11 - GEARHEADS AND SPEED REDUCERS

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S9160AMRTX...
RTX Planetary Gearheads Size 60
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PRX Planetary Gearheads Size 90
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How to choose the type of gearhead depends primarily on the application. Some of the factors to be considered to make proper trade-offs between cost and performance are shown below. The hybrid design of planetary and spur gears are not offered by us but are available on the market, and are included for comparison purposes.

<table>
<thead>
<tr>
<th>DESIGN FACTORS</th>
<th>GEARHEAD TYPE</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Planetary</td>
</tr>
<tr>
<td>Torque Capacity</td>
<td>High</td>
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<tr>
<td>Load Sharing</td>
<td>Yes</td>
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<tr>
<td>Power to Weight Ratio</td>
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<tr>
<td>Power to Size Ratio</td>
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<tr>
<td>Torsional Stiffness</td>
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<td>Backlash</td>
<td>Low 6-10 minutes</td>
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<tr>
<td>Available Number of Gear Ratios</td>
<td>Low</td>
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<tr>
<td>Cost</td>
<td>High</td>
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</table>
The basic form of planetary gear system is shown above. It consists of a sun gear A, planetary gears B, internal gear C and carrier D. In our gearheads the internal gear is fixed, the sun gear is the input pinion, and the output shaft is part of the carrier.

This relationship can be represented schematically as shown on the right. The speed ratio is given by the equation:

$$\text{Gear Ratio} = \frac{1+\frac{z_c}{z_a}}{\frac{z_a}{z_c}} = \frac{z_c}{z_a} + 1$$

where: $z_a =$ number of teeth in sun gear A, and $z_c =$ number of teeth in internal gear C.

For the example shown in the above illustration (where $z_a = 14$, $z_b = 18$ and $z_c = 50$), the Gear Ratio is 4.6:1.

For a double-stage planetary gearhead, the carrier of the first stage becomes the sun gear of the second stage.

The advantages of the planetary gearheads are:
1. The input and output axes are in the same line.
2. The planet gears used in a planetary system share the load, allowing for a much higher torque capacity unit than the comparable size spur gearheads.
3. The unit is compact and inertially balanced.

The disadvantages are:
1. The mechanism is complex.
2. The components require high-precision manufacturing.
3. The cost is considerably more than comparable size spur gearheads.

**USEFUL FORMULAS**

- **The maximum output HP of Gearhead**
  $$\text{HP of Gearhead} = \frac{(\text{Maximum continuous torque}) \times (\text{Maximum rated output rpm})}{63025}$$

- **The maximum allowable output HP of the motor**
  $$\text{The maximum output HP of gearhead} = 0.90 \text{ (single stage) or 0.85 (double stage)}$$

- **Effective inertia**
  $$\text{Effective inertia} = \text{load inertia} \left(\frac{\text{gear ratio}}{\text{gear ratio}}\right)^2 + \text{gearhead inertia} + \text{pinion inertia}$$

For very fast response, the effective inertia should be one to three times larger than the motor inertia (including the pinion).

For acceptably fast response, the effective inertia should be less than ten times larger than the motor inertia (including the pinion).

$\Delta$ Inertia values shown in this catalog include both the gearhead and pinion values.
PRX & RTX PLANETARY GEARHEADS

NEMA Inch: 23 & 34 & Metric: 60 & 90

Radial and Axial Output Shaft Loading Specifications

PRX TYPE (HEAVY-DUTY)

The graphs display allowable radial load at a given distance from the gearhead face based on an L₁₀ bearing life of:

- 20,000 hours (PRX)
- 15,000 hours (RTX)

023/060 PRX Bearing Radial Load Limits

034/090 PRX Bearing Radial Load Limits

RTX TYPE (STANDARD-DUTY)

023/060 RTX Bearing Radial Load Limits

034/090 RTX Bearing Radial Load Limits

KEY
- 50 rpm
- 125 rpm
- 250 rpm
- 500 rpm
- 1000 rpm
- 2000 rpm

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PRX PLANETARY GEARHEADS • SIZE 60

PRECISION SERIES
SINGLE & DOUBLE STAGE

› MATERIAL:
  Housing - Stainless Steel
  Mounting Flanges - Red Anodized Aluminum (Front)
  Aluminum (Back)
  Output Shafts - Stainless Steel
  Gears - Alloy and Stainless Steel
  Bearings - Ball and Angular Contact Bearings

› FEATURES:
  Standard METRIC Sizes
  High Torque Design with Optimized Gear Geometry
  High Torsional Stiffness
  Sealed to extend service life
  Captive, Bearing supported input pinion
  Simplified quick installation
  Single-piece construction
  Alloy Steel key is supplied

› SPECIFICATIONS:
  Max. Input Speed: 6500 rpm
  Shaft Loading:
    Axial: 226.8 kgf Value shown is for loads into the gearhead face. For loads away from the face, reduce by 50%
    Radial: See graph on page: 11-4
  Min. Efficiency:
    Single Stage: 95%
    Double Stage: 90%
  Backlash:
    Single Stage: 4 arc min.
    Double Stage: 6 arc min.
  Operating Temperature:
    -40°C to +121°C
  Weight:
    Single Stage: 1.27 kg
    Double Stage: 1.72 kg
  Torsional Stiffness:
    23.04 kgf cm/arc min.

METRIC COMPONENT

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<th>Catalog Number</th>
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<th>L Max.</th>
<th>Max. Rated Continuous Torque</th>
<th>Max. Momentary Torque</th>
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* Values shown include pinion, clamp and sleeve and are for standard METRIC mountings. Efficiency rated at 3000 rpm input speed, at nominal rated torque. All torque ratings are based upon 3000 rpm nominal input speed and 20,000 hours minimum service life.
### RTX PLANETARY GEARHEADS • SIZE 60

**PRECISION SERIES**

**SINGLE, DOUBLE & TRIPLE STAGE**

#### MATERIAL:
- **Housing** - Stainless Steel
- **Mounting Flanges** - Red Anodized Aluminum (Front) Aluminum (Back)
- **Output Shafts** - Stainless Steel
- **Gears** - Alloy and Stainless Steel
- **Bearings** - Ball Bearings

#### FEATURES:
- Standard METRIC Sizes
- High Torque Design with Optimized Gear Geometry
- High Torsional Stiffness
- Sealed to extend service life
- Captive, Bearing supported input pinion
- Simplified quick installation
- Single-piece construction
- Alloy Steel key is supplied

#### SPECIFICATIONS:
- **Max. Input Speed:** 6500 rpm
- **Shaft Loading:**
  - **Axial:** 158.75 kgf. Value shown is for loads into the gearhead face. For loads away from the face, reduce by 50%
  - **Radial:** See graph on page: 11-4
- **Min. Efficiency:**
  - Single Stage: 95%
  - Double Stage: 90%
  - Triple Stage: 85%
- **Backlash:**
  - Single Stage: 4 arc min.
  - Double Stage: 6 arc min.
  - Triple Stage: 8 arc min.
- **Operating Temperature:** -40°C to +121°C
- **Weight:**
  - Single Stage: 1.49 kg
  - Double Stage: 1.77 kg
  - Triple Stage: 2.13 kg
- **Torsional Stiffness:** 17.28 kgf-cm/arc min.

#### METRIC COMPONENT

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<th>Max. Rated Continuous Torque N • m</th>
<th>Max. Momentary Torque N • m</th>
<th>Max. Stopping Torque N • m</th>
<th>Gearhead Moment of Inertia* kg • m²</th>
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</table>

* Values shown include pinion, clamp and sleeve and are for standard METRIC mountings.

Efficiency rated at 3000 rpm input speed, at nominal rated torque. All torque ratings are based upon 3000 rpm nominal input speed and 15,000 hours minimum service life.
PRX PLANETARY GEARHEADS • SIZE 90

PRECISION SERIES
SINGLE & DOUBLE STAGE

› MATERIAL:
  Housing - Stainless Steel
  Mounting Flanges - Red Anodized Aluminum (Front)
  Aluminum (Back)
  Output Shafts - Stainless Steel
  Gears - Alloy and Stainless Steel
  Bearings - Ball and Angular Contact Bearings

› FEATURES:
  Standard METRIC Sizes
  High Torque Design with Optimized Gear Geometry
  High Torsional Stiffness
  Sealed to extend service life
  Captive, Bearing supported input pinion
  Simplified quick installation
  Single-piece construction
  Alloy Steel key is supplied

› SPECIFICATIONS:
  Max. Input Speed: 6500 rpm
  Shaft Loading:
    Axial: 340.2 kgf Value shown is for loads into the gearhead face. For loads away from the face, reduce by 50%
  Radial: See graph on page: 11-4
  Min. Efficiency:
    Single Stage: 95%
    Double Stage: 90%
  Backlash:
    Single Stage: 4 arc min.
    Double Stage: 6 arc min.
  Operating Temperature:
    -40°C to +121°C
  Weight:
    Single Stage: 4.13 kg
    Double Stage: 5.76 kg
  Torsional Stiffness:
    92.17 kgf-cm/arc min.

METRIC COMPONENT

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<th>Catalog Number</th>
<th>Gear Ratio</th>
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<th>Max. Rated Continuous Torque N•m</th>
<th>Max. Momentary Torque N•m</th>
<th>Max. Stopping Torque N•m</th>
<th>Gearhead Moment of Inertia* kg•m²</th>
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* Values shown include pinion, clamp and sleeve and are for standard METRIC mountings. Efficiency rated at 3000 rpm input speed, at nominal rated torque. All torque ratings are based upon 3000 rpm nominal input speed and 20,000 hours minimum service life.
RTX PLANETARY GEARHEADS • SIZE 90

PRECISION SERIES
SINGLE, DOUBLE & TRIPLE STAGE

› MATERIAL:
  Housing - Stainless Steel
  Mounting Flanges - Red Anodized Aluminum (Front)
  Aluminum (Back)
  Output Shafts - Stainless Steel
  Gears - Alloy and Stainless Steel
  Bearings - Ball Bearings

› FEATURES:
  Standard METRIC Sizes
  High Torque Design with Optimized Gear Geometry
  High Torsional Stiffness
  Sealed to extend service life
  Captive, Bearing supported input pinion
  Simplified quick installation
  Single-piece construction
  Alloy Steel key is supplied

› SPECIFICATIONS:
  Max. Input Speed: 6500 rpm
  Shaft Loading:
    Axial: 249.48 kgf. Value shown is for loads into the gearhead face. For loads away from the face, reduce by 50%
    Radial: See graph on page: 11-4
  Min. Efficiency:
    Single Stage: 95%
    Double Stage: 90%
    Triple Stage: 85%
  Backlash:
    Single Stage: 4 arc min.
    Double Stage: 6 arc min.
    Triple Stage: 8 arc min.
  Operating Temperature:
    -40°C to +121°C
  Weight:
    Single Stage: 4.35 kg
    Double Stage: 5.89 kg
    Triple Stage: 7.39 kg
  Torsional Stiffness:
    80.64 kgf-cm/arc min.

* Value shown include pinion, clamp and sleeve and are for standard METRIC mountings.
Efficiency rated at 3000 rpm input speed, at nominal rated torque. All torque ratings are based upon 3000 rpm nominal input speed and 15,000 hours minimum service life.

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<th>Max. Momentary Torque N•m</th>
<th>Max. Stopping Torque N•m</th>
<th>Gearhead Moment of Inertia* kg•m²</th>
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GEARHEAD TO MOTOR MOUNTING INFORMATION

MOUNTING INSTRUCTIONS:

A) Using the screws provided, bolt the mounting bracket to the input end of the gearhead ratio unit.

B) Slide the motor shaft sleeve into the input clamp and align the slot in the sleeve with the slot in the clamp.

C) Rotate the clamp to align the mounting bracket access holes with the clamping bolts.

D) Place the motor on a solid work surface with the output shaft pointing up. Slide the assembled gearhead onto the motor shaft.

E) Using a torque wrench, tighten the clamp bolts to the pretightening torque values listed below.

F) Using the screws provided, bolt the gearhead to the motor.

G) Using an alternating pattern, gradually tighten the clamp bolts until you reach the final tightening torque listed below.

<table>
<thead>
<tr>
<th>Gearhead Frame Size</th>
<th>Pretightening Torque</th>
<th>Final Tightening Torque</th>
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<tr>
<td></td>
<td>lb. in.</td>
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<tr>
<td>Metric 115</td>
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