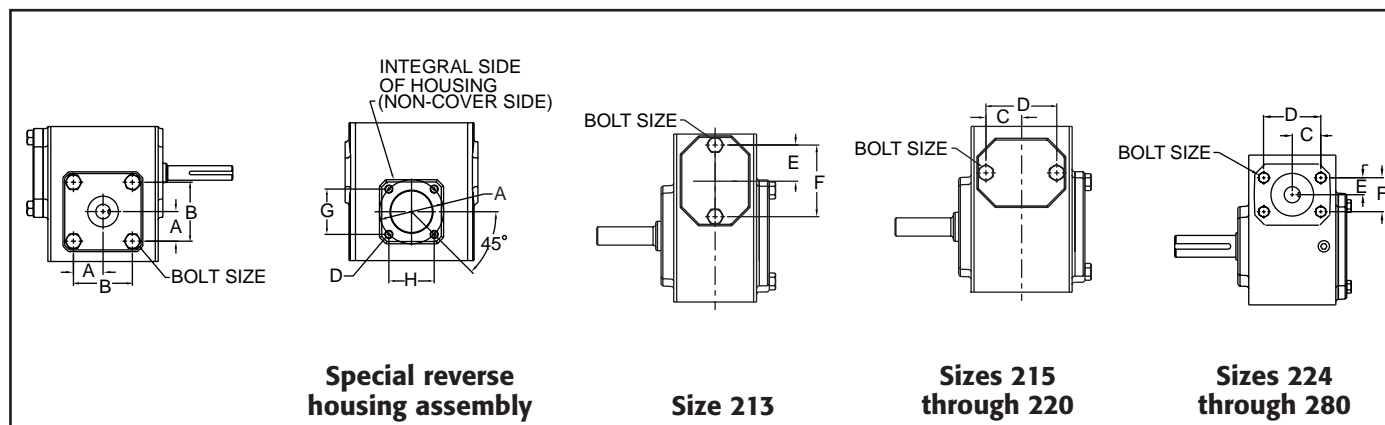
$$\text{OVERHUNG LOAD} = \frac{\text{Output Torque X Overhung Load Factor}}{\text{Radius (of Sprocket, Pinion, Sheave or Pulley)}}$$

$$\begin{array}{l} \text{(Rotational)} \\ \text{HORSEPOWER} = \end{array} \frac{\text{Torque X RPM}}{63025}$$

$$\begin{array}{l} \text{(In. - lbs.)} \\ \text{TORQUE} = \end{array} \frac{\text{HP X 63025}}{\text{RPM}}$$

$$\text{EFFICIENCY} = \frac{\text{Output HP}}{\text{Input HP}}$$

Bolt Circle Dimensions & Lubrication



Special reverse housing assembly - Contact factory for availability.

Bolt Circle

Output Cover

Unit	A	B	G	H	Bolt Size
213	1.016	2.033	1.768	1.768	.312-18
215	1.016	2.033	1.768	1.768	.312-18
218	1.480	2.961	2.051	2.051	.312-18
220	1.480	2.961	2.652	2.652	.312-18
224	1.856	3.712	2.652	2.652	.312-18
226	1.856	3.712	2.652	2.652	.312-18
230	2.298	4.596	3.536	3.536	.375-16
232	2.298	4.596	3.536	3.536	.375-16
242	2.939	5.877	3.712	3.712	.438-14
252	3.359	6.717	5.303	5.303	.438-14
2600	Consult Factory				.500-13
2700	Consult Factory				.500-13
2800	Consult Factory				.500-13
21000	Consult Factory				.500-13

Input Cover

Unit	C	D	E	F	Bolt Size
213	1.219	2.438	N/A	N/A	.312-18
215	1.219	2.438	N/A	N/A	.312-18
218	1.219	2.438	N/A	N/A	.312-18
220	1.219	2.438	N/A	N/A	.312-18
224	1.313	2.625	0.781	1.562	.312-18
226	1.313	2.625	0.781	1.562	.312-18
230	1.313	2.625	0.781	1.562	.312-18
232	1.313	2.625	0.781	1.562	.312-18
242	1.600	3.200	1.050	2.100	.438-14
252	1.600	3.200	1.050	2.100	.438-14
2600	1.370	2.740	1.370	2.740	.438-14
2700	2.033	2.033	2.033	2.033	.438-14
2800	2.121	2.121	2.121	2.121	.500-13
21000	Consult Factory				.625-11

Lubrication

With the exception of unit sizes 2700, 2800 and 21000 which are shipped dry, all standard reducers ordered from the factory are filled with lubricant for continuous operation within a 30° to 100° F ambient temperature range (for intermittent duty below 60° F, contact factory). Double and triple reduction units have separate oil sumps and must be filled/checked independently. Prior to startup, verify that the oil is at the level shown on the drawings on page 166. If the ambient temperature will be outside the range for the lubricant installed at the factory, drain and refill the reducer with the proper viscosity lubricant prior to use. Consult the chart on page 165 or the factory for alternate lubricants.

Change Intervals: Standard compounded lubricants should be changed every six months or 2500 operating hours, whichever comes first. Factory installed synthetic lubricants should be changed every four years or 11,000 hours, whichever comes first.

Internal pressure compensating system: Groove Gold and stainless steel reducers come standard with an internal pressure compensating system and synthetic oil pre-installed at the factory. It is not necessary to vent these reducers, and they can be used as supplied from the factory.

CAUTION Oil should be changed more often if reducer is used in a severe environment. (i.e. dusty, humid)

CAUTION In the Food and Drug Industry (including animal food), consult the lubrication supplier for recommendation of lubricants which are acceptable to the Food and Drug Administration and/or other authoritative bodies having jurisdiction. Factory supplied oil is not suitable for these applications or this industry.

GROVE GEAR

Special Lubrication Requirements - Sizes 218 & Larger

Units shipped from the factory are assembled to properly lubricate all internal components based on a specific assumed mounting orientation. The factory assumed mounting orientations are given below. If a size 218 or larger unit will be mounted in a different orientation than listed below, or run with sustained input speeds less than 900 RPM, it should be specified with the order. The unit can then be modified to assure proper lubrication.

Factory Assumed Mounting Orientation	Applicable Unit Styles*	
Worm Over	B, T, F, H, FH, C, D, DT, DF, DH, DFH, DX, DXT, DXH, DXFH, TT	Single Reduction Double Reduction Worm-Worm Double Reduction Helical-Worm Triple Reduction Worm-Worm-Worm
Worm Under	U DU	Single Reduction Double Reduction Worm-Worm
Vertical Output	VL/VH, FE DVL/DVH, DFE DXVL/DXVH, DXFE	Single Reduction Double Reduction Worm-Worm Double Reduction Helical-Worm
Vertical Input	J DJ DXJ	Single Reduction Double Reduction Worm-Worm Double Reduction Helical-Worm

* Includes "M" and "MQ" versions of all styles listed

The precision-made gears and bearings in Grove Gear Speed Reducers require high-grade lubricants of the proper viscosity to maintain trouble-free performance. For best results, use lubricants on the following chart for worm gear reducers:

Manufacturer	30° to 100° F Ambient Temperature* AGMA Compounded No. 7	50° to 125° F Ambient Temperature* AGMA Compounded No. 8
Amoco Oil Co.	Worm Gear Oil	Cylinder Oil #680
Chevron USA, Inc.	Cylinder Oil #460X	Cylinder Oil #680X
Exxon Co. USA	Cyclesstic TK-460	Cyclesstic TK-680
Gulf Oil Co.	Senate 460	Senate 680D
Mobil Oil Corp.	600 W Super Cylinder	Extra Hecla Super
Shell Oil Co.	Valvata Oil J460	Valvata Oil J680
Sun Oil Co.	Gear Oil 7C	Gear Oil 8C
Texaco	Honor Cylinder Oil	650T Cylinder Oil
Union Oil Co. of CA	Steaval A	Worm Gear Lube 140

 Standard factory-installed lubricant, shipped with 6.00" C.D. and smaller units.

*Temperature range for continuous duty. For intermittent duty, contact factory.

Some gear lubricants contain E.P. additives that can be corrosive to gear bronze. Avoid lubricants that are compounded with sulfur and/or chlorine.

For temperature ranges not shown, contact factory.

For lubrication requirements of helical reducers (primaries of helical/worm reducers, ratio multipliers, and styles BAMCQ, BAMC, and BA), contact factory.

Lubrication & Vent Plug Location

Oil Capacities (pints)

Mounting Position	UNIT SIZE													
	213	215	218	220	224	226	230	232	242	252	2600	2700*	2800*	21000*
Worm Over	1/4	3/4	3/4	1 1/4	1 1/2	2 1/2	3 1/2	4 1/2	7	11 3/4	19 1/2	35	48	72
Worm Under	1/2	1	1 1/4	1 3/4	2 1/2	3 3/4	5 1/4	6 3/4	9 1/2	19	20 1/2	32 3/4	51 1/4	80
Vertical Output	1/4	1	1	1 3/4	2	3	4 1/4	5 1/2	8	15 1/2	20	20 3/4	28 3/4	40
Vertical Input	1/4	1	1	1 1/2	2	3	4 1/2	5 3/4	8	15 1/2	20 1/3	36 1/2	50	75
Extended Bearing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8	12	17	27	40	63	102
Worm over on Secondary Unit of Double Reduction				N/A	N/A	N/A	N/A	12	19 1/4	20	30 1/3	50 1/3	71 1/2	107 1/4

*Shipped Dry

16 oz. = 1 pint
 2 pints = 1 quart
 4 quarts = 1 gallon
 1 gallon = 128 oz. = 231 cu. in.

Always check for proper oil level after filling. Capacities vary somewhat with model and mounting position. Oil should rise to bottom edge of level hole. Do not overfill.

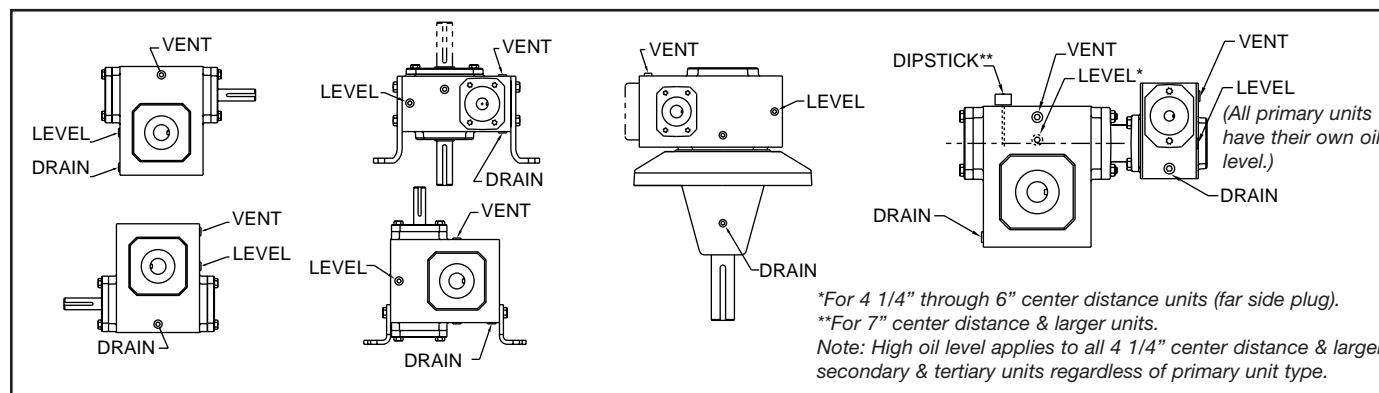
Synthetic Lubricants

Synthetic lubricants provide the potential for numerous benefits including wider operating temperature range and increased interval between changes. Use of synthetics can cause problems if they are not compatible with the seals or the conventional lubricants they replace. For normal ambient temperatures (-10°F to 105°F)* we recommend the use of Mobil SHC 634 which is compatible with the standard compounded oil shipped in our product and the Viton® seal material used through size 252. For other temperatures, contact factory for a recommendation.

For synthetic lubricants to be used in helical reducers (primaries of helical/worm reducers, ratio multipliers, and styles BAMCQ, BAMC, and BA), contact factory.

*Temperature range for continuous duty. For intermittent duty, contact factory.

Standard Speed Reducer Mounting Positions & Vent Plug, Level and Drain Locations



Hollow Output Shaft Bore Sizes

Hollow Output Shaft Bore Sizes

Fract. Size	Decimal Equiv.	KWY*	213	215	218	220	224	226	230	232	242	252	2600	2700	2800	21000
5/8	.625	3/16 x 3/32	*	*	*											
11/16	.688	3/16 x 3/32			*											
3/4	.750	3/16 x 3/32			*											
7/8	.875	3/16 x 3/32			*											
1	1.000	1/4 x 1/8			*	*	*	*								
1-1/8	1.125	1/4 x 1/8				*	*	*								
1-3/16	1.188	1/4 x 1/8				*	*	*	*	*						
1-1/4	1.250	1/4 x 1/8				*	*	*	*	*						
1-7/16	1.438	3/8 x 3/16				*	*	*	*	*	*					
1-1/2	1.500	3/8 x 3/16							*	*	*					
1-5/8	1.625	3/8 x 3/16							*	*	*					
1-11/16	1.688	3/8 x 3/16							*	*	*					
1-3/4	1.750	3/8 x 3/16							*	*	*					
1-7/8	1.875	1/2 x 1/4									*					
1-15/16	1.938	1/2 x 1/4							*	*	*					
2	2.000	1/2 x 1/4									*	*	*			
2-3/16	2.188	1/2 x 1/4									*	*	*			
2-1/4	2.250	1/2 x 1/4										*	*			
2-7/16	2.438	5/8 x 5/16										*	*	*		
2-1/2	2.500	5/8 x 5/16										*	*	*		
2-11/16	2.688	5/8 x 5/16										*	*	*		
2-15/16	2.938	3/4 x 3/8										*	*	*		
3	3.000	3/4 x 3/8										*	*	*		
3-3/16	3.188	3/4 x 3/8										*	*			
3-7/16	3.438	7/8 x 7/16										*	*	*	*	*
3-15/16	3.938	1 x 1/2												*	*	*
4-3/16	4.188	1 x 1/2													*	
4-7/16	4.438	1 x 1/2													*	*
4-15/16	4.938	1-1/4 x 5/8														*
5-7/16	5.438	1-1/4 x 5/8														*

*Dimensions refer to driven shaft.

Note: Special bores are available upon request. Consult factory for information.

Motor Compatibility Chart

Nema Motor Data						
Unit Size	48C	56C	140TC	180TC	210TC	250TC
213	Yes	Yes	Yes	No	No	No
215	Yes	Yes	Yes	No	No	No
218	Yes	Yes	Yes	No	No	No
220	Yes	Yes	Yes	No	No	No
224	No	Yes	Yes	Yes	Yes *	No
226	No	Yes	Yes	Yes	Yes *	No
230	No	Yes	Yes	Yes	Yes	No
232	No	Yes	Yes	Yes	Yes	No
242	No	Yes	Yes	Yes	Yes	Yes
252	No	Yes	Yes	Yes	Yes	Yes
2600	No	Yes **	Yes **	Yes	Yes	Yes
2700	No	No	No	Yes *	Yes *	Yes *
2800	No	No	No	No	Yes *	Yes *

Metric Motor Data						
Unit Size	D63D	D71D	D80D	D90D	D100LD D112MD	D132D
213	Yes **	Yes **	Yes **	No	No	No
215	Yes **	Yes **	Yes **	No	No	No
218	Yes **	Yes **	Yes **	No	No	No
220	Yes **	Yes **	Yes **	No	No	No
224	No	Yes **	Yes **	No	No	No
226	No	Yes **	Yes **	Yes **	No	No
230	No	Yes **	Yes **	Yes **	No	No
232	No	Yes **	Yes **	Yes **	Yes **	No
242	No	No	No	Yes **	Yes **	Yes **
252	No	No	No	Yes **	Yes **	Yes **
2600	No	No	No	No	No	No
2700	No	No	No	No	No	No
2800	No	No	No	No	No	No

* Available in "M" style "C" face only

** Available in "Quill" style "C" face only

Engineering Data

Double Reduction Ratio Combinations

Worm/Worm Ratio Combinations

Total	213		215		218		220		224		226		230		232		242		252		2600	
	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S
Ratio	213	213	213	215	213	218	213	220	213	224	213	226	215	230	215	232	220	242	226	252	232	2600
75:1	5	15	5	15	5	15	5	15	5	15	5	15	5	15	5	15	5	15	5	15	5	15
100:1	5	20	5	20	5	20	5	20	5	20	5	20	5	20	5	20	5	20	5	20	5	20
150:1	10	15	7 1/2	20	10	15	10	15	10	15	7 1/2	20	10	15	5	30	7 1/2	20	7 1/2	20	10	15
200:1	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20
250:1	10	25	10	25	10	25	10	25	10	25	10	25	10	25	10	25	10	25	10	25	10	25
300:1	10	30	15	20	10	30	15	20	15	20	15	20	20	15	10	30	15	20	15	20	20	15
400:1	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
500:1	20	25	25	20	25	20	25	20	25	20	25	20	20	25	25	20	25	20	25	20	25	20
600:1	20	30	30	20	20	30	30	20	20	30	30	20	20	30	20	30	30	20	30	20	30	20
750:1	30	25	30	25	25	30	25	30	25	30	30	25	30	25	25	30	25	30	30	25	30	25
900:1	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	60	15
1000:1	40	25	50	20	50	20	50	20	50	20	50	20	40	25	25	40	25	40	40	25	50	20
1200:1	40	30	60	20	40	30	40	30	40	30	60	20	40	30	40	30	40	30	40	30	60	20
1500:1	60	25	60	25	50	30	50	30	50	30	60	25	60	25	50	30	50	30	60	25	60	25
1800:1	60	30	60	30	60	30	60	30	60	30	60	30	60	30	60	30	60	30	60	30	60	30
2400:1	60	40	60	40	60	40	60	40	60	40	60	40	60	40	60	40	60	40	60	40	60	40
3000:1	60	50	60	50	60	50	60	50	60	50	60	50	60	50	60	50	60	50	60	50	60	50
3600:1	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60

P - The primary gear box in the combination.

S - The secondary gear box in the combination.

Note: Actual Ratio Combinations supplied by factory may vary from above depending on application and manufacturing requirements.

Helical/Worm Ratio Combinations

Total	213		215		218		220		224		226		230		232		242		252		2600	
	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S
Ratio	1	213	1	215	1	218	1	220	2	224	2	226	2	230	2	232	3	242	3	252	3	2600
10:1	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5
15:1	2	7 1/2	2	7 1/2	2	7 1/2	2	7 1/2	2	7 1/2	2	7 1/2	2	7 1/2	2	7 1/2	2	7 1/2	2	7 1/2	2	7 1/2
20:1	2	10	2	10	2	10	2	10	2	10	2	10	2	10	2	10	2	10	2	10	2	10
25:1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
30:1	2	15	2	15	2	15	3	10	3	10	3	10	3	10	3	10	3	10	2	15	2	15
40:1	4	10	4	10	4	10	4	10	4	10	4	10	4	10	4	10	4	10	2	20	2	20
45:1	3	15	3	15	3	15	3	15	3	15	3	15	3	15	3	15	3	15	3	15	3	15
50:1	5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	10	2	25	2	25
60:1	4	15	4	15	4	15	4	15	4	15	3	20	4	15	4	15	4	15	4	15	3	20
75:1	5	15	5	15	5	15	5	15	5	15	5	15	5	15	5	15	5	15	5	15	3	25
80:1	4	20	4	20	4	20	4	20	4	20	4	20	4	20	4	20	4	20	4	20	4	20
100:1	4	25	5	20	5	20	5	20	5	20	5	20	5	20	5	20	5	20	5	20	4	25
125:1	5	25	5	25	5	25	5	25	5	25	5	25	5	25	5	25	5	25	5	25	5	25
150:1	5	30	5	30	5	30	5	30	5	30	5	30	5	30	5	30	5	30	5	30	5	30
200:1	5	40	5	40	5	40	5	40	5	40	5	40	5	40	5	40	5	40	5	40	5	40
250:1	5	50	5	50	5	50	5	50	5	50	5	50	5	50	5	50	5	50	5	50	5	50
300:1	5	60	5	60	5	60	5	60	5	60	5	60	5	60	5	60	5	60	5	60	5	60

P - The primary gear box in the combination.

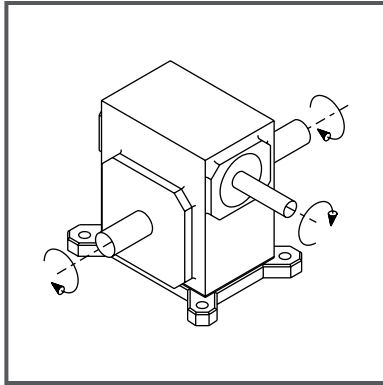
S - The secondary gear box in the combination.

Note: Actual Ratio Combinations supplied by factory may vary from above depending on application and manufacturing requirements.

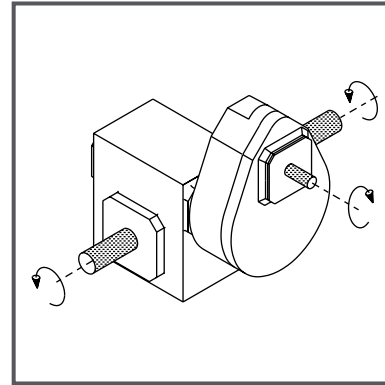
GROVE GEAR

Standard Shaft Rotation

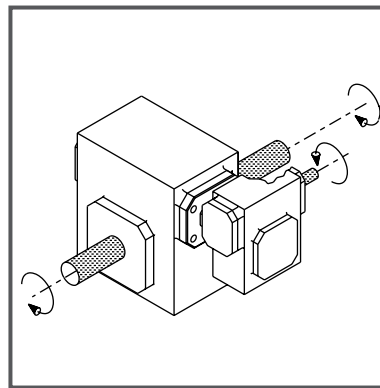
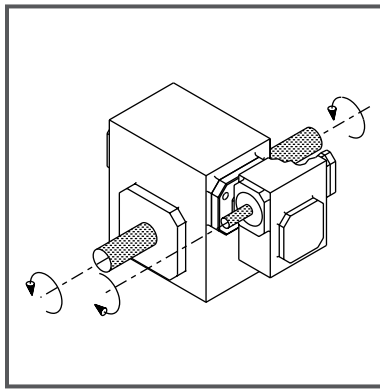
Single Reduction



Double Reduction Helical Worm



Double Reduction Worm/Worm



Note: For opposite shaft rotation—consult factory.

X= Exact Ratio

Flexaline Exact Ratios

Unit	5	7.5	10	15	20	25	30	40	50	60	70	80	100
213	X	X	X	X	X	X	X	X	X	X	NA	X	X
215	X	X	X	X	X	X	X	X	X	X	NA	X	X
218	X	X	X	X	X	X	X	X	X	X	NA	X	X
220	X	X	X	X	X	X	X	X	X	X	NA	X	X
224	X	X	X	X	X	X	X	X	X	X	NA	X	X
226	5 1/6	X	X	X	X	X	X	X	X	X	NA	X	X
230	X	X	X	X	X	X	X	X	X	X	NA	X	X
232	5 1/6	X	X	X	X	X	X	X	X	X	NA	X	X
242	5 1/6	X	X	X	X	X	X	X	X	X	NA	X	X
252	5 1/8	X	X	X	X	X	X	X	X	X	NA	X	X
2600	X	X	X	X	X	X	X	X	X	X	NA	X	X
2700	5 1/8	7 2/5	9 3/4	14 2/3	20 1/2	24 1/2	29 1/2	X	X	X	X	NA	NA
2800	5 1/8	7 2/5	9 3/4	14 2/3	20 1/2	24 1/2	29 1/2	X	X	X	X	NA	NA
21000	5 1/8	7 1/3	9 3/4	14 2/3	20 1/2	24 1/2	29 1/2	X	X	X	X	NA	NA

Classes of Service

The worm gear speed reducer ratings in this catalog are for a 1.00 service factor or Class I service. A 1.00 service factor applies when the use of the reducer is for continuous service free from recurrent shock loading and does not exceed 10 hours per day. When operating conditions are different from those described above, the input horsepower and torque ratings shown in this catalog must be divided by the appropriate service factor indicated in the table below. The catalog ratings may be used without adjustments if the actual driven machine horsepower and torque requirements are multiplied by the appropriate service factor indicated in the table below.

Service Factors

Service factors for electric and hydraulic motors
(For service factors for single or multi-cylinder engines, see below)

Duration of Service (Hours per day)	Uniform Load	Moderate Shock	Heavy Shock	Extreme Shock
Occasional 1/2 Hour	--*	--*	1.0	1.25
Less than 3 Hours	1.0	1.0	1.25	1.50
3 - 10 Hours	1.0	1.25	1.50	1.75
Over 10 Hours	1.25	1.50	1.75	2.00

*Unspecified service factors should be 1.00 or as agreed upon by the user and manufacturer.

Conversion table for single or multi-cylinder engines
to find equivalent single or multi-cylinder service factor

Hydraulic or Electric Motor	Single Cylinder Engines	Multi-Cylinder Engines
1.00	1.50	1.25
1.25	1.75	1.50
1.50	2.00	1.75
1.75	2.25	2.00
2.00	2.50	2.25

Normal starting or occasional peak loads, two or three times per day, up to 300% of catalog rating at 1800 RPM are permissible. If either the frequency or the magnitude of these loads exceed the above limits, a higher service factor is required and the application should be referred to the factory.

Worm gear reducers are not to be considered fail safe or self-locking devices. If these features are required, a properly sized, independent holding device should be utilized.

Depending upon gear geometry and operating conditions, worm gear reducers may or may not backdrive. Special consideration should be given to high inertia loads connected to the reducer output shaft. Consult factory for further details.

Reducers driven by brakemotors must be sized to accommodate motor driving, brake and inertia loads to prevent the braking torque or inertia loads from exceeding the motor rating.

WARNING For safety, purchaser or user should provide protective guards over shaft extensions and any couplings, sheaves and belts, sprockets and chains, etc., mounted thereon.

Engineering Data

A.G.M.A. Service Factors

Application	Service Factor		Application	Service Factor		Application	Service Factor	
	3-10 Hrs.	Over 10 Hrs.		3-10 Hrs.	Over 10 Hrs.		3-10 Hrs.	Over 10 Hrs.
AGITATORS			CLASSIFIERS	1.25	1.50	Tubing	1.25	1.25
Pure Liquids	1.00	1.25	CLAY WORKING INDUSTRY			Blow Molders, Pre-plasticizers		1.50
Liquids & Solids	1.25	1.50	Brick Press	1.75	2.00	FANS		
Liquids-Variable Density . .	1.25	1.50	Briquette Machines	1.75	2.00	Centrifugal	1.00	1.25
APRON CONVEYORS			Clay Working Machinery . .	1.25	1.50	Cooling Towers		
Uniformly Loaded or Fed .	1.00	1.25	Pug Mills	1.25	1.50	Refer to Factory		
Heavy Duty	1.25	1.50	COMPRESSORS			Forced Draft		1.25
APRON FEEDERS	1.25	1.50	Centrifugal	1.00	1.25	Induced Draft	1.25	1.50
ASSEMBLY CONVEYORS			Lobe	1.25	1.50	Large (Mine, etc.)	1.25	1.50
Uniformly Loaded or Fed .	1.00	1.25	Reciprocating:			Large Industrial	1.25	1.50
Heavy Duty	1.25	1.50	Multi-Cylinder	1.25	1.50	Light (Small Diameter) . .	1.00	1.25
BARGE HAUL PULLERS	1.50	1.75	Single Cylinder	1.50	1.75	FEEDERS		
BARKING			CONCRETE MIXERS			Apron, Belt	1.25	1.50
Drums (coupling connected)		1.75	Continuous	1.25	1.50	Disc	1.00	1.25
Mechanical		1.75	Intermittent	1.25	1.50	Reciprocating	1.75	2.00
BAR SCREENS (Sewage) . . .	1.00	1.25	CONVEYORS-Uniformly Loaded or Fed			Screw	1.25	1.50
BELT CONVEYORS			Apron, Assembly, Belt, Bucket, Chain,			FLIGHT		
Uniformly Loaded or Fed .	1.00	1.25	Flight, Oven, Screw	1.00	1.25	Conveyors, Uniform	1.00	1.25
Heavy Duty	1.25	1.50	CONVEYORS-Severe Duty			Conveyors, Heavy	1.25	1.50
BELT FEEDERS	1.25	1.50	Live Roll		Refer to Factory	FOOD INDUSTRY		
BLOWERS			Reciprocating, Shaker . . .	1.50	1.75	Beet Slicers	1.25	1.50
Centrifugal	1.00	1.25	COOLING TOWER FANS		Refer to Factory	Bottling, Can Filling Mach.	1.00	1.25
Lobe	1.25	1.50	CRANES			Cereal Cookers	1.00	1.25
Vane	1.00	1.25	Dry Dock Cranes		Refer to Factory	Dough Mixers, Meat Grinders	1.25	1.50
BOTTLING MACHINERY	1.00	1.25	Main Hoist	1.00	1.25	HAMMER MILLS	1.50	1.75
BREWING & DISTILLING			Bridge and Trolley Travel		Refer to Factory	HOISTS		
Bottling Machinery	1.00	1.25	CRUSHERS			Heavy Duty	1.75	2.00
Brew Kettles, Cont. Duty .	1.00	1.25	Ore or Stone	1.50	1.75	Medium Duty	1.25	1.50
Can Filling Machines	1.00	1.25	Sugar		1.50	Skip Hoist	1.25	1.50
Cookers-Cont. Duty	1.00	1.25	DISC FEEDERS	1.00	1.25	INDUCED DRAFT FANS	1.25	1.50
Mash Tubs-Cont. Duty . . .	1.00	1.25	DOUBLE ACTING PUMPS			LAUNDRY WASHERS AND		
Scale Hoppers-Frequent Starts	1.25	1.50	2 or more Cylinders	1.25	1.50	TUMBLERS	1.25	1.50
BUCKET			Single Cylinder		Refer to Factory	LINE SHAFTS		
Conveyors Uniform	1.00	1.25	DRAW BENCH (Metal Mills)			Driving Processing Equipment	1.25	1.50
Conveyors Heavy Duty . .	1.25	1.50	Carriage & Main Drive . . .	1.25	1.50	Other Line Shafts, Light . .	1.00	1.25
Elevators Cont.	1.00	1.25	DREDGES			LUMBER INDUSTRY		
Elevators Uniform	1.00	1.25	Cable Reels, Conveyors . .	1.25	1.50	Barkers-Spindle Feed	1.25	1.50
Elevators Heavy Duty . . .	1.25	1.50	Cutter Head & Jig Drives . .	1.75	2.00	Barkers-Main Drive	1.75	1.75
CALENDARS			Maneuvering Winches, Pumps	1.25	1.50	Carriage Drive		Refer to Factory
Rubber		1.50	Screen Drives	1.50	1.75	Conveyors		
Textile	1.25	1.50	Stackers, Utility Winches . .	1.25	1.50	Burner	1.25	1.50
CANE KNIVES		1.50	ELEVATORS			Main or Heavy Duty	1.50	1.50
CAN FILLING MACHINES . .	1.00	1.25	Bucket-Uniform Load . . .	1.00	1.25	Main Log	1.75	2.00
CAR DUMPERS	1.50	1.75	Bucket-Heavy Duty	1.25	1.50	Re-Saw Merry-Go-Round .	1.25	1.50
CAR PULLERS	1.25	1.50	Bucket-Continuous	1.00	1.25	Slab	1.75	2.00
CENTRIFUGAL			Centrifugal Discharge . . .	1.00	1.50	Transfer	1.25	1.50
Blowers, Compressors, Discharge			Escalators		Not approved	Chains-Floor	1.50	1.50
Elevator, Fans or Pumps .	1.00	1.25	Freight		Not approved	Chains-Green	1.50	1.75
CHAIN CONVEYORS			Gravity Discharge	1.00	1.25	Cut-Off Saws-Chain & Drag	1.50	1.75
Uniformly Loaded or Fed .	1.00	1.25	Man Lifts, Passenger		Not approved	Debarking Drums	1.75	2.00
Heavy Duty	1.25	1.50	EXTRUDERS (Plastic)			Feeds-Edger	1.25	1.50
CLARIFIERS	1.00	1.25	Film Sheet, Coating, Rods, Pipe					

Engineering Data

A.G.M.A. Service Factors

Application	Service Factor		Application	Service Factor		Application	Service Factor	
	3-10 Hrs.	Over 10 Hrs.		3-10 Hrs.	Over 10 Hrs.		3-10 Hrs.	Over 10 Hrs.
Feeds-Gang	1.50	1.50	Agitator for Pure Liquids	1.25		Calendars	1.50	
Feeds-Trimmer	1.25	1.50	Barking Drums, Barker-Mech.	1.75		Crackers	1.75	
Log Deck	1.50	1.50	Beater	1.50		Laboratory Equipment	1.25	1.50
Log Hauls-Incline Well Type	1.50	1.50	Breaker Stack	1.25		Mills (2 on line)	1.50	
Log Turning Devices	1.50	1.50	Calendar	1.25		Mills (3 on line)	1.25	
Planer Feed	1.25	1.50	Chipper	1.75		Mixing Mills	1.50	1.50
Planer Tilting Hoist	1.50	1.50	Chip Feeder	1.50		Refiners	1.50	
Rolls-Live-Off Bearing-Roll			Coating Rolls	1.25		Sheeters	1.50	
Cases	1.50	1.50	Conveyors-			Tire Building & Machines	Refer to Factory	
Sorting Table, Tipple Hoist	1.25	1.50	Chip, Bark, Chemical	1.25		Tire & Tube Press Openers	Refer to Factory	
Transfers-Chain & Craneway	1.50	1.75	Log (inc. Slab)	1.75		Tubers & Strainers	1.50	
Tray Drives	1.25	1.50	Couch Rolls	1.25		Warming Mills	1.50	
Veneer Lathe Drives	Refer to Factory		Cutter	2.00		SCREENS		
MACHINE TOOLS			Cylinder Molds	1.25		Air Washing	1.00	1.25
Auxiliary Drives	1.00	1.25	Dryers-			Rotary-Sand or Gravel	1.25	1.50
Bending Rolls	1.25	1.50	Paper Mach. & Conveyor Type	1.25		Traveling Water Intake	1.00	1.25
Main Drives	1.25	1.50	Embosser	1.25		SEWAGE DISPOSAL		
Notching Press (Belted)	Refer to Factory		Extruder	1.50		Bar Screens	1.00	1.25
Plate Planers	1.50	1.75	Fourdrinier Rolls-			Chemical Feeders	1.00	1.25
Punch Press (Geared)	1.50	1.75	Lumpbreaker, Wire Turning,			Collectors	1.00	1.25
Tapping Machines	1.50	1.75	Dandy & Return Rolls	1.25		Dewatering Screens	1.25	1.50
METAL MILLS			Jordan	1.50		Scum Breakers	1.25	1.50
Draw Bench Carriages &			Kiln Drive	1.50		Slow or Rapid Mixers	1.25	1.50
Main Drives	1.25	1.50	Mt. Hope & Paper Rolls	1.25		Thickeners	1.25	1.50
Pinch, Dryer and Scrubber			Platter	1.50		Vacuum Filters	1.25	1.50
Rolls Reversing	Refer to Factory		Presses (Felt & Suction)	1.25		SKI TOWS & LIFTS	Not approved	
Slitters	1.25	1.50	Pulper, Vacuum Pumps	1.50		STOKERS	1.00	1.25
Table Conveyors			Reel (Surface Type)	1.25		STONE CRUSHERS	1.50	1.75
Non-Reversing			Screens-			SUGAR INDUSTRY		
Group Drives	1.25	1.50	Chip, Rotary	1.50		Cane Knives, Crushers, Mills	1.50	
Individual Drives	1.50	1.75	Vibrating	1.75		TABLE CONVEYORS (Non-Reversing)		
Reversing Wire Drawing & Flattening			Size Press	1.25		Group Drives	1.25	1.50
Machines	1.25	1.50	Super Calendar	1.25		Individual Drives	1.50	1.75
Wire Winding Machines	1.25	1.50	Thickener & Washer-			Reversing	Refer to Factory	
MILLS, ROTARY			AC Motor	1.50		TEXTILE INDUSTRY		
Ball and Rod Mills			DC Motor	1.25		Batchers, Calendars	1.25	1.50
with Spur Ring Gear		1.75	Wind & Unwind Stand	1.00		Card Machines	1.25	1.50
with Helical Ring Gear		1.50	Winders (Surface Type)	1.25		Dry Cans, Dryers	1.25	1.50
Direct Connect		1.50	Yankee Dryers	1.25		Dyeing Machinery	1.25	1.50
Cement Kilns, Dryers, Coolers, Pebble,			PASSENGER ELEVATORS	Refer to Factory		Knitting Machinery	Refer to Factory	
Plain & Wedge Bar Mills		1.50	PLATE PLANERS	1.50	1.75	Looms, Mangles, Nappers,		
Tumbling Barrels	1.50	1.75	PRINTING PRESSES	Refer to Factory		Pads	1.25	1.50
MIXERS (Also see Agitators)			PUMPS			Range Drives	Refer to Factory	
Concrete, Cont. & Int.	1.25	1.50	Centrifugal	1.00	1.25	Slashers, Soapers, Spinners	1.25	1.50
Constant Density	1.00	1.25	Proportioning	1.25	1.50	Tenter Frames, Washers,		
Variable Density	1.25	1.50	Reciprocating			Winders	1.25	1.50
OIL INDUSTRY			Single Act, 3 or more Cyl.	1.25	1.50	TUMBLING BARRELS	1.50	1.75
Chillers	1.25	1.50	Double Act, 2 or more Cyl.	1.25	1.50	VANE BLOWERS	1.00	1.25
Oil Well Pumping	Refer to Factory		Single Act, 1 or 2 Cyl.	Refer to Factory		WINDLASS	Refer to Factory	
Paraffin Filter Press	1.25	1.50	Double Act, 1 Cyl.	Refer to Factory		WIRE		
Rotary Kilns	1.25	1.50	Rotary: Gear, Lobe, Vane	1.00	1.25	Drawing Machines	1.25	1.50
PAPER MILLS			PUNCH PRESSES (Gear Driven)	1.50	1.75	Winding Machines	1.25	1.50
Agitator (Mixer)		1.50	RUBBER & PLASTIC INDUSTRIES					

GROVE GEAR

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Torque and Horsepower

The feature that distinguishes torque (TQ) from horsepower (HP) is that torque is independent of speed or time while horsepower is a function of velocity which in turn is a factor of both radius and speed of rotation. With this in mind, there are several useful formulas that express this relationship.

$$\text{HP} = \frac{\text{TQ} \times \text{Speed (RPM)}}{63025}$$

$$\text{TQ} = \frac{\text{HP} \times 63025}{\text{RPM}}$$

Efficiency

The efficiency of a Worm Gear Speed Reducer is dependent on input speed, lead angle of the worm, type of lubricant, temperature and many other variables. The efficiency for speed reducer can be easily calculated as follows.

$$\text{Efficiency} = \frac{\text{Output HP}}{\text{Input HP}}$$

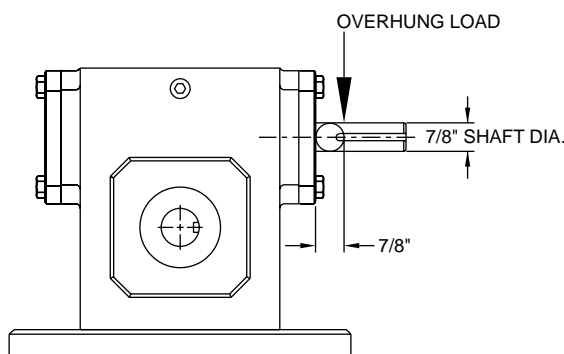
Overhung Load

Overhung load is the radial force exerted on a shaft at some position along its extension. The overhung load is usually imposed by either a sprocket, pinion, sheave, or pulley. When one of these items is mounted on the output shaft of the reducer, a calculation should be made to determine whether the resulting overhung load exceeds the reducers rated overhung load capacity.

$$\text{OHL} = \frac{\text{Output Torque} \times \text{Overhung Load Factor}}{\text{Radius (of Sprocket, Pinion, Sheave or Pulley)}}$$

Overhung Load Factor

Sprocket	1.00
Gear Pinion	1.25
V Belt Sheave or Pulley	1.50
Flat Belt	2.50



Note: The Overhung load ratings in the catalog are calculated at one shaft diameter out from the gear case housing.

Selection Information

Read ALL instructions prior to operating reducer. Injury to personnel or reducer failure may be caused by improper installation, maintenance or operation.

Written authorization from Grove Gear is required to operate or use reducers in man lift or people moving devices.

Check to make certain application does not exceed the allowable load capacities published in the current catalog.

Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which buyer shall apply the product. The application by buyer shall not be subject to any implied warranty of fitness for a particular purpose.

Safety Alert



For safety, Buyer or User should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The User is responsible for checking all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.



Hot oil or reducers can cause severe burns. Use extreme care when removing lubrication plugs and vents.



Make certain that the power supply is disconnected before attempting to service or remove any components. Lock out the power supply and tag it to prevent unexpected application of power.



Reducers are not to be considered fail safe or self-locking devices. If these features are required, a properly sized, independent holding device should be utilized. Reducers should not be used as a brake.



Any brakes that are used in conjunction with a reducer must be sized or positioned in such a way so as to not subject the reducer to loads beyond the catalog rating.



Test run unit to verify operation. If the unit tested is a prototype, that unit must be of current production.



If the speed reducer cannot be located in a clear and dry area with access to adequate cooling air supply, then precautions must be taken to avoid the ingestion of contaminants such as water and the reduction in cooling ability due to exterior contaminants. Reducers located in confined spaces may require forced air cooling.

Important Information

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

The manufacturer makes no warranties or representations, express or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the goods sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will manufacturer be liable for consequential, incidental or other damages.

Resellers/Buyers agree to also include this entire document including the warnings and cautions above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.

This instructions manual should be read together with all other printed information such as catalogs, supplied by Grove Gear.

General Operation

1. Run the motor which drives the reducer and check the direction of reducer output rotation. Consult motor nameplate for instructions to reverse the direction of rotation.
2. Attaching the load: On direct coupled installations, check shaft and coupling alignment between speed reducer and loading mechanism. On chain/sprocket and belt/pulley installation, locate the sprocket or pulley as close to the oil seal as possible to minimize overhung load. Check to verify that the overhung load does not exceed specifications published in the catalog.
3. High momentum loads: If coasting to a stop is undesirable, a braking mechanism should be provided to the speed reducer output or the driven mechanism.



The system of connected rotating parts must be free from critical speed, torsional or other type vibration, no matter how induced. The responsibility for this system analysis lies with the purchaser of the speed reducer.

Installation

1. Mount the unit to a rigid flat surface using grade 5 or higher fasteners. The mounting fasteners should be the largest standard size that will fit in the base mounting hole. Shim as required under flange or base feet which do not lie flat against the mounting surface.
2. For shipment, pipe plugs are installed in the unit and a vent plug is packed separately. After mounting the unit in position, remove the appropriate pipe plug and install the vent plug in the location shown on page 166. On double reduction units both the primary and the secondary must be vented. Failure to vent the unit can cause premature seal wear or loss of seal and oil. These conditions are not covered by warranty. Check for correct oil level. Contact the factory for level and vent recommendations on non-standard mounting positions. Units with optional internal pressure compensating system do not use vents. See (internal pressure compensating system) under **Lubrication** for further information.
3. Connect motor to speed reducer.



Depending upon gear geometry and operating conditions worm gear reducers may or may not backdrive. Special consideration should be given to high inertia loads connected to the output shaft. Consult the factory for further details.



DO NOT CHANGE MOUNTING POSITIONS WITHOUT CONTACTING FACTORY. Altering the mounting position may require special lubrication provisions which must be factory installed.



Do not operate the reducer without making sure it contains the correct amount of oil. Do not overfill or underfill with oil, or injury to personnel, reducer or other equipment may result.



A unit cannot be used as an integral part of a machine superstructure which would impose additional loads on the unit other than those imposed by the torque being transmitted either through a shaft-mounted arrangement, and any shaft mounted power transmitting device. (e.g. sprockets, pulleys, couplings)



For safe operation and to maintain the unit warranty, when changing a factory installed fastener for any reason, it becomes the responsibility of the person making the change to properly account for fastener grade, thread engagement, load, tightening torque and the means of torque retention.

Lubrication

With the exception of unit sizes 2700, 2800 and 21000 which are shipped dry, all standard reducers ordered from the factory are filled with lubricant for continuous operation within a 30° to 100°F ambient temperature range (for intermittent duty below 60°F, contact factory). Double and triple reduction units have separate oil sumps and must be filled/checked independently. Prior to startup, verify that the oil is at the level shown on the drawings on page 168. If the ambient temperature will be outside the range for the lubricant installed at the factory, drain and refill the reducer with the proper viscosity lubricant prior to use. Consult the chart on page 179 or the factory for alternate lubricants.

Change Intervals: Standard compounded lubricants should be changed every six months or 2500 operating hours, whichever comes first. Factory installed synthetic lubricants should be changed every four years or 11,000 hours, whichever comes first.

Internal pressure compensating system: Grove Gold and stainless steel reducers come standard with an internal pressure compensating system and synthetic oil pre-installed at the factory. It is not necessary to vent these reducers, and they can be used as supplied from the factory.



Oil should be changed more often if reducer is used in a severe environment. (i.e. dusty, humid)



In the Food and Drug Industry (including animal food), consult the lubrication supplier for recommendation of lubricants which are acceptable to the Food and Drug Administration and/or other authoritative bodies having jurisdiction. Factory supplied oil is not suitable for these applications or this industry.

Special Lubrication Requirements - Sizes 218 & Larger

Units shipped from the factory are assembled to properly lubricate all internal components based on a specific assumed mounting orientation. The factory assumed mounting orientations are given below. If a size 218 or larger unit will be mounted in a different orientation than listed below, or run with sustained input speeds less than 900 RPM, it should be specified with the order. The unit can then be modified to assure proper lubrication.

Factory Assumed Mounting Orientation	Applicable Unit Styles*	
Worm Over	B, T, F, H, FH, C,	Single Reduction
	D, DT, DF, DH, DFH	Double Reduction Worm-Worm
	DX, DXT, DXH, DXFH,	Double Reduction Helical-Worm
	TT	Triple Reduction Worm-Worm-Worm
Worm Under	U	Single Reduction
	DU	Double Reduction Worm-Worm
Vertical Output	VL/VH, FE	Single Reduction
	DVL/DVH, DFE	Double Reduction Worm-Worm
	DXVL/DXVH, DXFE	Double Reduction Helical-Worm
Vertical Input	J	Single Reduction
	DJ	Double Reduction Worm-Worm
	DXJ	Double Reduction Helical-Worm

* Includes "M" and "MQ" versions of all styles listed

The precision-made gears and bearings in Grove Gear Speed Reducers require high-grade lubricants of the proper viscosity to maintain trouble-free performance. For best results, use lubricants on the following chart for worm gear reducers:

Manufacturer	30° to 100° F Ambient Temperature* AGMA Compounded No. 7	50° to 125° F Ambient Temperature* AGMA Compounded No. 8
Amoco Oil Co.	Worm Gear Oil	Cylinder Oil #680
Chevron USA, Inc.	Cylinder Oil #460X	Cylinder Oil #680X
Exxon Co. USA	Cyclesstic TK-460	Cyclesstic TK-680
Gulf Oil Co.	Senate 460	Senate 680D
Mobil Oil Corp.	600 W Super Cylinder	Extra Hecla Super
Shell Oil Co.	Valvata Oil J460	Valvata Oil J680
Sun Oil Co.	Gear Oil 7C	Gear Oil 8C
Texaco	Honor Cylinder Oil	650T Cylinder Oil
Union Oil Co. of CA	Steaval A	Worm Gear Lube 140

Standard factory-installed lubricant, shipped with 6.00" C.D. and smaller units.

Some gear lubricants contain E.P. additives that can be corrosive to gear bronze. Avoid lubricants that are compounded with sulfur and/or chlorine.

For temperature ranges not shown and/or intermittent duty, contact factory.

For lubrication requirements of helical reducers (primaries of helical/worm reducers, ratio multipliers, and styles BAMCQ, BAMC, and BA), contact factory.

Oil Capacities (pints)

Mounting Position	UNIT SIZE													
	213	215	217	220	224	226	230	232	242	252	2600	2700*	2800*	21000*
Worm Over	1/4	3/4	3/4	1 1/4	1 1/2	2 1/2	3 1/2	4 1/2	7	11 3/4	19 1/2	35	48	72
Worm Under	1/2	1	1 1/4	1 3/4	2 1/2	3 3/4	5 1/4	6 3/4	9 1/2	19	20 1/2	32 3/4	51 1/4	80
Vertical Output	1/4	1	1	1 3/4	2	3	4 1/4	5 1/2	8	15 1/2	20	20 3/4	28 3/4	40
Vertical Input	1/4	1	1	1 1/2	2	3	4 1/2	5 3/4	8	15 1/2	20 1/3	36 1/2	50	75
Extended Bearing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8	12	17	27	40	63	102
Worm over on Secondary Unit of Double Reduction				N/A	N/A	N/A	N/A	12	19 1/4	20	30 1/3	50 1/3	71 1/2	107 1/4

*Shipped Dry

16 oz. = 1 pint
 2 pints = 1 quart
 4 quarts = 1 gallon
 1 gallon = 128 oz. = 231 cu. in.

Always check for proper oil level after filling. Capacities vary somewhat with model and mounting position. Oil should rise to bottom edge of level hole. Do not overfill.

Synthetic Lubricants

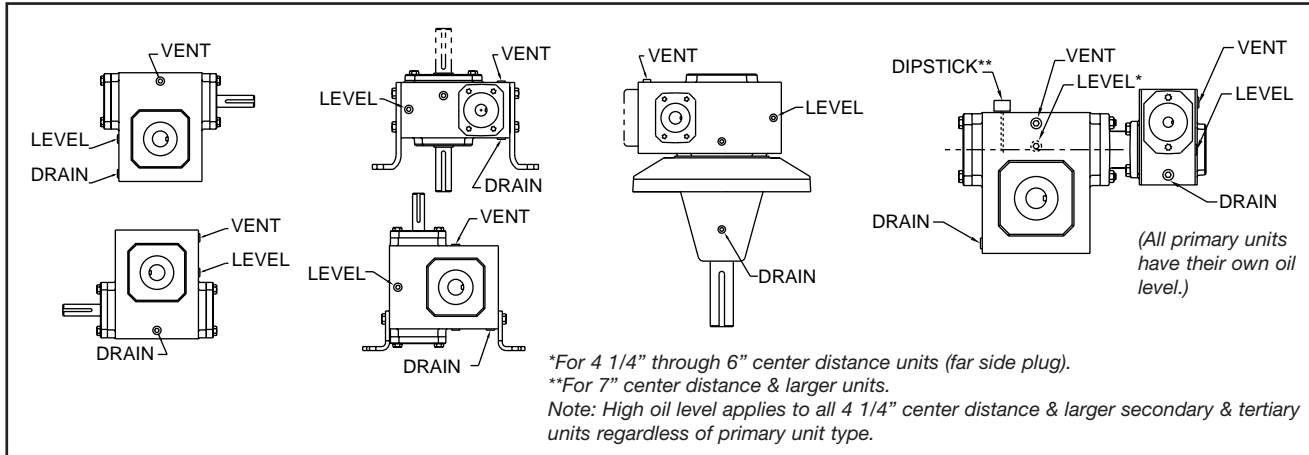
Synthetic lubricants provide the potential for numerous benefits including wider operating temperature range and increased interval between changes. Use of synthetics can cause problems if they are not compatible with the seals or the conventional lubricants they replace. For normal ambient temperatures (-10°F to 105°F)* we recommend the use of Mobil SHC 634 which is compatible with the standard compounded oil shipped in our product and the Viton® seal material used through size 252. For other temperatures, contact factory for a recommendation.

For synthetic lubrication to be used in helical reducers (primaries of helical/worm reducers, ratio multipliers, and styles BAMCQ, BAMC, and BA), contact factory.

* Temperature range for continuous duty. For intermittent duty, contact factory.

Instructions Manual

Standard Speed Reducer Mounting Positions & Vent Plug, Level and Drain Locations



Maintenance

Your Grove Gear reducer has been tested and adjusted at the factory. Dismantling or replacement of components must be done by Grove Gear to maintain the warranty.

Frequently check the oil level of the reducer. If oil level is low, (refer to reducer vent and level position chart) add proper lubrication through the filler plug until it comes out the oil level plug.

Inspect vent plug often to insure it is clean and operating.



Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation.

Seals: The Grove Gear line of speed reducers utilize premium quality seals which are the state-of-the-art in sealing technology. Seals are, however, a wear item and eventually need to be replaced. Replacement can be easily accomplished by following the steps below:

1. Remove the worn seal without damaging the shaft surface or the seal bore. This can be done by drilling a .062 diameter hole in the seal casing (being careful not to drill into the bearing behind the seal). Screw a #10 sheet metal screw into the hole and pry out the seal.
2. Clean the seal bore of sealant.
3. Before installing the new seal, use electrical tape to cover any keyways on the shaft to prevent seal lip damage.
4. Grease the seal lips with bearing grease and apply a sealant to the seal bore.
5. Slide the seal into the shaft being careful not to fold the inner lip over on any shaft steps.
6. Press the seal into its bore with a sleeve that presses on the seal casing, being careful to keep the seal square in its bore.

Class of Service

All capacity ratings are based on American Gear Manufacturers Association (AGMA) Standards. Load conditions be within cataloged ratings published in the current Grove Gear Catalog (available upon request).