Advantages of Delroyd Worm Gearing

Compactness and High Ratio Reduction
Single reduction worm gearing offers high ratio reduction with few moving parts in a close-coupled compact drive. The right angle arrangement of driving-to-driven machine requires a minimum of space. Input and output shafts can be extended in either or both directions in horizontal or vertical arrangements adaptable to any mounting requirement. Efficient motor speeds are reduced to slow speed requirements of many industrial machines in one reduction.

Double reduction units give a wider ratio range beyond practical single reduction limits. Compact right angle or parallel shaft arrangements are provided with the same versatility of shaft extensions.

Long, Quiet Life
All worm gears incorporated in Delroyd reducers are made from phosphor bronze. The hardened, ground and polished alloy steel worm develops a smooth, work hardened surface on the bronze. For this reason, worm gears wear in and improve with prolonged service while other gears are wearing out. Two or more teeth are in contact with the worm at all times, transmitting power by a continuous, quiet and shockless action. The flow of torque is smooth and free from angular velocity changes. Vibration, pulsation, chatter, and other customary gear noises are thus eliminated.

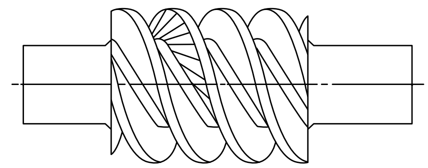
High Shock Load Capacity
The Delroyd worm gear tooth form is such that the gear teeth are under a crushing, rather than a bending load. For this reason, extremely high momentary shock loads, damaging to many forms of gearing, can be successfully withstood. High momentary overloads seldom cause failure, as worm gear ratings are figured on the wear resistance of the gear teeth.

Safety and Ease of Maintenance
The few moving parts are completely enclosed assuring oil tightness. Hazards of exposed moving parts are avoided. Reducers operate with minimum attention even under the most adverse conditions.

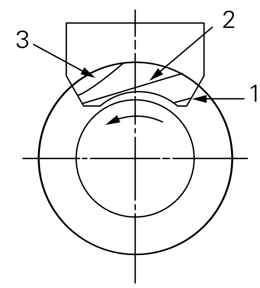
Interchangeability of Components
Standard parts are always available. All parts are manufactured to be interchangeable by use of limit gages retained as reference standards to assure precision and uniformity. The need for matched gearing is thus avoided. Worms and gears of different ratios can be readily interchanged if revision of speeds becomes necessary.

The involute helicoid ensures accuracy of profile and shape necessary to obtain proper contact and closeness of contact. More load carrying capacity, better accuracy, and longer life than any other thread form are assured.

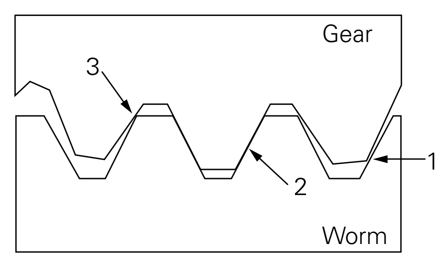
Conservative Delroyd ratings are based on more contact and greater torque arm in a given space. Delroyd contact is less sensitive to mounting dimension variations than any other thread form. Delroyd worms or gears can be replaced as interchangeable components without hours of lapping and running-in.



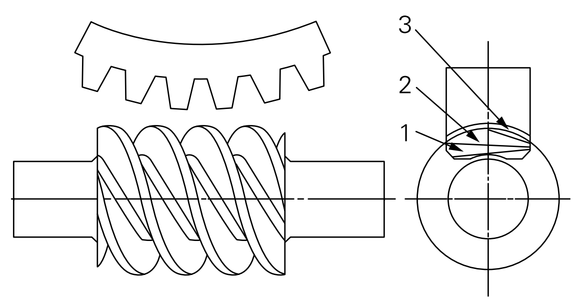
Involute Helicoid Straight Line Generation



Proper Contact

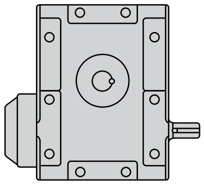


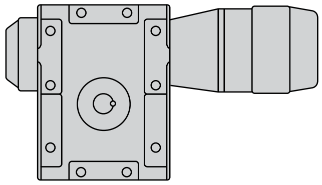
Closeness of Contact

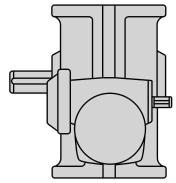


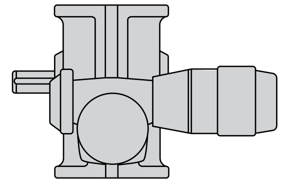
Multiple Lines of Contact

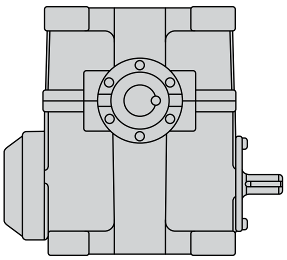
Models Available

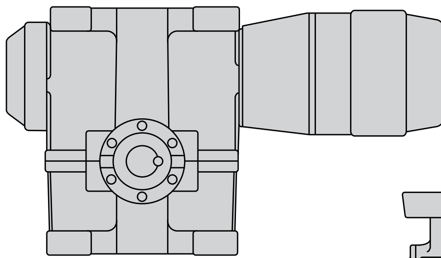

E20-E40

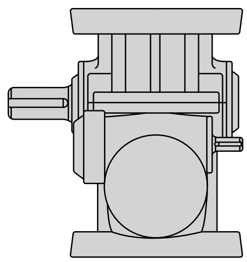

EMM20-EMM40

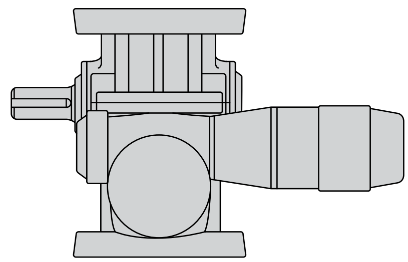

DE35-DE40

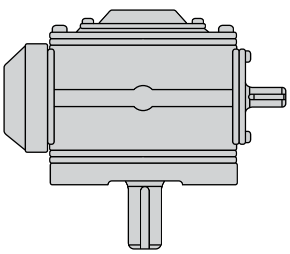

DEMM35-DEMM40

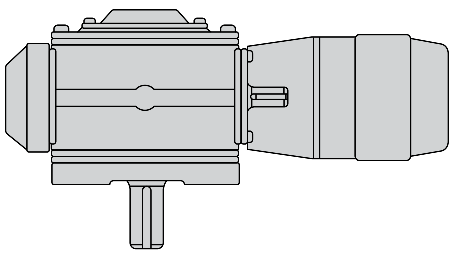

E50-E140

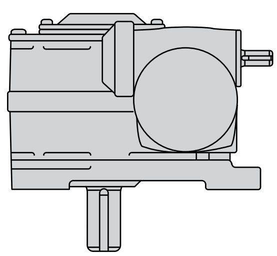

EMM50-EMM80

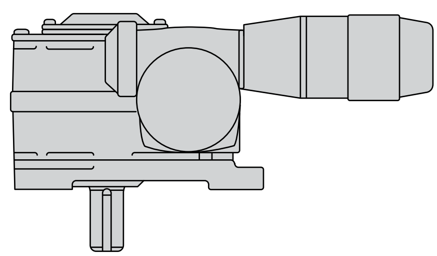

DE50-DE140

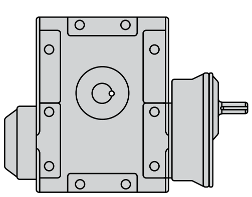

DEMM50-DEMM140

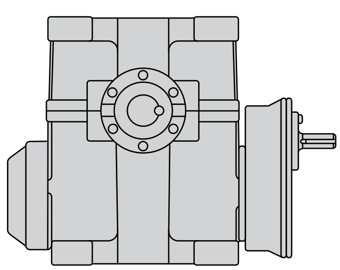

V30-V200

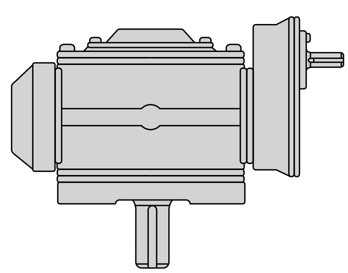

VMM30-VMM80


DV35-DV200

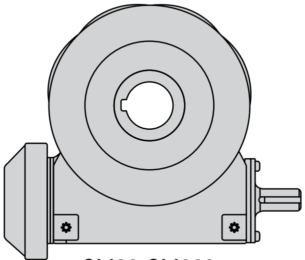

DVMM35-DVMM170


HE35-HE40

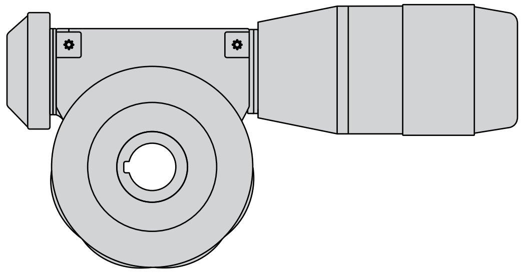

HE50-HE140


HV35-HV200

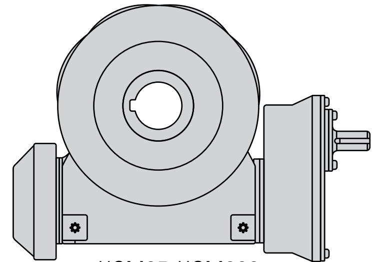
Models Available



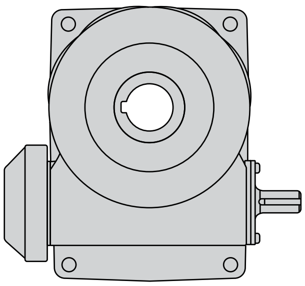
SM30-SM200



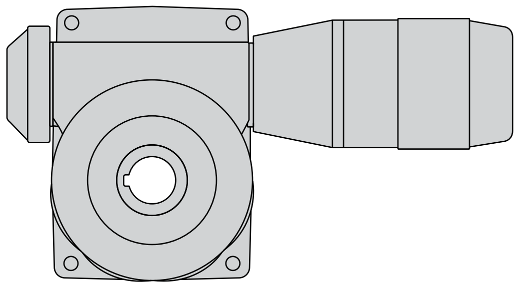
SMMM30-SMMM80



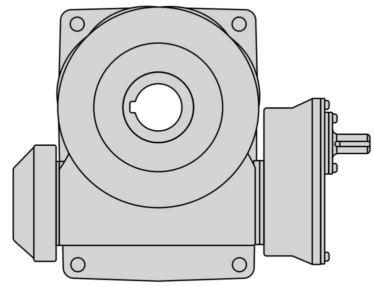
HSM35-HSM200



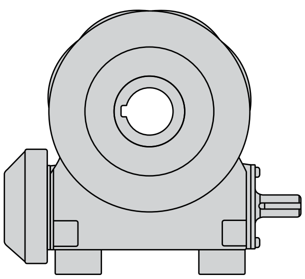
SMF30-SMF200



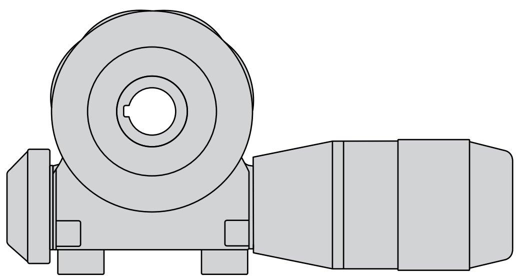
SMFMM30-SMFMM80



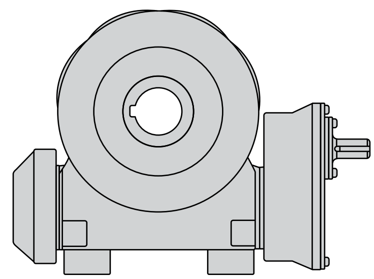
HSMF35-HSMF200



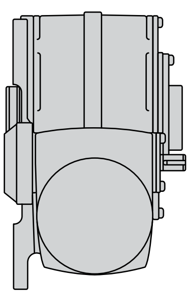
SMB30-SMB200



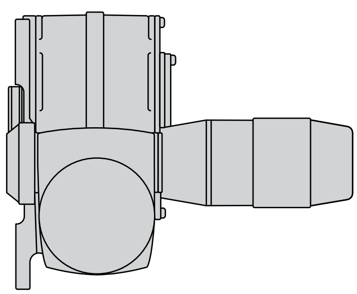
SMBMM30-SMBMM80



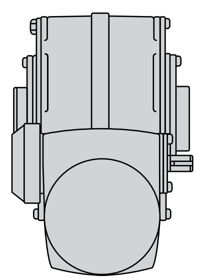
HSMB35-HSMB200



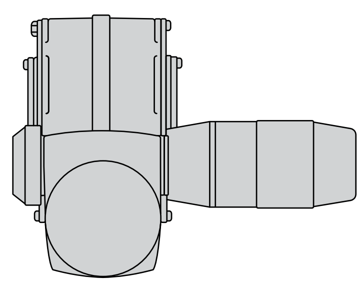
DSMF35-DSMF200



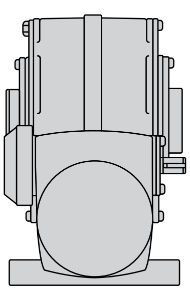
DSMFMM35-DSMFMM170



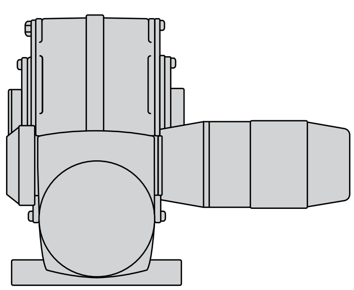
DSM35- DSM200



DSMMM35-DSMMM170

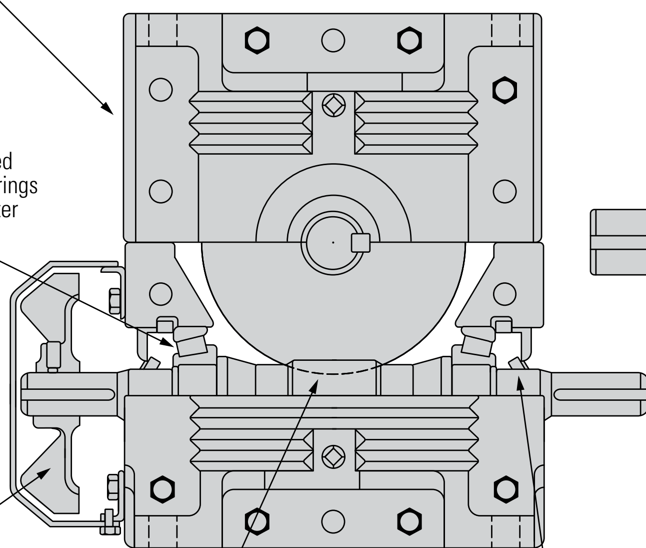


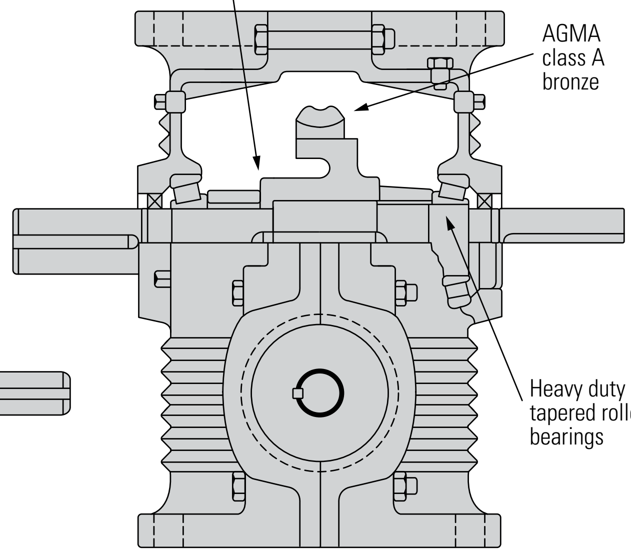
DSMB35-DSMB200

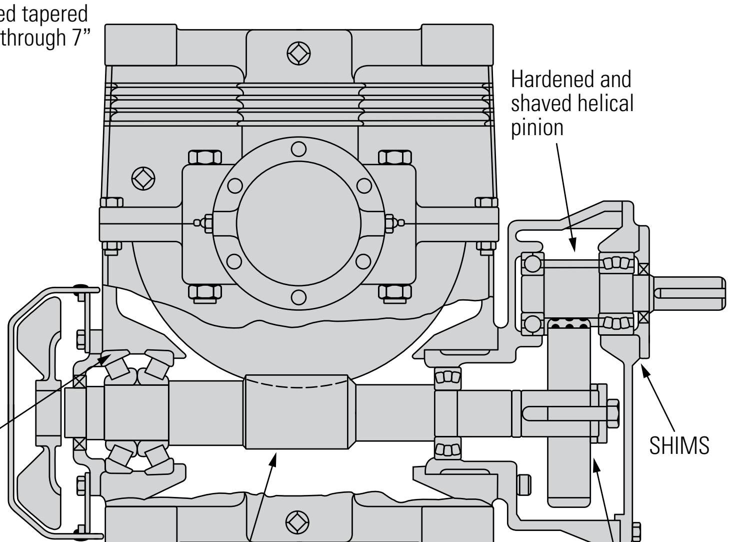


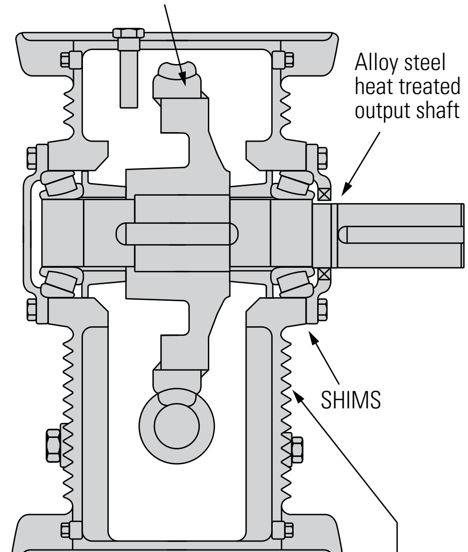
DSMBMM35-DSMBMM170

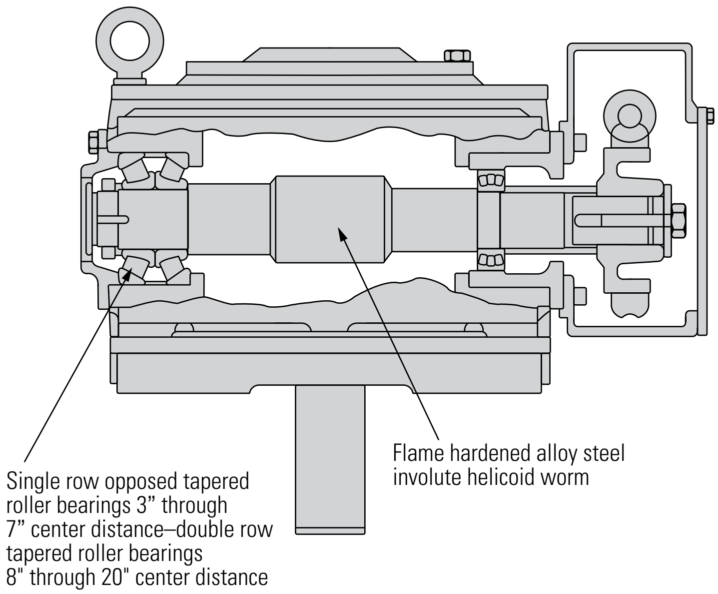
Design Features and Internal Construction

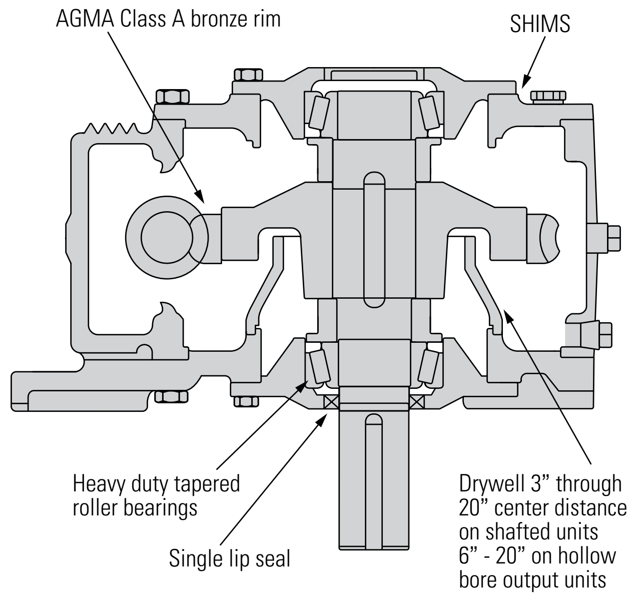


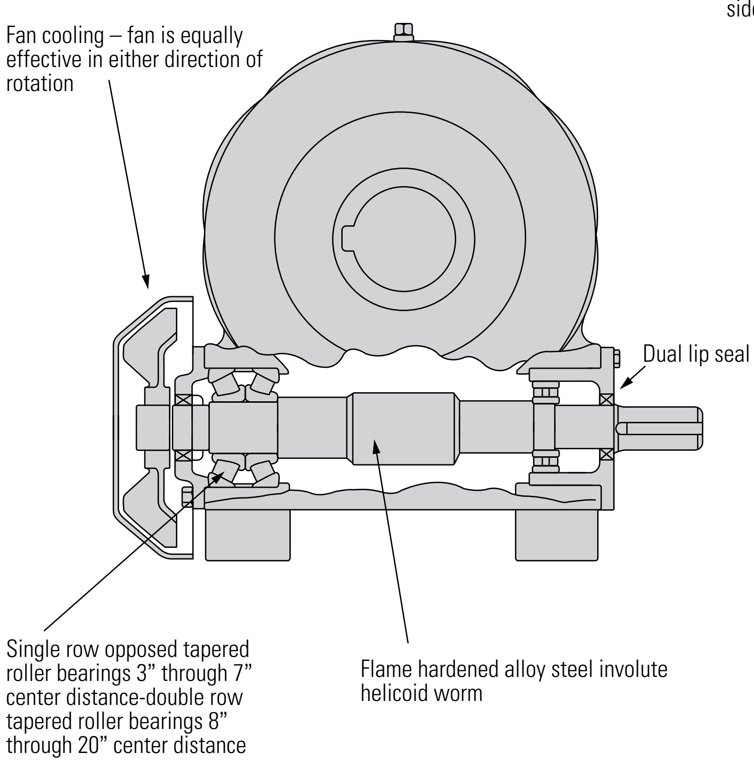


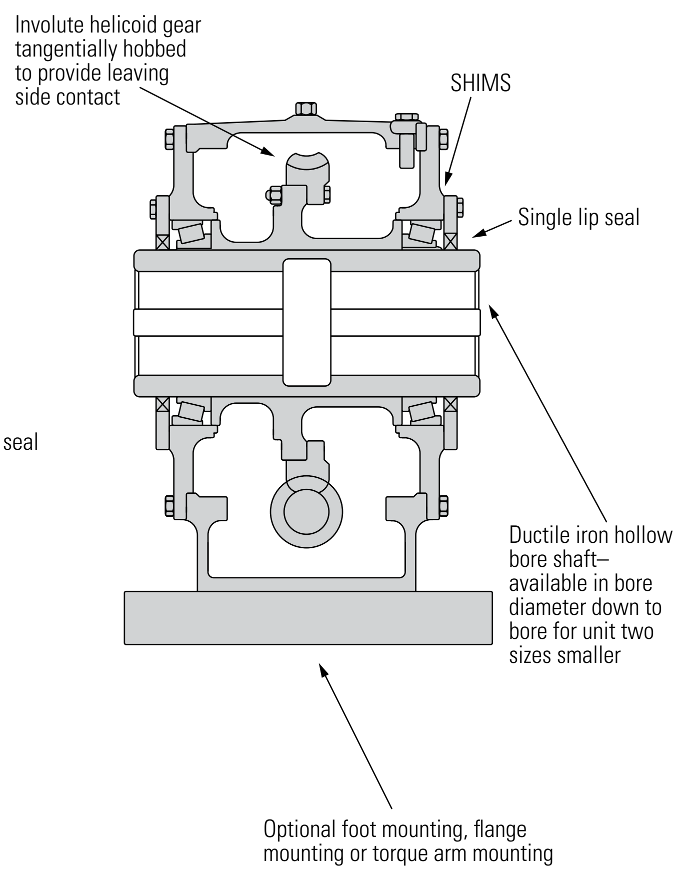




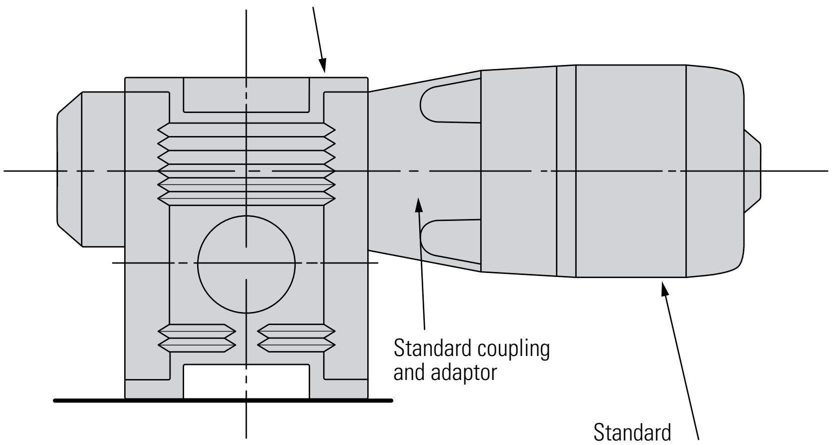

Flame hardened alloy steel involute helicoid worm
Single row opposed tapered roller bearings 3” through 7” center distance–double row tapered roller bearings 8" through 20" center distance


AGMA Class A bronze rim
SHIMS
Heavy duty tapered roller bearings
Single lip seal
Drywell 3” through 20” center distance on shafted units 6” - 20” on hollow bore output units

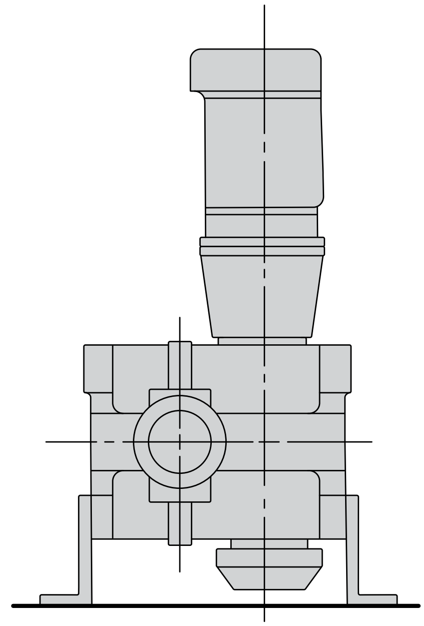

Fan cooling – fan is equally effective in either direction of rotation
Dual lip seal
Single row opposed tapered roller bearings 3” through 7” center distance-double row tapered roller bearings 8” through 20” center distance
Flame hardened alloy steel involute helicoid worm


Involute helicoid gear tangentially hobbed to provide leaving side contact
SHIMS
Single lip seal
Ductile iron hollow bore shaft– available in bore diameter down to bore for unit two sizes smaller
Optional foot mounting, flange mounting or torque arm mounting

Typical Applications of Delroyd Speed Reducers

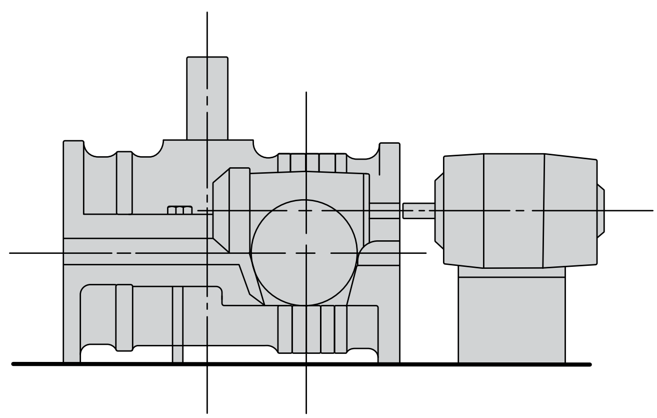


Motorized

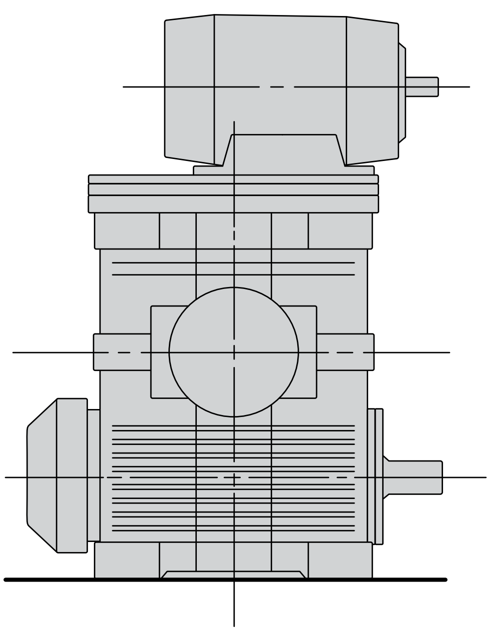


Bracket mounting worm vertical

Verso® Units

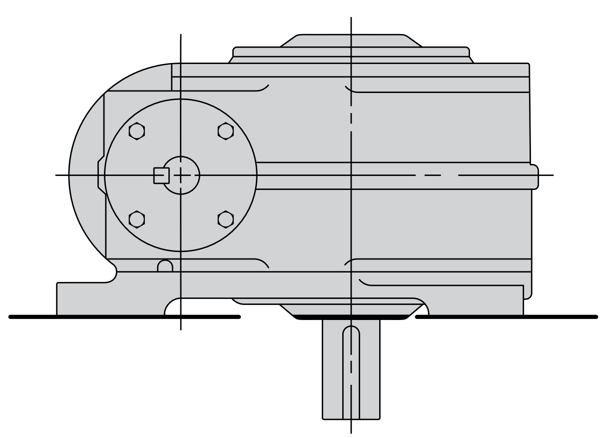


Direct coupled



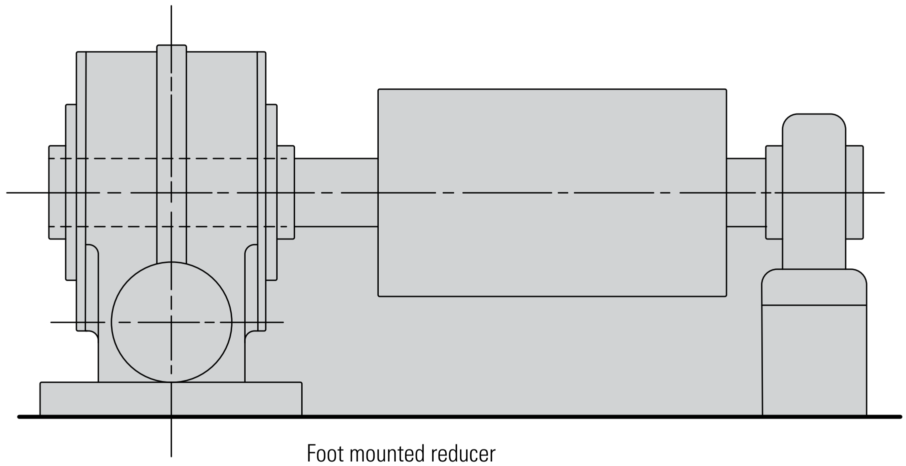
V-belt or timing belt

Vertical Units

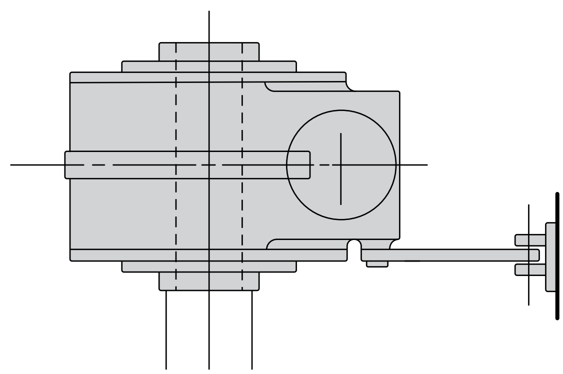


Vertical mounted reducer
Output shaft down

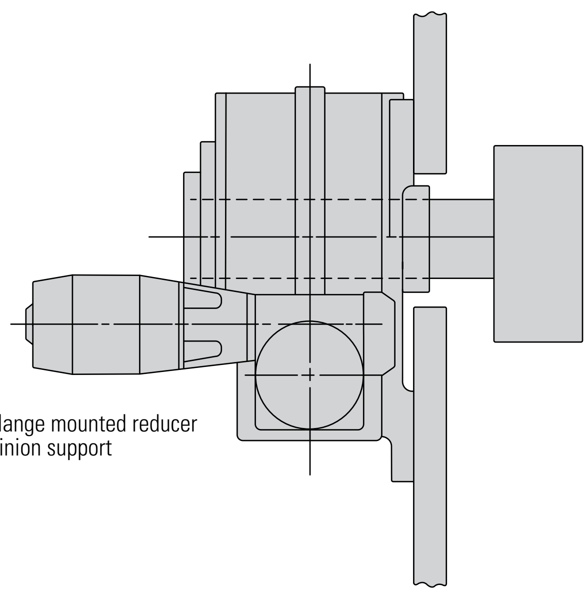
Typical Applications of Delroyd Speed Reducers



Foot mounted reducer
Conveyor head shaft support

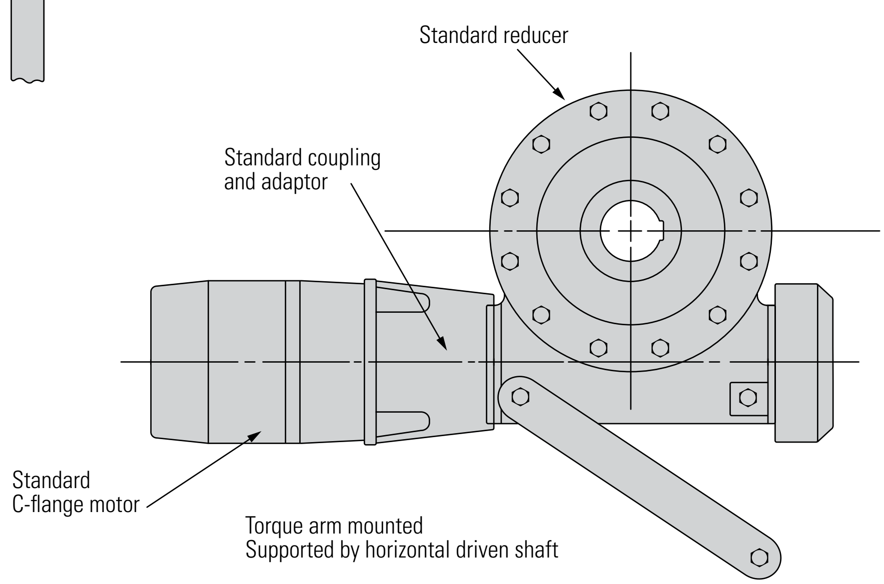


Torque arm mounted
Supported by vertical driven shaft



Flange mounted reducer
Pinion support

Shaft Mounted Units



Torque arm mounted
Supported by horizontal driven shaft

Standard Specifications

Backlash
The gearing contained in any reducer requires a certain amount of backlash for satisfactory operation. Clearance must be provided to accommodate an oil film and to allow for thermal expansion. The amount of backlash provided is not of particular importance in most applications, though closer limits than required will result in unnecessary higher costs and should be avoided. It is important, however, to recognize where minimum backlash may be required to insure proper equipment functioning. Close limits are most often specified for accuracy of index or timing. In other instances it may be advantageous to specify minimum backlash for the purpose of limiting the stress at the gear teeth caused by shock loading- such as a reversing impact load.

Listed in the table are standard single reduction limits measured by a “circular shake” movement at an output shaft radius equal to the gear pitch radius. The peripheral movement of the worm, with the gear shaft held fixed, would differ from values shown in the table. For this reason the actual value of total backlash between double reduction gear pairs is not determined by adding table tolerances for respective sizes. Consult the factory for double reduction unit backlash.

Center Distance	Backlash Limits
2.00”	.003/.013”
2.50”	.003/.013”
3.00”	.003/.013”
3.50”	.003/.013”
4.00”	.004/.014”
5.00”	.004/.014”
6.00”	.005/.015”
7.00”	.006/.018”
8.00”	.007/.020”
9.00”	.008/.021”
10.00”	.010/.023”
12.00”	.010/.026”
14.00”	.013/.031”
17.00”	.015/.036”
20.00”	.019/.043”

Lubrication
Oil contained in the housing reservoir is automatically directed by splash to the worm bearings and zone of tooth contact. (Gear bearings are grease lubricated at the factory and require only occasional attention.) Oil levels should be maintained properly. In accordance with best practice, a complete oil change is advisable after every six months of normal service.

Oil seals are fitted on all shaft extensions. “Drywells” are standard equipment on the larger units to assure positive sealing of vertical down shaft extensions. Filler plugs, drain holes, breathers and inspection openings are accessible for all mounting arrangements.

Lubricant types and oil capacities for each size and type reducer can be found in the Operation and Maintenance Manuals which are shipped with each unit or can be found at our web site. The oil level should be maintained at heights determined by the oil level sight gauge or plug in the reducer housing and checked only when the reducer is not operating.

Reversibility
All units are capable of running in either direction of worm rotation. Both faces have leaving side contact in relation to the corresponding direction of worm rotation. All Delroyd gears are hobbed to attain this ideal condition.

Self-Locking or Irreversibility
A self-locking worm gear is one which cannot be operated by applying power at the gear. Standard reducers incorporate gearing designed for most efficient power transmission and are not usually suited for self-locking service. A gear which is self-locking when stationary and subjected to only steady or light loads may start to creep in the presence of vibration and heavy loads. Owing to the rapid drop in the coefficient of friction with an increase in rubbing velocity, the efficiency of the drive rapidly increases with the RPM and the unit will quickly gather speed.

Means of approaching locking characteristics include use of higher, less efficient ratios (above 50:1) and designing for inefficiency (purposely using special design worms of large diameter and lead angles of 5 degrees or less). Such recourse cannot be depended upon in actual practice. The best way to obtain locking is to use a brake, released electrically when the motor is started. The best location for this brake is on the motor shaft or reducer input shaft. With worm gears of high ratios, the braking effect should be only a fraction of full load motor torque.

Overdriving
Ratios of 5: 1 through 15:1 can be used as speed increasers with approximately the same ratings as given in the catalog. Ratios above approximately 15:1 can tend to lock dynamically. Therefore, these ratios should be avoided in applications involving high inertia loads such as fan drives and wheel axle drives where the load tends to drive the gear when stopping. When ratios above 15:1 must be used in such applications, consult the factory.

Ratings and Service Factors
Reducers must be selected by considering both mechanical and thermal ratings. Tables in this book provide both mechanical ratings and thermal ratings in terms of input horsepower and inch-pounds output torque. Note that the fan cooled Delroyd design permits continuous service thermal ratings at a level equal to mechanical gearing capacities in most ranges.

Mechanical ratings reflect gearing wear capacity. Values in the rating tables apply for continuous service, free from recurrent shock loading, and of total duration up to ten hours per day. Normal starting or momentary peak loads up to 300% of this rating are permissible for a maximum period of two seconds duration. The total number of 300% peak loads is limited to 25,000 over the life of the reducer. Use of service factors is necessary dependent on actual nature and duration of service. The terms **"intermittent"** and **"occasional"** specified in the service factor table refer to total operating time per day while the term **"frequent starts and stops"** refers to more than ten starts per hour.

Thermal ratings above 100-200 RPM worm speed represent the input HP which will provide a stabilized 100°F oil temperature rise over ambient air temperature when operated continuously. For example, if the ambient air temperature is 70°F, a reducer carrying rated thermal HP will operate with an average oil temperature of 170°F. Since normal worm gear lubricants will deteriorate rapidly and require frequent replacement when operating continuously at 210-220°F, they may not properly support gear mesh loads. Thus the practical I maximum ambient air temperature for worm gear reducers carrying full thermal rating HP is 100°F.

Service Factors

		Driven Machine AGMA Load Classification		
Prime Mover	**Duration of Service**	**Uniform (Peak Load of 100% of Driver Hp.)**	**Moderate Shock (Peak Load of 125% of Driver Hp.)**	**Heavy Shock (Peak Load of 150% of Driver Hp.)**
Electric motor	occasional – ½ hr/day	0.80	0.90	1.00
	intermittent – 2 hr/day	0.90	1.00	1.25
	10 hr/day	1.00	1.25	1.50
	24 hr/day	1.25	1.50	1.75
Multicylinder internal combustion engine	occasional – ½ hr/day	0.90	1.00	1.25
	intermittent – 2 hr/day	1.00	1.25	1.50
	10 hr/day	1.25	1.50	1.75
	24 hr/day	1.50	1.75	2.00
Single cylinder internal combustion engine	occasional – ½ hr/day	1.00	1.25	1.50
	intermittent – 2 hr/day	1.25	1.50	1.75
	10 hr/day	1.50	1.75	2.00
	24 hr/day	1.75	2.00	2.25
For Frequent Starts and Stops				
Electric motor	occasional – ½ hr/day	0.90	1.00	1.25
	intermittent – 2 hr/day	1.00	1.25	1.50
	10 hr/day	1.25	1.50	1.75
	24 hr/day	1.50	1.75	2.00

Selection Procedure

Selections must be made on the basis of thermal ratings when they are less than the mechanical rating divided by the appropriate service factor. In making this comparison, do not apply service factors to thermal ratings since the nature of loading has a negligible effect on oil bath temperature rise. Thermal ratings can be completely ignored in occasional or intermittent service classification since the reducer can cool down between runs.

The total ratings of double reduction units are based on a 1.0 service factor. When operating conditions differ from those for proper application of a 1.0 service factor, the tabulated ratings for both helical-worm and double worm units must be divided by the appropriate service factors selected from the table on the opposite page.

Allowable Starting Load

If the peak starting load of the driven machine is within 300% of the normal operating load, and has a maximum starting period of two seconds duration, the reducer selection may be based on the catalog rating with a 1.0 service factor. When the starting load exceeds 300% of the listed rating, the reducer selection should be based on peak load divided by 3. If the starting load is 300% of the catalog rating and exceeds two seconds in length, a larger size reducer is required.

The procedure in the selection of a reducer should be as follows:	
Step 1.	Determine ratio required to provide desired output speed.
Step 2.	Determine service classification and corresponding service factor.
Step 3.	Refer to the horsepower rating table of the desired ratio. Select mechanical input and output rating which, when divided by the service factor, is equal to or greater than the required load.
Step 4.	In all applications except for intermittent service, check to see that the thermal horsepower or torque rating is greater than the mechanical rating divided by the service factor.
Step 5.	Check external loads applied to reducer.
	This procedure involves careful consideration of driven machine load classification for proper determination of service factor. See pages 13 and 14.

Standard Ratios

Ratios are listed in the rating tables. All are standard with right hand threads as manufactured in stock lots using existing tooling. They should be used whenever possible since special ratios require special tools and additional costs. Note that the hunting tooth principle is used to provide highest accuracy throughout the gearing life.

Horsepower and Torque

In transmitting power through a speed reducer, neglecting losses due to friction, the HP remains constant and the torque increases in the same ratio as the speed is reduced. To determine the horsepower required to drive a machine, it is sometimes necessary to ascertain the torque needed to operate the driven shaft at its desired speed. The conversion of output shaft torque and speed to input horsepower may be accomplished by using the following formula:

$$HP = \frac{P \times R \times RPM}{63{,}025 \times Eff} = \frac{T \times RPM}{63{,}025 \times Eff}$$

HP = Input HP

T = Output torque, in inch-pounds

R = Radius at which load force or weight is applied, in inches

RPM = Revolutions per minute of output shaft

P = Force or weight, in pounds

Eff = Efficiency, from table on page 15

Partial List of Typical Equipment Using Delroyd Reducers

Application	Load Nature		
	UNIFORM (Peak load of 100% of Driver Hp.)	MODERATE SHOCK (Peak load of 125% of Driver Hp.)	HEAVY SHOCK (Peak load of 150% of Driver Hp.)
Agitators	Pure and semi-liquids (with uniform density)	Liquids and solids Liquids (variable density)	
Blowers	Vane and centrifugal	Lobe	
Brewing	Bottling machines Brew kettles Can filling machines Cookers Mash tubs	Scale hoppers - frequent starts	
Car dumpers			Heavy
Car pullers		Moderate	
Clarifiers	Uniform		
Clay working machinery		General and pug mills	Brick presses Briquette machines
Compressors	Centrifugal Rotary	Lobe Reciprocating (multi-cylinder)	Reciprocating (single-cylinder)
Conveyors (uniformly loaded or fed)	Apron Assembly Belt Bucket Flight Floor Oven Screw Trolley		
Conveyors (not uniformly loaded or fed and non-uniform material)		Apron Assembly Belt Bucket Chain Flight Oven Screw	Reciprocating Shaker
Cranes and Hoists	Auxiliary hoists Luffing booms Main hoists	Medium duty: reversing, skip, travel or trolley motion	Heavy duty: reversing, skip, travel or trolley motion
Crushers			Ore or stone
Elevators	Bucket (uniform and continuous) Centrifugal discharge Escalators Gravity discharge	Bucket (heavy load) Freight	Refer passenger elevators to factory
Fans	Centrifugal (uniform speed & balance) Light, small diameter propeller type	Induced draft Large mine	Refer cooling towers to factory
Feeders	Disc	Apron Belt Screw	Reciprocating
Food	Bottling machines Can filling machines Cereal cookers	Beet slicers Dough mixers Meat grinders	
Hoists (see cranes)			
Line shafts	Group drives (light duty) Other line shafts	Driving process equipment	
Lumbering and sawmills	Small waste conveyor belts	Burner conveyors Edger feeds Gang feeds Green chains Off bearing rolls Plane feed & floor chains Planer tilting hoists Re-saw conveyors Small waste conveyor chains Sorting tables Tipple hoist conveyors Tipple hoist drives Transfer and waste conveyors Transfer rolls Tray drives Trimmer reeds	Chain transfers Craneway transfers Live rolls Log decks Log hauls-incline and well type Log turning devices Main log conveyors Roll cases Slab conveyors
Machine tools	Auxiliary drives (feed, traverse)	Bending rolls Main drives	Plate planers Punch presses Tapping machines

Load classes identified above are for guidance. Choice of applicable service factor should be based on consideration of the actual load nature and duty cycle anticipated. Applications involving more than ten starts and stops per hour or where high energy loads must be absorbed are not covered.
Maximum momentary starting load must not exceed 300% of speed reducer rating with service factor of 1.0.

Load Class Tables

Partial List of Typical Equipment Using Delroyd Reducers

Application	Load Nature		
	UNIFORM (Peak load of 100% of Driver Hp.)	MODERATE SHOCK (Peak load of 125% of Driver Hp.)	HEAVY SHOCK (Peak load of 150% of Driver Hp.)
Marine machinery	Turning gear	Dredges - cable reel, conveyor cutter head, jig, pump, screen stackers Utility winches	Main winches Pulleys, barge head Windlasses and capstans
Metal mills		Draw bench carriage and main drives Slab pushers Slitters Small rolling mill drives Table conveyors (non-reversing) Wire drawing and flattening machines Wire winding machines	Forming machines Manipulators Punch presses Table conveyors – individual drive Table conveyors – reversing
Mills-rotary type		Ball Cement kilns Dryers and coolers Kilns (other than cement) Pebble Pug Rod-plain and wedge bar	Hammer Tumbling barrels
Mixers	Constant density	Variable density Concrete mixers	
Oil production and refining		Chillers Paraffin filter presses Rotary kilns	Refer well pumping units to factory
Paper mill drives	Bleacher Conveyors (uniformly loaded) Presses Suction roll Winders	Agitators or mixers Beaters and pulpers Calenders Converting machines, except cutters, platers Couch rolls Cylinders Dryers Felt stretchers Pulp machine reels Stock chests Washers and thickeners	Cutters- platers Felt whippers Jordans Log hauls Super calenders
Pumps	Centrifugal, Rotary, gear, screw, lobe, vane	Proportioning Reciprocating- single acting (3 or more cylinders) or double acting (2 or more cylinders)	Reciprocating-single acting (1 or 2 cylinders) or double acting (single cylinder)
Rubber and plastics industry	Rubber mills – three on line	Calenders Extruders Laboratory equipment Refiners Rubber mills-two on line Sheeters Tubers and strainers Warming mills	Mixing mills Refer tire building machines, tire and tube openers to factory
Sand mullers		Moderate	
Screens	Air washing Traveling water intake	Rotary (stone or gravel)	
Sewage disposal equipment	Bar screens Chemical feeders Collectors (sludge, grit)	Dewatering screens Scum breakers Slow or rapid mixers Thickeners Vacuum filters	
Stokers	Uniform		
Textile machinery		Batchers Calenders Cards Dry cans Dryers Dye boxes Jigs Looms Nappers and gigs Pads Slashers Soapers Spinning frames Tenter frames Washers Winders	Refer knitting machines and range drives to factory

Load classes identified above are for guidance. Choice of applicable service factor should be based on consideration of the actual load nature and duty cycle anticipated.
Applications involving more than ten starts and stops per hour or where high energy loads must be absorbed are not covered.
Maximum momentary starting load must not exceed 300% of speed reducer rating with service factor of 1.0.

The approximate percentage efficiency of a single reduction set of gearing in a Delroyd unit for any speed may be taken from the table below. Double worm reductions have an overall efficiency equal to the product of the separate reduction values at their actual operating speeds. Helical attachments, any ratio, run approximately 97% efficient.

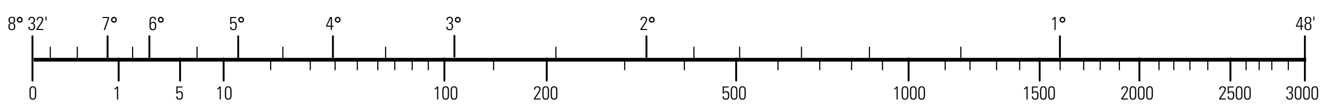
When using the table of efficiencies, some allowance should be made for reducer mechanical losses such as bearing friction and oil churning. Values listed are sufficiently accurate for most calculation purposes. First select the center distance and then read horizontally from the worm speed to the proper ratio column. Efficiencies for intermediate speeds and ratios may be obtained by interpolation.

$$VS = \frac{.262\ (WPD)\ RPM}{COS\ (LA)}$$

$$Efficiency = \frac{TAN\ (LA)}{TAN\ (LA + Ø)}$$

VS = Rubbing speed - feet per minute
WPD = Worm Pitch Diameter - inches
RPM = Worm RPM
LA = Lead angle of worm - degrees
Ø = Friction angle - degrees (see chart)

Friction Angle Ø



V_S - Rubbing Speed (Feet per Minute)

C.D.	RPM of Worm	Nominal Ratio										
		5	7.5	10	15	20	25	30	40	50	60	70
2"-7" C.D.	1750	96	95.5	94.5	92.5	90.5	90	87.5	85	81.5	78.5	74.5
	1450	95.5	95	94	92	90	89	86.5	83.5	80	76.5	72.5
	1150	95	94.5	93.5	91	89	89	85.5	82	78	74.5	70.5
	865	94.5	94	93	90.5	88.5	87	84.5	81	77	73	69
	680	94	93.5	92	90	87.5	86	83	79.5	75.5	71.5	67.5
	575	93	92	90.5	88	85.5	84	80.5	77	72.5	69	65
	300	92	90	88	84.5	81.5	80	76	72	67	64	60
	50	86	85	84	80	75	73	71	63	58	55	49
	0	76	76	74	70	63	60	58	49	44	42	36
8"-10" C.D.	1750	97.5	97	96.5	95	93	92.5	91.5	88.5	85.5	84	81 .5
	1450	97	96.5	96	94.5	92.5	92	91	87.5	85	83	80
	1150	96.5	96	95.5	94	92	91.5	90	86	83.5	81.5	78.5
	865	96	95.5	95	93.5	91.5	90.5	89	85	82	80	77
	680	95.5	95	94.5	92.5	90.5	89.5	88	83.5	80	78	75
	575	94.5	94	93.5	91	88.5	87	85.5	81	77	75	71.5
	300	93.5	92	91	88.5	84.5	83	81.5	76	72	69.5	66
	50	87	86	85	82	76	74	72	65	60	57	51
	0	76	76	74	70	63	60	58	49	44	42	36
12"-20" C.D.	1750	98	97.5	97	96	95	93.5	93	91	88.5	86.5	85
	1450	97.5	97	96.5	95.5	94.5	93.5	92.5	90.5	88	86	84.5
	1150	97.5	97	96.5	95	94	93	92	89.5	87	85	83
	865	97	96.5	96	95	93.5	92.5	91.5	89	86	84	81.5
	680	96.5	96.5	95.5	94.5	93	92	91	88	84.5	82	79
	575	96	95.5	95	93.5	91.5	90	88.5	85.5	81	78.5	75
	300	94.5	93.5	92.5	90.5	88	86	84	80.5	76	72.5	68
	50	90	89	88	85	82	80	77	72	68	63	57
	0	73	72	71	69	65	61	57	52	47	42	35

Axial Thrust Capacity

Axial Thrust Capacity - Low Speed Shaft- Pounds

Unit Size	Low Speed Shaft RPM 350	300	250	200	150
20	170	200	220	240	260
25	300	310	320	330	360
30	380	400	420	450	480
35	650	730	800	850	940
40	700	750	850	970	1100
50	1000	1150	1200	1250	1360
60	1300	1375	1425	1500	1650
70	1500	1900	2200	2500	2800
80	3100	3700	4200	4700	5300
90	3200	3800	4300	4800	5400
100	3300	3900	4400	4900	5600
120	5000	6000	7000	7800	8800
140	6000	6500	6600	6750	6950
170	12000	13200	14400	15700	17200
200	17200	18300	18900	19700	20600

Unit Size	Low Speed Shaft RPM 100	75	50	25	10-0
20	320	380	480	740	900
25	450	550	730	1100	1200
30	550	610	730	1100	1370
35	1000	1050	1170	1620	2200
40	1220	1300	1400	1800	2300
50	1500	1550	1800	2500	3500
60	1800	1820	2150	3150	4500
70	3100	3250	3600	4800	6500
80	5800	6100	6700	8200	9650
90	6000	6200	6800	8300	9900
100	6100	6400	7000	8400	10100
120	9700	10200	11500	14500	16500
140	7250	7550	7950	8650	10120
170	18900	19900	21000	24500	25000
200	21800	22800	24100	27600	30000

Axial thrust capacity is calculated assuming no overhung load is applied. When both thrust and overhung loads are applied, consult the factory.

Overhung load capacities for both input and output shafts are listed on these and following pages. Tabulated figures provide the maximum radial load which may be applied to the shafts. The determination of these figures is based on the load being applied at the midpoint of standard shaft extensions. A method is also included to provide the percentage reduction in output shaft overhung load capacity when force must be applied beyond midpoint of standard shaft extension. This load is usually in the form of a pull due to a chain on a sprocket, a belt on a pulley, the tooth pressure between a pinion and gear, or a weight such as might be carried by a hoisting drum.

In order to calculate the applied overhung load, first determine the torque at the shaft on which this load is applied. This may be accomplished by means of the formula given in the section on Horsepower and Torque on page 12.

In solving for torque, this formula is used in the following form:

$$T = \frac{HP \times 63{,}025}{RPM}$$

The tangential force on the overhung member may then be found by dividing the torque (T) by the pitch radius (R) of the overhung member. For a chain reduction the tangential force calculated in this manner is the actual overhung load. When the overhung member is a pinion or belt pulley, the actual overhung load is greater than the tangential force due to the separating force between gears or the initial tension required in the belts. The approximate overhung load may be determined by multiplying the tangential force by a suitable factor taken from the following tabulation:

Spur pinion 1.25

V-belt pulley 1.5 Flat belt pulley 2.5

Worm Shaft Overhung Load Capacity*
Pounds

	Worm Shaft RPM								
Unit Size	1750	1450	1150	870	680	580	450	300	100
20	100	110	120	130	135	140	145	150	160
25	150	160	170	180	185	190	195	200	210
30	200	210	220	240	260	275	290	310	330
35	230	250	275	300	340	360	390	425	470
40	270	310	350	400	450	480	520	570	650
50	340	395	450	540	620	680	740	830	950
60	500	520	600	710	800	850	930	1040	1210
70	550	575	650	770	850	920	1000	1100	1260
80	590	625	710	820	910	980	1050	1150	1300
90	680	725	790	890	1000	1040	1125	1250	1420
100	780	825	900	1000	1100	1160	1275	1400	1600
120	900	950	1000	1050	1150	1180	1400	1525	1740
140	1140	1200	1400	1600	1750	1800	1950	2100	2300
170	1380	1500	1700	1900	2100	2200	2300	2500	2800
200	1600	1750	2000	2400	2600	2750	2900	3100	3500

Helical Pinion Overhung Load Capacity*
Pounds

	Helical Pinion RPM				
Unit Size	1750	1450	1150	870	580
35	55	54	45	43	40
40	110	100	90	85	80
50	140	135	130	125	120
60	210	205	200	190	180
70	275	240	250	225	200
80	400	375	350	300	250
90	650	625	600	550	475
100	800	750	700	675	500
120	900	850	800	750	700
140	1200	1150	1100	950	1000
170	1700	1650	1600	1550	1500
200	2500	2450	2400	2300	2200

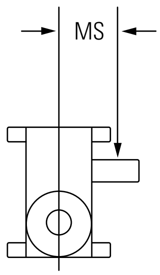
*Worm shaft and helical pinion shaft overhung load capacities are calculated based on loads applied at midpoint of standard shaft extensions.

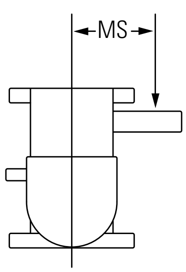
Overhung Load Capacity

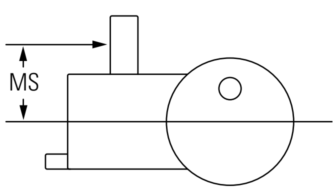
Overhung Load Capacity- Low Speed Shaft- Pounds at Mid-point of Shaft Extension (Dimension "MS")

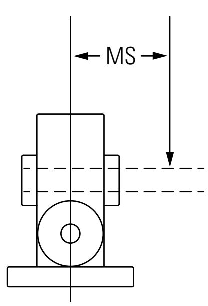
The overhung load capacities given below can vary based on the type of reducer being considered. For purposes of this catalog entry, the worst case (direction of application) for the overhung load was assumed for each of the different types of reducers (horizontal, vertical, and shaft mounted).

Overhung load capacity was calculated taking into consideration the bearing capacity, shaft stress, housing strength, and foot bolt stress. Since the minimum value of overhung load capacity is listed below, it is recommended that these figures be used as a guide only. Consult the factory when greater overhung load capacities are desired. We will quickly calculate the exact capacity for your application using our existing computerized formulas.









Load applied in any direction

Unit Size	Point of Application Dimension MS	Low Speed Shaft RPM				
		350	300	250	200	150
20	3	400	410	420	430	450
25	4 ¼	540	545	550	560	580
30	4 ¾	780	800	830	900	1000
35	5 ⅝	1510	1550	1600	1720	1930
40	6 ¾	1565	1600	1670	1800	2000
50	7 ⅝	2070	2100	2200	2350	2600
60	8 ½	2400	2410	2500	2650	2950
70	9	3800	3900	4050	4300	4800
80	9 ⅜	4800	5000	5400	5800	6400
90	11	5600	5900	6300	6800	7600
100	12 ⅜	5600	5900	6300	6800	7700
120	13 ¼	7100	7400	7700	8200	9200
140	14 ¾	8200	8300	8500	8900	9500
170	16 ½	14700	15200	15800	16600	17600
200	18 ¼	15000	15500	16200	17100	18000

Overhung load capacity is calculated assuming no thrust load is applied. When both overhung load and thrust loads are applied, consult the factory.

Unit Size	Point of Application Dimension MS	Low Speed Shaft RPM				
		100	75	50	25	10 – 0
20	3	500	600	700	900	900
25	4 ¼	720	840	1000	1220	1500
30	4 ¾	1170	1300	1470	1720	2100
35	5 ⅝	2270	2500	2850	3070	3070
40	6 ¾	2300	2570	2950	3300	3300
50	7 ⅝	3000	3320	3750	4400	4830
60	8 ½	3470	3800	4300	4900	6880
70	9	5500	6100	6800	7800	8970
80	9 ⅜	7400	8000	8800	9700	11700
90	11	8800	9600	10700	12000	14500
100	12 ⅜	9000	9900	11000	12500	16300
120	13 ¼	10500	11500	12700	14400	20000
140	14 ¾	10500	11500	12900	14500	22000
170	16 ½	19100	20200	22000	25500	27000
200	18 ¼	19300	20600	22300	25700	28000

Overhung load capacity is calculated assuming no thrust load is applied. When both overhung load and thrust loads are applied, consult the factory.

Overhung Load Capacity – Low Speed Shaft –
Pounds at Distances Greater than Mid-point of Shaft Extension (Dimension “X”)

Maximum overhung load capacity at “ X” dimension is the smaller of the following:

$$OHL_{at\ x} = (OHL_{at\ MS} \text{ @ operating RPM}) \left(\frac{MS\cdot + A}{X + A}\right)$$

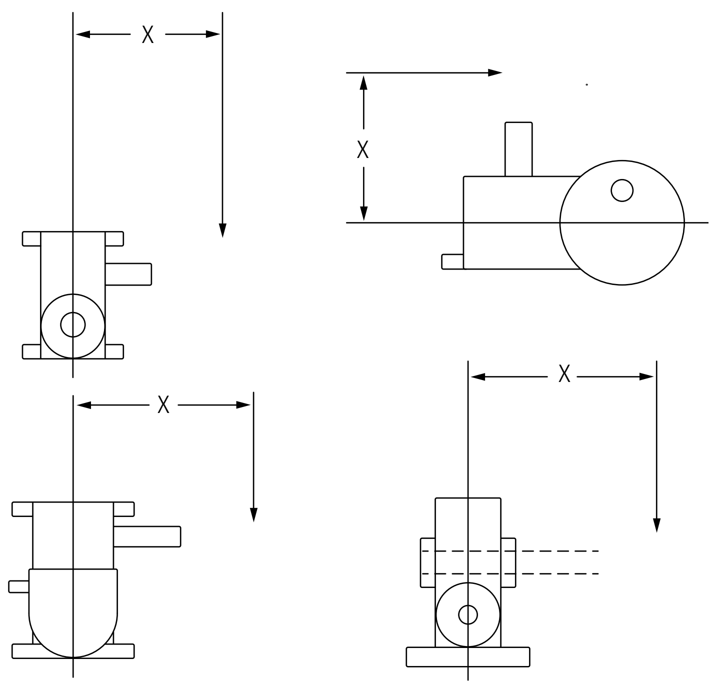
$$OHL_{at\ x} = (OHL_{at\ MS} \text{ @ 10 RPM}) \left(\frac{B}{X - C}\right)$$

Where $OHL_{at\ x}$ = overhung load at X

$OHL_{at\ MS}$ = overhung load at MS given in table on page 18

A, B, and C = factors given in this table

Unit Size	A	B	C
20	1 1/4	1 7/16	1 9/16
25	2 1/8	1 3/4	2 1/2
30	2 3/8	1 7/8	2 7/8
35	2 3/4	2 5/16	3 5/16
40	3 5/8	2 5/8	4 1/8
50	4 1/8	2 7/8	4 3/4
60	4 5/8	3 1/8	5 3/8
70	4 3/4	3 9/16	5 7/16
80	4 7/8	3 11/16	5 11/16
90	5 5/8	4 1/2	6 1/2
100	6 3/8	5 1/16	7 5/16
120	6 7/8	5 3/8	7 7/8
140	8	5 7/8	8 7/8
170	8 1/2	6 1/2	10
200	9 7/8	7 1/16	11 13/16



Load applied in any direction

Examples of Worm Gear Selection

Example I

A vertical worm gear reducer is to be selected to drive a pure liquid agitator by means of a direct coupled arrangement.

Conditions:

1. Motor: 10 HP, 1750 RPM.
2. Agitator Speed- 58 RPM.
3. Axial thrust load due to weight of agitator and hydraulic thrust: 1650 pounds.
4. Service: 10 hours per day, no shock load.

Solution:

1. Approximate ratio required is

$$\frac{1750}{58} = 30.2$$

2. 10 hour duty, pure liquid agitator service, electric motor drive (Refer to pages 12, 13 and 14.) Service factor = 1.0.
3. By reference to page 27, it is found that a 6" center distance reducer with a 30:1 ratio at 1750 RPM worm speed has a mechanical input horsepower rating of 10.2.
4. Since the mechanical rating divided by the appropriate service factor (1.0) is less than or equal to the thermal rating (10.2 HP), there will be no thermal problem.
5. Having established that a 30:1 ratio reducer of 6" center distance is of suitable size to transmit the load horsepower, the axial thrust capacity should next be checked by reference to the table on page 16. For output shaft speeds under 75 RPM, the 6" center distance unit has a thrust capacity of 1820 pounds. This is more than adequate.

Example II

A horizontal worm gear reducer is to drive a medium duty hoisting drum. A chain reduction will be provided between the reducer shaft and the drum shaft.

Conditions:

1. Motor: 575 RPM, horsepower to be determined.
2. Drum: radius from center of drum to centerline of rope is 8"; rope pull: 1700 pounds; drum speed 10 RPM.
3. Chain reduction: ratio 3:1, pitch diameter of sprocket mounted on reducer output shaft 5".
4. Service: intermittent, moderate shock, 5 or 6 cycles of operation per day with no more than one minute of operation during a one hour period.

Solution:

1. The output speed of the reducer is obtained by multiplying the drum speed by the ratio of chain reduction

$$3 \times 10 = 30 \text{ RPM}$$

The approximate ratio required is

$$\frac{575}{30} = 19.2 \text{ or } 20:1$$

2. The torque at the drum is the product of the rope pull and the radius from the center of the drum to the rope centerline: 1700 x 8 = 13,600 inch-pounds. This figure divided by the ratio of chain reduction provides the torque at the reducer output shaft

$$\frac{13{,}600}{3} = 4530 \text{ in-lbs}$$

3. The horsepower input to the reducer is found from the formula on page 12

Input HP =

$$\frac{T \times RPM}{63{,}025 \times Eff} = \frac{4530 \times 30}{63{,}025 \times .855} = 2.52$$

A 3 HP motor should therefore be used to supply the necessary power.

4. Determine proper service factor: 1.0 for occasional, moderate shock, total operating time not exceeding ½ hour per day, electric motor driven, from table on page 11.
5. Reference to rating tables for the desired 20:1 ratio shows that a 4.0" reducer operating at 575 RPM input has a mechanical rating of 3.11 HP. The reducer rating for this service is determined by dividing by the service factor

$$\frac{3.11}{1.0} = 3.11$$

This rating exceeds the required load to be transmitted, meaning the 3112" unit is proper. A thermal rating limitation will not be necessary due to the intermittent nature of the load.

6. The chain pull (overhung load) is determined by dividing the torque at the reducer output shaft by the pitch radius of the sprocket

$$\frac{4530}{2.5} = 1810 \text{ pounds}$$

Reference to page 18 shows the overhung load capacity of the 3½" unit low speed shaft to be 2850 pounds at speeds under 50 RPM.

Example III

A right angle, horizontal output reduction unit is to be selected to drive a belt conveyor, not uniformly fed.

1. Operation: one eight hour continuous shift per day.
2. Load torque at conveyor headshaft: 32,000 inch-pounds.
3. Electric motor speed: 1750 RPM, HP to be determined.
4. Conveyor drum to turn 30 RPM.
5. Momentary starting load not exceeding 250% of transmitted power.

Solution:

1. Approximate ratio required

$$\frac{1750}{30} = 58.3$$

2. Determine proper service factor: load class table, page 11, indicates moderate shock, 8 hours per day service factor = 1.25 (pages 13 & 14).
3. Selection can be made using output torque ratings from the tables. Page 44 shows that a 9" center distance, ratio 59.25 helicalworm unit has a mechanical output torque rating of 45,200 inch-pounds torque at 1750 RPM input with a 1.0 service factor. The equivalent rating with a 1.25 service factor is

$$\frac{45{,}200}{1.25} = 36{,}200 \text{ inch-pounds}$$

4. The HE-90 selection is good since:
   a. Equivalent rating with 1.25 service factor (36,200 inch-pounds), exceeds load torque (32,000 inch-pounds).
   b. Equivalent mechanical rating is less than thermal rating.

$$45{,}200 \frac{21.4}{24.4} = 39{,}800 \text{ inch-pounds}$$

   c. Starting torque rating of HE-90 (3 x 45,200) exceeds conveyor peak starting load (2½ x 32,000).
5. The helical gear efficiency times second reduction worm efficiency .97 x .903- from page 15 = 87% overall. The motor horsepower necessary to deliver 32,000 inchpounds torque at the conveyor shaft is

Input HP =

$$\frac{T \times RPM}{63{,}025 \times Eff} = \frac{32{,}000 \times 30}{63{,}025 \times .87} = 17.5$$

As a check, efficiency can be determined calculating from input and output values listed in rating tables.
The mechanical input HP rating of this selection is 24.4, the mechanical output torque 45,200 inch pounds.

Therefore

$$Eff = \frac{\text{Output RPM} \times \text{Output Torque Rating}}{\text{Input HP Rating} \times 63{,}025}$$

$$= \frac{29.5 \times 45{,}200}{24.4 \times 63{,}025} = 87\%$$

Use a 20 HP motor with proper starting characteristics.

Important Notes

Dimensions and Weights

This catalog contains outline drawings for all Delroyd types. Major overall and mounting hole dimensions, plus shaft elevations, lengths and diameters are shown. Net weights in pounds of the reducers are included in the same tables. Outline drawings illustrating reducers combined with baseplates are available from your Delroyd salesman.

How to Order

See page 2 for a quotation sheet. In ordering, specific reducer designations from this catalog should be used to avoid questions as to what is actually required. This description should include type, center distance, ratio, shaft assembly, and bore size (shaft mounted units only). Driving motor HP, operating worm speed, and output torque together with a short description of the nature of the load and duration of operation is desirable if available.

Shaft arrangements are shown in chart form on the dimension pages for each type. Carefully relate these charts to the input and output shaft construction needed for proper use with the driving and driven machines. Where motor adaptor and couplings are required, specify standard NEMA “C” face frame size to be used. If Delroyd is supplying the motor, include motor HP, speed, enclosure, voltage, phase, cycles and starting characteristics required.

Worm-above-gear arrangements (shaft assemblies T-1, etc.) require special design attention when operating under worm speeds of approximately 500 RPM. To insure adequate lubrication of worm bearings, please make special note of worm speeds under 500 RPM on order. Necessary lubrication modifications will then be provided at no increase in price.

Requirements for special worm lengths, special mounting positions, special low speed shafts, and special shaft mounted bores should be accompanied by sketches where possible. Shaft mounted units can be supplied with special bores from bore shown down to bore for unit two sizes smaller. Special modifications should be avoided whenever possible since additional charges must be made.

Selections Beyond Range of This Catalog

Worm gear units and sets can be supplied to meet any requirement. Delroyd literature is available featuring selection and dimensional data on worm gearing to fit rating categories above and below those listed in this catalog. Specifications on machining limits, interchangeability of parts, materials, heat treatments, anti-friction bearings, self-contained lubrication systems, and increased ratings apply through the entire line.

Inquiries for these or any other reducers should specify type, rating, and speed of the driving machine; the load nature, duty cycle, speed, actual and starting horsepower of the particular kind of driven machine; plus space, mounting, position or other special requirements to be met by the reducer.