A planetary gearbox is comprised of three members: a sun gear, multiple satellite or planet gears (hence the gearbox’s name), and an internal ring gear.

A cycloidal gearbox (or cycloidal reducer) is comprised of four components: the input shaft, a cycloidal cam (single or compound), cam followers, and an output shaft.
A planetary gearbox is comprised of three members: a SUN gear, multiple satellite or PLANET gears, and an internal ring gear. The input shaft attaches to the sun gear, which transmits rotational motion to the planet gears, which in turn rotate the internal RING gear, which is part of the gearbox housing. Planet gears rotate on rigid shafts attached to a plate called a planet carrier; this rotation of the planet carrier is what causes the output shaft to rotate. As with all mechanical speed reduction, this gives the output shaft a lower rotational speed and higher torque than the input shaft. Planetary gearboxes may also be single- or double-reduction, with reduction ratios ranging from 3:1 to over 100:1. Additional stages can be added for even higher reduction, or to change output shaft orientation (i.e. via bevel gearing, miter gearing, etc.).
A cycloidal gearbox (or cycloidal reducer) is comprised of four components: the input shaft, a cycloidal cam (single or compound), cam followers, and an output shaft. The input shaft attaches to a drive member that induces an eccentric rotation of the cycloidal cam; in compound reducers, the first cycloidal cam engages a second cycloidal cam (double reduction), which may then engage a third cycloidal cam (triple reduction). The cam followers act as gear teeth, and will exceed the number of cam lobes. Cycloidal gearboxes offer ratios from as low as 10:1 to over 300:1 without stacking stages in the manner of a planetary gearbox, and thus cycloidal gearboxes may have a more compact footprint. A typical cycloidal gear is seen here:
The drive or servomotor is connected to the spur gear stage of the gearbox via a pinion.

The first reduction gears are connected to crankshafts which drive the cams using needle bearings. These cams rotate inside the case which is lined with pins.
Planetary VS Cycloid

- Planetary Gears may run at higher speeds.
- Cycloidal Gears are very good for extremely heavy loads.
- Planetary Gears will work with very low Ratio’s.
- Cycloidal Gears work at higher ratio’s allowing them to be driven with less power.
- Planetary Gears are good if positioning accuracy and lost motion are not a concern.
- Cycloidal Gears are best in applications for high positioning accuracy and a minimum lost motion is required.
- Planetary Gears are ok if regular “monthly maintenance” is acceptable for the application.
- Cycloidal Gears are best if little maintenance and long gear life are required.
**Things to consider when choosing a Gearbox.**

After many years developing Cycloidal Gears our engineers have created some basic questions to help you in the beginning steps of selecting a gearbox for your application.

What environmental conditions will gear box need to endure? (Operating temperature, dust, moisture exposure, etc.)

What physical size envelope does your gear box need? (any shape or space requirements)

Maintenance and lubrication access? (After the application is assembled how will you maintain the gear box?)
How much torque do you require to do the work required by the application? (Weight it needs to move.)

What if any, speed requirement does the application require? (How fast you need the gear box to go.)

Angle of the gearbox mounting? (Horizontally, vertically or angled.)

Moment rigidity? (Weight deflection of the gear box shaft due to the fixture and work load.)

Torsional rigidity? (Shaft deflection, stopping and starting the application load.)
Momentary Maximum allowable torque? (Worst case E-stop condition with a load.)

What kind of duty cycle will the Gear box have? (Hours of operation and number of days per week.)
Description
Ferris Wheel Positioner

Center of Gravity
12” off center max

Center of Gravity
12” off center max

5000 lb

60"

5000 lb
### Work Place Mass (kg)
- 2314.0

### Rotating Assy Mass (kg)
- 4629.50

### Rotating Assy Mass (N)
- 56589.10

### CG distance from axis of rotation (M)
- 0.08600

### Moment of Inertia (kg*m^2)
- 6444.0

### Acceleration Time (s)
- 2.0

### Constant Speed Operation Time (s)
- 4.0

### Deceleration Time (s)
- 2.0

### One Operation Cycle Time (s)
- 60.0

### Constant Speed (rpm)
- 5.0

### Average Speed for Startup (rpm)
- 2.5

### Average Speed for Stop (rpm)
- 2.5

### Constant Speed Torque (Nm)
- 14517.84

### Load Moment of Inertia (kg*m^2)
- 6444.0

### Inertia Torque During Acceleration (Nm)
- 1425.23

#### Formula:
\[
T_a = \left\{ \frac{\ln (N_2 - 0)}{t_1} \right\} \times \frac{2\pi}{60}
\]

### Inertia Torque During Deceleration (Nm)
- 1425.24

#### Formula:
\[
T_d = \left\{ \frac{\ln (0 - N_2)}{t_2} \right\} \times \frac{2\pi}{60}
\]

### Maximum Torque For Startup (Nm)
- 2973.00

### Constant Speed Torque (Nm)
- 4547.84

### Maximum Torque For Stop (Nm)
- 3122.00

### Average Output Speed (rpm)
- 3.75

### Nxa
- \[
N_{xa} = \frac{t_1 \cdot N_1 + t_2 \cdot N_2 + t_3 \cdot N_3}{t_1 + t_2 + t_3}
\]

### Max Output Torque (Nm)
- 2973.00

### GearBox Reduction Ratio
- 5.56

### GearBox Efficiency
- 72%

### Max Input Torque (Nm)
- 14.95
White Papers

**MOTION CONTROL, INC. MOTION CONTROL, INC.**

**Conditions to be determined for selection**

- Input speed
- Input torque
- Input speed

- Determine load capacity
- Determine load characteristic
- Calculate average load torque (Tav)
- Calculate average output speed (Nav)
- Determine output speed deviation factor

**Check the external load applied to the RV-E.**

**Selection example**

- Selection conditions:
  - Input speed: 900 rpm
  - Input torque: 5 Nm
  - Input speed: 1000 rpm

- Calculation:
  - Torque required:
    - \( T_{req} = \frac{W}{\eta} \) (where \( \eta \) is the efficiency)
  - Torque selection:
    - Select the closest torque value to \( T_{req} \)

- Output speed:
  - \( N_{out} = \frac{T_{in}}{P} \)

- Output speed deviation factor:
  - \( F = \frac{N_{out}}{N_{in}} \)

- Check the external load applied to the RV-E.

**Determine output shaft torque (Tshaft):**

- \( T_{shaft} = \frac{W}{\eta} \) (where \( \eta \) is the efficiency)

- \( T_{shaft} = \frac{W}{\eta} \times \frac{N_{out}}{N_{in}} \)
Strength and service life

Allowable torque during acceleration or deceleration
When the Machine starts (or stops) a larger torque than steady-state torque is applied to the reduction gear because of the internal loads. The values in the ratings table (see page 11) show the allowable value of the peak torque when the reduction gear starts or stops. With the RV-6E, the allowable acceleration/deceleration torque is 200% of the rated torque; other models in the series have an acceleration/deceleration torque of 250% of the rated torque.

Momentary maximum allowable torque
A large torque during an emergency stop or external shock may be applied to the reduction gear. The maximum allowable torque is shown in the ratings table (see page 11). Momentary maximum allowable torque is 500% of the rated torque.

Note: When shock torque is applied, be sure to use at below the limit cycle per minute of reduction (maximum on page 12).

![Diagram showing load torque graph]

Rated service life
The service life of the RV-6 reduction gear is based on the life of the roller bearings of the crankshafts. The service life is set at 6000 hours as shown in Table 3 for all models and ratios at rated torque and at rated output speed.

Table 3
<table>
<thead>
<tr>
<th>Model</th>
<th>Service life (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV-6E</td>
<td>6,000</td>
</tr>
<tr>
<td>RV-28E</td>
<td></td>
</tr>
<tr>
<td>RV-42E</td>
<td></td>
</tr>
</tbody>
</table>

When in actual service installed in the equipment, calculate the service life using the following formula because the load condition depends on the types of reduction gear.

\[ L_S = K \times \frac{N_m}{N_m} \times \left( \frac{T_0}{T_m} \right)^2 \]

- \( L_S \) = Service life to be obtained (hrs)
- \( N_m \) = Average output speed (rpm) (calculation on page 13)
- \( T_0 \) = Average output torque (in-lb) (calculation on page 13)
- \( T_m \) = Rated output torque (in-lb) (table 4)
- \( T_0 \) = Rated output torque (in-lb) (table 4)

Table 4
<table>
<thead>
<tr>
<th>Type</th>
<th>Rated torque (in-lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV-6E</td>
<td>914</td>
</tr>
<tr>
<td>RV-28E</td>
<td>1,473</td>
</tr>
<tr>
<td>RV-42E</td>
<td>3,549</td>
</tr>
<tr>
<td>RV-80E</td>
<td>5,944</td>
</tr>
<tr>
<td>RV-115E</td>
<td>2,547 (1,078)</td>
</tr>
<tr>
<td>RV-150E</td>
<td>13,567 (1,500)</td>
</tr>
<tr>
<td>RV-320E</td>
<td>27,774 (3,136)</td>
</tr>
<tr>
<td>RV-400E</td>
<td>88,056 (4,410)</td>
</tr>
</tbody>
</table>