Harmonic Drive Technologies has the perfect solution for applications that require accurate positioning and precise motion control. The PS series Flange Output PSF-G and Shaft Output PSS-G Gearheads utilize the zero backlash and high torque of harmonic drive gearing mounted in superior quality housings and precision high load output bearings. Input options allow compatibility with most servo or stepper motors.

FEATURES

- **Zero Backlash**
- **High Torque**
- **High Torsional Stiffness**
- **High Precision**
- **Motor Mounting Options**
- **High Overhung Load Capacity**

GEARHEAD SELECTION

LOADING ANALYSIS

To select from the ratings table it is necessary to construct or estimate a torque speed profile diagram as in figures 1 and 2.

Normal operating conditions involve momentary peak torques substantially higher than constant speed running torques. These peak torques must be carefully considered when selecting a Harmonic Drive Gearhead.

Maximum Repeated Acceleration
The torque required to accelerate the driven components from rest to normal continuous running speed. T_1

Normal Constant Speed Torque, T_2

Normal Deceleration Torque, T_3

Maximum Momentary Torque, T_4
This is the peak torque generated by sudden shock loads such as emergency stops or crashes. Particularly severe conditions exist with high output inertia and stringent rapid stop requirements. These high levels of torque must be limited.

Figure 1 : Speed Profile

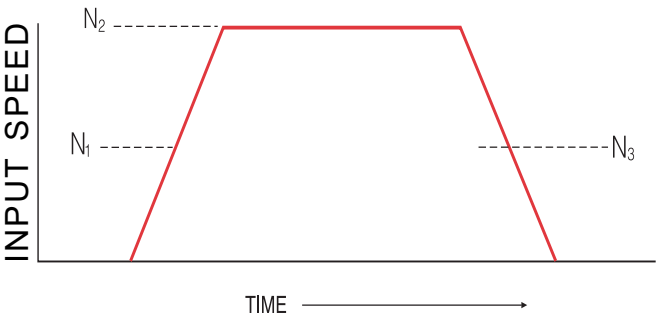
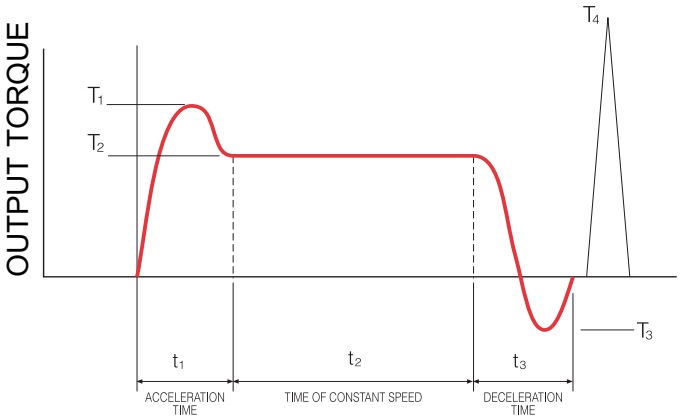


Figure 2 : Torque Profile



Mean Torque, T
Calculate the mean Torque

$$T = \sqrt[3]{\frac{t_1 N_1 T_1^{\,3} + t_2 N_2 T_2^{\,3} + t_3 N_3 T_3^{\,3}}{t_1 N_1 + t_2 N_2 + t_3 N}}$$

Mean Speed, N
Calculate the mean speed

$$N = \frac{t_1 N_1 + t_2 N_2 + t_3 N_3}{t_1 + t_2 + t_3}$$

GEARHEAD SPECIFICATIONS

PSS PSF	Ratio	Rated Output Torque @2000rpm		Limit for Repeated Output Torque		Limit for Momentary Overload Torque		Static Torque Limit		Maximum Speed	Input Inertia		Weight PSS		Weight PSF	
		lb in	Nm	lb in	Nm	lb in	Nm	lb in	Nm	RPM	lb in²	kg cm²	lb	kg	lb	kg
20	50	344	39	470	53	780	88	1280	145	5600	0.072	.20	4.2	1.9	2.6	1.2
	80	370	42	660	74	1120	127	2200	245							
	100	380	43	740	83	1300	147	2200	245							
25	50	570	64	800	90	1500	169	2500	282	4500	.18	.50	8.5	3.9	5.2	2.4
	80	570	64	1200	136	2200	255	3400	384							
	100	570	64	1400	158	2510	284	3400	384							
	160	610	69	1550	175	2780	314	3400	384							
32	50	1100	124	1800	203	4000	452	4900	553	3500	.56	1.6	12.7	5.9	8.0	4.1
	80	1100	124	2690	304	5030	568	6900	779							
	100	1150	130	2950	333	5730	647	6900	779							
	160	1250	141	3290	372	6080	686	6900	779							

Maximum Output Torque Limit Tmax
This is the maximum allowable torque that should be developed with dynamic torque at the input. Repetitive momentary or continuous running loads (T1, T2, and T3) should not exceed this rating.

Backdriving
Harmonic Drive gearing can be easily backdriven unless the input shaft is locked. *Under no circumstances should a gearhead be used to support a load without a failsafe device on the output if there is risk of personal injury.*

Maximum Input Speed
The Maximum input speed is limited by the DN value of the wave generator bearing and the type of lubricant used. Maximum input speeds for each size unit using recommended grease are listed in the ratings table.

Static Torque Limit
This is the maximum allowable torque that should be applied to the output when the input is locked. A typical example is the torque applied to the output during a work or machining operation when the Harmonic Drive is stationary.

Rated Output Torque at Rated Speed Tn
Assuming the maximum output torque (Tmax) is not exceeded, this is the maximum output torque which can be transmitted at the rated input speed (2000 rpm) to achieve an average wave generator life of L50=35000 hours.

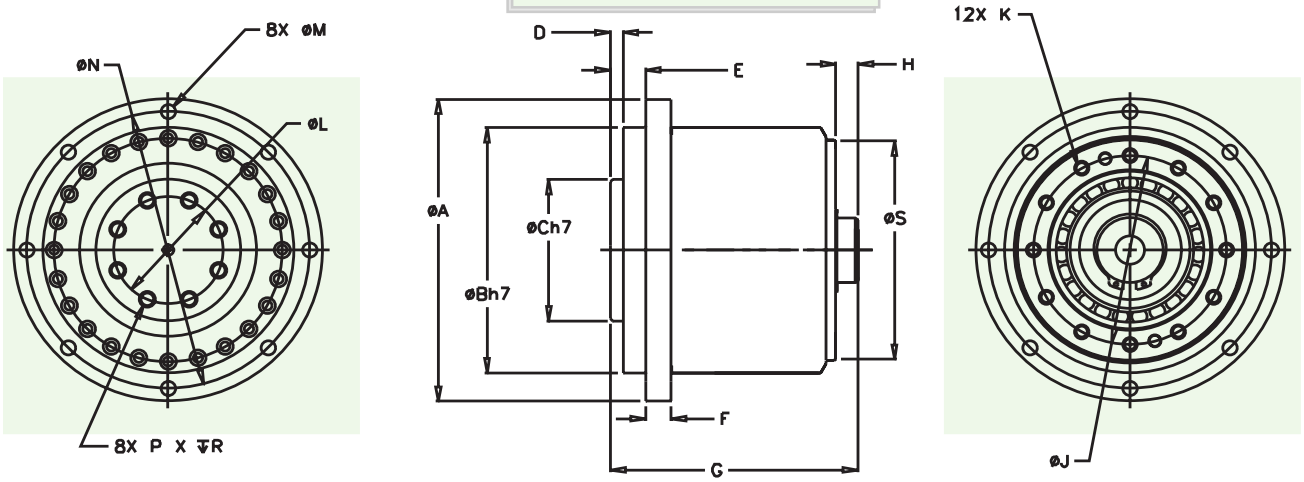
The following formula is used to calculate the continuous torque rating at input speeds other than 2000rpm:

$$T = \left[\frac{2000}{N}\right]^{.33} \times T_N$$

T = permissible continuous torque
N = required speed
T_N = rated torque (see chart)

T must not exceed the limit for repeated output torque.

PSF GEARHEAD



PSF	ØA	ØB	ØC	D	E	F	G	H	ØJ	K	ØL	ØM	ØN	P	R	ØS
20	96	58h7	45h7	4	10.9	8	77	6.9	60	M3	34	4.5	88	M5	10	70h6
25	121	99h7	55h7	4	12	10	93	8	75	M4	42	5.5	111	M6	10	85h6
32	147	123h7	75h7	4	14	9	105	1.5	100	M6	60	6.6	136	M8	12	110h6

(mm)

The output flange of PSF gearheads is supported by precision bearings that allow combinations of axial and moment loads.The maximum allowable combination of these external loads are shown in figure 2. A moment load applied to the output flange will create a deflection as shown in figure 1. It is not recommended to exceed 1.5 arc minutes.

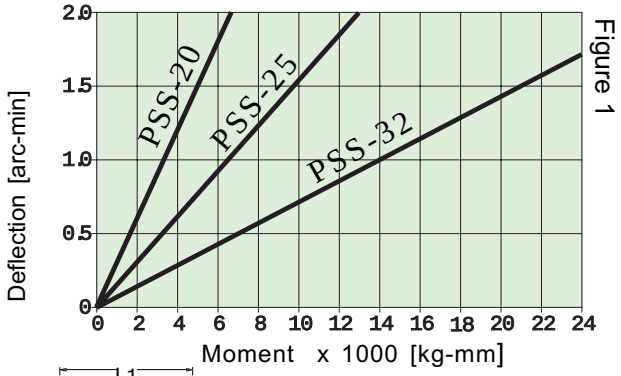


Figure 1

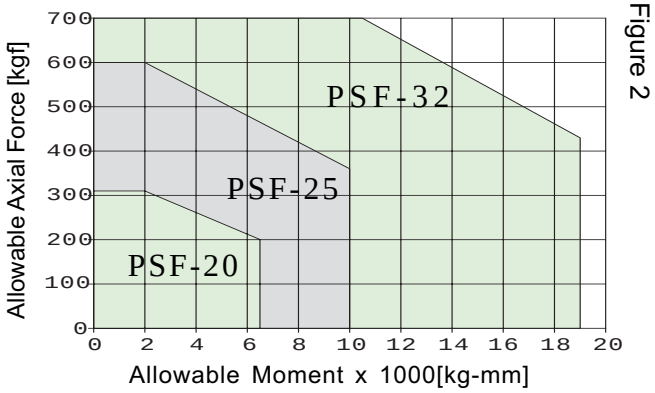
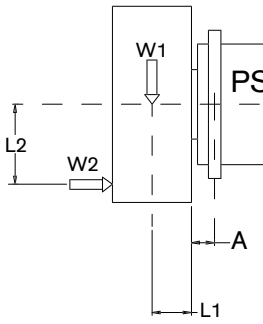


Figure 2

Example 1

Axial ForceFa = $W_1^{kg}+W_2^{kg}+W_3^{kg}+...$

Moment Load = $W_1^{kg}(L_1^{mm}) + W_2^{kg}(L_2^{mm})+...$



Size	A
20	16.5
25	20.0
32	26.0

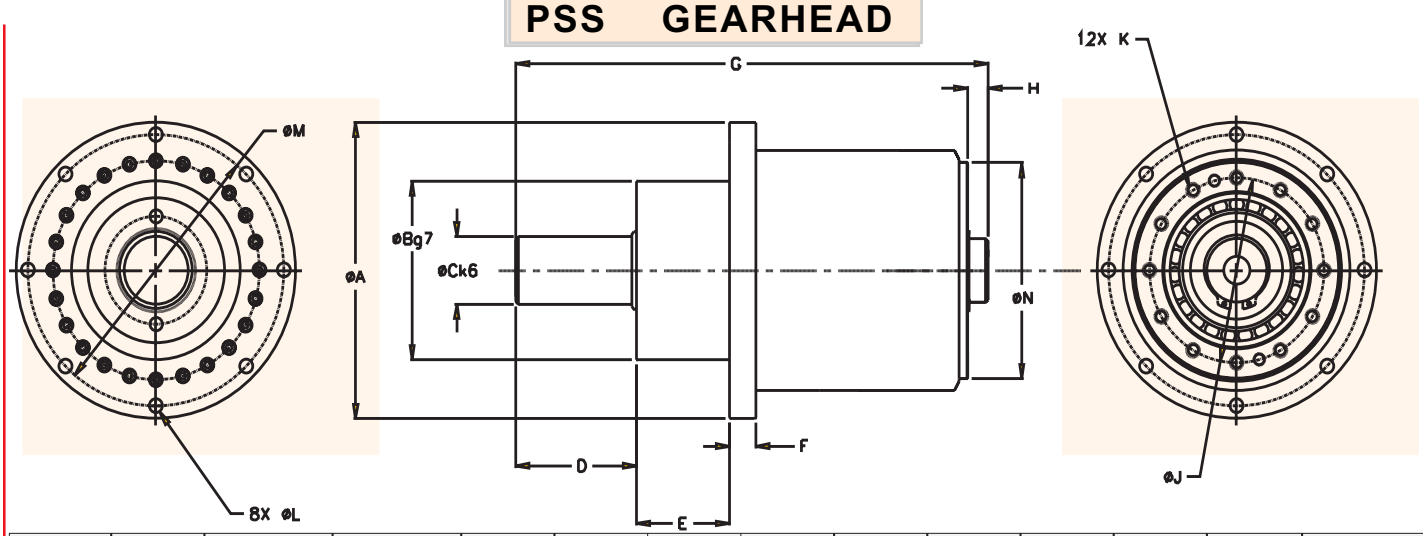
(mm)

Example 2

Axial Force Fa = W_2^{kg}

Moment Load = $W_1^{kg}(L_1^{mm} + A^{mm}) + W_2^{kg}(L_2^{mm})+...$

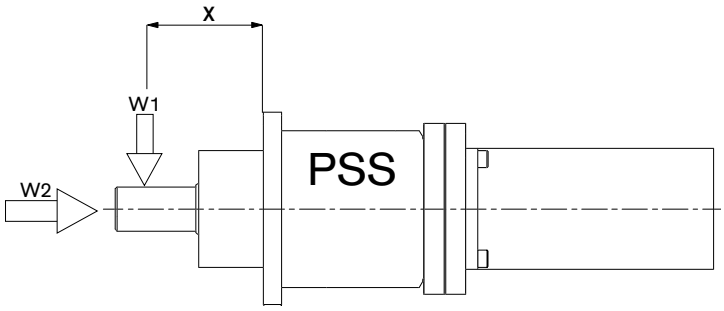
PSS GEARHEAD



PSS	ØA	ØB	ØC	D	E	F	G	H	ØJ	K	ØL	ØM	ØN
20	96	58g7	22k7	41.5	32	9	162	6.9	60	M3	4.5	88	70h6
25	121	70g7	28k7	51	36	11	186	8	75	M4	5.5	111	85h6
32	145	90g7	32k7	73.5	40	12	239	1.5	90	M5	6.6	136	110h6

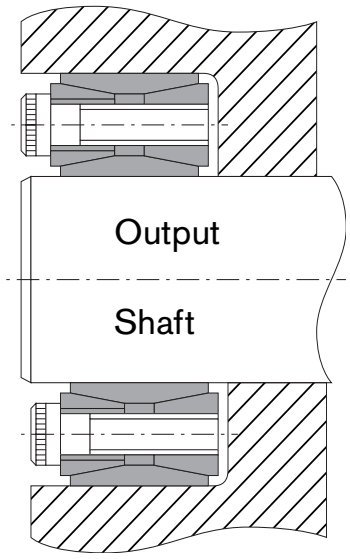
(mm)

The output shaft of the PSS gearhead is supported by pre-loaded taper roller bearings to eliminate end float and radial play. The maximum axial and radial loads that can be applied are demonstrated below.

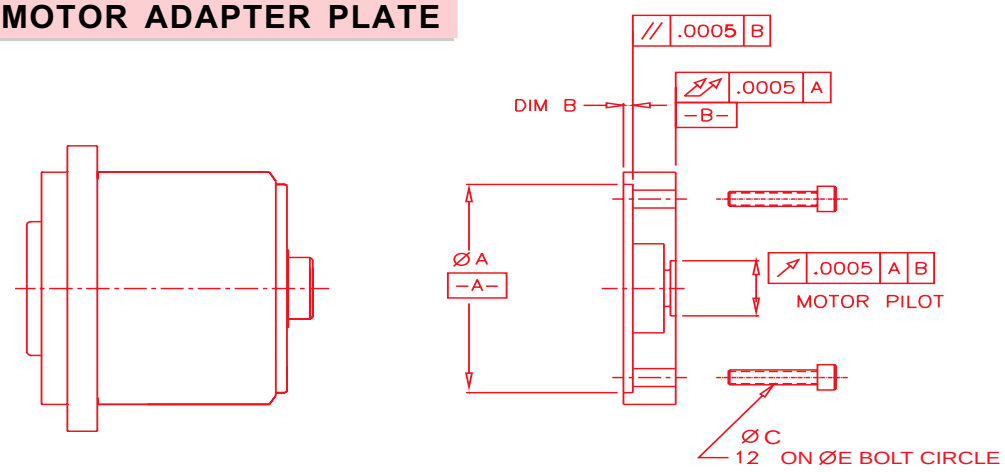


PSF	X(mm)	W1(kg)	W2(kg)
20	48	170	170
25	77	380	320
32	90	520	490

PSS output shafts are manufactured from high quality alloy steel of hardness 220 Br. and 70,000 KSI compression strength. Keys and keyways are not recommended for high performance servo applications. Zero backlash friction clamp ring devices that are not affected by reversing or dynamic shock loads should be used. Axial impact loads on the end of the shaft should be avoided.



TYPICAL MOTOR ADAPTER PLATE



It is recommended that PSS/ PSF gearheads be purchased with motor adapter kits supplied by Harmonic Drive Technologies. Contact our engineering department with the details of your motor interface.

PSS/PSF	ØA	B	C	E	T	
20	70H6	2.5	M3x0.5	60	17 lb-in	1.9 Nm
25	85H6	2.5	M4x0.7	75	40 lb-in	4.5 Nm
32	110H6	2.5	M5x0.8	100	80 lb-in	9.0 Nm

Diagram 1

DETAILS

Motor Shafts should be sealed or the adapter plate should be fitted with a seal to prevent contamination of the motor from the grease contained in the gearhead.

Maintain the tolerances shown in diagram 1 for correct assembly.

Use Loctite on all bolts and tighten to value “T” shown

INPUT ASSEMBLY

The typical input assembly consists of an elliptical wave generator bearing and an Oldham coupling. The wave generator assembly can be easily removed from the gearset and disassembled for attachment to the motor shaft.

Coupling hubs can be removed and rebored, or supplied to suit various motor shaft configurations on a custom basis. Consult our engineering department for details. Maximum bore sizes are shown in figure 2. Input hubs must be fixed both radialy and axially to the motor shaft. Contact our engineering department for assistance.

If a stepper motor is being used the Oldham coupling should be eliminated

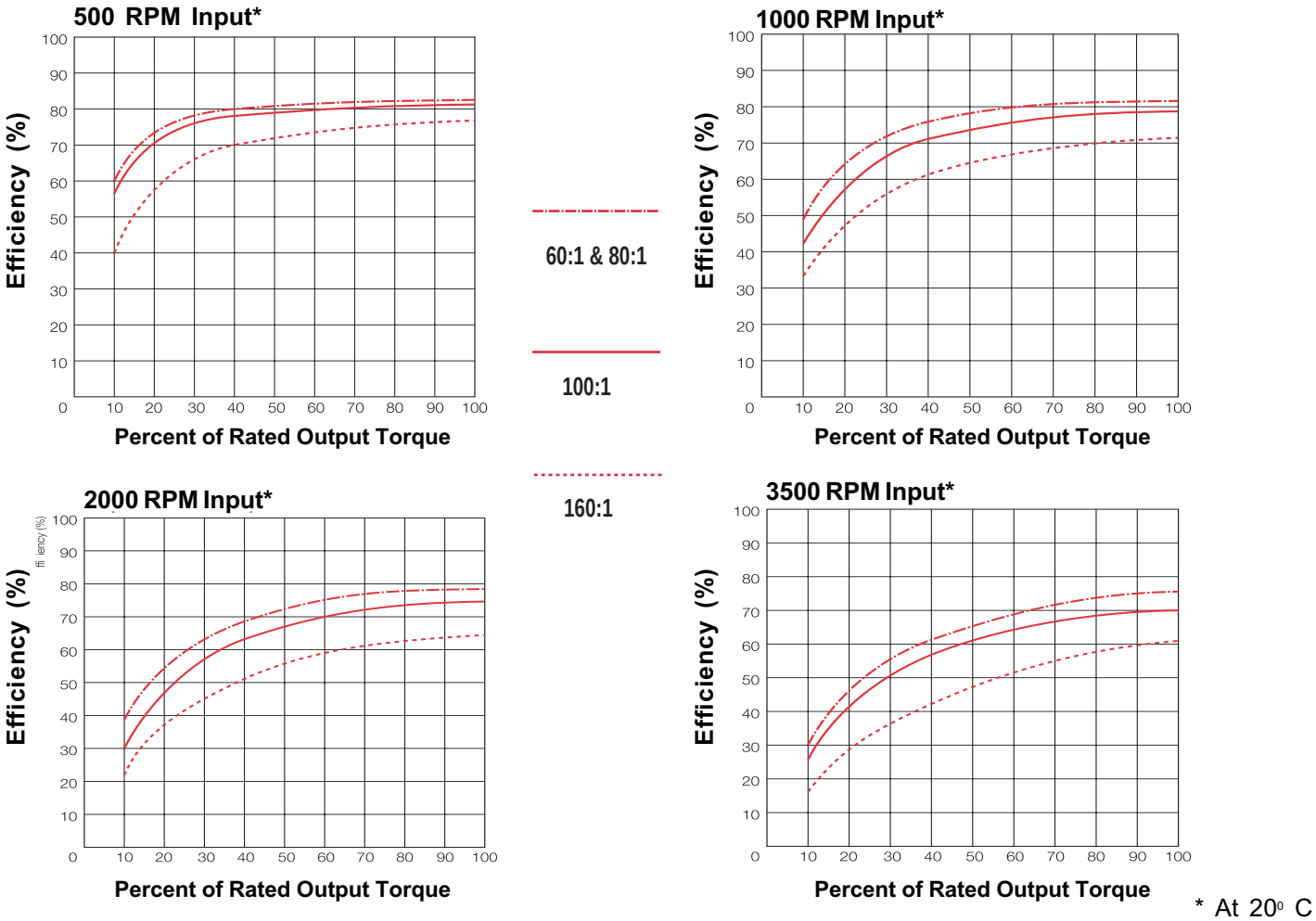
PSF PSS	MAX BORE
20	10 mm
25	14 mm
32	14 mm

Diagram 2

LUBRICATION

All gearheads are supplied with special RE 00 grease to be applied before assembly. Do not substitute without consulting our engineers. Convienent grease cartridges are also available upon request.

Efficiencies



* At 20° C

The efficiency of a Harmonic drive gearbox is dependent on speed, ratio, load and temperature. For convenience the above graphs show efficiency against percentage of rated output torque. In applications where the output torque is very low compared to the ratings or in extreme temperature consult our factory.

Typical Application Examples

Harmonic Drive Technologies' gearheads and actuators provide the optimum solution to any high precision motion control application.

- Precise Positioning Systems
- Semi-Conductor
- Robotics
- Index Tables
- Medical Equipment
- Laboratory Equipment
- Print Machine Rollers
- Wafer Handling
- Laser Positioning

Harmonic Drive Technologies has been providing quality motion control products to industry for over 40 years. Our intention is to offer a total solution to any motion control problem you may be confronted with. We have a full engineering staff on hand to answer any question you may have, and all of our manufacturing is done, on-site at our factory in Peabody, Massachusetts.