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

**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.

**Mean Torque, \( T \)**

Calculate the mean Torque

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

**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

<table>
<thead>
<tr>
<th>PSS</th>
<th>Ratio</th>
<th>Rated Output Torque @2000rpm</th>
<th>Limit for Repeated Output Torque</th>
<th>Limit for Momentary Overload Torque</th>
<th>Static Torque Limit</th>
<th>Maximum Speed</th>
<th>Input Inertia</th>
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### Maximum Output Torque Limit T<sub>max</sub>
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 T<sub>n</sub>
Assuming the maximum output torque (T<sub>max</sub>) 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.
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.
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.

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.
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.

<table>
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<tr>
<th>PSS/PSF</th>
<th>ØA</th>
<th>B</th>
<th>C</th>
<th>E</th>
<th>T</th>
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</table>

**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 radially 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

**LUBRICATION**
All gearheads are supplied with special RE 00 grease to be applied before assembly. Do not substitute without consulting our engineers. Convenient grease cartridges are also available upon request.
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
- Index Tables
- Semi-Conductor
- Medical Equipment
- Robotics
- 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.