MODEL HP

Cone Drive

0906.19

Gearsets

Single Reduction

Multiple Reduction

Custom Design

CONEDRIVE™

GEARING SOLUTIONS

PRODUCTS IN THE RANGE

Serving an entire spectrum of mechanical drive applications from food, energy, mining and metal; to automotive, aerospace and marine propulsion, we are here to make a positive difference to the supply of drive solutions.

Model HP
Worm Gear units with double enveloping worm gearing. Available in single, double and triple reductions.

Series A3
Universal metric housing featuring doubling enveloping gearing & drywell feature

Series B
Industrial Duty worm gear unit featuring Conex gearing

DuoDrive
Dual gears on parallel output shafts

Extruder Drive
Rugged duty reducer takes high screw pressure

Series G
Helical parallel shaft & bevel helical right angle drive gear units

Series W
Precision right angle servo gearboxes

Model RG
Moderate precision right angle servo gearboxes

Series S
Value Engineered right angle servo gearboxes

Series P
Precision planetary servo gearboxes

Series E
Economical planetary servo gearboxes

Series M
In-line helical geared motors & reducers

Series K
Right angle helical bevel helical geared motors & reducers

Series C
Right angle drive helical worm geared motors & reducers

Series F
Parallel angle helical bevel helical geared motors & reducers

We can create custom engineered transmission solutions of any size and configuration.

General Information

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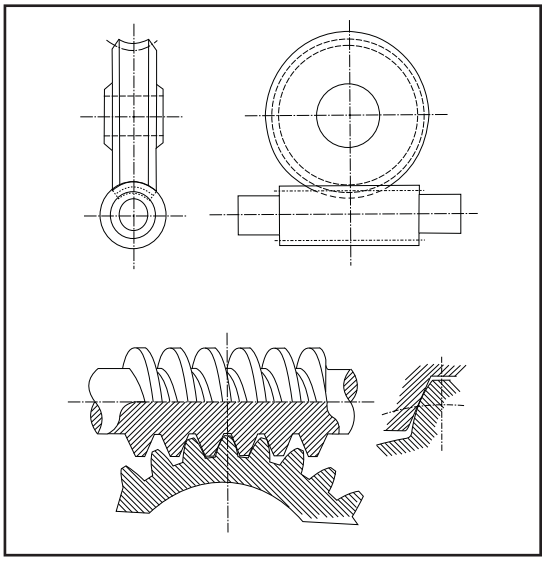
The Cone Drive Advantage

The element that distinguishes Cone Drive products from all the others is the double enveloping design. The term “double-enveloping” is an apt description, as the worm and gear wrap around each other. This greatly increases load carrying capacity by providing more tooth area contact and more teeth in mesh than other worm gear designs.

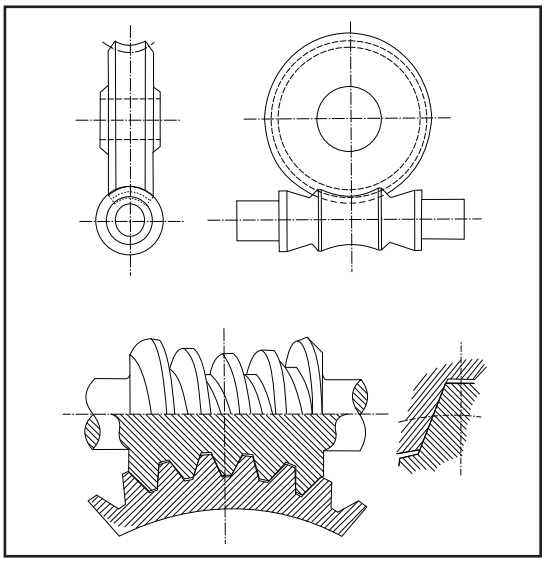
This design difference leads to many advantages, among them:

- Extra torque with no increase in size, or conversely, smaller, more reliable speed reducers
- High shock resistance, and the ability to withstand heavy starting and stopping loads
- Low backlash due to the inherent precision of the double-enveloping design
- Increased durability and longer gear life
- Design flexibility resulting from smaller and lighter envelopes

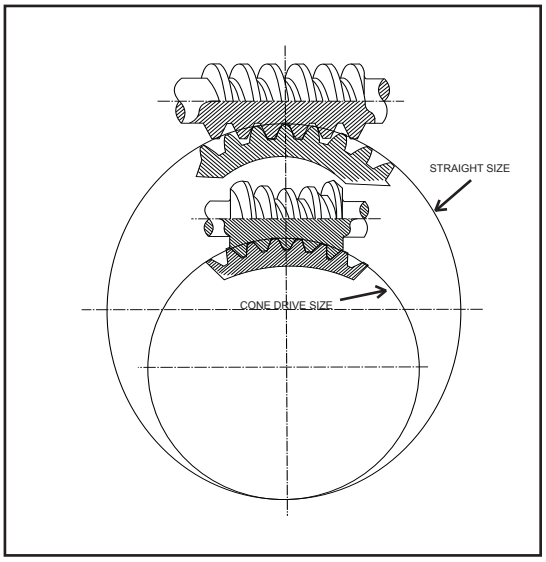
Simply stated, a Cone Drive speed reducer is a small machine doing the work of a big one.



The mesh of common Cylindrical worm gearing provides one to one and one-half gear teeth in contact with the worm.



The Cone Drive double-enveloping design typically provides contact between one-eighth of the total number of teeth on the gear and the worm.



The Cone Drive design gear set can carry loads which would require cylindrical worm gearing to be much larger and heavier.

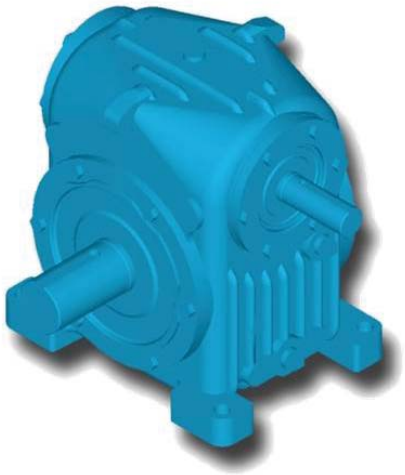
Cone Drive Drawing Downloads

Visit ***www.Conedrive.com***

Download 2-D or 3-D models of standard single or double reduction reducers

Products Drawings & Models Available for Download Include:

- Model HP
- Series B
- AccuDrive (Servo rated range)
- David Brown Gearmotor
- Series G (Industrial Reducer)



Cone Drive Products Overview

Shown below are just a few of the many thousands of styles and configurations available from Cone Drive. This page will introduce you to the many possibilities.

Cone Drive®
Double Enveloping Worm Gears and Speed Reducers

Single Reduction Sizes
17 standard center distance sizes, from 1.5 through 28 inches.
Ratios: From 5:1 through 70:1.

Double Reduction Sizes:
15 standard center distances, from 2 through 10 inches in primary unit and 3 through 24 inches in secondary unit.
Ratios: Up to 4900:1

Triple Reduction Sizes:
15 standard center distances, from 2 through 5 inches in primary unit and 3 through 10 inches in secondary unit, and 6 through 24 in tertiary unit.
Ratios: Up to 343,000:1

Helical/Worm Reducer Sizes:
Nine standard center distance sizes from 2.5 through 10 inches in worm secondary.
Ratios: From 1:1 through 4:1 in helical primary, 5:1 through 70:1 in worm secondary, allowing 34 standard output ratios from 5:1 though 280:1, special ratios available.

Helical/Worm D-Flanged Gearheads:
Helical/worm double reduction speed reducer, modified NEMA D flange for electric motor mount, motor sold separately.

Gear Set Styles:
Solid Shaft, hollow shaft, ring and flange.
Sizes: 17 standard center distance sizes, from 1.5 through 28 inches, special sizes available through 52 inches.
Ratios: From 3:1 through 240:1.

Also Available,
Custom Design Speed Reducers, Low Backlash and Precision Gear Sets and Speed Reducers.

Series B

The Cone Drive solution for low cost applications. The Series B drops in to many competitors foot print however, with it's Conex™ worm gear geometry, the Series B offers the highest ratings in the industry. Available in both single and double redutions.
Sizes: From 1.33 inch to 3.54 inch centers
Ratios: From 5:1 through 60:1 (single reduction) and up to 3600:1 for double reductions.

Series W

Quiet operating right-angle precision gearhead is designed to compliment high precision servo systems, nominal positioning accuracy of six arcminutes, or true zero backlash gearing option available. Choose from solid or hollow output shafts, inch or metric shaft dimensions,speed range up to 6000 RPM, factory filled with synthetic lubricant and sealed for life.
Sizes: Five standard center distances from 38 through 89 millimeters.
Ratios: From 5:1 through 60:1, special ratios available.

Model RG

Designed to compliment the Series W as an alternative where high levels of precision are not required when driven by a servo motor. Availalble with solid or hollow output shafts, inch or metric, speed range up to 4000 RPM, factory filled with synthetic lubricant and sealed for life.
Sizes: Five standard sizes 1.500 inch through 3.500 inch.
Ratios: From 5:1 through 60:1, special ratios availble.

Series S

The Series S is a value engineered right-angle servo reducer ideal where a servo rated reducer is required in a less demanding positioning application. The Series S is an all aluminum housing with a plug-in output shaft.
Sizes: Five sizes available from 1.33 to 3.54 inches.
Ratios: From 5:1 through 60:1

AccuDrive®

ZERO BACKLASH gear set has a unique two pieces pre-loaded to eliminate backlash for accurate and positive rotation positioning.
Sizes: Center distances from 2 through 32 inches, special sizes available.
Ratios: From 5:1 through 180:1, special ratios available.

Special Purpose Speed Reducers

DuoDrive® Pinch Roll Reducers

Available in solid or hollow output shafts, comprised of one worm (input shaft) driving two gears on parallel output shafts.
Sizes: Center distance sizes from 2 through 24 inches.
Ratios: From 5:1 through 60:1, special ratios available.

Extruder Drives

The Cone Drive Extruder Drive has rigid housing and shafts, tapered roller thrust bearing, and is designed for screw pressure up to 10,000 P.S.I.
Sizes: Seven standard center distance sizes, from 3.5 through 10 inches.
Ratios: From 5:1 through 70:1, special ratios available.

How To Order

When you order or request a quotation for a Cone Drive unit, you will need to provide some basic information. Please provide complete information.

How to Order Example: **SHU** **40 - 2** **15 to 1** **1800 RPM** **87086660010**

Model _____

Size _____

Assembly, Mounting No. _____

Overall Ratio _____

Input Speed* _____

Serial No. (if available for replacement or rebuild) _____

If you require an Application Review, you may wish to provide...

1. Input power (HP)
2. Output torque requirement
3. Service factor (duty cycle)
4. Application data
5. Special requirements
6. Sketch or drawing
7. Hollow shaft bore size (when required)

*Standard units are set up for 1750RPM. If input is to be other than 1750, the information should be made to Cone Drive to ensure proper bearing and oil level settings are defined.

Making a selection for your application

We look forward to serving you. Please phone us at 1-888-994-2663 for help specifying gear ratio, speed, duty cycle, and backlash. Or tell us about your application by faxing us the information below to 1-888-907-2663. Our dedicated teams are waiting for your call.

1. Application:
   - General type of application or machine.
   - Specific consideration; eg. positioning accuracy, shock loading, or self-locking.
2. Duty cycle:
   - Continuous or intermittent
     If continuous:
     - Hours per week

     If intermittent:
     - How many starts and stops per hour.
     - Average “on” time per hour.
3. Ratio and operating speed:
   - Variable or continuous speed input.
   - Preferred input speed.
   - Desired output speed.
4. Loading:
   - Horsepower or torque available or required for starting, running, and stopping.
   - General type of driving motor; eg. AC motor, servo motor, or hydraulic motor.
   - Special load classification; eg. shock loading, reversing, potential for emergency stops.
   - Unusually high inertia loading at the input or output shaft.
   - Overhung and/or thrust loading on shafts.
5. Environmental:
   - Any unusual environmental conditions such as high or low temperature, grit or other contaminants, or wet or spray exposure.
6. Configuration:
   - With or without a Cone Drive supplied drive motor.
   - Flange mounting provisions for the drive motor.
   - Solid or hollow output shaft.
   - Special modifications, dimensions, or features desired.

If Cone Drive is to provide the motor, please provide the following information:

1. Horsepower (HP)
2. RPM
3. Frame Size
4. Phase
5. Cycle (Hertz)
6. Voltage
7. Enclosure
8. Type
9. Design
10. Duty
11. Percent slip
12. Brake rating
13. Conduit box location when exact location is required (see view)

If customer is to furnish and mount the motor, please provide the following information so that the correct motor adaptor and coupling will be provided.

1. Horsepower (HP)
2. Frame size
3. Speed
4. Motor pilot diameter
5. Motor shaft dimensions
6. Brake rating (when units or motors are to be equipped with brakes having a torque rating that exceeds the unit or motor rating, the brake rating must be used to select unit size.
7. Complete coupling information (if alternate coupling is required and is not being furnished by Cone Drive)

Selection Procedure

The Procedure for Determining Speed Reducer Load Capacity is as Follows:

1. Determine the proper service factor by matching your duty requirements with the "Service Factor" chart in this section.

2. Determine the actual input horsepower required to drive the reducer. In case of operating worm speed under 100 RPM. use only output torque ratings. Multiply this horsepower or torque value by the appropriate service factor rather than adjust the ratings in the Catalog. This will give you the adjusted horsepower or torque required.

3. Find the ratio by dividing the speed of the input shaft by the speed of the output shaft.

4. Referring to the Selection guide in this section or the mechanical horsepower ratings charts in the Traditional Products Section, select a unit, at the given worm RPM and ratio, having a corresponding mechanical rating (or one slightly in excess) to the adjusted horsepower or torque.

5. Check the actual input horsepower to be transmitted (horsepower before applying service factor) against the thermal rating listed in the same table as in 4 above. The thermal rating defines the maximum horsepower which can be transmitted continuously (30 minutes or longer). This is based on an oil sump temperature rise of 100°F above ambient, and must not exceed 200°F. If the thermal rating is a lower value than the mechanical rating, choose the unit on the basis of the thermal rating. Exceptions to this rule are applications, where operation is intermittent and does not permit thermal build-up. For applications involving multiple cycles the average horsepower required should be compared with the thermal rating of the reducer. Where water-cooled units are used, thermal ratings can be obtained from our Traverse City, Michigan office; where fan cooled units are used, use the fan cooled thermal ratings shown on the fan cooled pages in the Traditional Products Section.

6. If either input or output shaft is connected to driver or driven mechanism other than by direct shaft coupling, calculate overhung load requirements (Chain Pull) by dividing the torque demand by the pitch radius of the sprocket, sheave, spur or helical gear used. Multiply by the following factor:

Type of Drive	Overhung Load Factor
Chain Sprocket	1.00
Spur or helical gearing	1.25
"V" belt sheave	1.50
Flat belt sheave	2.50

As modified by the applicable service factor, this load may not exceed the overhung load rating listed under Chain Pull in the HP. and Torque Ratings Tables. The Chain Pull figures are based on the center of the load being no further from the centerline of the reducer than one-half the keyway length on the output shaft extension. When Chain Pull approaches full rated capacity as listed, use heat-treated foundation bolts (150,000 PSI tensile strength).

7. Cone Drive's Application Engineering Department is available to assist you with selection of the reducer for your application. Computer programs and technical personnel are available to discuss your application. We invite you to forward all pertinent data to Cone Drive's Traverse City, Michigan office or your local representative for our full review and selection assistance.

Horsepower, Speed and Torque Relationship

Formula 1: $P = \frac{T_w n}{63{,}000}$

Formula 2: $T_w = \frac{P \cdot 63{,}000}{n}$

Formula 3: $T_G = T_w \cdot m_G \cdot \eta$

Definitions

M_G = gear ratio $\frac{N_G}{N_w}$

n = rotational speed of worm (rpm)

P = power input to worm (Horsepower)

T_w = input torque (inch pounds)

T_G = output torque (inch pounds)

η = efficiency (percent)

Service Factors (Duty Cycle)

Service Factors

Duty Cycle	Hours/Day	Uniform	Moderate Shock	Heavy Shock	Extreme Shock
	1/2	0.8	0.9	1.0	1.2
	2	0.9	1	1.2	1.3
	10	1	1.3	1.5	1.7
	24	1.3	1.5	1.7	2

For continuous operation thermal ratings must be considered.
See Rating Charts in reducer section.

Example 1
10 HP 1750 RPM motor input, 10 hr per day service with moderate shock loading. This requires a **1.3 service factor**. Selection of a reducer from the Mechanical HP ratings charts is based on 10 HP x 1.3 = 13.00 HP. Thermal ratings shown in the ratings charts must be adequate for 13 HP input.

Example 2
5 HP 1750 RPM motor input, uniform loading operating approximately 2 hour per day. This requires a 0.9 service factor. Selection of a reducer from mechanical HP ratings charts in based on 5 HP * 0.9 =4.5 Hp. Thermal consideration is not required.

Cone Drive Worm Gears Work in Any Environment

Cone Drive double-enveloping worm gear reducers are operating in extreme environments all over the world.

Here are more examples:

- **Food Processing and Chemical Mixing**
  The reducer is designed to withstand corrosion and protect the mixture from contamination.
- **Coal Mining**
  Feeder breaker drives are built to survive the dust, dirt, grim and shock loads, and do it all in a severely limited space.
- **Marine Applications**
  Naval ship capstans and winches driven by Cone Drives shed the effects of salt water spray.
- **Taconite and Phosphate Handling**
  Cone Drive has solved the problem of fine dust working its way into gearboxes, which can contaminate lubricants and ruin gear sets.

Efficiency

The values shown in the following table are approximate. Overall Reducer efficiencies which have been determined and substantiated by extensive dynamometer testing. They are for a complete reducer and include all losses within the unit from oil churning, oil seals and bearings. The efficiencies shown are based on the catalog ratings with the unit at normal operating temperature and with an approved lubricant. Varying conditions such as extremely cold or hot ambient temperatures, and excessively high or low loading will affect the efficiency of the reducer. **If the reducer is required to start under load, consideration must be given to the starting efficiency, which would be less than the running efficiency.** For additional information on efficiency under abnormal temperatures and loading and for starting efficiencies, please contact Cone Drive.

Efficiency (Percent) - Single Reduction

SIZE	RPM	RATIO									
		5	10	15	20	25	30	40	50	60	70
20 thru 35	1750	92	90	88	85	84	80	76	73	70	69
	1150	92	90	88	84	84	80	76	73	70	69
	870	92	89	87	83	83	79	75	72	69	68
	580	91	87	85	83	81	75	72	70	66	65
	300	91	86	82	78	77	72	67	64	61	60
	200	90	85	81	77	75	70	63	60	59	58
	100	89	83	79	75	71	68	61	54	53	52
40 thru 80	1750	95	93	91	88	87	83	79	76	73	72
	1150	95	93	91	87	87	83	79	76	73	72
	870	95	92	90	86	86	82	78	75	72	71
	580	94	90	88	86	84	78	75	73	69	68
	300	94	89	85	81	80	75	70	67	64	63
	200	93	88	84	80	78	73	66	63	62	61
	100	92	86	82	78	74	71	64	57	56	55
100 thru 150	1750	97	95	93	90	89	85	81	78	75	74
	1150	97	95	93	89	89	85	81	78	75	74
	870	97	94	92	88	88	84	80	77	74	73
	580	96	92	90	88	86	80	77	75	71	70
	300	96	91	87	83	82	77	70	69	66	65
	200	95	90	86	82	80	75	68	65	64	63
	100	94	88	84	80	76	73	66	59	58	57
180 thru 280	1750	97	95	95	93	89	85	81	78	75	74
	1150	97	95	93	89	89	85	81	78	75	74
	870	97	94	92	88	88	84	80	77	74	73
	580	96	92	90	88	86	80	77	75	71	70
	300	96	91	87	83	83	77	72	69	66	65
	200	95	90	86	82	80	75	68	65	64	63
	100	94	88	84	80	76	73	66	59	58	57

The overall efficiency of the above units is equal to the product of the efficiencies of each stage at the input speed to that stage.

Double reduction overall efficiency = Primary efficiency x secondary efficiency.

Triple reduction overall efficiency = Primary efficiency x secondary efficiency x tertiary efficiency.

Helical/worm overall efficiency = .97 x worm gear efficiency.

Gearmotor overall efficiency = .97 x worm gear efficiency.

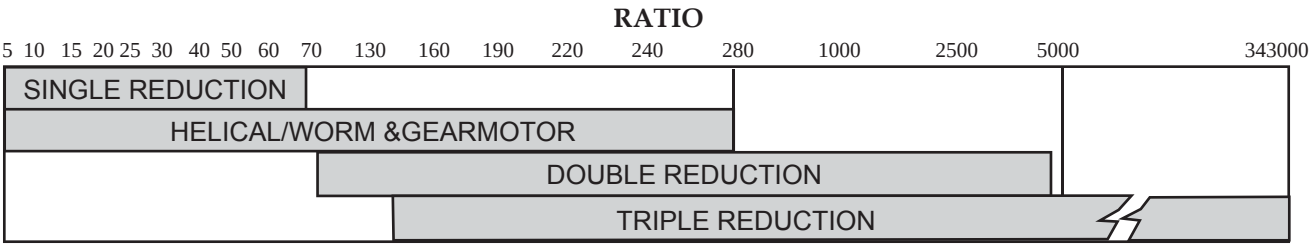
Note: (1) Helical gearing efficiency equals approximately 97% regardless of speed or ratio. (2) Efficiency for worm gearing is determined at the speed the worm is operating.

Example: Size 30-60 reducer 225:1 ratio operating at 1750 RPM input speed. The 15:1 ratio primary efficiency is 88% at 1750 RPM. The 15:1 ratio secondary efficiency is 83% at 117 RPM. Overall efficiency is 88% x 83% = 73%.

Selection Guide

The table below illustrates the range of standard available reations which can be provided on each type of reducer.

Cone Drive speed reducers are availalble in six basic combinations.
1. Single reduction worm gear reducers. See pages 32 - 65
2. Double reduction worm gear reducers. See pages 78 - 105
3. Gearmotors. See pages 146 - 163
4. Helical/worm speed reducer. See pages 118 - 135



When input and output shaft speeds are calculated and motor horse power is known, the selection charts presented on the following pages may be used as a guide to rapidly approximate the size and type of reducer required. Refer to pages 114 - 116 for triple reduction units.

To use these charts, read across the output speed line to the motor horsepower column, on the appropriate input rpm chart. The number presented is the approximate size Cone Drive speed reducer recommended. Refer then to this size and type reducer in the individual unit rating tables on pages 32 through 163.

*This selection guide is based on Class 1 mechnical horsepower ratings only. Thermal capacity must be considered.

SINGLE REDUCTION REDUCER 1750 RPM

MINIMUM REDUCER SIZE FOR INPUT FOR INPUT HORSEPOWER SHOWN BASED ON MECHANICAL H.P. RATING*

OUTPUT SPEED	RATIO	MOTOR HORSEPOWER												
		1	1.5	2	3	5	7.5	10	15	20	25	30	50	75
350.0	5	15	15	15	20	25	25	30	35	35	40	40	50	60
175.0	10	15	15	20	20	25	30	30	35	40	50	50	60	70
116.7	15	15	15	20	25	30	30	35	40	50	50	50	70	80
87.5	20	15	20	25	25	30	35	35	40	50	50	60	70	80
70.0	25	20	20	25	25	30	35	40	50	50	60	60	80	100
58.3	30	20	25	25	30	35	40	40	50	60	60	70	80	100
43.7	40	20	25	30	30	35	40	50	60	70	70	80	100	120
35.0	50	25	25	30	35	40	50	50	60	70	80	80	100	120
29.2	60	25	30	30	35	40	50	60	70	80	80	100	120	-
25.0	70	-	-	50	50	50	50	60	70	80	100	100	120	-

SINGLE REDUCTION REDUCER 1150 RPM

MINIMUM REDUCER SIZE FOR INPUT FOR INPUT HORSEPOWER SHOWN BASED ON MECHANICAL H.P. RATING*

OUTPUT SPEED	RATIO	MOTOR HORSEPOWER												
		1	1.5	2	3	5	7.5	10	15	20	25	30	50	75
230.0	5	15	15	20	20	25	30	30	35	40	40	50	60	70
115.0	10	15	15	20	25	30	30	35	40	50	50	50	60	70
76.7	15	15	15	20	25	30	35	35	40	50	50	60	70	80
57.5	20	15	20	25	25	30	35	40	50	50	60	60	80	100
46.0	25	20	25	25	30	35	40	50	50	60	60	70	80	100
38.3	30	20	25	25	30	35	40	50	50	60	70	70	100	100
28.8	40	25	25	30	35	40	50	50	60	70	80	80	100	120
23.0	50	25	30	30	35	40	50	60	70	80	80	100	100	120
19.2	60	25	30	35	35	50	50	60	70	80	100	100	120	150
16.4	70	-	-	50	50	50	60	70	80	80	100	100	120	-

HELICAL / WORM REDUCER, 1750 RPM
GEARMOTOR & DOUBLE REDUCTION REDUCER

MINIMUM REDUCER SIZE FOR INPUT HORSEPOWER SHOWN BASED ON MECHANICAL H. P. RATING*

Output Speed	Ratio		Motor Horsepower											
			1	2	3	5	7.5	10	15	20	25	30	50	70
350	5	1 x 5	25	25	25	25	30	30	35	35	50	50	50	70
233.3	7.5	1.5 x 5	25	25	25	25	30	35	35	40	50	50	70	70
194.4	9	1.8 x 5	25	5	25	25	30	35	35	50	50	50	70	70
175	10	1 x 10	25	25	25	30	35	35	50	50	50	50	70	80
140	12.5	2.5 x 5	25	25	25	30	35	35	50	50	50	50	70	80
116.7	15	1.5 x 10	25	25	25	30	35	35	40	50	50	60	70	80
97.2	18	1.8 x 10	25	25	25	30	35	35	50	50	50	60	70	80
87.5	20	4 x 5	25	25	30	30	35	40	50	60	60	70	80	
77.8	22.5	1.5 x 15	25	25	30	35	35	40	50	50	60	70	80	
70	25	2.5 x 10	25	25	30	35	35	40	50	50	60	60		
58.3	30	1.5 x 20	25	25	30	35	40	50	50	60	70	70		
48.6	36	1.8 x 20	25	30	30	35	40	50	60	60	70	70		
43.8	40	4 x 10	25	30	30	35	40	50	50	60	70	70		
38.9	45	1.8 x 25	25	30	35	40	50	50	60	70	70	80		
35	50	2.5 x 20	25	30	35	40	50	50	60	70	70	80		
29.2	60	4 x 15	25	30	35	40	50	50	60	70	70	80		
24.3	72	1.8 x 40	30	35	40	50	60	60	70	80				
23.3	75	2.5 x 30	25	35	35	50	50	60	70	80	80			
		5 x 15	20-30	20-30	20-35	25-40	30-60	30-60	35-70	35-70	40-80	50-100	60-120	70-150
21.9	80	4 x 20	25	35	35	50	50	60	70	70	80			
19.4	90	1.8 x 50	30	35	40	50	60	70	80					
17.5	100	4 x 25	30	35	40	50	60	60	70	80				
		5 x 20	20-30	20-35	25-70	25-50	30-60	30-60	35-70	40-80	40-80	50-100	60-120	70-150
14.6	120	4 x 30	30	35	40	50	60	70	80					
14	125	5 x 25	20-30	20-35	25-40	25-50	30-60	30-70	40-80	40-80	50-100	50-100	60-120	70-150
11.7	150	10 x 15	20-30	20-35	25-40	30-60	30-60	35-70	40-80	50-100	50-100	50-100	70-150	70-150
10.9	160	4 x 40	35	40	50	60	70	70	80					
10	175	2.5 x 70	50	50	50	60	70	80						
8.8	200	4 x 50	35	50	50	60	70	80						
		10 x 20	20-35	25-40	25-50	30-60	35-70	35-70	40-80	50-100	50-100	60-120	70-150	80-180
7.8	225	15 x 15	20-35	25-40	25-50	30-60	35-70	40-70	50-100	50-100	60-120	60-120	70-150	
7.3	240	4 x 60	35	50	50	70	80	80						
7	250	10 x 25	20-35	25-50	30-60	30-70	30-70	40-80	50-100	50-100	60-120	60-120	70-150	80-180
6.3	280	4 x 70	50	50	60	70	80							

Note: *Sizes shown not shaded are for helical/worm reducers and gear motors. Sizes shaded are for double reduction worm gear speed reducers.*

DOUBLE REDUCTION REDUCER 1750 RPM

MINIMUM REDUCER SIZE FOR INPUT HORSE POWER SHOWN BASED ON MECHANICAL H.P. RATING*

Output Speed	Ratio		MOTOR HORSEPOWER											
			1	2	3	5	7.5	10	15	20	25	30	50	75
5.8	300	15X20	20-35	25-50	25-50	30-60	35-70	40-80	50-100	50-100	60-120	60-120	70-150	
5	350	5X70	25-50	25-50	30-60	30-70	40-80	50-100	60-120	60-120				
4.7	375	15X25	25-40	25-50	30-60	30-70	50-100	50-100	50-100	60-120	60-120	60-120	70-150	
4.4	400	20X20	25-40	25-50	30-60	35-70	40-80	50-100	50-100	60-120	60-120	70-150	80-180	
3.9	450	15X30	25-40	25-50	30-60	30-70	50-100	50-100	60-120	60-120	60-120	70-150	80-180	
3.5	500	20X25	25-40	25-50	30-60	35-70	40-80	50-100	50-100	60-120	70-150	70-150	80-180	
2.9	600	20X30	25-40	30-60	30-60	40-80	50-100	50-100	60-120	70-150	70-150	70-150	80-180	
2.8	625	25X25	25-50	30-60	30-70	40-80	50-100	50-100	60-120	60-120	70-150	70-150		
2.5	700	10X70	25-50	30-60	30-70	50-100	50-100	60-120						
2.3	750	25X30	25-50	30-60	30-70	40-80	50-100	50-100	60-120	70-150	80-180	80-180		
2.2	800	20X40	25-50	30-60	35-70	40-80	50-100	60-120	70-150	70-150	70-150	80-180		
1.9	900	30X30	25-50	30-70	35-70	50-100	50-100	50-100	70-150	70-150	70-150	80-180		
1.8	1000	40X25	25-50	30-70	35-70	50-100	50-100	60-120	70-150	70-150	80-180			
1.7	1050	15X70	30-60	30-70	40-80	50-100	60-120	60-120	80-180					
1.5	1200	40X30	25-50	30-70	40-80	50-100	60-120	60-120	70-150	70-150	80-180			
1.4	1250	50X25	25-50	35-70	40-80	50-100	60-120	60-120	70-150	80-180				
1.3	1400	20X70	30-60	40-80	50-100	50-100	60-120	70-150	80-180					
1.2	1500	50X30	30-60	35-70	50-100	50-100	60-120	70-150	70-150	80-180				
1.1	1600	40X40	30-60	40-80	50-100	50-100	60-120	70-150	70-150	80-180	80-180			
1.0	1750	30-70	30-70	40-80	50-100	50-100	60-120	70-150	80-180					
.97	1800	30-60	30-70	40-80	50-100	60-120	60-120	70-150	80-180					
.88	2000	50X40	30-60	40-80	50-100	60-120	70-150	70-150	80-180	80-180				
.83	2100	30X70	30-70	50-100	50-100	60-120	60-120	70-150	80-180					
.73	2400	40X60	30-70	50-100	50-100	60-120	70-150	70-150	80-180					
.70	2500	50X50	30-70	50-100	50-100	60-120	70-150	70-150	80-180					
.63	2800	40X70	30-70	50-100	50-100	60-120	70-150	70-150	80-180					
.58	3000	30-70	30-70	60-120	60-120	60-120	70-150	80-180	80-180					
.50	3500	50X70	40-80	50-100	60-120	70-150	70-150	80-180						
.49	3600	60X60	40-80	50-100	60-120	70-150	70-150	80-180						
.42	4200	60X70	40-80	50-100	60-120	70-150								
.36	4900	70X70	50-100	60-120	60-120									

*This selection guide is based on mechanical H. P. ratings only. Thermal capacity must be considered.

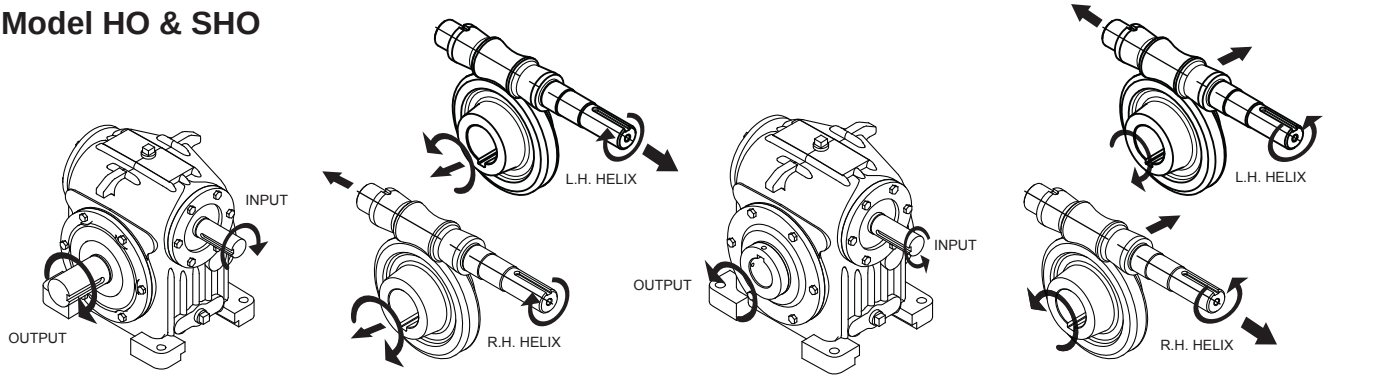
Cone Drive Shaft Rotation and Thrust Direction

Shaft rotations shown for standard right hand and left hand helix gear sets.

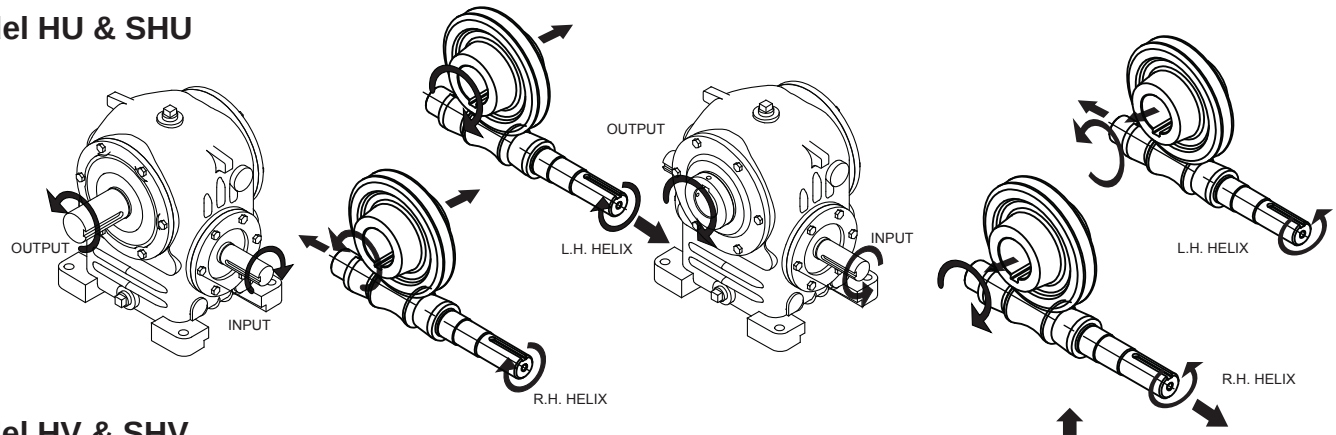
Many ratios can be furnished with left hand helix, see section G tool charts and under additional ratios for availability and tool numbers.

When a reducer is built with a left hand helix gear set the output shaft will rotate in opposite direction shown for a right hand helix gear set.

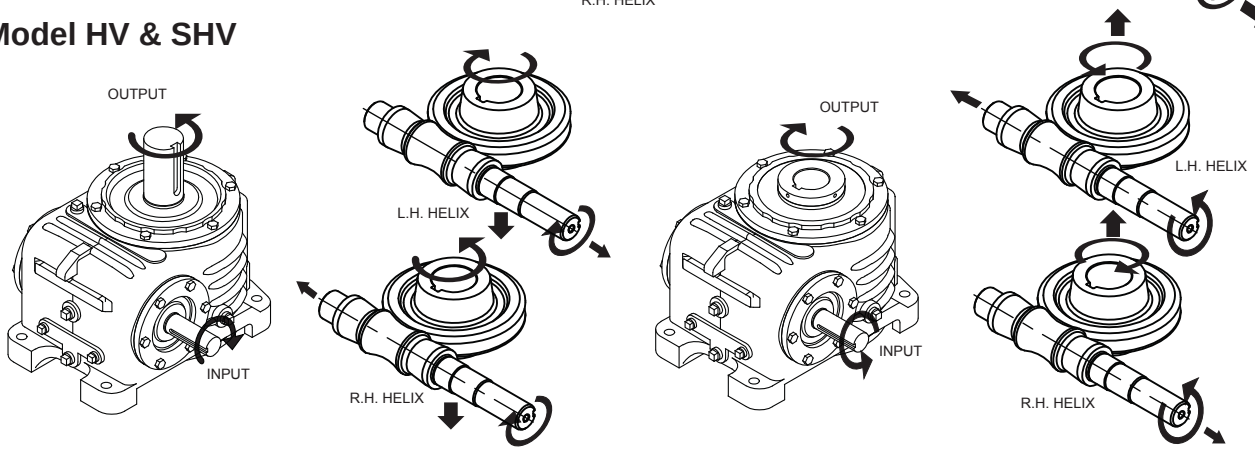
Model HO & SHO



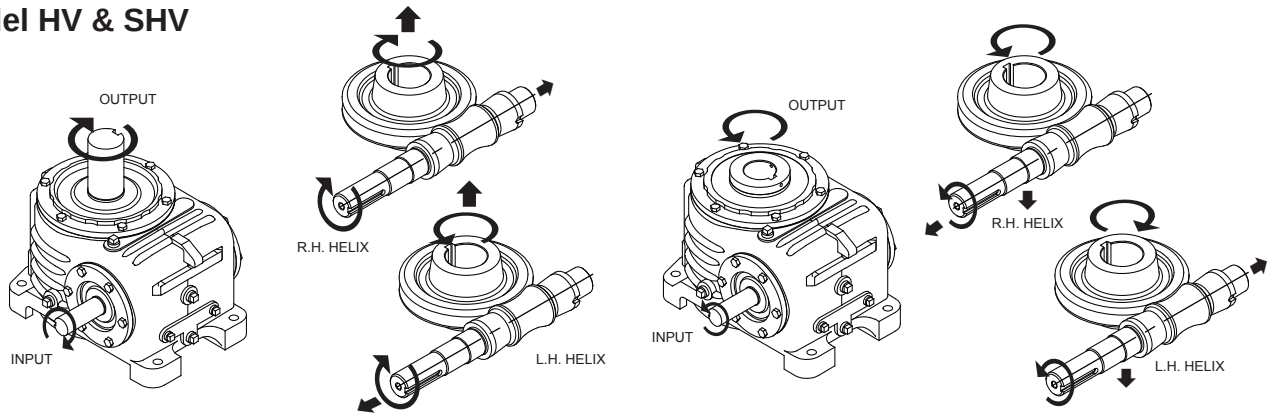
Model HU & SHU



Model HV & SHV



Model HV & SHV



WK² Rotational Inertia of Moving Parts (LB-IN²)

REFERRED TO HIGH SPEED SHAFT
Single Reduction Worm - **Solid** Low Speed Shaft
Single Extended High and Low Speed Shafts

Ratio	UNIT SIZE															
	15	20	25	30	35	40	50	60	70	80	100	120	150	180	220	240
4															15700	
5	0.116	0.532	1.06	2.62	5.80	9.86	20.2	52.0	102	168	547	1160	2000	5550		17300
5 5/8															8800	
7															6300	
8														3180		9040
10	0.096	0.365	0.772	1.80	3.36	6.52	12.6	29.5	48.4	92.2	313	590	1000	2640	4000	
14															2910	
15	0.092	0.334	0.719	1.65	2.90	5.90	11.2	25.3	38.4	78.0	270	484	818	2100		5270
20	0.091	0.323	0.700	1.59	2.74	5.69	10.7	23.9	34.9	73.0	254	447	753	1910	2340	4620
25		0.318	0.691	1.57	2.67	5.59	10.5	23.2	33.3	70.7	247	430	723	1820	2140	4310
30	0.090	0.315	0.687	1.55	2.63	5.53	10.3	22.8	32.4	69.5	244	421	707	1770	2030	4150
40	0.090	0.313	0.682	1.54	2.59	5.48	10.2	22.5	31.5	68.2	240	412	691	1730	2030	3980
50	0.089	0.311	0.680	1.53	2.57	5.45	10.2	22.3	31.1	67.7	238	408	683	1710	1920	3910
60	0.089	0.311	0.678	1.53	2.56	5.44	10.1	22.2	30.9	67.4	237	405	679	1690	1870	
70							10.1	22.2	30.8	67.2	237	404				

ADDITIONAL WK FOR DOUBLE EXTENDED WORM (HIGH SPEED SHAFT) (ADD DIRECTLY TO ABOVE FIGURES)

15	20	25	30	35	40	50	60	70	80	100	120	150	180	220	240
0.008	0.017	0.028	0.103	0.241	0.727	0.775	1.62	3.11	3.94	5.74	16.5	36.5	80.0	165	309

ADDITIONAL WK FOR DOUBLE EXTENDED SOLID GEARSHAFT (LOW SPEED SHAFT)
DIVIDE FIGURE BY SQUARE OF RATIO AND ADD TO ABOVE FIGURES

15	20	25	30	35	40	50	60	70	80	100	120	150	180	220	240
0.013	0.116	0.189	0.511	1.29	4.05	7.83	18.2	27.7	31.69	60.4	332	772	1580	3910	6650

Single Reduction Worm - Hollow Low Speed Shaft
Single Extended High and Low Speed Shafts

RATIO	UNIT SIZE										
	20	25	30	35	40	50	60	70	80	100	120
5	0.565	1.40	3.99	7.58	12.8	27.5	64.4	133	206	518	1170
10	0.373	0858	2.14	3.80	7.25	14.4	32.6	56.1	102	306	593
15	0.337	0.757	1.80	3.10	6.23	12.0	26.7	41.8	82.1	266	486
20	0.325	0.722	1.68	2.86	5.87	11.21	24.6	36.8	75.3	253	448
25	0.319	0.705	1.62	2.74	5.70	10.8	23.7	34.5	72.2	246	431
30	0.316	0.696	1.59	2.68	5.61	10.6	23.2	33.2	70.4	243	421
40	0.313	0.687	1.56	2.62	5.53	10.3	22.7	32.0	68.8	239	412
50	0.312	0.683	1.55	2.59	5.48	10.2	22.4	31.4	68.0	238	408
60	0.311	0.681	1.54	2.58	5.46	10.2	22.3	31.1	67.5	237	405
70						10.2	22.2	30.9	67.3	236	404

ADDITIONAL WK2 FOR DOUBLE EXTENDED WORM (HIGH SPEED SHAFT)
ADD DIRECTLY TO ABOVE FIGURES

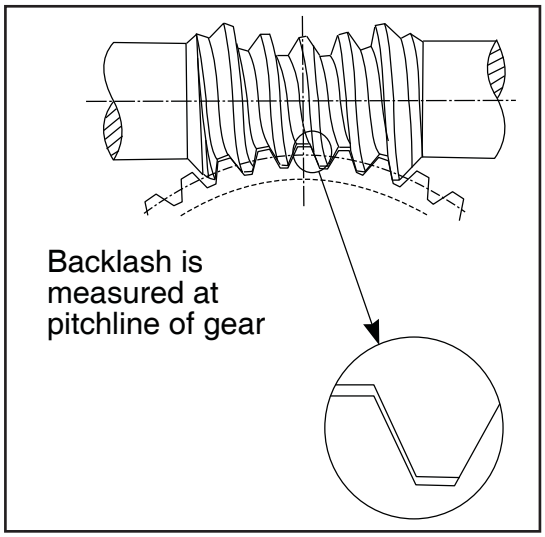
20	25	30	35	40	50	60	70	80	100	120
.0017	0.028	0.103	0.241	0.727	0.775	1.62	3.11	3.94	5.74	16.5

**ROTATIONAL INERTIAS LISTED DETERMINED AT HIGH SPEED SHAFT AND INCLUDE ALL MOVING PARTS IN STANDARD REDUCERS.*
DOUBLE REDUCTION INERTIA AT HIGH SPEED SHAFT = SECONDARY WK²/(PRIMARY RATIO)²+ PRIMARY WK².
CONVERT FIGURES TO LB-IN-SEC² BY DIVIDING BY 386 IN/SEC² (GRAVITY).

For Extra Precision…
Cone Drive's Low Backlash Gearing

The inherent accuracy of Cone Drive's standard product line fulfills a broad range of precision drive requirements. But, for those applications that demand more precision we have a low backlash gear set to suit your needs. As Cone Drive's manufacturing processes lend themselves to generating precision gearing, these low backlash gear sets and reducers can be obtained at very little additional expense.

A standard Cone Drive gear unit provides about half the backlash of other standard gear units. Cone Drive also offers low backlash and zero backlash gearing.



Measuring Backlash:

Backlash is measured at the pitchline of the gear by rotating the output shaft while holding the input shaft stationary. Bearings are set at zero end play for measurement, then adjusted afterwards according to loading, speed and duty cycle.

Double Enveloping:

Cone Drive's unique double-enveloping worm gear sets are double throated. This allows each element to envelop the other to provide area contact between the worm and gear. This design provides more output torque than cylindrical worm gearing for a given center distance. Double enveloping worm gearing also provides multiple tooth contact which will substantially reduce wear and allow extended life of the gear set.

Zero Backlash Gear Set** **.000"**
Low Backlash Gear Set* **(refer to page 17)** **.000" — .002"** **for Unit Size 15-80**
Assembled Reducer* **with Low Backlash Gear Set** **(refer to page 17)** **.000 — .004"**

* at pitchline of gear.

•• does not include worm bearing end play.

Cone Drive's Low Backlash Gear Sets and Reducers offer:

- Accuracy
- Minimum Backlash
- Smooth Motion

Application Assistance:

To assure optimum performance, Cone Drive's application engineers are available to provide further explanations of precision characteristics under operating conditions. All reducers provided with low backlash gear sets require a review of loading speed and duty cycle so that bearings and lubrication can be given proper consideration.

Backlash

The following chart lists the backlash for standard reducers. Backlash is defined as the amount of movement at the pitch line of the gear with the worm locked and the gear set on exact center distance. When the gear set is assembled into a machine or reducer, the assembled backlash may fall outside of the limits shown in the table depending on worm and gear bearing looseness, and the actual center distance on which the gear set is mounted. Backlash is measured at the pitch line of the gear and is not dependent on ratio. Backlash is generally not measured at the worm because the amount of rotation of the worm with gear locked is a function of ratio.

Standard Backlash

SIZE	RPM INPUT											
	100-499			500-999			1000-2000			2001-3000		
	INCHES	DEGREES	ARC MINUTES	INCHES	DEGREES	ARC MINUTES	INCHES	DEGREES	ARC MINUTES	INCHES	DEGREES	ARC MINUTES
15	0.009	0.44	26	0.009	0.44	26	0.011	0.54	32	0.012	0.59	35
20	0.009	0.32	19	0.009	0.32	19	0.011	0.40	24	0.013	0.47	28
25	0.009	0.26	16	0.009	0.26	16	0.011	0.32	19	0.013	0.38	23
30	0.009	0.22	13	0.009	0.22	13	0.011	0.26	16	0.013	0.31	19
35	0.010	0.20	12	0.010	0.20	12	0.012	0.25	15	0.014	0.29	17
40	0.010	0.18	11	0.011	0.20	12	0.013	0.23	14	0.015	0.27	16
50	0.011	0.16	9	0.012	0.17	10	0.014	0.20	12	0.016	0.23	14
60	0.012	0.14	9	0.013	0.16	9	0.015	0.18	11	0.017	0.20	12
70	0.013	0.13	8	0.015	0.15	9	0.018	0.18	11	0.019	0.19	12
80	0.014	0.12	7	0.016	0.14	8	0.019	0.17	10	0.020	0.18	11
100*	0.024	0.17	10	0.024	0.17	10	0.024	0.17	10	0.024	0.17	10
120*	0.026	0.15	9	0.026	0.15	9	0.026	0.15	9	0.026	0.15	9
150*	0.030	0.15	9	0.030	0.15	9	0.030	0.15	9	0.030	0.15	9
180*	0.030	0.12	7	0.030	0.12	7	0.030	0.12	7	0.030	0.12	7
220*	0.031	0.10	6	0.031	0.10	6	0.031	0.10	6	0.031	0.10	6
240*	0.036	0.11	7	0.036	0.11	7	0.036	0.11	7	0.036	0.11	7
280*	0.036	0.09	5	0.036	0.09	5	0.036	0.09	5	0.036	0.09	5

Nominal Backlash values in inches, degrees, and arcminutes for standard backlash reducers.
Backlash in inches is measured at pitch line.
**This worm is mounted in a type TDO double locked up tapered roller bearing with a fixed spacer which can be ground to reduce end play for low speeds. Contact Cone Drive.*

SIZE	RPM INPUT											
	100-499			500-999			1000-2000			2001-3000		
	INCHES	DEGREES	ARC MINUTES	INCHES	DEGREES	ARC MINUTES	INCHES	DEGREES	ARC MINUTES	INCHES	DEGREES	ARC MINUTES
15	0.003	0.15	9	0.003	0.15	9	0.005	0.24	15	0.006	0.29	18
20	0.003	0.11	6	0.003	0.11	6	0.005	0.18	11	0.007	0.25	15
25	0.003	0.09	5	0.003	0.09	5	0.005	0.15	9	0.007	0.20	12
30	0.003	0.07	4	0.003	0.07	4	0.005	0.12	7	0.007	0.17	10
35	0.003	0.06	4	0.003	0.06	4	0.005	0.10	6	0.007	0.14	9
40	0.003	0.05	3	0.004	0.07	4	0.006	0.11	6	0.008	0.14	9
50	0.003	0.04	3	0.004	0.06	3	0.006	0.09	5	0.008	0.11	7
60	0.003	0.04	2	0.004	0.05	3	0.006	0.07	4	0.008	0.10	6
70	0.003	0.03	2	0.005	0.05	3	0.008	0.08	5	0.009	0.09	6
80	0.003	0.03	2	0.005	0.04	3	0.008	0.07	4	0.009	0.08	5
100*	0.012	0.08	5	0.012	0.08	5	0.012	0.08	5	0.012	0.08	5
120*	0.012	0.07	4	0.012	0.07	4	0.012	0.07	4	0.012	0.07	4
150*	0.012	0.06	4	0.013	0.06	4	0.013	0.06	4	0.013	0.06	4
180*	0.012	0.05	3	0.013	0.05	3	0.013	0.05	3	0.013	0.05	3
220*	0.012	0.04	2	0.013	0.04	2	0.013	0.04	2	0.013	0.04	2
240*	0.012	0.04	2	0.013	0.04	2	0.013	0.04	2	0.013	0.04	2
280*	0.012	0.03	2	0.013	0.03	2	0.013	0.03	2	0.013	0.03	2

Nominal Backlash values in inches, degrees, and arcminutes for low backlash reducers.
Backlash in inches is measured at pitch line.
*This worm is mounted in a type TDO double locked up tapered roller bearing with a fixed spacer which can be ground to reduce end play for low speeds. Contact Cone Drive.

Horsepower, Speed and Torque Relationship

Formula 1: $P = \frac{Twn}{63{,}000}$

Formula 2: $Tw = \frac{P \cdot 63{,}000}{n}$

Formula 3: $TG = Tw \cdot mG \cdot n$

Definitions

mG = gear ratio $\frac{NG}{Nw}$

n = rotational speed of worm (rpm)

P = power input to worm (horsepower)

Tw = input torque (inch pounds)

Tg = output torque (inch pounds)

n = efficiency (percent)

Example 1

Select a reducer for a conveyor.

Service 8-10 hours per day
5 hp motor at 1750 rpm
43.75 rpm output speed
6.74 inch diameter chain sprocket on output shaft.

Unit to be a vertical reducer with output shaft through a feet side. wall mounted. right hand assembly, worm over gear and extended to the right.

Application is a uniformly loaded conveyor to be operated 10 hours a day. From the Service Factor Chart we find that this qualifies for a 1 service factor.

The driver is a 5 hp motor, operating at 1750 rpm. Since the service factor in this case is 1, we need not determine the adjusted horsepower requirement. since the worm speed is over 100 rpm, we use the input horsepower rating rather than the output torque.
Our conveyor shaft must have a speed of 43.75 rpm. We divide 1750 (rpm of input shaft) by 43.75 (rpm of output shaft) to get a reduction of 40 to 1.
From the Rating Tables we find that a standard size 35, 40:1 ratio speed reducer will transmit 5.6 hp, at 1750 rpm.

Also we find that the size 35, 40:1 ratio unit will have a fan thermal hp rating of 5.6 hp at 1750 rpm. Since the actual power to be transmitted is 5 hp at 1750 rpm, the unit will be adequate to handle the applied load.

However, the output shaft is connected with a chain drive sprocket having a pitch diameter of 6.74 inches or a radius of 3.37 inches. The efficiency of 79% is found on page 10. The torque load on the outupt shaft is found, from formulae 2 and 3 to be

$$\frac{63000 \times 5 \text{ hp} \times .79 \times 40}{1750}$$

which gives us a torque load on the sprocket of 5688 in. -lbs.

Overhung load = $\frac{\text{torque}}{\text{sprocket radius}}$ or $\frac{5688}{3.37}$

for a required chain pull capacity of 1688 lbs. In the rating tables the size 35, 40:1 speed reducer we have chosen has a chain pull rating of 3500 lbs. , more than sufficient for the job.

To order this reducer proceed as follows:
Specify quantity required. model disignation, size, mounting position designation as selected from the hand of assembly and mounting position pages, then the ratio and loading requirements of horsepower speed and service factor. Example: FHV 35-Z8B, 40:1 ratio, 5 hp at 1750 rpm service factor 1, conveyor drive.

Example 2
Application is an intermittent positioner drive, operating one hour per day at service factor of 0.8. The unit must deliver 72500 in. lbs. at 23 rpm. The adjusted output torque is 72,500 x 0.8 = 58,000 in lbs. With a motor speed of 1150, the ratio required is 1150/23 = 50:1.

Referring to the rating tables we find that a size 80, 50:1 ratio unit at 1150 rpm has an output torque rating of 59,905 in.-lbs. This is the smallest size unit meeting the adjusted output torque requirement.

The required input hp to produce the 72,500 in.-lbs. output torque is found using formulae 1,2 and 3. The estimated operating efficiency of 76% is taken from the table on page 10. Thus the motor size nearest our requirement is 25 hp at 1150 rpm, which will be adequate due to the intermittent cycle of the application. the thermal capacity of this unit is 13.3 hp, which we have been able to disregard due to the intermittent service.

In selecting the reducer, refer to size 80, section 2 which shows three styles of standard reducers. We have determined that a worm-under unit is the most suitable. The unit description would therefore, be HU 80, then shaft arrangement from the hand of assembly and mounting position pages, followed by the ratio 50:1, 25 hp at 1150 rpm, service factor slope mounted, send sketch or detailed description.

Should the application be continous the thermal HP rating would dictate either a larger unit or additional cooling.

Example 3
Select a speed reducer to drive a vertical bucket hoist, operating 8 hours per day at multiple cycles. This requires a 1 Service Factor.

The following are the load and operating conditions:

3000# Line load on hoist
800# Weight of bucket
300# Weight of chain or cable
400# Add 10% for friction
4500# Total load to be raised
12.44" Drum diameter = 39.07"
Circumference
19 FPM lifting speed
Service-8 hours per day...uniform load
Output or drum RPM=$\frac{19 \times 12}{39.07}$ =5.8 rpm
Output torque required =
$\frac{4500\# \times 12.44}{2}$ = 28,000 in.-lbs.
Total reduction, using a 1750 rpm motor, would be $\frac{1750}{5.8}$ = 302:1 ratio
The high ratio indicates a double reduction reducer would be necessary with a 1750 rpm motor. Referring to the double-reduction reducer ratings, we would select a 300 to 1 ratio, providing a 5.83 rpm output speed.

Checking the output torque rating. we find that unit size 25-50 has a catalog rating of 35,830 in.-lbs., which would handle the load requirement of 28,000 in.-lbs., using a 5 hp, 1750 rpm motor. This is determined by knowing that an input horsepower of 4.8 will deliver 35,830 in.-lbs. O.T. Thus we require (4.8 x 28,000) / 35,830 or 3.75 hp.

The 4500 lbs. load is going to be hung on the output shaft, such that the load is at the center of the keyway. We can check the ability of the unit to handle this "chain pull" by referring to the ratings in single-reduction reducer section under size 50 and 20:1 ratio.

The input rpm to the secondard unit would be 1750 divided by the primary ratio or approximately 100 rpm. A quick check of the chain pull rating tells us that we have a capacity of 7,180 lbs. at 100 rpm.
Our requirement is
Chain Pull = (28,000 / 6.22) or 4,500 lbs.

Chain pull is satisfactory. If the chain pull had exceeded the allowable of 7,180 lbs., an outboard bearing on an extended output shaft would have solved the problem.

If the drum is to be mounted on the output shaft. such that that load of chain pull concentration is further away from the reducer than half the length of the standard gearshaft keyway, the problem should be referred to our Engineering Department for further investigation.

If the drum is to be connected to the reducer by means of a flexible coupling. no consideration need be given to the question of "chain pull" because the load is applied as torque only.

If other than 8-hour-per-day uniform service is to be applied, the correct service factor should be selected from the service factor char, and the size required refigured.

You will find the double reduction unit available in several configurations and shaft extensions. This application requires a primary having worm (input) over gear, and a secondary unit with worm under gear (model OU). This unit s to be supplied with a single extended input and output shaft. It is therefore necessary to specify these requirements. See the notes on dimension sheets, and the hand of assembly and mounting position pages.

To order the reducer proceed as follows:
Specify quantity required model designation, size, hand of assembly and mounting position, plus overall ratio and loading requirements.

Example:
1 OU 25-50 A1, 300: 1 ratio, 5 hp at 1750 rpm, service factor 1, bucket hoist.

General Information

Proper Application of Cone Drive Products

Cone Drive products, including gear sets and reducers, are designed and built to rigorous specifications. However, Cone Drive must have adequate application information in order to properly design and build products which meet the needs of its customers.

Consequently, in any applications of Cone Drive products where breakage, damage, disconnection, any other malfunction of any drive train component, or excessive wear could result in personal injury or property damage, a fail-safe device capable of stopping and holding the load in the event of such an occurrence must be incorporated after the drive train.

Cone Drive reserves the right to specify minimum service factors, stress levels, speed limitations, etc. for drives of this nature and will not be responsible for applications of our products that have not been reviewed or approved in writing prior to installation or for products installed or used in a manner different than originally specified by the customer.

Ratings

Cone Drive speed reducers and gear sets are designed and rated in accordance with American Gear Manufacturers Association specifications 6030-C87 and 6017-E86. Ratings for standard reducers as well as standard and special gear sets are shown in this catalog. These ratings allow for starting and **momentary** peak overloads of up to 300% of the catalog rating (service factor = 1). Ratings for worm speeds above 100 RPM not shown in the tables may be obtained by direct interpolation. The output torque ratings for worm speeds of 100 RPM or less are considered to be constant. Horsepower ratings for ratios, sizes, or speeds not shown in the catalog may be obtained by contacting Cone Drive or by calculation using the above AGMA specifications.

The thermal power rating of a speed reducer is the maximum allowable continuous input power with the reducer running in a 100°F ambient condition. The maximum permissible internal operating temperature is 200°.

The thermal power rating can often be increased with optional water cooling coils or external heat exchanger. In cases of unusually high or low ambient temperatures, please consult Cone Drive Engineering for assistance.

Self-Locking

It is a common misconception that all worm gears are self-locking or non-overhauling. Actually, worm gear ratios up to 15:1 will overhaul quite freely. Ratios from 20:1 to 40:1 can generally be considered as overhauling with difficulty (particularly from rest). Ratios above 40:1 may or may not overhaul depending on loading, lubrication and the amount of vibration present. Cone Drive cannot guarantee any worm gear ratio to be self-locking. There have been instances where single reduction ratios as high as 100:1 have overhauled. Therefore, it is not acceptable to rely on a worm gear to prevent movement in a system. Whenever a load must be stopped or held in place, a positive mechanical device must be incorporated into the system to prevent rotation of the gear set.

Backdriving or Overhauling

Applications such as wheel drives that require a brake on the motor or input shaft to decelerate a high inertial load require special attention to brake selection. Whenever possible, these applications should utilize freely overhauling ratios (15:1 or less). If self-locking ratios are used with a brake, the gear set can, under certain conditions, lock-up during decelerations and impose severe shock loading on the reducer and driven equipment. Each reduction should be limited to 15:1 or less to allow the reducer to overhaul. Contact Cone Drive for specific information on backdriving efficiency and brake selection.

Bearings

All standard Cone Drive reducers are furnished with antifriction bearings. When tapered roller bearings are used, axial endplay is built into the worm or gearshaft in accordance with the bearing manufacturer's recommendations for the specified operating speed and duty cycle. Typically, size 20 thru size 80 worm bearings will have from .003 to .007 axial endplay built in at assembly. This endplay will decrease as the unit approaches operating temperature. If we are not advised of the specific operating speed and duty cycle, the bearings will be set for continuous service at 1750 RPM input speed. If intermittent service is specified, bearing endplay will be reduced accordingly.

All standard output shaft mountings use tapered roller bearings. Overhung load (or chain pull) ratings shown in the single reduction ratings charts (see Traditional Products Section). The chain pull rating shown are the acceptable loads which can be applied to a standard solid output shaft (gearshaft) at the midpoint of the extension keyway length. The indicated load is that load which will produce a min. bearing (L10) life of 5000 hrs. or a shaft material limiting value, whichever is the limiting. Due to improved steel processing our tapered roller bearing supplier issued a rating supplement in late 1982 for many bearings up thru 7.125 in. bore increasing the basic radial rating (BRR). They have also introduced environmental factors (L10A) which are rating modifiers for operating temperature (ft) and viscosity (fv).

Our catalog chain pull ratings have not been revised at this time and will continue to be based on L-10 life calculations until such time as the effect of the new environmental factors can be reviewed.

In the event you have an application operating at maximum overhung load using a reducer loaded to maximum mechanical capacity, please consult Cone Drive engineering for bearing life review.

General Information (continued)

Overhung Load Capacity (Chain Pull)

The output shaft chain pull capacities are tabulated in the single reducer ratings tables. The same values apply and should be used for double and triple reduction and helical worm reducers. To determine chain pull ratings for these units calculate the worm speed of the final reduction and refer to the appropriate unit size, ratio and speed in the single reduction section. The chain pull values shown are calculated with the load applied at the center of the keyway. For other locations please contact Cone Drive.

The input shafts are equipped with high capacity bearings suitable for belt and primary gear drives. For specific information in input shaft chain pull capacity, please contact Cone Drive.

Stairstepping

Self-locking ratios (generally 40:1 and higher) are susceptible to the phenomenon of “stairstepping” when backdriving or overhauling. “Stairstepping”, which is an erratic rotation of the gear set, occasionally occurs when the gear set is backdriven at worm speeds less than the theoretical lockup speed of the gear set. This erratic rotation of the gear set can be amplified by the rest of the drive train creating a very undesirable operating condition. “Stairstepping” can occur on hoists, or other drives where there is a high inertial load at the output shaft. Contact Cone Drive for specific information.

The preceding comments on backdriving or overhauling and stairstepping are intended as a general guide when selecting ratios for applications where high inertial loads are present at the reducer output shaft. Ratios outside of the specified ranges have been successfully used in many applications where brake size and backdriving efficiency were carefully analyzed or where prototype testing and experience with specific applications confirmed their suitability.

Design Assistance and Customer Service

Cone Drive can save your designers time and money. Our application engineers are experienced in all phases of power transmission. We welcome the opportunity to review and assist you in selecting the right reducer for your application We’ll help you benefit from the advantages of design flexibility with our limitless range of sizes, styles and ratios.

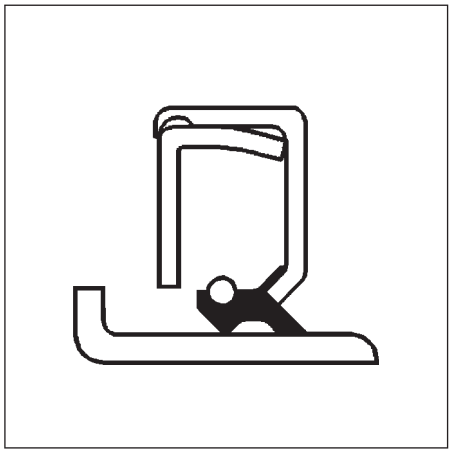
Cone Drive sales representatives and engineers are problem solvers. They are with you to review your situation first hand, and working as a team with our application engineers, find the right solution.

When you place an order with Cone Drive, our entire business and manufacturing system is “on deadline” for your order. Our high degree of computer integration means that order processing, materials planning, manufacturing, and shipping become and interconnected, highly efficient mechanism. Virtually all information about your order is immediately available at any time, anywhere in the plant. This boils down to one important fact, when you call Cone Drive, there’s no guessing.

Cone Drive service does not end when you receive shipment. Should you require assistance with installation or repair, our field service representatives are there when you need them.

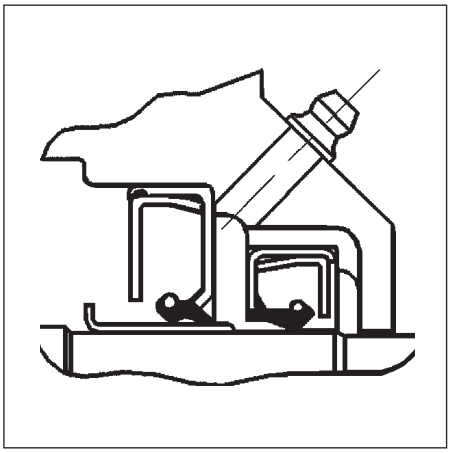
Oil Seals

Cone Drive standard speed reducers are furnished with the highest quality available oil seals. The following types are most generally used.



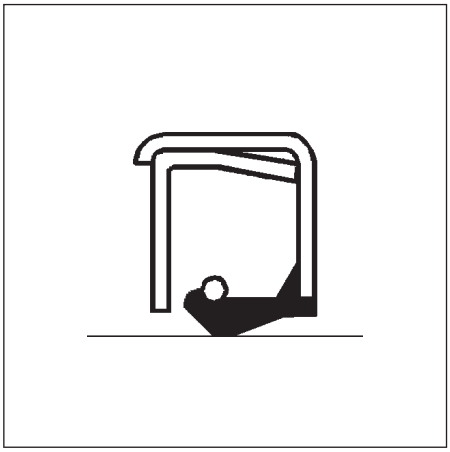
Wear Ring Double Lip Type

Wear Ring Double Lip Type: Consists of a conventional double lip seal with a steel wear sleeve that is pressed on the shaft to provide a specially prepared sealing surface for the oil seal lips. This seal provides an effective proven sealing method and also eliminates seal lip wear on the shaft itself.



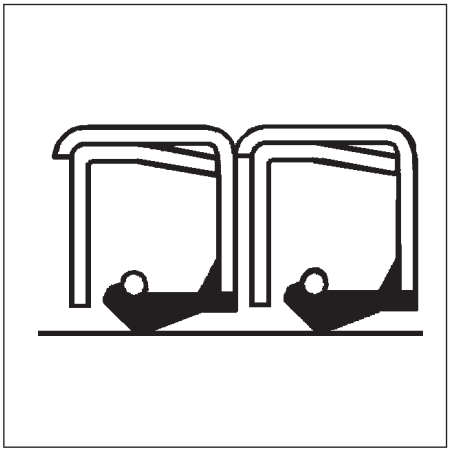
"Taconite" Seal Type

Taconite Seal Type: Consists of a double seal arrangement with special cap which embodies grease channels, a grease fitting and purge hole. This arrangement provides a cavity between seals, and around the outside seal for grease packing and purging. The taconite seal is optional at extra cost. This seal is used in areas requiring protection against outside contaminants such as coal dust, cement dust, taconite, water and steam.



Standard Single Lip Type

Standard Type A: A conventional single lip seal which seals directly on a specially prepared shaft surface.



This type seal will be used singularly or tandem to suit sealing requirement.

Lubrication Data

Lubrication is very important for successful operation of Cone Drive gearsets and speed reducers. Inadequate lubrication can result in increased power consumption, added maintenance and gearset failure. Please review the following recommendations and the "Approved List of Lubricants" shipped with all Cone Drive gearsets and speed reducers. Cone Drive recommends only those lubricants listed or any lubricant which meets all the requirements of AGMA (American Gear Manufacturers Association) 9004-D94 "Lubrication of Industrial Enclosed Gear Drives" as it applies to double enveloping worm gearing. Use of other lubricants can result in gearset failure which will not be covered under warranty. See reducers nameplate for the recommended lubricant.

Type of Oil

Lubricating oils for use in gear units should be high quality well refined steam cylinder petroleum oils. They must not be corrosive to gears, to ball, roller or sleeve bearings; they must be neutral in reaction; free from grit or abrasives; and have good defoaming properties. As they may be subject to high operating temperatures, they must have good resistance to oxidation.

For worm-gears additions of 3 percent to 10 percent of acidless tallow or similar animal fats are desirable.

Ambient Temperature

The oils shown in the table on the following page are for use in an ambient temperature range of approximately 15° to 125°F with the low end of the range depending on the pour point of the specific oil used. If the ambient temperature will be below or above this range please contact Cone Drive for specific recommendations on proper lubricant as well as proper oil seal and shim materials.

Oil Sump Temperatures

The maximum recommended oil sump temperature is 200°F. Where reducers will be used at maximum ambient and full catalog rating. Contact Cone Drive for lubrication recommendations.

Sludge

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

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

Cone Drive Reducers are Shipped without Oil.*

At assembly all reducers are treated with a rust inhibitor. This treatment coats all internal parts and will protect the reducer for a period of 30 days. If the unit is to be stored longer than 30 days, see long term storage instructions.

Oil Change

If an approved synthetic lubricant is used, it should be changed after 5000 hours of operation or once per year, whichever occurs first. If a recommended steam cylinder oil is used, the change interval should be after 2500 hours of operation or every six months, whichever occurs first. These change intervals are recommended for units operating under favorable conditions. Where operating conditions are severe, such a rapid rise and fall in temperature of the gear case with accompanied sweating of the inside walls and resulting formation of sludge, or where operation is in moist or dusty atmospheres, or in the presence of chemical fumes or extended running at sump temperatures in excess of 180° F, it may be necessary to change the oil at intervals of one to three months. It is recommended a sampling program be established with your lubricant manufacturer where reducers are exposed to the severe operating conditions, mentioned above.

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. Estimated oil capacities for standard reducers, are listed in this section.

Attachable Helical Primary, Double and Triple Reductions Reducers.

These units utilize separate housings and are furnished with separate oil sumps. It is important that all sumps are filled to the proper oil level.

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. 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.

Extreme Pressure (E.P.) Lubricants

Extreme Pressure (E.P.) lubricants or cylinder oils with sulphur-phosphorus additives are not acceptable and should not be used in Cone Drive Speed reducers or worm gearing.

Lubrication Data

Viscosity

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

AGMA Lubricant Number	VISCOSITY RANGE		
	ASTM System		
	SUS @210°F	SUS @100°F	CST @ 40°C
7 COMP*	125 - 150	1919 - 2346	ISO460 (414-506)
8 COMP*	150 - 190	2837 - 3467	ISO680 (612-748)
8A COMP*	190 - 250	2236	ISO460
SHC634	215	2236	ISO460

*Compounded with 3 to 10 percent of acidless tallow or other suitable animal fats. Refer to Cone Drive approved list of lubricants for specifice oils that meet the above specifications.

RECOMMENDED LUBRICANTS							
REDUCER SIZES	Worm Speed Up To RPM	AMBIENT TEMPERATURE °F		WORM SPEED ABOVE RPM	AMBIENT TEMPERATURE °F		AGMA Standard Specification of Industrial Enclosed Gearing (9005). *Pour Point of the oil used should be less than the minimum ambient temperature expected. These lubricants are satisfactory for sump temperatures up to 200°F.
		*14-50	50-125		*14-50	50-125	
20 thru 60	700	8 comp.	8A comp.	700	8 comp.	8 comp.	
70 thru 120	450	8 comp.	8A comp.	450	8 comp.	8 comp.	
150 thru 180	300	8 comp.	8A comp.	300	8 comp.	8 comp.	
220 thru 240	250	8 comp.	8A comp.	250	8 comp.	8 comp.	
280	200	8 comp.	8A comp.	200	8 comp.	8 comp.	

Limiting Speeds for Splash Type Lubrication

The maximum sliding velocity for splash lubrication is 2000 ft. per minute. If the gear set sliding velocity exceeds this value special lubrication provisions are required. Please contact Cone Drive Engineering for specific recommendations.

The ratings charts in the following section are blocked to indicate acceptable operating speeds with splash lubrication for standard reducers and gear sets.

The sliding velocity for standard reducers or gear sets is determined by multiplying the factor from the table by the speed of the worm in RPM.

Sliding Velocity - "V" in ft. per min.

Example:
4.000 C.D. 20:1 Ratio
at 3000 RPM:

"V" = Sliding Velocity (Ft/Min.)
"V" = .489 x 3000
"V" = 1467 Ft/Min.

SLIDING VELOCITY FACTOR										
RATIO										
Size	C.D.	5:1	10:1	15:1	20:1	25:1	30:1	40:1	50:1	60:1	70:1
20	2.000	.291	.261	.253	.250	.249	.248	.247	.247	.246	.246
25	2.500	.377	.334	.324	.249	.320	.319	.318	.318	.317	
30	3.000	.457	.382	.369	.363	.362	.361	.360	.359	.359	.359
35	3.500	.533	.453	.439	.433	.431	.430	.429	.428	.428	.428
40	4.000	.613	.512	.495	.489	.486	.485	.484	.483	.483	.482
50	5.000	.722	.632	.612	.605	.600	.598	.597	.596	.595	.595
60	6.000	.888	.763	.740	.731	.726	.724	.723	.722	.722	.722
70	7.000	1.050	.860	.827	.818	.812	.809	.807	.806	.805	.805
80	8.000	1.180	.920	.882	.870	.863	.860	.857	.856	.855	.855
100	10.000	1.468	1.138	1.095	1.080	1.070	1.070	1.070	1.060	1.060	1.060
120	12.000	1.760	1.362	1.308	1.292	1.282	1.278	1.273	1.271	1.270	1.270
150	15.000	2.200	1.635	1.565	1.542	1.530	1.528	1.522	1.518	1.516	
180	18.000	2.535	1.865	1.775	1.743	1.728	1.720	1.715	1.711	1.706	

Oil Capacities

Approximate Quantities in Quarts & Gallons

Single Reduction Reducers - Floor Mounted Position

UNIT SIZE		20	25	30	35	40	50	60	70	80	100	120	150	180
WORM OVER GEAR	HO SHO	1 Qt	1 1/2 Qt.	2 1/2 Qt.	1 Gal.	1 1/2 Gal.	2 1/2 Gal.	3 3/4 Gal.	6 1/2 Gal.	10 1/2 Gal.	19 Gal.	45 Gal.		
	ALT OIL LEVEL	1/2 Qt.	1 Qt.	1 1/2 Qt.	2 1/2 Qt.	1 Gal.	1 3/4 Gal.	2 1/2 Gal.	4 Gal.	6 1/2 Gal.	12 1/2 Gal.	26 Gal.		
WORM UNDER GEAR	HU SHU	1/2 Qt.	1 Qt.	1 1/2 Qt.	3 1/2 Qt.	1 1/2 Gal.	2 1/4 Gal.	3 1/4 Gal.	5 1/4 Gal.	7 3/4 Gal.	15 Gal.	30 Gal.	45 Gal.	70 Gal.
VERTICAL HV OUTPUT SHAFT SHV		1 Qt.	1 Qt.	1 1/2 Qt.	2 1/2 Qt.	1 Gal.	1 3/4 Gal.	2 3/4 Gal.	5 Gal.	6 1/2 Gal.	14 Gal.	26 Gal.	50 Gal.	80 Gal.

Double Reduction Reducers - Floor Mounted Position

UNIT SIZE	20/30	20/35	25/40	25/50	30/60	30/70	35/70	40/70	40/80	50/100	60/120	70/150	80/180
OO-UO-VO OOS-UOS-VOS	3 Qt.	1 1/2 Qt.	1 3/4 Gal.	2 3/4 Gal.	4 1/4 Gal.	7 Gal.	7 1/4 Gal.	7 1/2 Gal.	11 1/2 Gal.	20 3/4 Gal.	47 1/2 Gal.		
OU-UU-VU	2 1/2 Qt.	1 Gal.	1 3/4 Gal.	2 1/2 Gal.	4 Gal.	5 1/4 Gal.	5 1/2 Gal.	6 Gal.	8 1/2 Gal.	16 Gal.	30 Gal.	50 Gal.	76 Gal.
OUS-UUS-VUS			1 1/4 Gal.	2 Gal.	3 1/4 Gal.	6 1/4 Gal.	6 1/2 Gal.	7 Gal.	9 3/4 Gal.	18 1/2 Gal.	34 Gal.		
OV-UV-VV OVS-UVS-VVS	2 Qt.	2 Qt.											

Gearmotors & Helical/Worm Reducers - All Positions

UNIT SIZE		25	30	35	40	50	60	70	80
ALL MODELS MOUNTED WITH WORM UNDER GEAR	STANDARD SHAFT HOLLOW SHAFT	2 Qt.	2 1/2 Qt.	1 1/4 Gal.	2 1/4 Gal.	3 Gal.	4 1/4 Gal.	7 Gal.	8 1/2 Gal.
ALL MODELS MOUNTED WITH WORM OVER GEAR		1 1/2 Qt.	1 1/4 Gal.	2 Gal.	2 1/4 Gal.	4 Gal.	5 Gal.	9 Gal.	11 Gal.
ALL MODELS MOUNTED WITH VERTICAL OUTPUT SHAFT		2 1/2 Qt.	3 1/2 Qt.	1 1/2 Gal.	2 1/4 Gal.	3 Gal.	3 3/4 Gal.	8 Gal.	10 1/4 Gal.
ALL MODELS MOUNTED WITH INPUT END UP		4 Qt.	1 1/4 Gal.	2 1/4 Gal.	3 Gal.	5 1/4 Gal.	6 3/2 Gal.	13 1/2 Gal.	16 Gal.
ALL MODELS MOUNTED WITH INPUT END DOWN		3 1/2 Qt.	1 Gal.	1 3/4 Gal.	2 1/2 Gal.	3 1/2 Gal.	4 3/4 Gal.	8 3/4 Gal.	10 1/2 Gal.

Important: Do not overfill units. Fill to center line of oil gauge or to pipe plug identified with oil level sticker. Oil capacities will vary due to mounting positions or type of gearshaft mounting used, such as solid shaft, hollow shaft or spread bearings. Each reducer is built and oil levels are set at the factory for a specific mounting position.

Approved List of Lubricants for Cone Drive Double-Enveloping Worm Gear Speed Reducers & Gear Sets

WORM SPEED (RPM)	† AMBIENT TEMPERTURE	
	-10 °C to +10 °C (14 °F to 50 °F)	-10 °C to +50 °C (50 °F to 125 °F)
0-700	8 Comp.	8A Comp.
0-450	8 Comp.	8A Comp.
0-300	8 Comp.	8A Comp.
0-200	8 Comp.	8A Comp.

(‡) WORM SPEED ABOVE (RPM)	† AMBIENT TEMPERTURE
	-10 °C to +50 °C (14 °F to 125 °F)
700	8 Comp.
450	8 Comp.
300	8 Comp.
200	8 Comp.

AGMA LUBRICANT NUMBER	VISCOSITY RANGE		
	ASTM SYSTEM		ISO GRADE
	SUS@210 °F	SUS@100 °F	CST@40 °F
7 Comp.	125-150	1919-2346	ISO460 (414-506)
8 Comp.	150-190	2837-3467	ISO680 (612-748)
8A Comp.	190-250	4171-5098	ISO1000(900-1100)

	AGMA #8 COMPOUND (NON-E.P)			AGMA #8 COMPOUND (NON-E.P)		
MANUFACTURER	BRAND NAME	P.P.F.	SUS@210°F	BRAND NAME	P.P.F.	SUS@210°F
Mobil Oil Corp.	600W Super Cylinder Oil	10	155	Extra Hecla Super Cylinder Oil	20	198
Amoco	Cylinder Oil 680	15	200	Cylinder Oil 1000	15	243
BP Oil NOT AVAILABLE IN THE U.S				Energo DC-C 1000	6	1000 CST
Behnke Lubricants Inc.	Jax Super Cylinder	30	190	Jax Super Cylinder	15	243
Bel-Ray Company, Inc.	Stream Cylinder Oil 150	5	167	Steam Cylinder Oil 250	10	205
Bel-Ray Company, Inc.	No-Tox worm Gear Lube (FOOD GRADE H1) Oil ISO 680	5	216	No-Tox Worm Gear Lube (FOOD GRADE H1) OIL ISO 1000	5	292
Cato Oil and Grease Corp.	Mystik Power Lube #680	5	212	Mystik Power Lube #1000	5	315
Century Lubricating Oils, Inc.	Garwal #680	35	183			
Chevron Products Comp.	Cylinder Oil W-ISO #680	10	191	Cylinder Oil W-ISO #1000	10	252
Citgo Petroleum Corp.	Cylinder Oil #680-7	15	193			
Conoco Inc.	Inca Oil #680	30	165	Inca Oil #1000	35	211
Dryden Oil Company Inc.	Worm Gear Oil #680	20	180	Worm Gear #1000	20	222
Engineered Lubricants	Enlubol SCO-3400	15	685CST	Enlubol SCO-193 Comp.	15	916CST
Exxon Company	Cylesstic TK 680	20	184	Cylesstic TK 1000	30	227
Fina Oil Company	Cylan Steam Cyl. Oil 680	20	175			
Fiske Brothers Refining	Lubriplate CP-8	22	160	Lubriplate CP-8A	35	230
Fiske Brothers Refining	*Lubriplate SPO-288	20	173			
Huls	PQ-AGMA#8	10	175			
Imperial/Esso Oil	Cylesso TK 680	37	680 CST	Cylesso TK 1000	37	925 CST
Kendall Motor Oil Company	Kendco 155 Comp.	25	177	Kendco 206 Comp.	35	229
Lubrication Engineers	680 Almasol	15	191			
Lyndell Lubricants	Modoc #175	30	190			
Mobil Oil Corp.	600W Super Cyl. Oil	20	155	Extra Hecla Super Cyl.Oil	30	200
Pennzoil Products Company	Cylinder Oil #680	30	680 CST	Cylinder Oil #1000	30	1000 CST
Pennzoil Products Company	Cylinder Oil #6-NR	36	680 CST			
Philips 66 Company	Hector 630-S	10	172			
Primrose Oil Company				243 Cylinder Oil #8A	15	220
Schaeffer Mfg. Company	#147 Steam Cylinder Oil	10	190			
Shell Oil Products Company	Valvata J-680	20	650 CST			
Sunoco	Sun Gear Oil 8c	10	677			
Texaco Lubricants Company	Vanguard 680	20	190	Vanguard 1000	25	220

APPROVED SYNTHETIC LUBRICANTS:	
MANUFACTURER	**BRAND NAME**
Henkel Corp./Emery Group	*Emery-2843 Synthetic Lubricant
Keystone / Atochem	*Keystone KSL-367 Synthetic Lubricant
Mobil Oil Corp.	*Mobil SH634 Synthetic Lubricant
Texaco Lubricants Co.	*Pinnacle 460Synthetic Lubricant

BEARING GREASE: Hign quality lithium base NLGI #2 or NLGI #3

NOTES:

Note #1.....The listed synthetic lubricants are acceptable for use as an AGMA #7, AGMA #8 and AGMA #8A. AGMA #7 lubricants are primarily used in force feed lubrication systems or other special applications.

Note #2.....Worm gears operating at a sliding velocity in excess of 10 m/s (2,000 ft. per min.) may require force feed lubrication. For force feed lubrication recommendations. see Cone Drive Product Catalog or contact Cone Drive Engineering.

Note #3.....Major oil companies, not on the above list, do not have products which meet the requirements of AGMA. #9005-D94

Note #4.....Manufacturers listed above, in bold print, have product available world wide. Contact a listed manufacturer for availability in your area.

Note #5.....All lubricants are listed per the manufacturers recommendation.

Note #6.....(*)This is a special lubricant, not an AGMA compound

Note #7.....Centistoke viscosity values are at 40 centigrade

Note #8.....If a Cone Drive reducer is to be operated at an input rpm other than that shown on the name plate, contact Cone Drive Engineering Department for recommendations.

Note #9.....For double and triple reduction reducers an ISO 1000 (AGMA #8A) lubricant can be used in the primary as well as the final reduction stages.

Note #10.....Pour point of the oil used should be 5 C (9 F) less than the minium ambient temperature expected. For special temperature or operating conditions, contact Cone Drive Engineering Department for the proper lubrication selection.

Note #11.....AGMA specifications require a viscosity index (VI) of 90 (min.). However, lubricants listed with a VI of less than 90 may be used if a recommended lubricant with a VI of 90 (min.) is not available.

Material Specifications

Gears

For normal worm speeds up to 3600 rpm, or 2000 feet per minute sliding velocity, Cone Drive gear units rated in accordance with our standard formulae, we recommend our standard gear bronze. Gears are chill or centrifugally cast bronze according the following specifications.

Chemical:

Tin	10.00% to 12.00 %
Impurities	.50% Max.
Phosphorus	.05% - .25%
Copper	Remainder

Mechanical:*

Tensile strength	45,000 Lbs./ Sq.In.Min
Yield Point	25,000 Lbs./ Sq. In. Min.
Elongation in 2"	14% Min.

*Gear mechanical properties are test bar values.

**Worm mechanical properties are typical for 1" rounds having 32 Rc surface hardness.

Worms

Worm threads are cut integral with the worm shaft from #4150 resulphurized steel within the limitations of the chemical specifications shown below.

Chemical:

Carbon	.48% - 53%
Manganese	.75% - 1.30%
Phosphorus	.035% Max
Sulphur	.06% - .10%
Silicon	.15% - .35%
Chromium	.60% - 1.10%
Molybdenum	.15% - .25%

Mechanical:**

Tensile strength	140,000 Lbs./ Sq. In. Min.
Yield Point	120,000 Lbs./ Sq. In. Min.
Reduction in area…	40%
Elongation in 2"	12%

Housing, Caps & Carriers

Housing, Caps & Carriers size 1.5 through size 120 are generally supplied in cast iron. Larger sizes are supplied in welded steel or cast iron at our option.

Solid Output Shafts

Output shafts for size 1.5 through size 60 are cold drawn steel. Size 70 and greater are heat treated alloy steel, the same as the worm material in the listing above.