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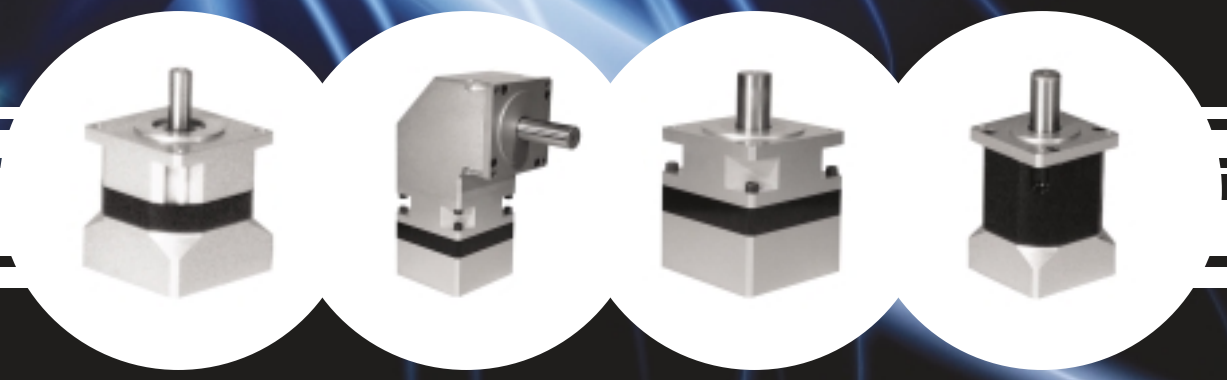
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CARSON MFG. INC.

MOTION PRODUCTS DIVISION



PLANETARY GEARHEADS

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INTRODUCTION

Established in 1973, Carson Mfg. Inc. (CMI) brings to the motion control industry our experience in manufacturing precision machined components and assemblies for a worldwide customer base.

Our company has made a substantial investment in research and development; and with extensive in-house testing that has enabled us to select superior materials and heat treating processes, our units have been designed to provide reliable performance. Our test equipment has also allowed us to physically validate our catalog data.

We will maintain an inventory of components and work in process so as to deliver standard NEMA product within a timely manner. Our gearheads can be specified to easily mount to any motor. A special rear bracket and clamp-on pinion are provided, usually at no extra charge.

We take pride in the fact that our products are manufactured 100% in the USA. "Made in the USA" stands for quality and reliability. Our goal is to continue to provide the highest quality gearheads, with the best service at competitive prices. We welcome the opportunity to be the source for your gearhead requirements.

CMI currently offers the following line of gearheads:



PRECISION PLANETARY (PL)

This is Carson Mfg.'s top of the line gearhead. It is manufactured with a stainless steel ring gear, pinion, output shaft and gears. This line offers our highest performance and ratings. We recommend the "Precision" gearhead for your most strenuous applications. Due to its adaptability this is the gearhead we recommend for all your special needs applications. This is our most complete line, offering frame sizes 17, 23, 34, 42 and 56; 13 standard ratios ranging from 3:1 to 100:1, and also offered in a low backlash option.



ELIMINATOR PLANETARY (EP)

Carson Mfg.'s most popular gearhead line, the "Eliminator" offers high performance and reliability at an economical price. The "Eliminator" was designed for strenuous applications, is offered in a low backlash option and comes in frame size 17, 23 and 34. This line offers 13 standard ratios ranging from 3:1 to 100:1.



"S" SERIES PLANETARY (SP)

Our most economical gearhead line, the "S" Series was developed to compete in pricing with spur gearheads, while offering the reliability and performance of a planetary gearhead. The "S" Series is considered our light duty gearhead. This line is available in sizes 17, 23 and 34 and in eight standard ratios ranging from 4:1 to 100:1.



RIGHT ANGLE PLANETARY (RP) OR (RE)

Carson Mfg. offers right angle gearheads in both the "Eliminator" and "Precision" gearhead lines. Depending on your application; the "Precision" for highest performance or the "Eliminator" for more economical applications, we feel we can meet your design needs. Sizes and standard ratios are the same as the regular gearhead lines.

We are also capable of manufacturing custom gearheads that are engineered to meet customers specifications of any ratio, configuration and size.

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23 PL 010 - L - XXXX

SIZE:
> 17, 23, 34, 42, 56

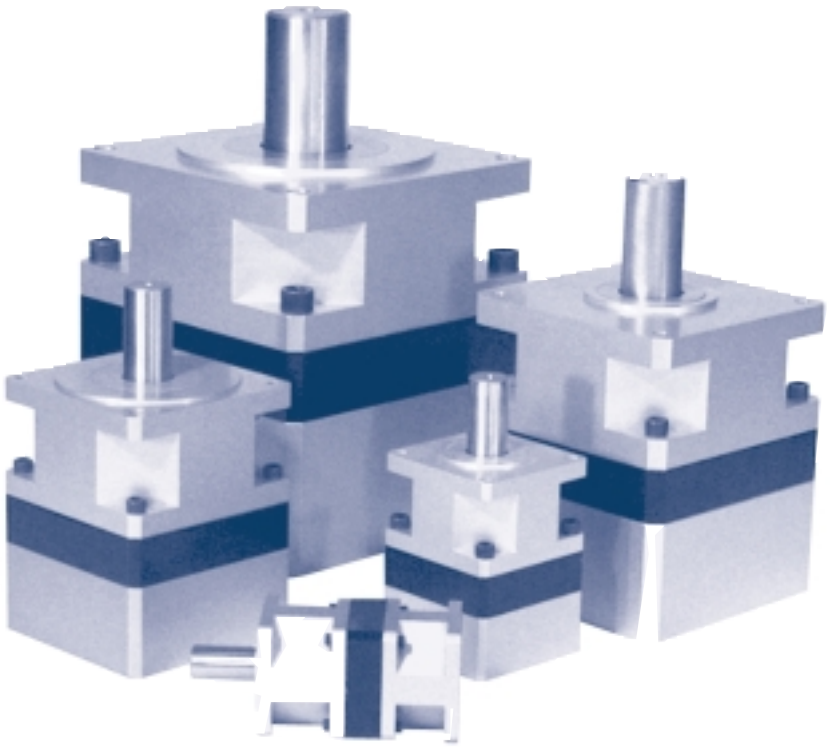
GEARHEAD LINE:
> SP = “S” Series Planetary
> EP = Eliminator Planetary
> PL = Precision Planetary
> RE = Right Angle Eliminator Planetary
> RP = Right Angle Precision Planetary

RATIO:
> 003 = 3:1
> 004 = 4:1
> 005 = 5.5:1
> ETC. See Spec Sheet for available ratios

BACKLASH TYPE:
> BLANK = Standard Backlash
> L = Low Backlash Option

MOTOR DESCRIPTION TO WHICH GEARHEAD WILL BE MOUNTED TO OR PRE-ASSIGNED PROJECT NO.:
> NEMA = Standard NEMA Motor (See Page 43)
> Specify Motor Make and Model
> Project Number Specifies Custom Modifications

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OVERVIEW:

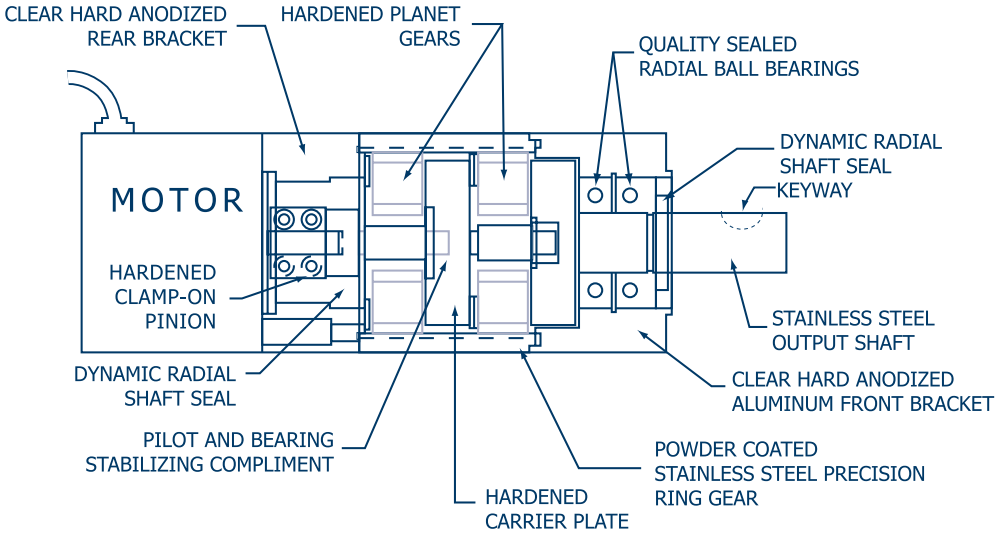
- The Precision Planetary (PL) line of gearheads is our high end line designed for the most strenuous applications.
- Made in sizes 17, 23, 34, 42 & 56 with standard ratios from 3:1 to 100:1. We are capable of producing ratios up to 10,000:1.

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FEATURES:

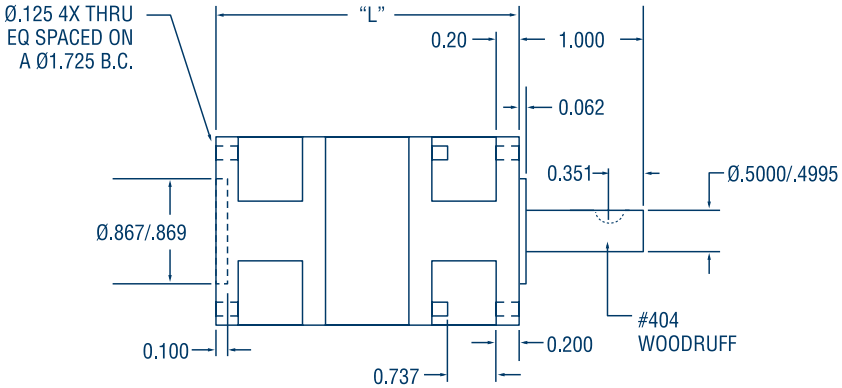
- Dynamic radial shaft seal at the input and output.
- Enclosure rating = IP65.
- Operating temperature range = ¯20°F to 250°F.
- Aluminum hard anodized rear and front brackets with surface hardnesses of 60 rockwell.
- Powder coated steel ring gear.
- Quality sealed radial ball bearings.
- Stainless steel output shaft.
- Hardened precision gearing throughout.
- Precision clamp on pinion with four clamping screws to eliminate slippage.

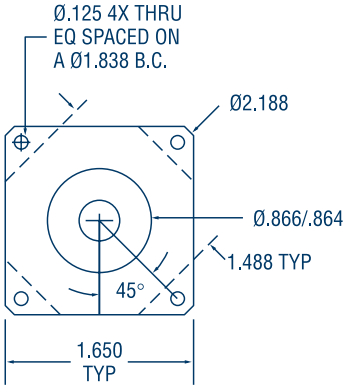


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DIMENSION "L"
Single Stage (3:1 to 10:1) = 2.869± .015
Double Stage (16:1 to 100:1) = 3.738 ± .015





	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec^2)
SINGLE STAGE	17PL003	3:1	243	169	137	3.25×10^{-5}
	17PL004	4:1	220	166	140	1.60×10^{-5}
	17PL005	5.5:1	197	159	139	1.10×10^{-5}
	17PL007	7:1	180	151	135	9.56×10^{-6}
	17PL010	10:1	143	126	116	8.36×10^{-6}
DOUBLE STAGE	17PL016	16:1	304	276	259	1.59×10^{-5}
	17PL022	22:1	311	289	275	1.10×10^{-5}
	17PL028	28:1	394	296	285	9.54×10^{-6}
	17PL040	40:1	319	306	296	8.35×10^{-6}
	17PL049	49:1	230	224	219	9.44×10^{-6}
	17PL055	55:1	264	256	251	8.31×10^{-6}
	17PL070	70:1	231	226	224	8.30×10^{-6}
	17PL100	100:1	176	174	173	8.29×10^{-6}

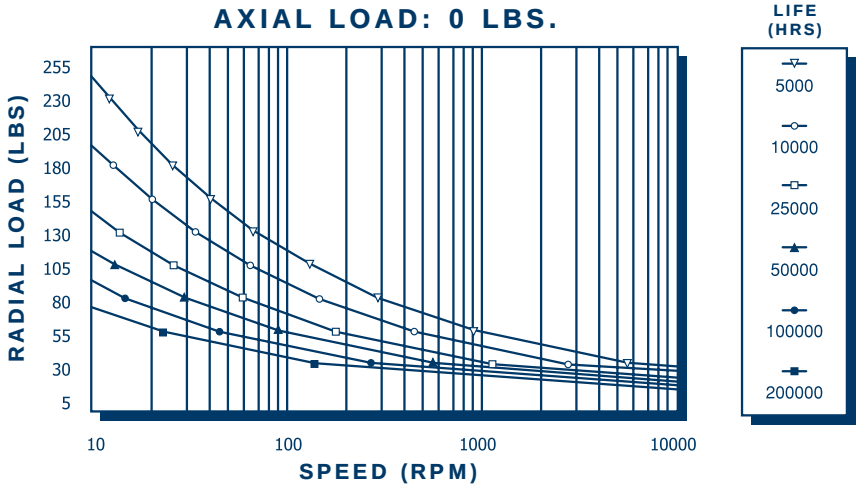
GENERAL SPECIFICATIONS

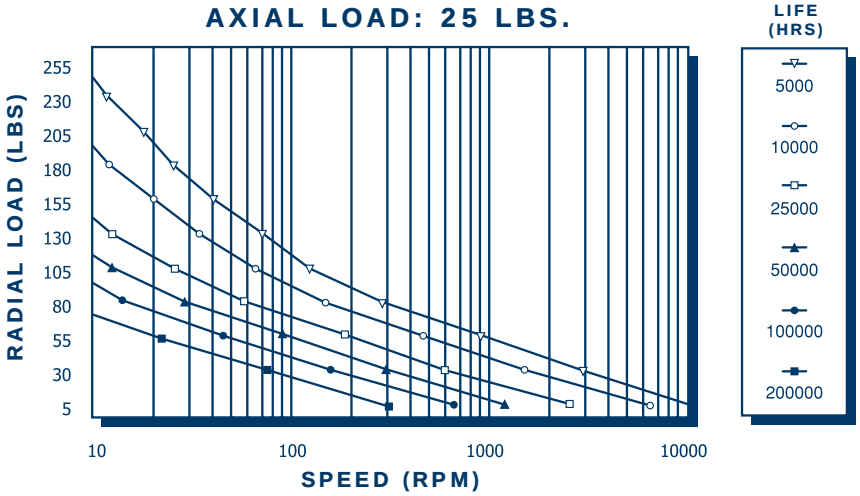
Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	6	3	90%	1.00	5000
Double Stage	16:1 to 100:1	10	7	85%	1.60	5000

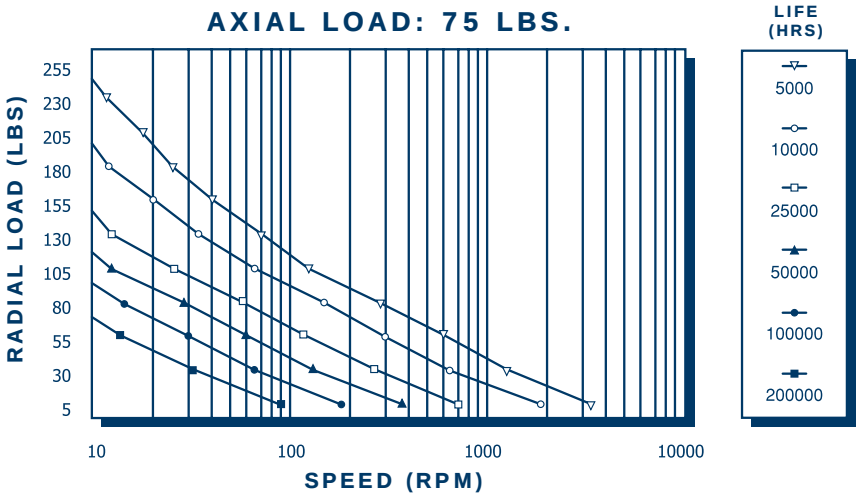
PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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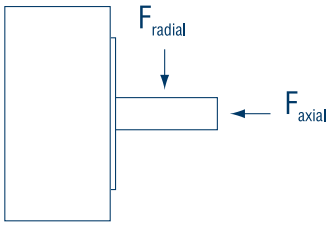




SPEED (RPM) refers to the gearheads output shaft speed.

LIFE (HRS) = (# of lifetime revolutions) ÷ (60 x rpm)

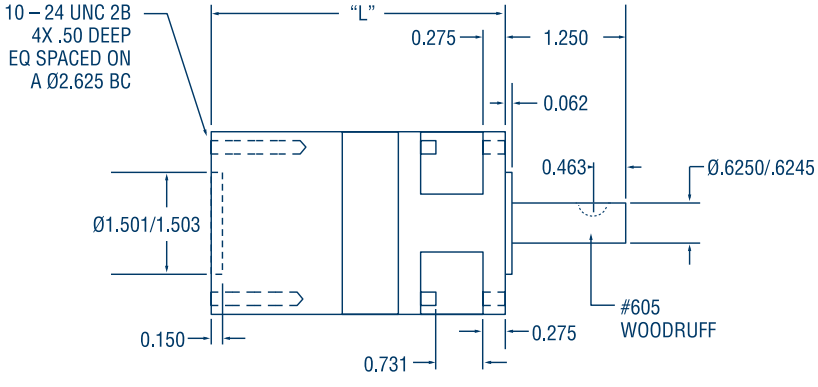
F_{RADIAL} is calculated at 1/2 the shaft length.

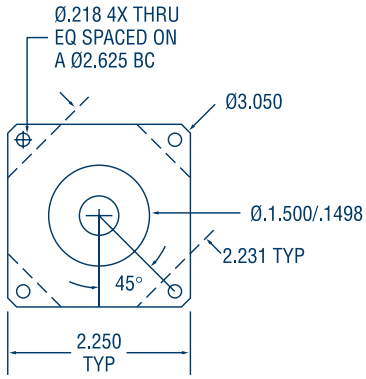


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DIMENSION "L"
Single Stage (3:1 to 10:1) = 3.146± .015
Double Stage (16:1 to 100:1) = 4.249 ± .015





	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec^2)
SINGLE STAGE	23PL003	3:1	520	343	273	1.22×10^{-4}
	23PL004	4:1	482	346	285	5.24×10^{-5}
	23PL005	5.5:1	439	339	290	2.65×10^{-5}
	23PL007	7:1	405	329	288	1.93×10^{-5}
	23PL010	10:1	325	280	253	1.35×10^{-5}
DOUBLE STAGE	23PL016	16:1	698	619	571	5.32×10^{-5}
	23PL022	22:1	716	654	614	2.70×10^{-5}
	23PL028	28:1	728	676	643	1.96×10^{-5}
	23PL040	40:1	740	703	676	1.36×10^{-5}
	23PL049	49:1	535	515	501	1.90×10^{-5}
	23PL055	55:1	615	593	578	1.34×10^{-5}
	23PL070	70:1	540	525	515	1.33×10^{-5}
	23PL100	100:1	411	404	399	1.33×10^{-5}

GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	6	3	90%	2.05	5000
Double Stage	16:1 to 100:1	10	7	85%	3.30	5000

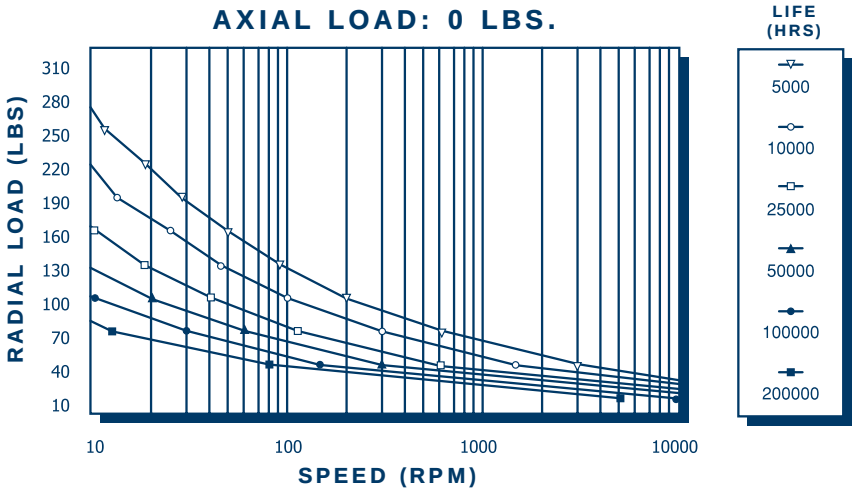
PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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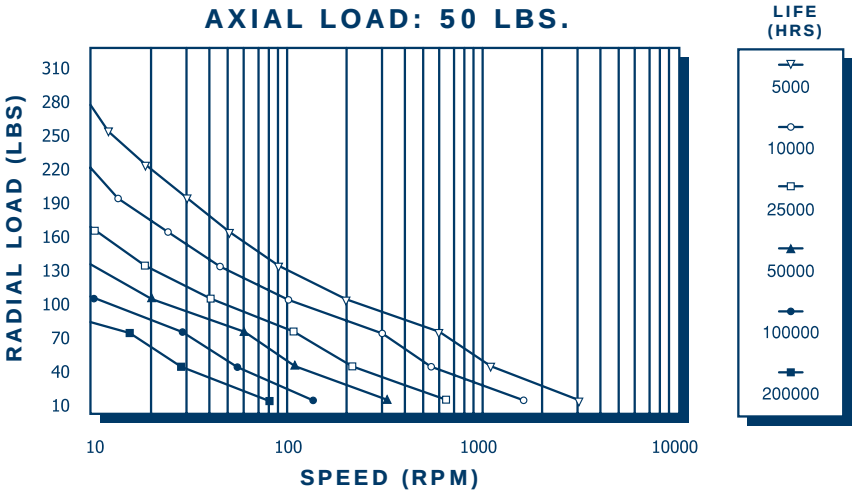
SIZE 23 PL BEARING LIFE VS. SHAFT LOAD



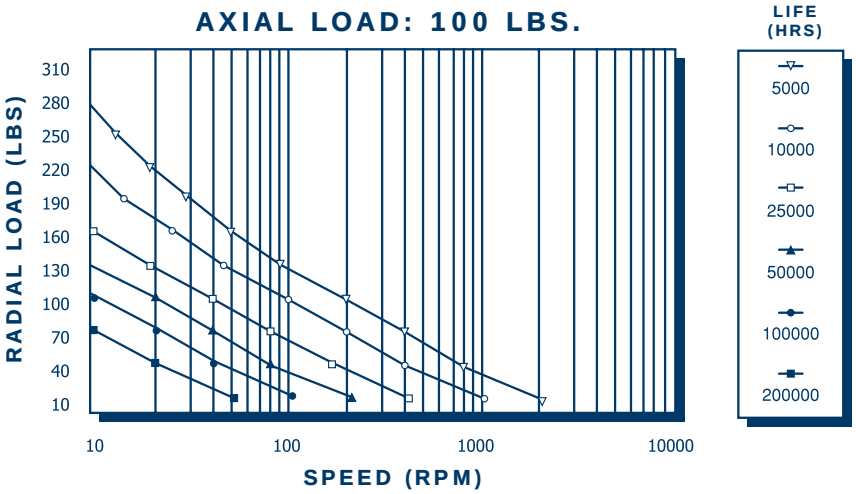
AXIAL LOAD: 0 LBS.



AXIAL LOAD: 50 LBS.



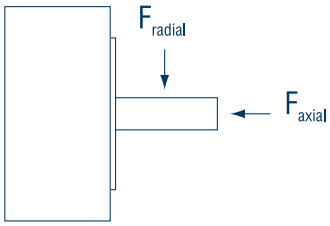
AXIAL LOAD: 100 LBS.



SPEED (RPM) refers to the gearheads output shaft speed.

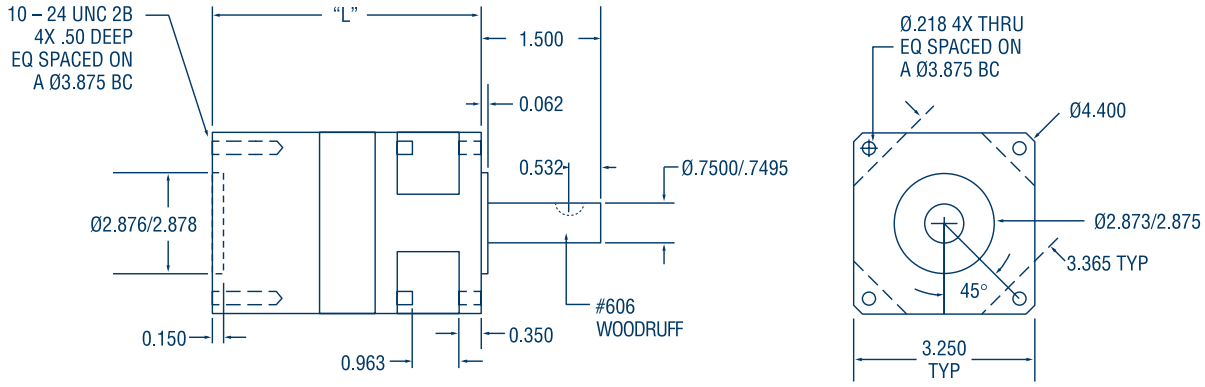
LIFE (HRS) = (# of lifetime revolutions) ÷ (60 x rpm)

F_{RADIAL} is calculated at 1/2 the shaft length.



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DIMENSION "L"
Single Stage (3:1 to 10:1) = 4.063 ± .015
Double Stage (16:1 to 100:1) = 5.431 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec^2)
SINGLE STAGE	34PL003	3:1	1189	724	560	6.77×10^{-4}
	34PL004	4:1	1144	757	604	2.77×10^{-5}
	34PL005	5.5:1	1074	773	638	1.51×10^{-5}
	34PL007	7:1	1011	768	651	1.11×10^{-5}
	34PL010	10:1	832	677	594	7.90×10^{-5}
DOUBLE STAGE	34PL016	16:1	1805	1531	1374	2.86×10^{-5}
	34PL022	22:1	1874	1650	1515	1.55×10^{-5}
	34PL028	28:1	1915	1728	1609	1.14×10^{-5}
	34PL040	40:1	1963	1821	1728	8.04×10^{-5}
	34PL049	49:1	1428	1351	1298	1.11×10^{-5}
	34PL055	55:1	1640	1558	1501	7.94×10^{-5}
	34PL070	70:1	1445	1390	1351	7.90×10^{-5}
	34PL100	100:1	1106	1078	1056	7.87×10^{-5}

GENERAL SPECIFICATIONS

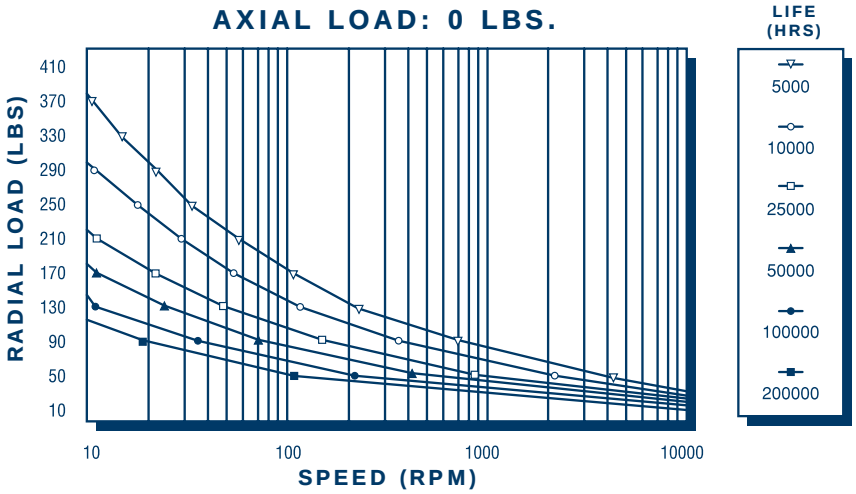
Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	6	3	90%	5.47	5000
Double Stage	16:1 to 100:1	10	7	85%	8.85	5000

PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

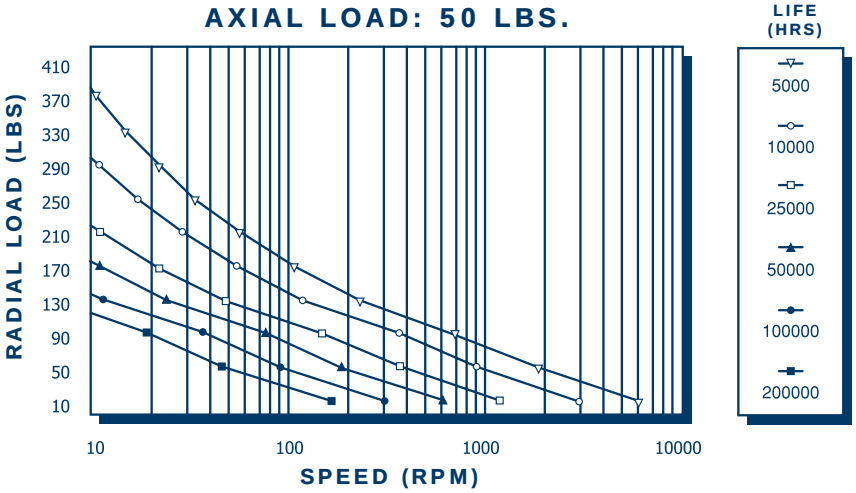
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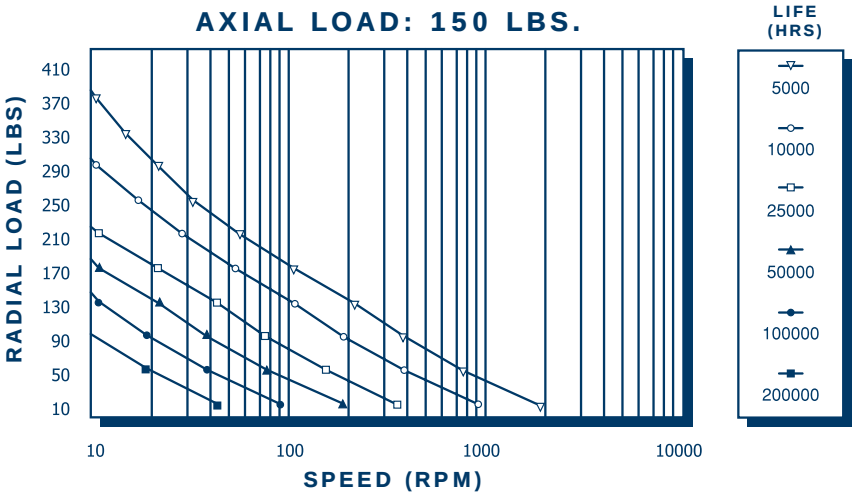
AXIAL LOAD: 0 LBS.



AXIAL LOAD: 50 LBS.



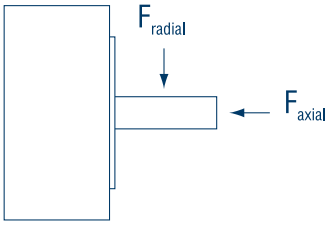
AXIAL LOAD: 150 LBS.



SPEED (RPM) refers to the gearheads output shaft speed.

LIFE (HRS) = (# of lifetime revolutions) ÷ (60 x rpm)

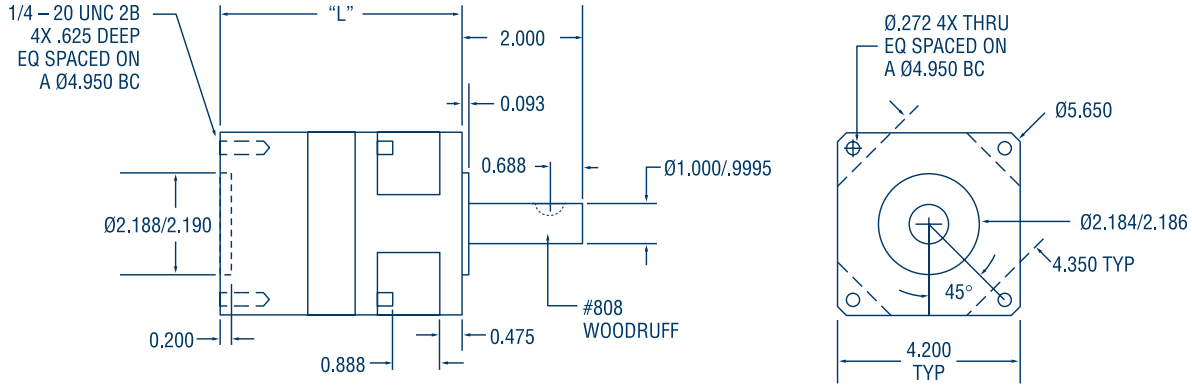
F_{RADIAL} is calculated at 1/2 the shaft length.



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DIMENSION "L"
Single Stage (3:1 to 10:1) = 4.624 ± .015
Double Stage (16:1 to 100:1) = 6.237 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec²)
SINGLE STAGE	42PL003	3:1	2022	1175	894	2.27×10^{-3}
	42PL004	4:1	1993	1256	983	1.02×10^{-3}
	42PL005	5.5:1	1913	1312	1062	5.87×10^{-4}
	42PL007	7:1	1826	1327	1101	4.56×10^{-4}
	42PL010	10:1	1527	1196	1029	3.52×10^{-4}
DOUBLE STAGE	42PL016	16:1	3346	2745	2419	1.05×10^{-3}
	42PL022	22:1	3503	3003	2711	6.01×10^{-4}
	42PL028	28:1	3599	3173	2913	4.65×10^{-4}
	42PL040	40:1	3711	3383	3173	3.57×10^{-4}
	42PL049	49:1	2710	2530	2411	4.56×10^{-4}
	42PL055	55:1	3118	2923	2793	3.53×10^{-4}
	42PL070	70:1	2754	2621	2530	3.52×10^{-4}
	42PL100	100:1	2113	2043	1994	3.51×10^{-4}

GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	6	3	90%	10.37	5000
Double Stage	16:1 to 100:1	10	7	85%	16.89	5000

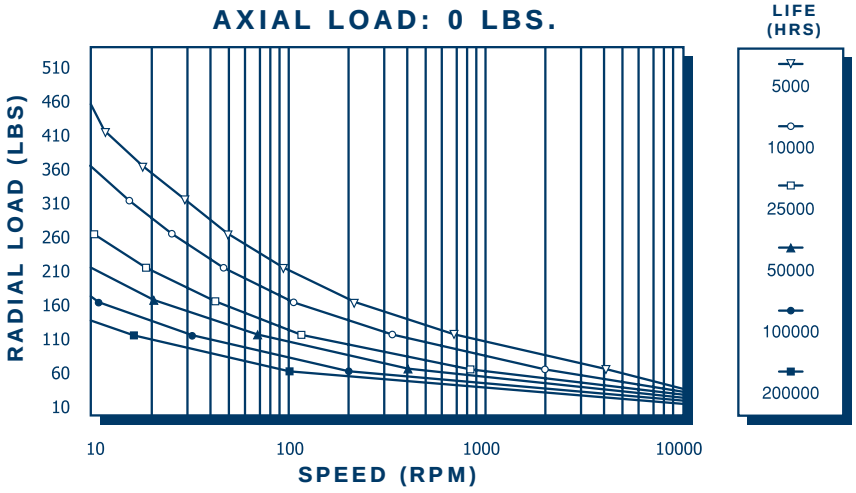
PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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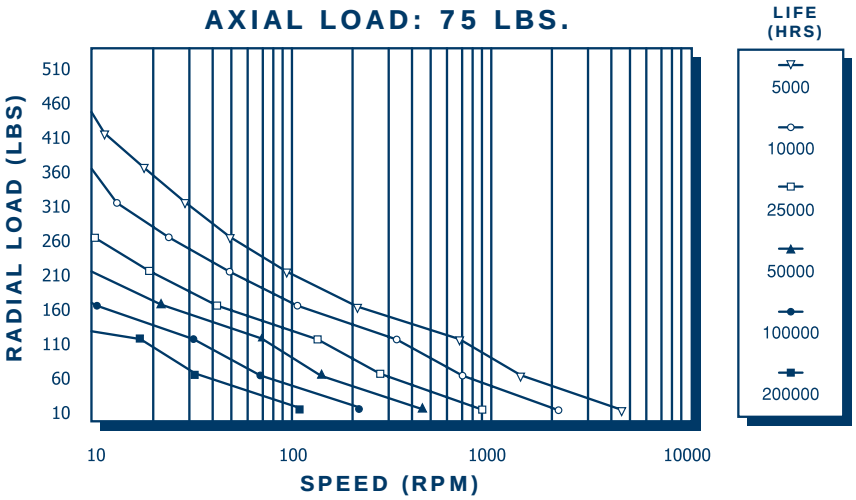
SIZE 42 PL BEARING LIFE VS. SHAFT LOAD



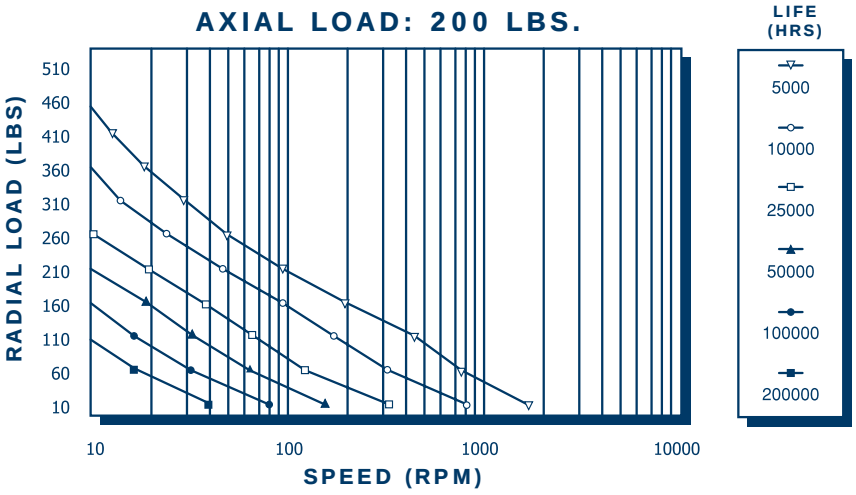
AXIAL LOAD: 0 LBS.



AXIAL LOAD: 75 LBS.



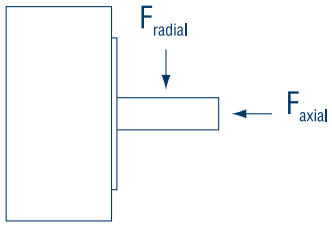
AXIAL LOAD: 200 LBS.



SPEED (RPM) refers to the gearheads output shaft speed.

LIFE (HRS) = (# of lifetime revolutions) ÷ (60 x rpm)

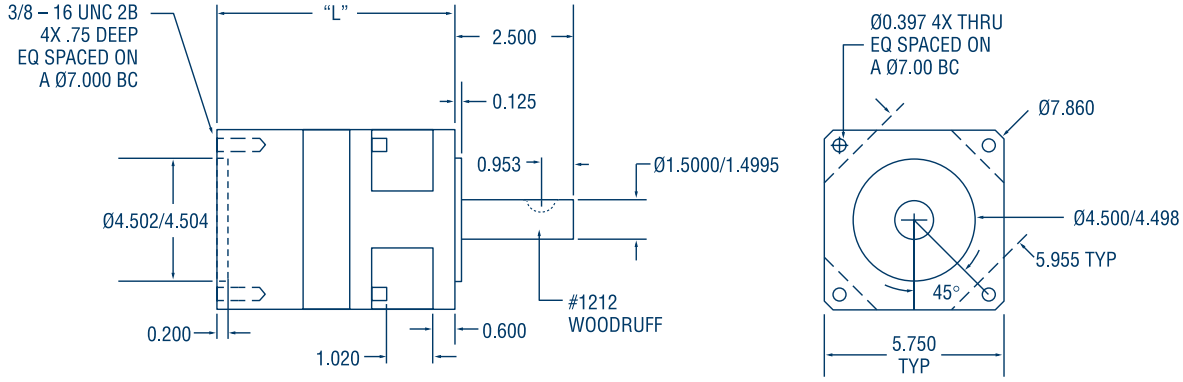
F_{RADIAL} is calculated at 1/2 the shaft length.



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DIMENSION "L"
Single Stage (3:1 to 10:1) = 6.475 ± .015
Double Stage (16:1 to 100:1) = 8.588 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec^2)
SINGLE STAGE	56PL003	3:1	4176	2292	1713	1.12×10^{-2}
	56PL004	4:1	4244	2512	1923	5.58×10^{-3}
	56PL005	5.5:1	4203	2702	2131	4.06×10^{-3}
	56PL007	7:1	4093	2793	2256	3.51×10^{-3}
	56PL010	10:1	3509	2597	2174	3.08×10^{-3}
DOUBLE STAGE	56PL016	16:1	7801	6086	5225	5.67×10^{-3}
	56PL022	22:1	8278	6800	5996	4.11×10^{-3}
	56PL028	28:1	8578	7288	6549	3.54×10^{-3}
	56PL040	40:1	8934	7913	7288	3.09×10^{-3}
	56PL049	49:1	6569	6000	5635	3.50×10^{-3}
	56PL055	55:1	7566	6948	6548	3.08×10^{-3}
	56PL070	70:1	6713	6286	6000	3.07×10^{-3}
	56PL100	100:1	5174	4946	4788	3.07×10^{-3}

GENERAL SPECIFICATIONS

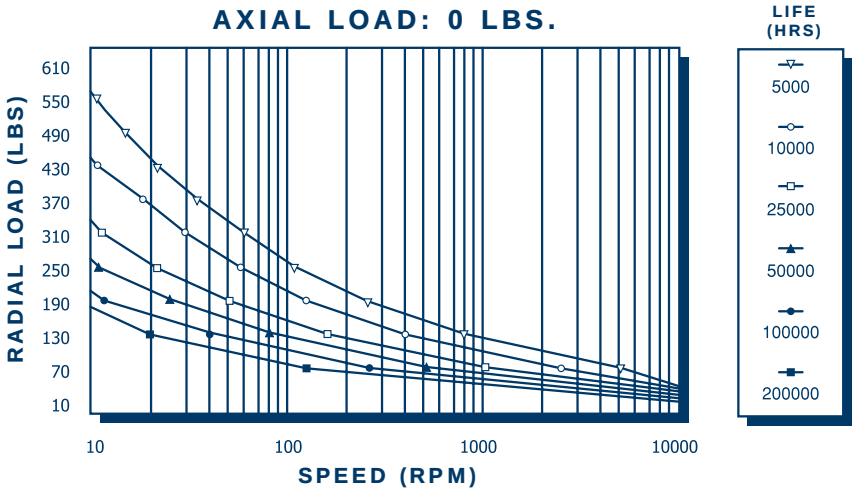
Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	6	3	90%	27.11	5000
Double Stage	16:1 to 100:1	10	7	85%	43.48	5000

PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

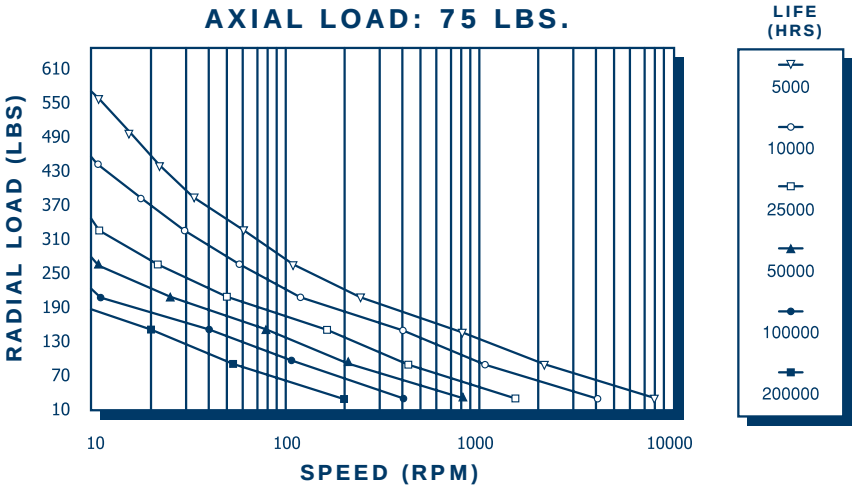
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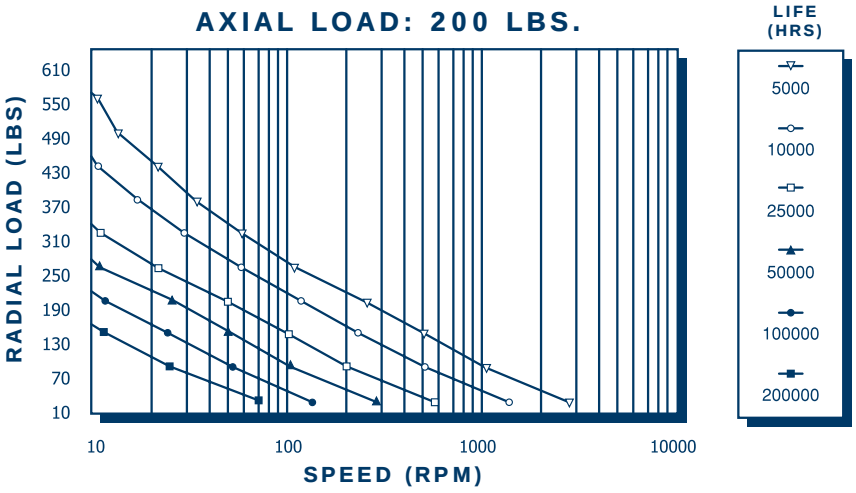
AXIAL LOAD: 0 LBS.



AXIAL LOAD: 75 LBS.



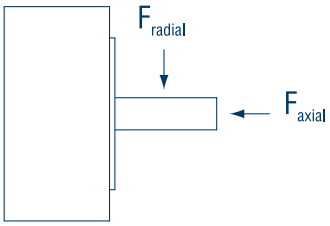
AXIAL LOAD: 200 LBS.



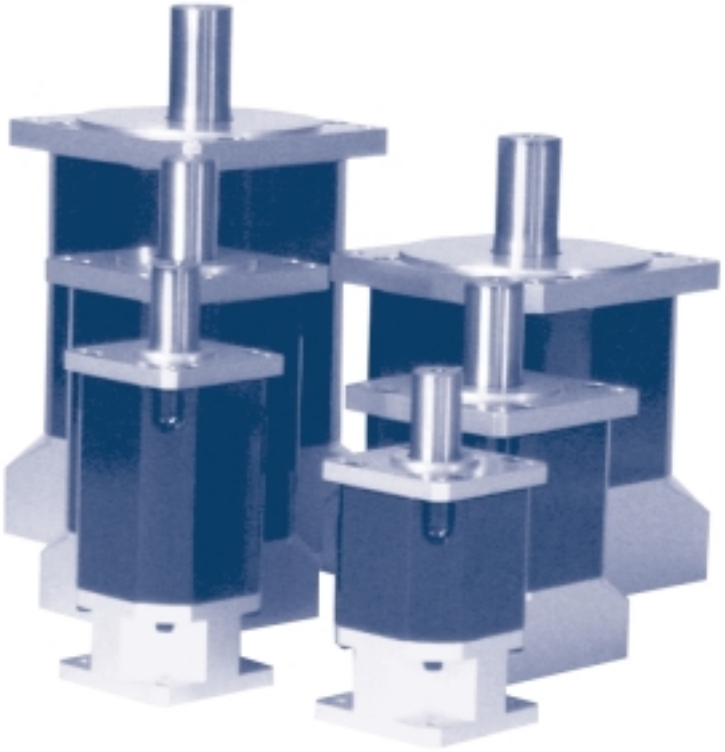
SPEED (RPM) refers to the gearheads output shaft speed.

LIFE (HRS) = (# of lifetime revolutions) ÷ (60 x rpm)

F_{RADIAL} is calculated at 1/2 the shaft length.



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OVERVIEW:

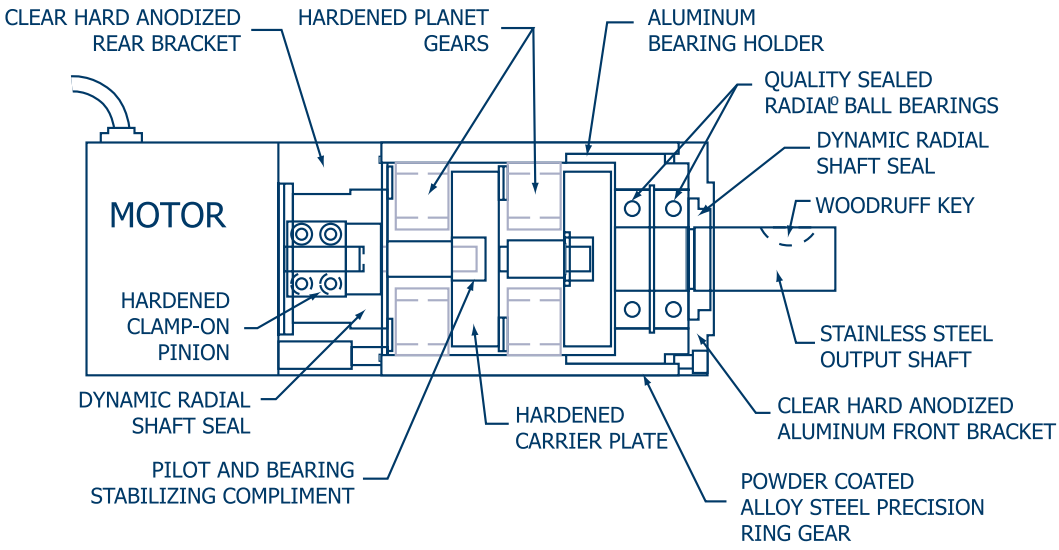
- The Eliminator Planetary (EP) line of gearheads is our economical high end line designed for strenuous applications.
- Made in sizes 17, 23 & 34 with standard ratios from 3:1 to 100:1. We are capable of producing ratios up to 10,000:1.

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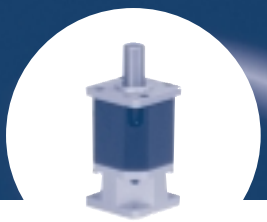


FEATURES:

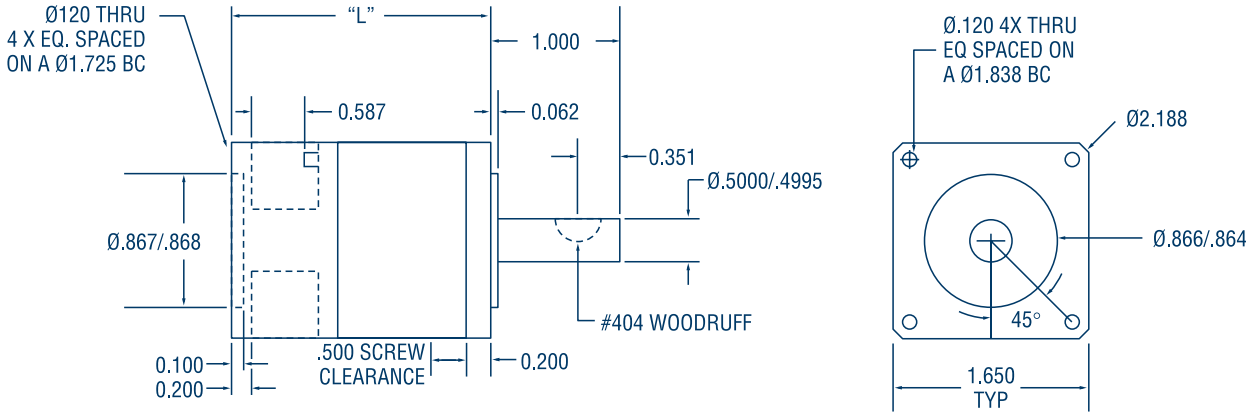
- Dynamic radial shaft seal at the input and output.
- Enclosure rating = IP65.
- Operating temperature range = ¯20ºF to 250ºF.
- Aluminum hard anodized rear and front brackets with surface hardnesses of 60 rockwell.
- Alloy steel powder coated ring gear.
- Quality sealed radial ball bearings.
- Stainless steel output shaft.
- Hardened precision gearing throughout.
- Precision clamp on pinion with four clamping screws to eliminate slippage.



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DIMENSION "L"
Single Stage (3:1 to 10:1) = 2.869± .015
Double Stage (16:1 to 100:1) = 3.738 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec²)
SINGLE STAGE	17EP003	3:1	197	140	115	3.25×10^{-5}
	17EP004	4:1	177	136	116	1.60×10^{-5}
	17EP005	5.5:1	157	129	113	1.10×10^{-5}
	17EP007	7:1	143	122	110	9.56×10^{-6}
	17EP010	10:1	113	101	93	8.36×10^{-6}
DOUBLE STAGE	17EP016	16:1	211	194	182	1.59×10^{-5}
	17EP022	22:1	216	201	193	1.10×10^{-6}
	17EP028	28:1	218	207	199	9.54×10^{-6}
	17EP040	40:1	220	212	207	8.35×10^{-6}
	17EP049	49:1	158	154	152	9.44×10^{-6}
	17EP055	55:1	183	177	175	8.31×10^{-6}
	17EP070	70:1	160	156	154	8.30×10^{-6}
	17EP100	100:1	122	120	119	8.29×10^{-6}

GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	6	3	90%	1.14	5000
Double Stage	16:1 to 100:1	10	7	85%	1.62	5000

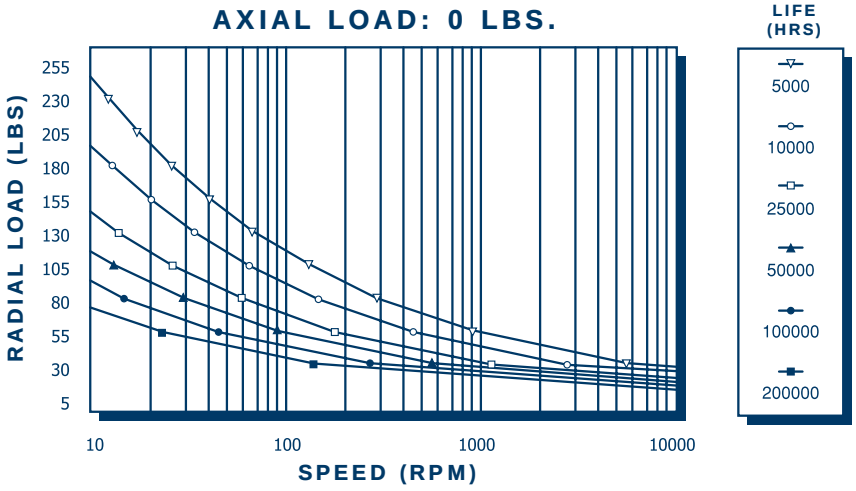
PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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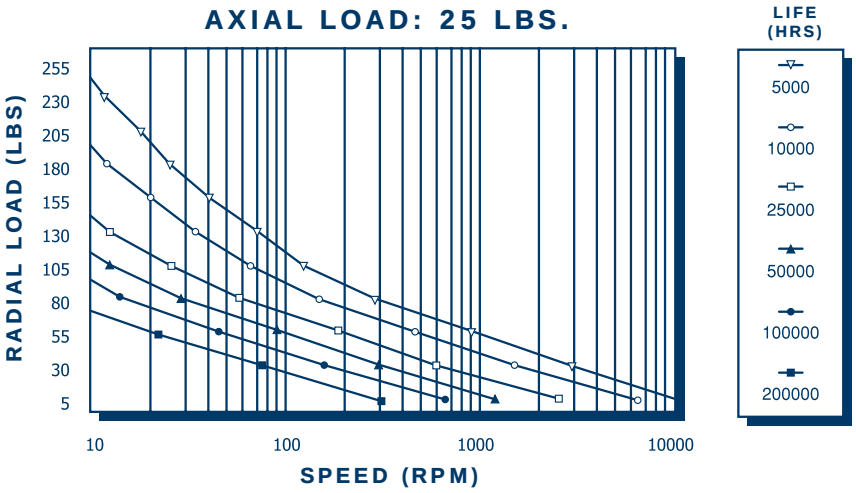
SIZE 17 EP BEARING LIFE VS. SHAFT LOAD



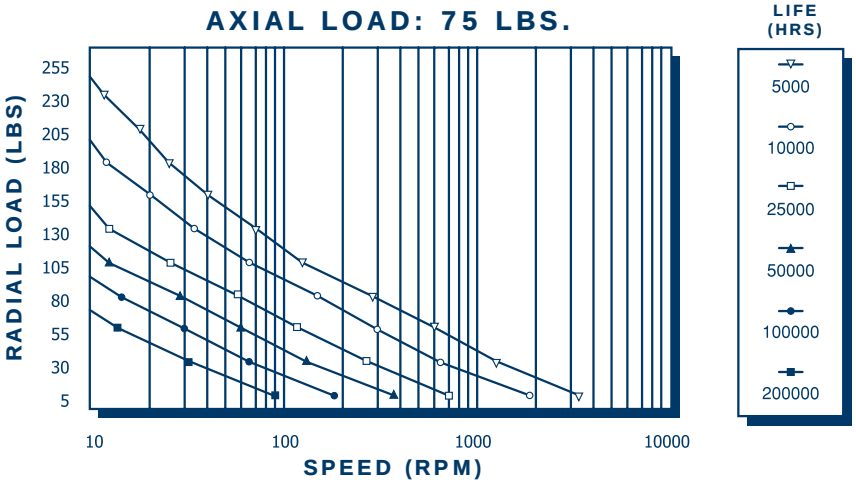
AXIAL LOAD: 0 LBS.



AXIAL LOAD: 25 LBS.



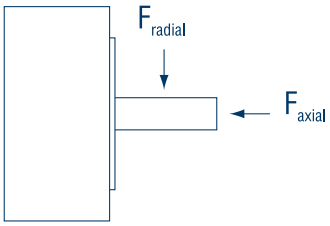
AXIAL LOAD: 75 LBS.



SPEED (RPM) refers to the gearheads output shaft speed.

LIFE (HRS) = (# of lifetime revolutions) ÷ (60 x rpm)

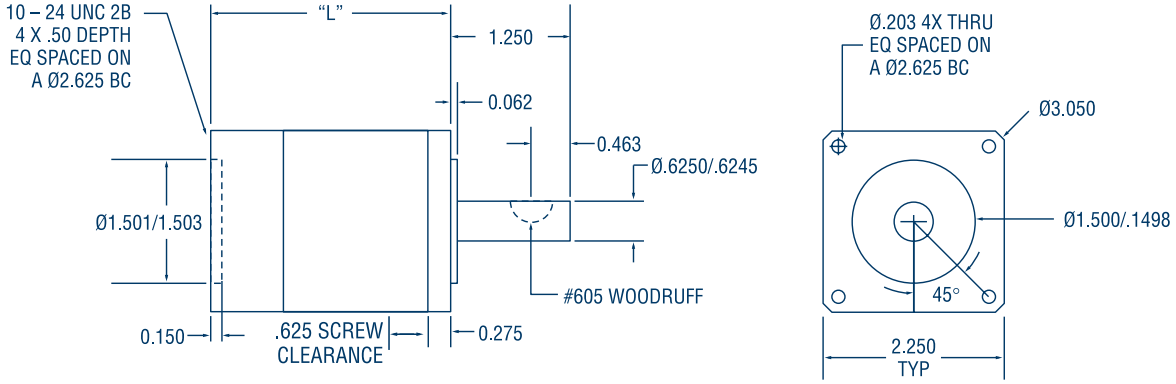
F_{RADIAL} is calculated at 1/2 the shaft length.



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DIMENSION "L"
Single Stage (3:1 to 10:1) = 3.146± .015
Double Stage (16:1 to 100:1) = 4.249 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec²)
SINGLE STAGE	23EP003	3:1	442	292	232	1.22×10^{-4}
	23EP004	4:1	410	294	242	5.24×10^{-5}
	23EP005	5.5:1	373	288	247	2.65×10^{-5}
	23EP007	7:1	344	279	245	1.93×10^{-5}
	23EP010	10:1	277	238	215	1.35×10^{-5}
DOUBLE STAGE	23EP016	16:1	521	463	427	5.32×10^{-5}
	23EP022	22:1	536	490	460	2.70×10^{-5}
	23EP028	28:1	545	506	481	1.96×10^{-5}
	23EP040	40:1	553	525	506	1.36×10^{-5}
	23EP049	49:1	400	385	375	1.90×10^{-5}
	23EP055	55:1	460	443	432	1.34×10^{-5}
	23EP070	70:1	404	393	385	1.33×10^{-5}
	23EP100	100:1	308	303	298	1.33×10^{-5}

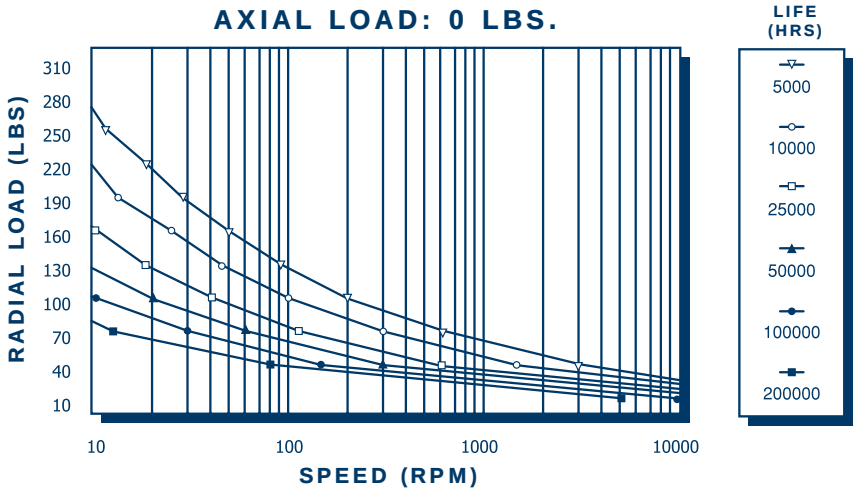
GENERAL SPECIFICATIONS

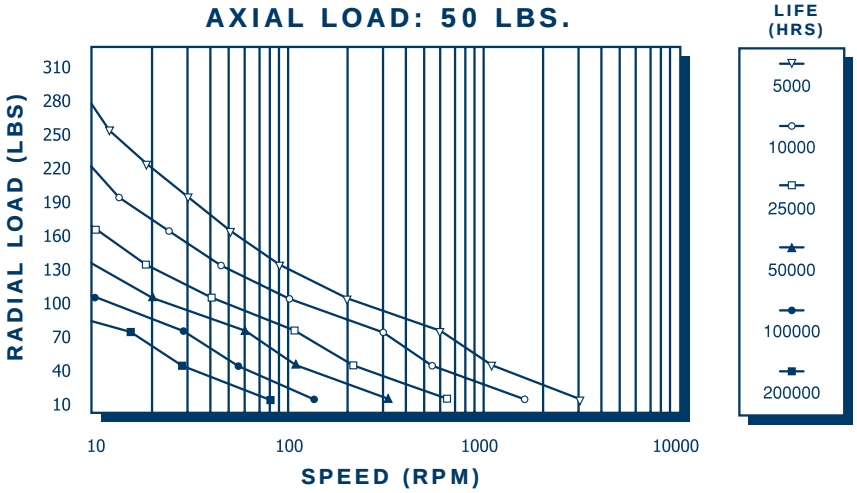
Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	6	3	90%	2.29	5000
Double Stage	16:1 to 100:1	10	7	85%	3.42	5000

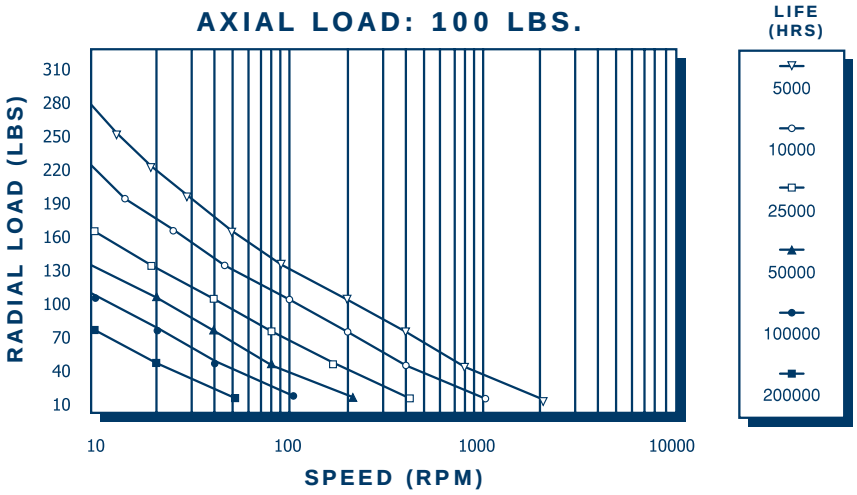
PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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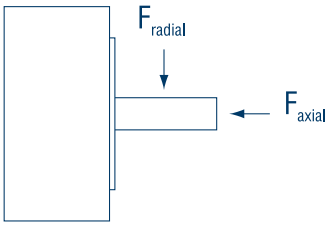




SPEED (RPM) refers to the gearheads output shaft speed.

LIFE (HRS) = (# of lifetime revolutions) ÷ (60 x rpm)

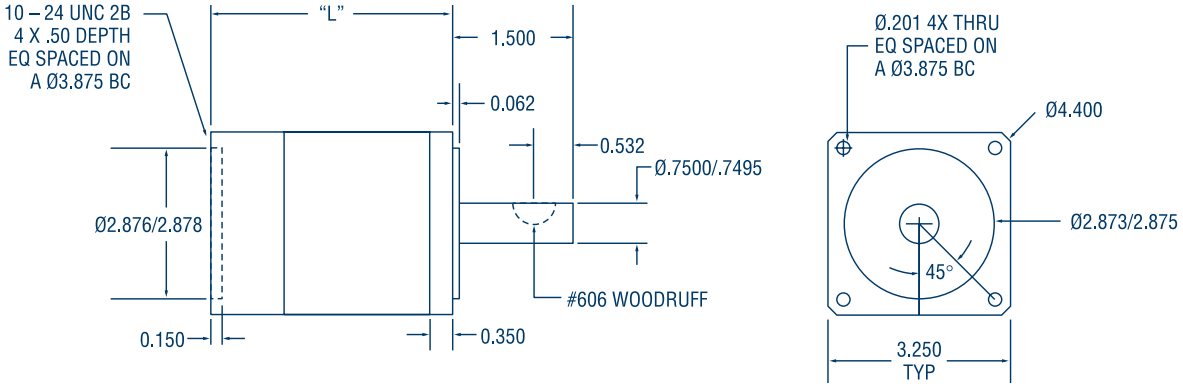
F_{RADIAL} is calculated at 1/2 the shaft length.



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DIMENSION "L"
Single Stage (3:1 to 10:1) = 4.063± .015
Double Stage (16:1 to 100:1) = 5.431 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec^2)
SINGLE STAGE	34EP003	3:1	1010	615	475	6.77×10^{-4}
	34EP004	4:1	972	643	513	2.77×10^{-4}
	34EP005	5.5:1	913	657	543	1.51×10^{-4}
	34EP007	7:1	859	653	554	1.11×10^{-4}
	34EP010	10:1	707	575	505	7.90×10^{-5}
DOUBLE STAGE	34EP016	16:1	1350	1145	1027	2.86×10^{-4}
	34EP022	22:1	1401	1234	1133	1.55×10^{-4}
	34EP028	28:1	1432	1293	1203	1.11×10^{-4}
	34EP040	40:1	1469	1362	1293	8.04×10^{-5}
	34EP049	49:1	1067	1010	971	1.11×10^{-4}
	34EP055	55:1	1228	1165	1123	7.94×10^{-5}
	34EP070	70:1	1081	1040	1010	7.90×10^{-5}
	34EP100	100:1	827	805	790	7.87×10^{-5}

GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	6	3	90%	5.67	5000
Double Stage	16:1 to 100:1	10	7	85%	8.41	5000

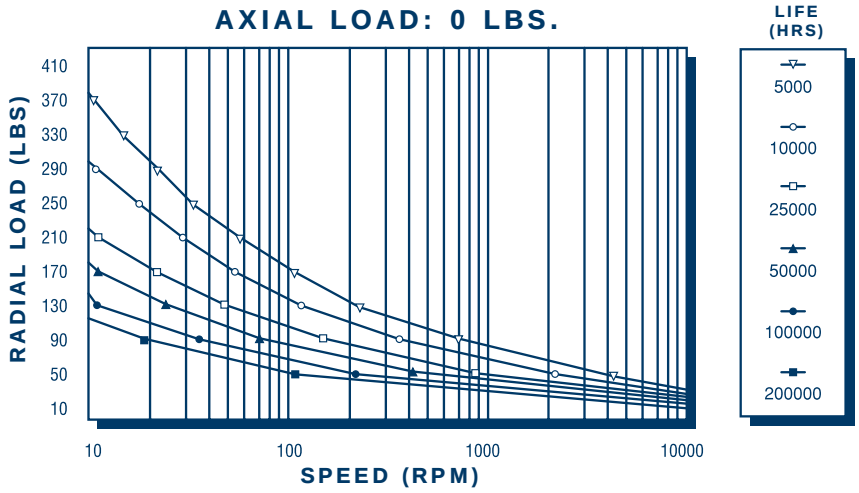
PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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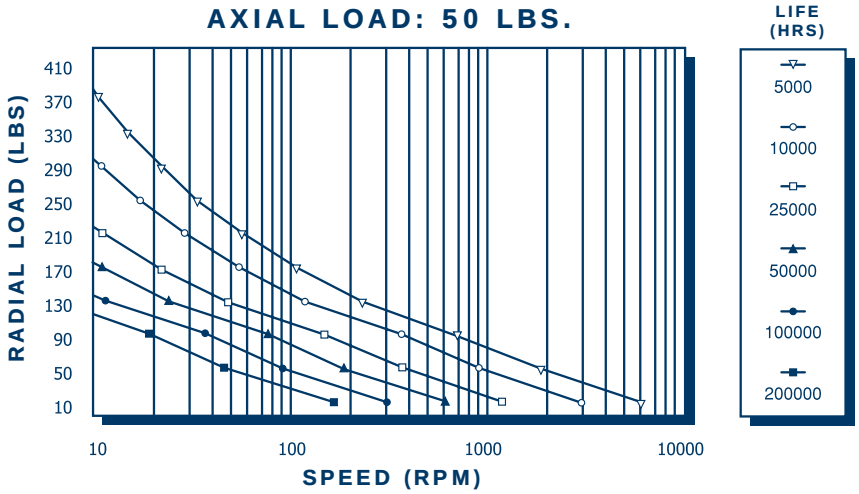
SIZE 34 EP BEARING LIFE VS. SHAFT LOAD



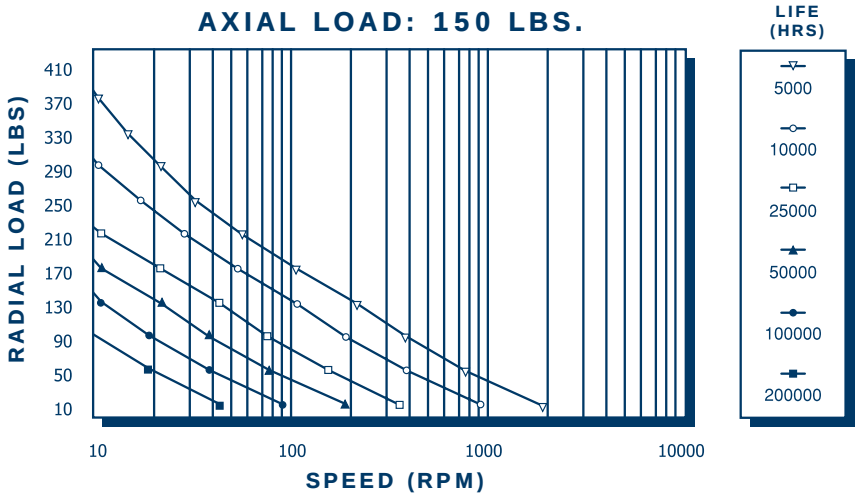
AXIAL LOAD: 0 LBS.



AXIAL LOAD: 50 LBS.



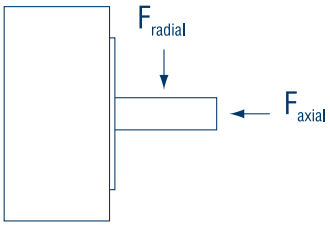
AXIAL LOAD: 150 LBS.



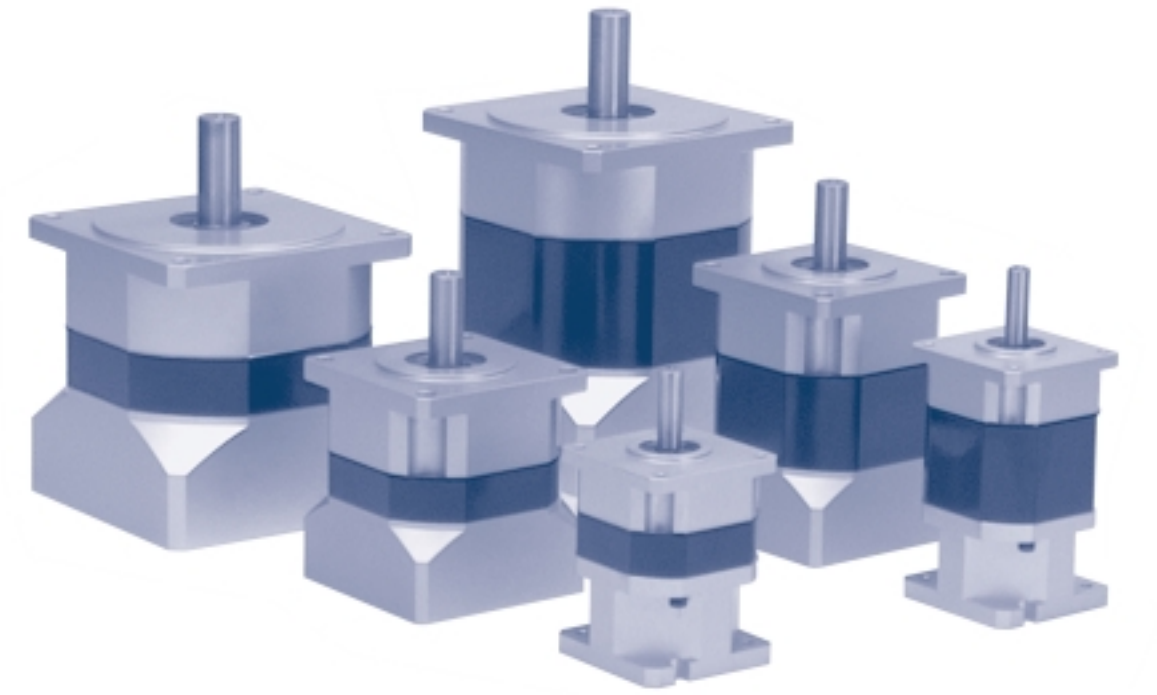
SPEED (RPM) refers to the gearheads output shaft speed.

LIFE (HRS) = (# of lifetime revolutions) ÷ (60 x rpm)

F_{RADIAL} is calculated at 1/2 the shaft length.



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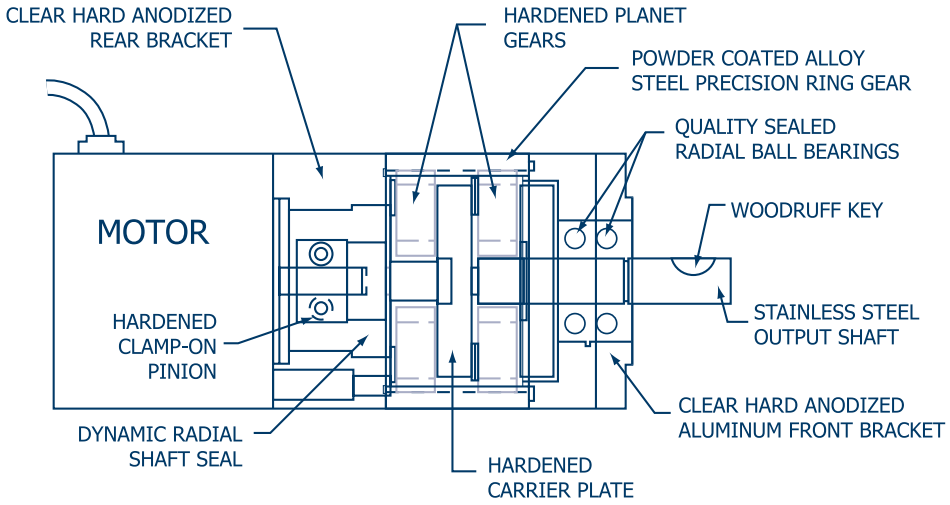
OVERVIEW:

- The "S" Series Planetary (SP) Line of gearheads is our most economical line designed for light duty applications.
- Made in sizes 17, 23 & 34 with standard ratios from 4:1 to 100:1. We are capable of producing ratios up to 10,000:1

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FEATURES:

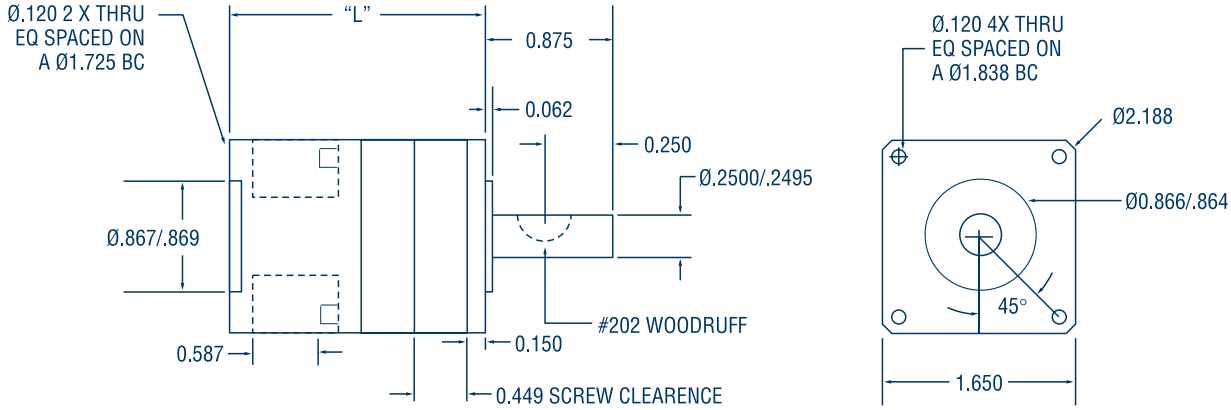
- Dynamic radial shaft seal at the input and sealed bearings at the output.
- Enclosure rating = IP54
- Operating temperature range = ¯20ºF to 250ºF.
- Aluminum hard anodized rear and front brackets with surface hardnesses of 60 rockwell.
- Alloy steel powder coated ring gear.
- Quality sealed radial ball bearings.
- Stainless steel output shaft.
- Hardened precision gearing throughout.
- Precision clamp on pinion to eliminate slippage.



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DIMENSION "L"
Single Stage (4:1 to 10:1) = 2.17± .015
Double Stage (16:1 to 100:1) = 2.78 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec^2)
SINGLE STAGE	17SP004	4:1	75	57	49	1.28×10^{-5}
	17SP007	7:1	60	51	46	7.65×10^{-6}
	17SP010	10:1	48	43	39	6.69×10^{-6}
DOUBLE STAGE	17SP016	16:1	81	74	70	1.27×10^{-5}
	17SP028	28:1	83	79	76	7.63×10^{-6}
	17SP049	49:1	61	59	58	7.55×10^{-6}
	17SP070	70:1	61	60	59	6.64×10^{-6}
	17SP100	100:1	47	46	46	6.63×10^{-6}

GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	4:1 to 10:1	12	6	95%	0.59	5000
Double Stage	16:1 to 100:1	16	10	90%	0.88	5000

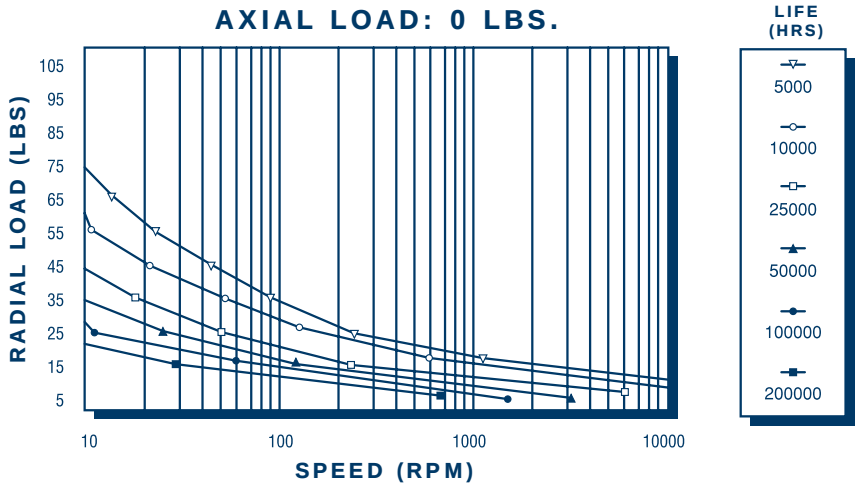
PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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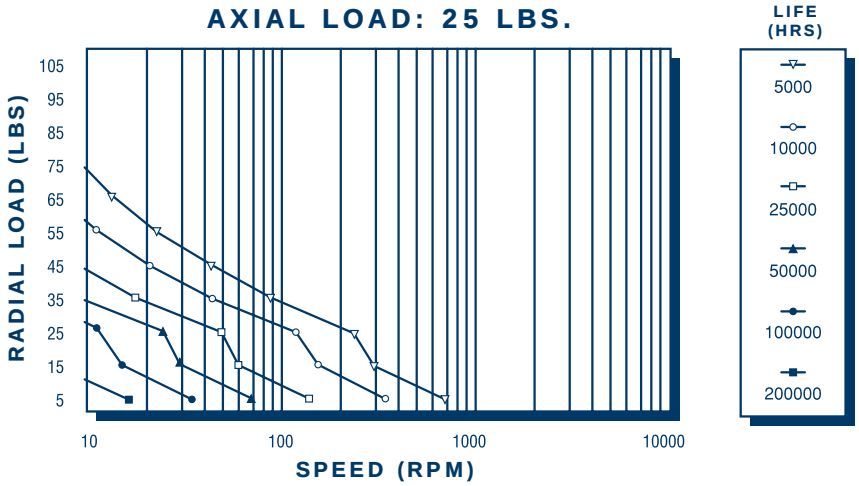
SIZE 17 SP BEARING LIFE VS. SHAFT LOAD



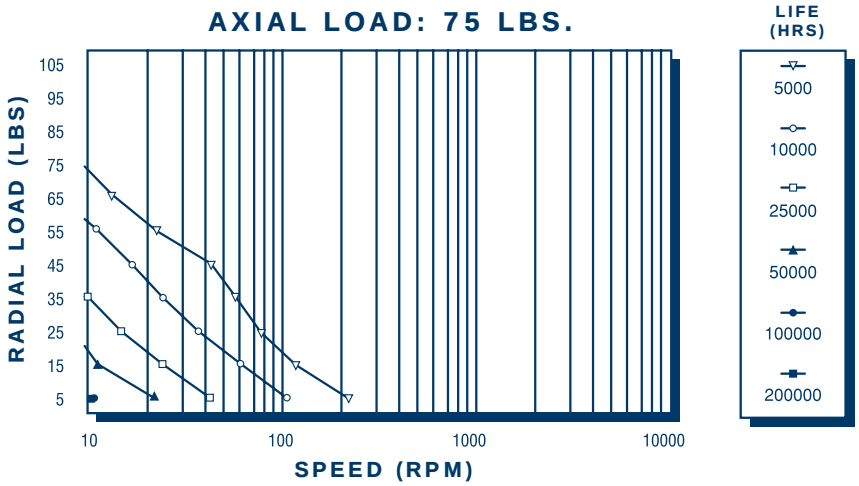
AXIAL LOAD: 0 LBS.



AXIAL LOAD: 25 LBS.



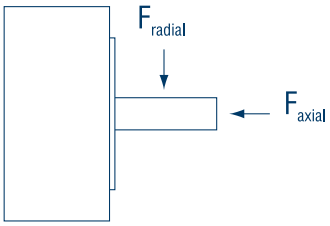
AXIAL LOAD: 75 LBS.



SPEED (RPM) refers to the gearheads output shaft speed.

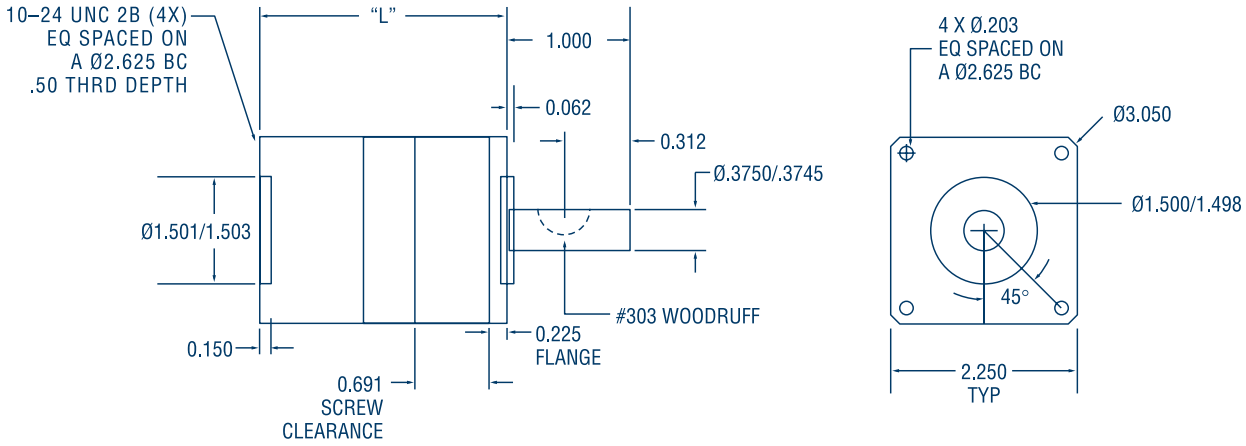
LIFE (HRS) = (# of lifetime revolutions) ÷ (60 x rpm)

F_{RADIAL} is calculated at 1/2 the shaft length.



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DIMENSION "L"
Single Stage (4:1 to 10:1) = 2.436± .015
Double Stage (16:1 to 100:1) = 3.029 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input ($lb\text{-}in\text{-}sec^2$)
SINGLE STAGE	23SP004	4:1	185	133	109	4.19×10^{-5}
	23SP007	7:1	155	126	110	1.54×10^{-5}
	23SP010	10:1	125	107	97	1.08×10^{-5}
DOUBLE STAGE	23SP016	16:1	214	190	175	4.26×10^{-5}
	23SP028	28:1	223	208	197	1.57×10^{-5}
	23SP049	49:1	164	158	154	1.52×10^{-5}
	23SP070	70:1	166	161	158	1.06×10^{-5}
	23SP100	100:1	126	124	122	1.06×10^{-5}

GENERAL SPECIFICATIONS

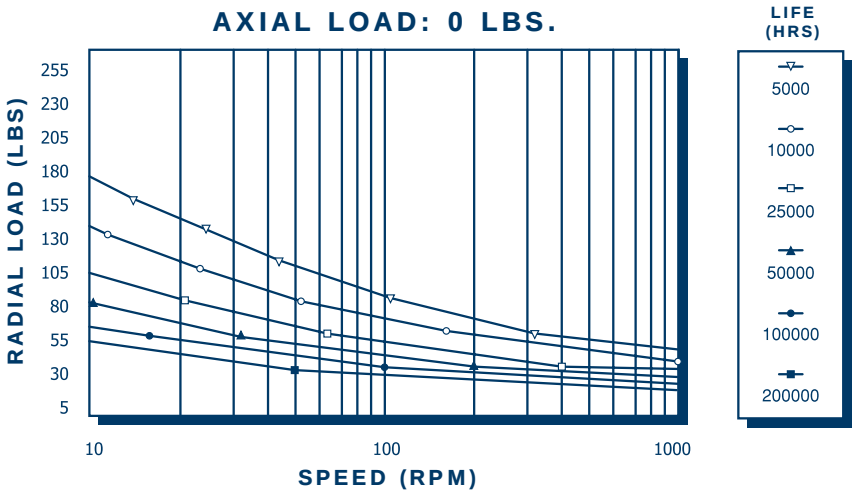
Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	4:1 to 10:1	12	6	95%	1.55	5000
Double Stage	16:1 to 100:1	16	10	90%	1.95	5000

PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

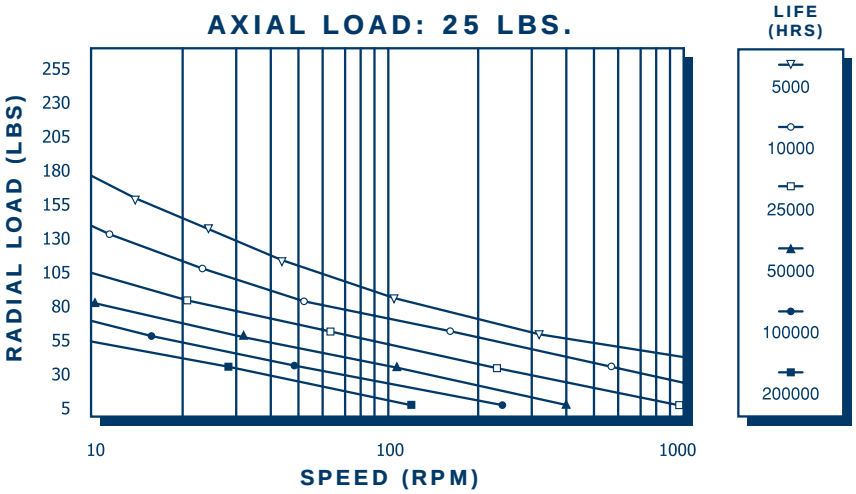
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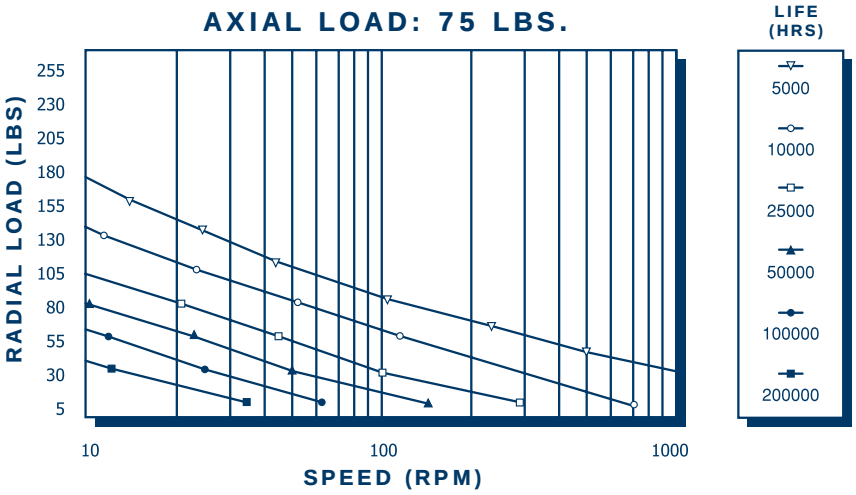
AXIAL LOAD: 0 LBS.



AXIAL LOAD: 25 LBS.



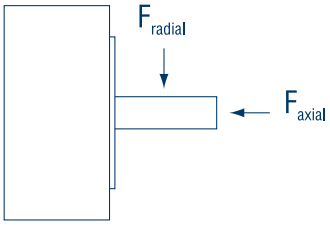
AXIAL LOAD: 75 LBS.



SPEED (RPM) refers to the gearheads output shaft speed.

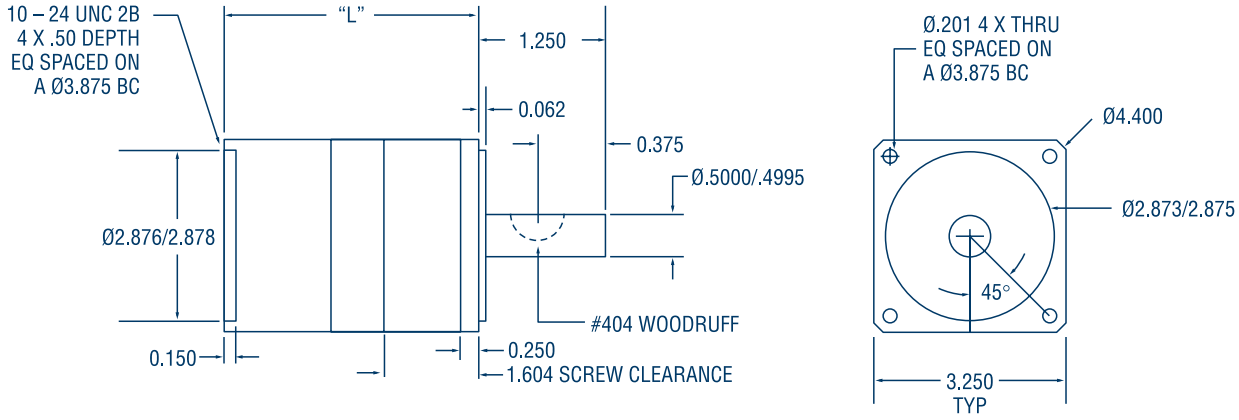
LIFE (HRS) = (# of lifetime revolutions) ÷ (60 x rpm)

F_{RADIAL} is calculated at 1/2 the shaft length.



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DIMENSION "L"
Single Stage (4:1 to 10:1) = 3.229± .015
Double Stage (16:1 to 100:1) = 4.087 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input ($lb\text{-}in\text{-}sec^2$)
SINGLE STAGE	34SP004	4:1	529	350	279	1.28×10^{-4}
	34SP007	7:1	467	355	301	7.65×10^{-5}
	34SP010	10:1	384	313	275	6.69×10^{-5}
DOUBLE STAGE	34SP016	16:1	667	566	508	1.27×10^{-4}
	34SP028	28:1	670	639	595	7.63×10^{-5}
	34SP049	49:1	528	499	480	7.55×10^{-5}
	34SP070	70:1	534	514	499	6.64×10^{-5}
	34SP100	100:1	409	398	391	6.63×10^{-5}

GENERAL SPECIFICATIONS

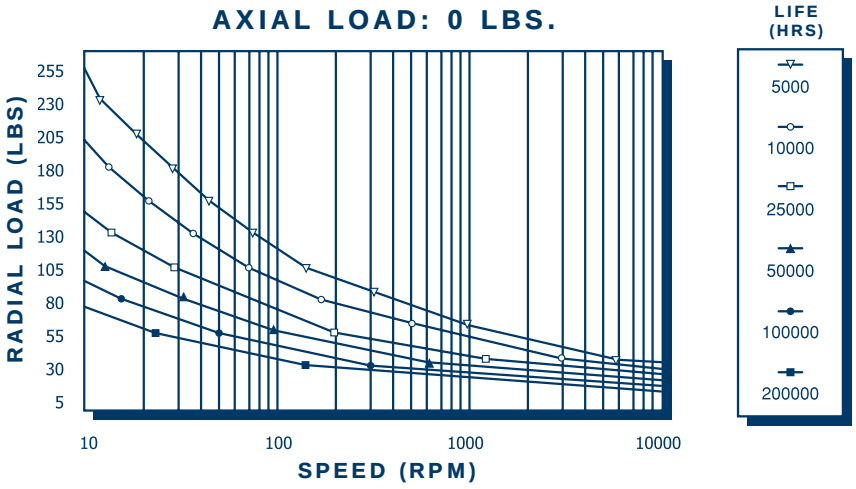
Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	4:1 to 10:1	12	6	95%	3.67	5000
Double Stage	16:1 to 100:1	16	10	90%	5.10	5000

PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

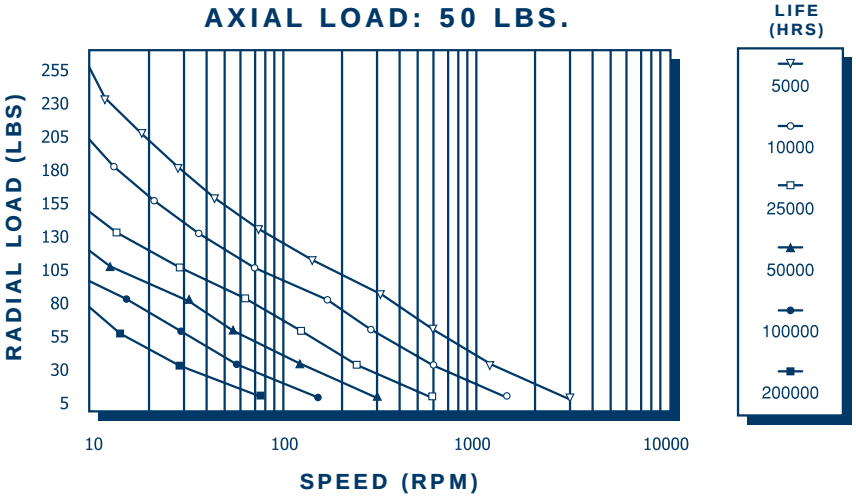
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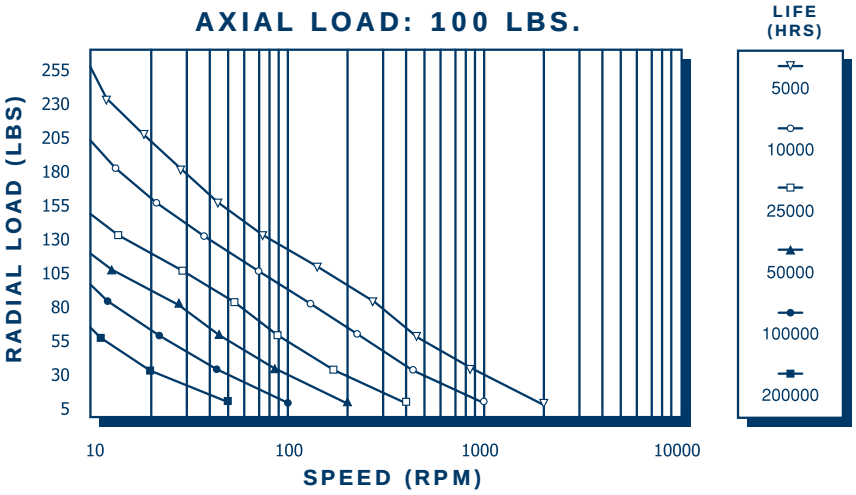
AXIAL LOAD: 0 LBS.



AXIAL LOAD: 50 LBS.



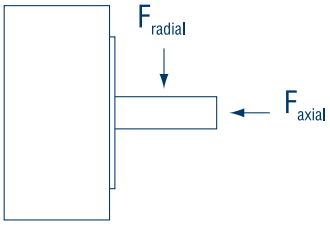
AXIAL LOAD: 100 LBS.



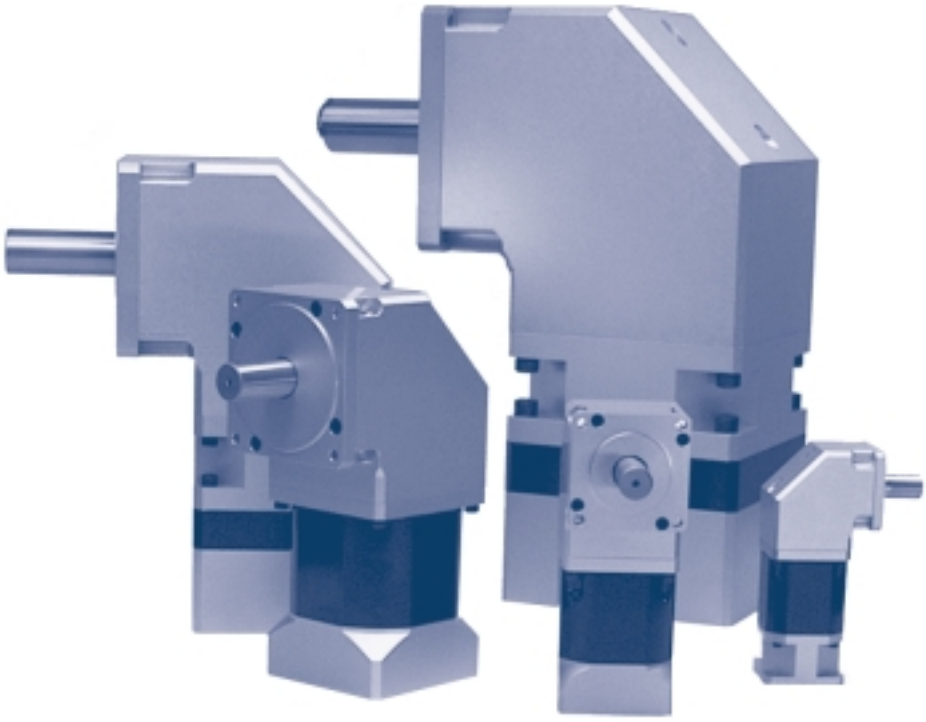
SPEED (RPM) refers to the gearheads output shaft speed.

LIFE (HRS) = (# of lifetime revolutions) ÷ (60 x rpm)

F_{RADIAL} is calculated at 1/2 the shaft length.



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OVERVIEW:

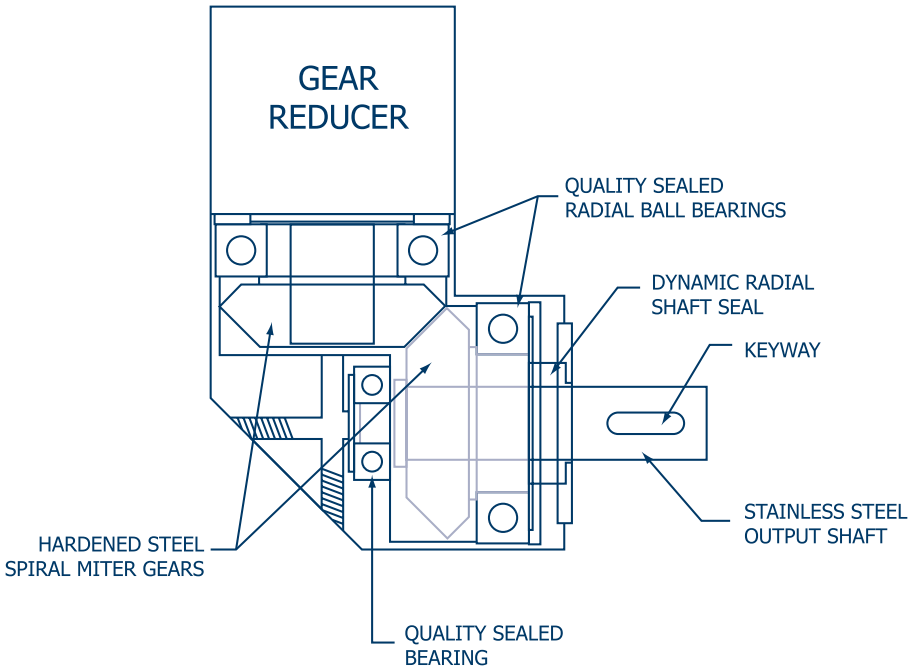
- We offer two lines of the Right Angle Planetary gearheads, the Right Angle Eliminator Planetary (RE) and the Right Angle Precision Planetary (RP).
- The Right Angle Eliminator Planetary line is offered in sizes 17, 23 & 34.
- The Right Angle Precision Planetary line is offered in sizes 17, 23, 34, 42 & 56.
- Standard ratios from 3:1 to 100:1.
- Capable of producing ratios up to 10,000:1.

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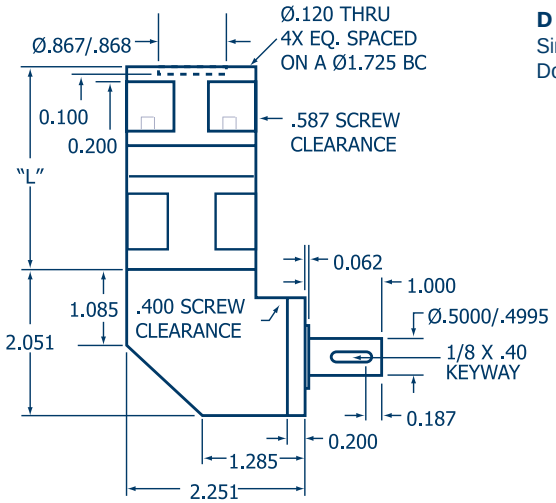
FEATURES:

- Enclosure rating = IP65.
- Operating temperature range = ¯20ºF to 250ºF.
- Hardened steel spiral miter gears.

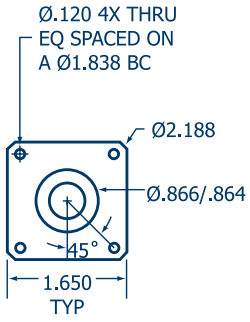


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DIMENSION "L"
Single Stage (3:1 to 10:1) = 2.869 ± .015
Double Stage (16:1 to 100:1) = 3.738 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec^2)
SINGLE STAGE	17RP003	3:1	80	80	80	4.96×10^{-5}
	17RP004	4:1	80	80	80	2.56×10^{-5}
	17RP005	5.5:1	80	80	80	1.61×10^{-5}
	17RP007	7:1	80	80	80	1.27×10^{-5}
	17RP010	10:1	80	80	80	9.90×10^{-6}
DOUBLE STAGE	17RP016	16:1	100	100	100	1.65×10^{-5}
	17RP022	22:1	100	100	100	1.13×10^{-5}
	17RP028	28:1	100	100	100	9.74×10^{-6}
	17RP040	40:1	100	100	100	8.45×10^{-6}
	17RP049	49:1	100	100	100	9.50×10^{-6}
	17RP055	55:1	100	100	100	8.36×10^{-6}
	17RP070	70:1	100	100	100	8.33×10^{-6}
	17RP100	100:1	100	100	100	8.31×10^{-6}

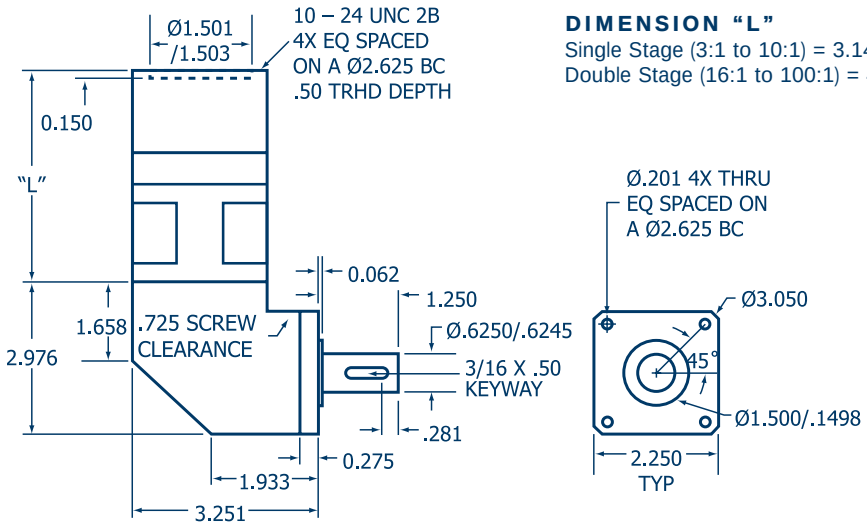
GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	10	7	90%	1.82	5000
Double Stage	16:1 to 100:1	14	11	85%	2.42	5000

PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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DIMENSION "L"
Single Stage (3:1 to 10:1) = 3.146 ± .015
Double Stage (16:1 to 100:1) = 4.249 ± .015

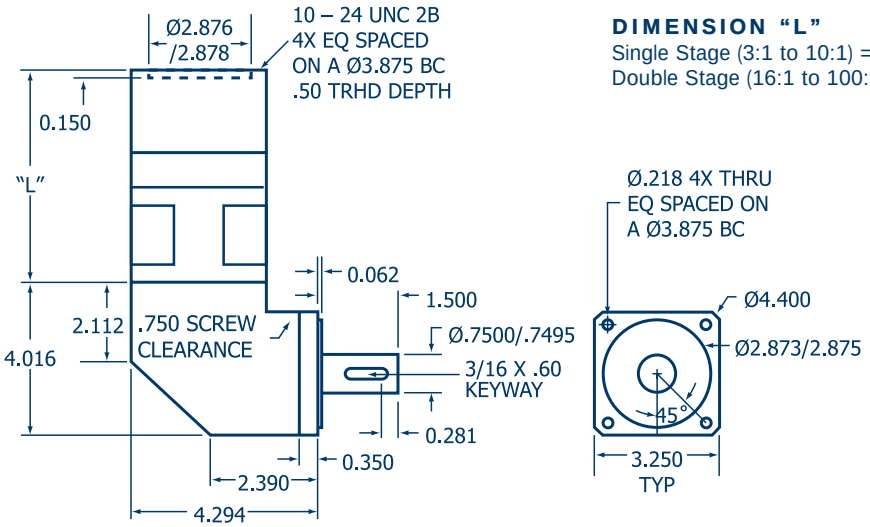
	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input ($lb\text{-}in\text{-}sec^2$)
SINGLE STAGE	23RP003	3:1	280	280	273	2.94×10^{-4}
	23RP004	4:1	280	280	280	1.49×10^{-4}
	23RP005	5.5:1	280	280	280	7.77×10^{-5}
	23RP007	7:1	280	280	280	5.09×10^{-5}
	23RP010	10:1	280	280	253	2.90×10^{-5}
DOUBLE STAGE	23RP016	16:1	350	350	350	5.93×10^{-5}
	23RP022	22:1	350	350	350	3.02×10^{-5}
	23RP028	28:1	350	350	350	2.16×10^{-5}
	23RP040	40:1	350	350	350	1.46×10^{-5}
	23RP049	49:1	350	350	350	1.96×10^{-5}
	23RP055	55:1	350	350	350	1.39×10^{-5}
	23RP070	70:1	350	350	350	1.36×10^{-5}
	23RP100	100:1	350	350	350	1.35×10^{-5}

GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	10	7	90%	4.63	5000
Double Stage	16:1 to 100:1	14	11	85%	5.88	5000

PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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DIMENSION "L"
Single Stage (3:1 to 10:1) = 4.063 ± .015
Double Stage (16:1 to 100:1) = 5.431 ± .015

	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec^2)
SINGLE STAGE	34RP003	3:1	525	525	525	1.20×10^{-3}
	34RP004	4:1	525	525	525	5.73×10^{-4}
	34RP005	5.5:1	525	525	525	3.08×10^{-4}
	34RP007	7:1	525	525	525	2.08×10^{-4}
	34RP010	10:1	525	525	525	1.26×10^{-4}
DOUBLE STAGE	34RP016	16:1	656	656	656	3.05×10^{-4}
	34RP022	22:1	656	656	656	1.65×10^{-4}
	34RP028	28:1	656	656	656	1.20×10^{-4}
	34RP040	40:1	656	656	656	8.34×10^{-5}
	34RP049	49:1	656	656	656	1.13×10^{-4}
	34RP055	55:1	656	656	656	8.10×10^{-5}
	34RP070	70:1	656	656	656	8.00×10^{-5}
	34RP100	100:1	656	656	656	7.92×10^{-5}

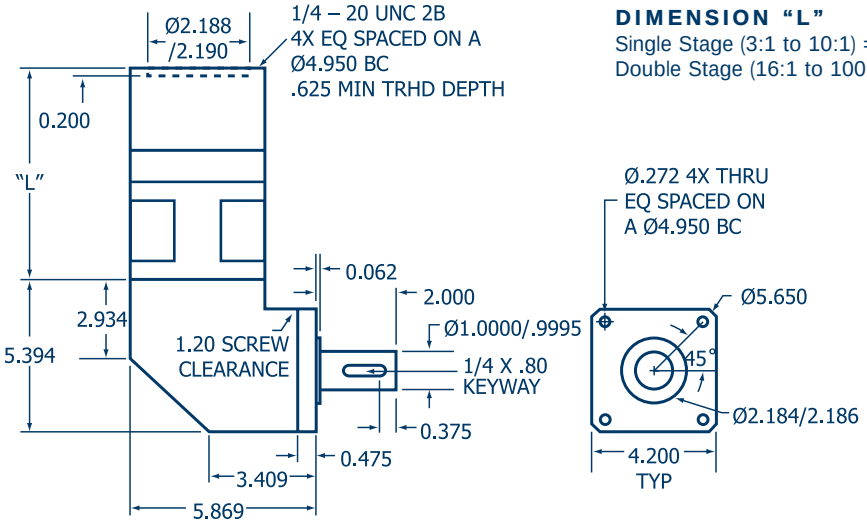
GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	10	7	90%	11.69	5000
Double Stage	16:1 to 100:1	14	11	85%	15.07	5000

PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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DIMENSION "L"
Single Stage (3:1 to 10:1) = 4.624 ± .015
Double Stage (16:1 to 100:1) = 6.237 ± .015

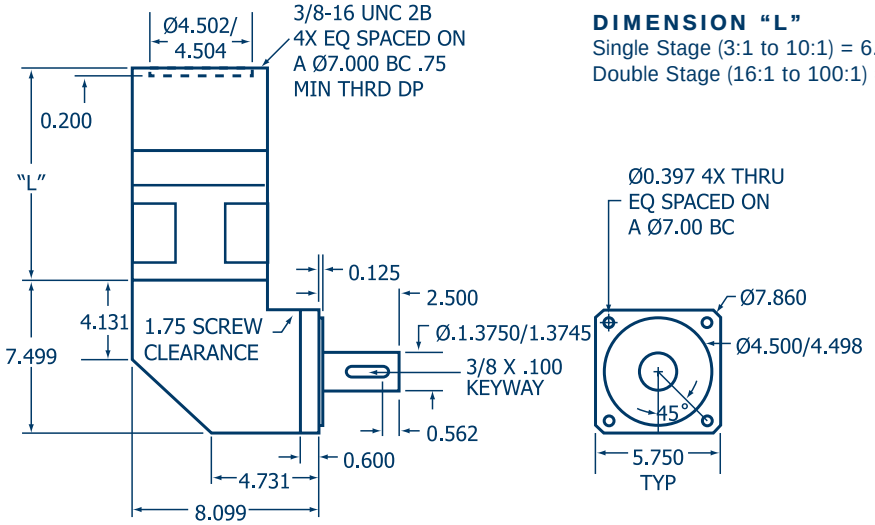
	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input ($lb\text{-}in\text{-}sec^2$)
SINGLE STAGE	42RP003	3:1	1100	1100	894	4.76×10^{-3}
	42RP004	4:1	1100	1100	983	2.42×10^{-3}
	42RP005	5.5:1	1100	1100	1062	1.33×10^{-3}
	42RP007	7:1	1100	1100	1100	9.13×10^{-4}
	42RP010	10:1	1100	1100	1029	5.76×10^{-4}
DOUBLE STAGE	42RP016	16:1	1375	1375	1375	1.14×10^{-3}
	42RP022	22:1	1375	1375	1375	6.47×10^{-4}
	42RP028	28:1	1375	1375	1375	4.94×10^{-4}
	42RP040	40:1	1375	1375	1375	3.71×10^{-4}
	42RP049	49:1	1375	1375	1375	4.65×10^{-4}
	42RP055	55:1	1375	1375	1375	3.60×10^{-4}
	42RP070	70:1	1375	1375	1375	3.57×10^{-4}
	42RP100	100:1	1375	1375	1375	3.53×10^{-4}

GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	10	7	90%	22.43	5000
Double Stage	16:1 to 100:1	14	11	85%	34.01	5000

PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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DIMENSION "L"
Single Stage (3:1 to 10:1) = 6.475 ± .015
Double Stage (16:1 to 100:1) = 8.588 ± .015

	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec^2)
SINGLE STAGE	56RP003	3:1	2500	2292	1713	2.66×10^{-2}
	56RP004	4:1	2500	2500	1923	1.43×10^{-2}
	56RP005	5.5:1	2500	2500	2131	8.66×10^{-3}
	56RP007	7:1	2500	2500	2256	6.35×10^{-3}
	56RP010	10:1	2500	2500	2174	4.47×10^{-3}
DOUBLE STAGE	56RP016	16:1	3125	3125	3125	6.21×10^{-3}
	56RP022	22:1	3125	3125	3125	4.40×10^{-3}
	56RP028	28:1	3125	3125	3125	3.72×10^{-3}
	56RP040	40:1	3125	3125	3125	3.18×10^{-3}
	56RP049	49:1	3125	3125	3125	3.56×10^{-3}
	56RP055	55:1	3125	3125	3125	3.13×10^{-3}
	56RP070	70:1	3125	3125	3125	3.10×10^{-3}
	56RP100	100:1	3125	3125	3125	3.08×10^{-3}

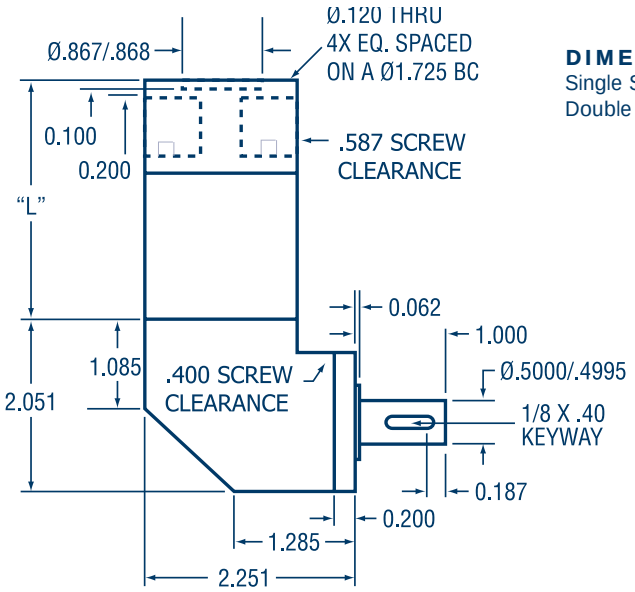
GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	10	7	90%	58.16	5000
Double Stage	16:1 to 100:1	14	11	85%	74.53	5000

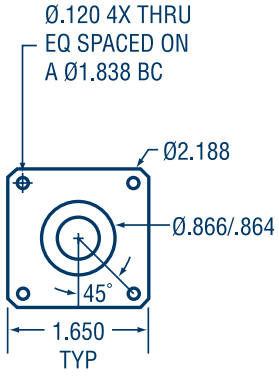
PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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DIMENSION "L"
Single Stage (3:1 to 10:1) = 2.869 ± .015
Double Stage (16:1 to 100:1) = 3.738 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec^2)
SINGLE STAGE	17RE003	3:1	80	80	80	4.96×10^{-5}
	17RE004	4:1	80	80	80	2.56×10^{-5}
	17RE005	5.5:1	80	80	80	1.61×10^{-5}
	17RE007	7:1	80	80	80	1.27×10^{-5}
	17RE010	10:1	80	80	80	9.90×10^{-6}
DOUBLE STAGE	17RE016	16:1	100	100	100	1.65×10^{-5}
	17RE022	22:1	100	100	100	1.13×10^{-5}
	17RE028	28:1	100	100	100	9.74×10^{-6}
	17RE040	40:1	100	100	100	8.45×10^{-6}
	17RE049	49:1	100	100	100	9.50×10^{-6}
	17RE055	55:1	100	100	100	8.36×10^{-6}
	17RE070	70:1	100	100	100	8.33×10^{-6}
	17RE100	100:1	100	100	100	8.31×10^{-6}

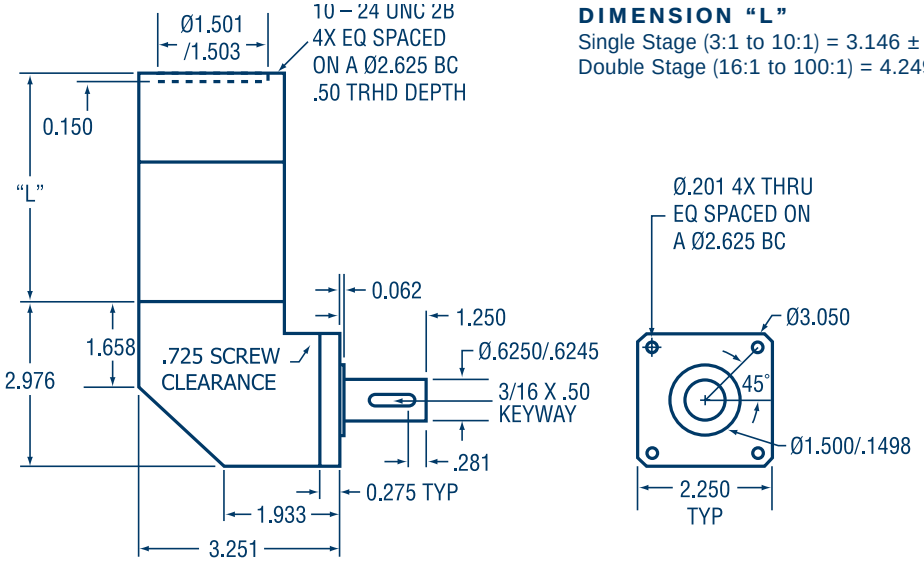
GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	10	7	90%	1.96	5000
Double Stage	16:1 to 100:1	14	11	85%	2.44	5000

PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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DIMENSION "L"
Single Stage (3:1 to 10:1) = 3.146 ± .015
Double Stage (16:1 to 100:1) = 4.249 ± .015

	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec²)
SINGLE STAGE	23RE003	3:1	280	280	232	2.94×10^{-4}
	23RE004	4:1	280	280	242	1.49×10^{-4}
	23RE005	5.5:1	280	280	247	7.77×10^{-5}
	23RE007	7:1	280	279	245	5.09×10^{-5}
	23RE010	10:1	277	238	215	2.90×10^{-6}
DOUBLE STAGE	23RE016	16:1	350	350	350	5.93×10^{-5}
	23RE022	22:1	350	350	350	3.02×10^{-5}
	23RE028	28:1	350	350	350	2.16×10^{-6}
	23RE040	40:1	350	350	350	1.46×10^{-6}
	23RE049	49:1	350	350	350	1.96×10^{-6}
	23RE055	55:1	350	350	350	1.39×10^{-6}
	23RE070	70:1	350	350	350	1.36×10^{-6}
	23RE100	100:1	308	303	298	1.35×10^{-6}

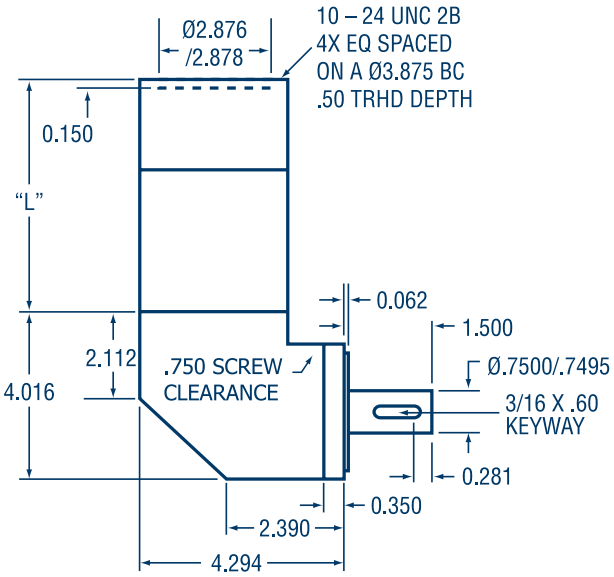
GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	10	7	90%	4.87	5000
Double Stage	16:1 to 100:1	14	11	85%	6.00	5000

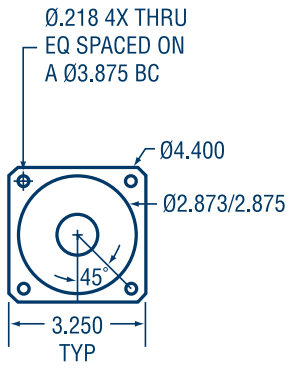
PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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DIMENSION "L"
Single Stage (3:1 to 10:1) = 4.063 ± .015
Double Stage (16:1 to 100:1) = 5.431 ± .015



	Part #	Ratio	Continuous output torque at 1500 rpm input (in-lbs)	Continuous output torque at 3500 rpm input (in-lbs)	Continuous output torque at 5000 rpm input (in-lbs)	Gearhead intertia at input (lb-in-sec^2)
SINGLE STAGE	34RE003	3:1	525	525	475	1.20×10^{-3}
	34RE004	4:1	525	525	513	5.73×10^{-4}
	34RE005	5.5:1	525	525	525	3.08×10^{-4}
	34RE007	7:1	525	525	525	2.08×10^{-4}
	34RE010	10:1	525	525	505	1.26×10^{-4}
DOUBLE STAGE	34RE016	16:1	656	656	656	3.05×10^{-4}
	34RE022	22:1	656	656	656	1.65×10^{-4}
	34RE028	28:1	656	656	656	1.20×10^{-4}
	34RE040	40:1	656	656	656	8.34×10^{-5}
	34RE049	49:1	656	656	656	1.13×10^{-4}
	34RE055	55:1	656	656	656	8.10×10^{-5}
	34RE070	70:1	656	656	656	8.00×10^{-5}
	34RE100	100:1	656	656	656	7.92×10^{-5}

GENERAL SPECIFICATIONS

Construction Type	Ratio	Backlash: Standard (arc-minutes)	Backlash: Low Backlash (arc-minutes)	Efficiency	Weight (lbs)	Maximum Tested Input rpm
Single Stage	3:1 to 10:1	10	7	90%	11.89	5000
Double Stage	16:1 to 100:1	14	11	85%	14.62	5000

PEAK TORQUE: 15% above continuous rating. **NOTE:** Repeated peak torque loading may cause failure.

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Gearheads are incorporated into motion control systems for various reasons. Some of the most common applications include:

1. Inertia Matching
2. Torque Amplification
3. Position Resolution Enhancement

The engineers at Carson Mfg., Inc. are available for technical assistance. Below are some helpful equations and definitions.

EQUATIONS AND DEFINITIONS

$J_{total} = J_{motor} + J_{gear} + J_{ref}$
$J_{ref} = J_{app} + ratio^2$
$T_{gear} = [(J_{gear} + J_{ref}) \times (W_{final} - (W_{initial}) /t] + [T_{app} / (ratio \times e)]$
$T_{motor} = J_{total} \times (W_{final} - W_{initial}) /t + T_{app} / ratio \times e$
$T_{total} = T_{gear} \times ratio \times e$
$RPM_{out} = RPM_{in} / ratio$

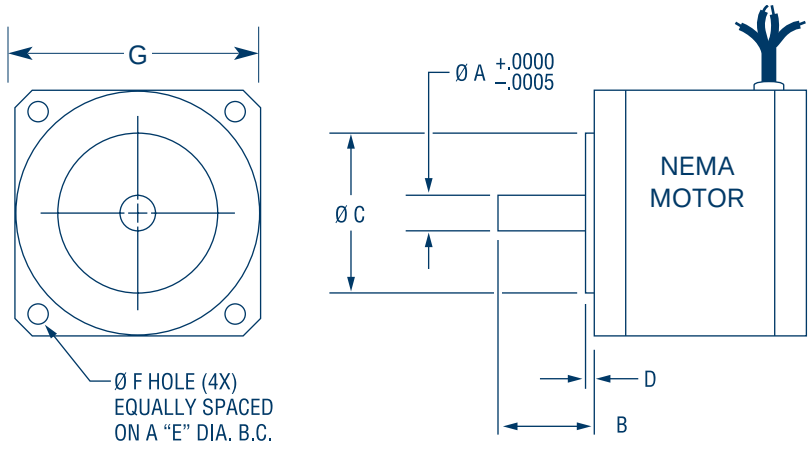
T (sec) = time
E = gearhead efficiency
J_{total} (lbs-in-sec2) = total inertia
J_{total} (lbs-in-sec2) = motor inertia
J_{total} (lbs-in-sec2) = gearhead inertia at input
J_{ref} (lbs-in-sec2) = applications' reflected load inertia
J_{app} (lbs-in-sec2) = applications' load inertia
T_{motor} (lbs-in) = motor torque required to satisfy the applications
T_{gear} (lbs-in) = application torque at the gearhead input
T_{app} (lbs-in) = application torque at the gearhead output
T_{total} (lbs-in) = torque at the gearhead output (compare with gearhead continuous output torque)
W_{final} (rad/sec) = final angular velocity at motor output
$W_{initial}$ (rad/sec) = initial angular velocity at motor output
F_{axial} (lbs) = axial force on the gearhead output shaft
F_{radial} (lbs) = radial force on the gearhead output shaft calculated at half the shaft length
LIFE (hrs) = bearing life hours
RPM_{out} (rev/min) = revolutions per minute at the gearhead output
RPM_{in} (rev/min) = revolutions per minute at the gearhead output

USEFUL CONVERSIONS

1 in = 25.4 mm
1 in-lb = .113 N-m
1 in-lb = 16 oz-in
1 lb = .4536 kg

(ºF-32) x 5/9 = ºC
1 rad = 180/π
1 degree = 60 arc minutes

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ITEM	DESCRIPTION	17	23	34	42	56
A	SHAFT DIAMETER	0.1968	0.2500	0.3750	0.6250	1.1250
B	SHAFT LENGTH	0.945	0.810	1.250	1.380	2.375
C	PILOT DIAMETER	0.866	1.500	2.875	2.186	4.500
D	PILOT LENGTH	0.080	0.062	0.062	0.062	0.094
E	MOUNTING HOLE BOLT CIRCLE	1.725	2.625	3.875	4.950	7.000
F	MOUNTING HOLE DIAMETER	4-40	0.206	0.206	0.266	0.391
G	SQUARE	1.650	2.250	3.250	4.200	5.750

Any motor matching the dimensions above will mount up to our stock gearheads. If your gearhead requirement involves a non-NEMA motor frame, we will provide the necessary clamp-on pinion and mounting bracket, usually at no extra charge. Please note that the length of the mounting bracket may differ from the gearhead catalog dimensions listed. All gearheads come with a complete mounting kit which includes all necessary hardware and instructions.





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WARNING

This catalog and other information from Carson Mfg. Inc. and authorized distributors provide product options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product in the current product catalog. Due to the variety of operating conditions and applications for these products, the user, through his or her own analysis and testing, is solely responsible for making the final selection of the products and assuring that all performance, safety and warning requirements of the application are met.

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