ETP-E Plus

Rapid improvement in labor effectiveness

Accurate:
Precise phase matching on demand both axially and in the direction of rotation.

Simple:
Every hydraulic mounting with uniform pressurization—no skill required.

Speedy:
Quick fastening with one bolt.

Operating Principles:
Tightening the pressure screw applies pressure to the pressure medium sealed in the chamber so the pressure medium moves into the sleeve. Applying pressure to the pressure medium applies pressure to the sleeve from the inside, so that the shaft side sleeve is shrunk and the hub side sleeve is expanded. Thus, the shaft and the hub are connected through the sleeve.

Operating Conditions:
- Pressure Screw: 10 - 15 MPa
- Temperature: 100 - 180°C

Variations and Materials:
ETP-E Plus
Standard types of the ETP-E Plus models.

ETP-E C
The main body and pressure screw are electrolytic nickel coated (simple outline finish).

ETP-E N
Standard body material: CK40 or equivalent
Pressure screw material: Alloy steel for machine structure use Surface finishing: Black coating

ETP-E G
Standard body material: CK40 or equivalent
Pressure screw material: CNC grade tool steel for machine structure use Surface finishing: Chrome free polishing

Mounting time:
hydraulic vs. mechanical

ETP-E Plus
Faster one bolt, and mounting is complete.

19 seconds
1 minute
2 minutes
3 minutes

General mechanical fastening elements
Multiple bolts must be fastened uniformly, diagonally and in a sequential manner.

Installation time: Time varies depending on various conditions.
Items Checked for Design Purposes

**Selection Procedure**

1. Torque is determined by the used shaft diameter, in general, and the lowest output speed, in the same time, the rated values of it, in the chart on the right. Those values can be obtained based on the coefficients in the chart on the right.

   \[ T_a (N\cdot m) = 9550 \times \frac{P (kW)}{n}\ ]

   \[ T_a \text{ Torque applied to the connecting element}\]

   \[ n \text{ Rated speed of motor}\]

   \[ P \text{ Rated power of motor}\]

   \[ f \text{ Shaft material}\]

2. Determine the service factor, K3, based on the load property and obtain the corrected torque, Td, and corrected thrust, Fd, applied to the connecting element.

   \[ T_d = T_a \times K_1 \times K_2 \]

   \[ F_d = F_a \times K_1 \times K_2 \]

   \[ T_a \text{ Torque applied to the connecting element}\]

   \[ F_a \text{ Thrust applied to the connecting element}\]

   \[ K_i \text{ Service factor}\]

3. Correct the values according to the load property.

   - For the torque alone
     - Connect the calculated element’s rated torque, T, based on the used diameter with the calculated corrected torque, Td.
     - For use in conditions 10°C and under, use the K3 coefficient with T.
   - For the thrust alone
     - Connect the calculated element’s rated thrust, F, based on the used diameter with the calculated corrected thrust, Fd.
     - For use in conditions 10°C and under, use the K3 coefficient with F.

4. Torque and thrust are applied at the same time.

   - Calculate the combined load, F = Td and Fd, and compare with the result with the corrected torque, Td and Fd.
   - For use in conditions 10°C and under, use the K3 coefficient with T and F.

5. Thrust and thrust are applied at the same time.

   - Calculate the combined load, F = Td and Fd, and compare with the result with the corrected torque, Td and Fd.
   - For use in conditions 10°C and under, use the K3 coefficient with T and F.

**Service Factor**

- **Service factor based on the load property:** K1

- **Service factor based on the repeated heavy loading:** K2

**Hub’s Minimum External Diameter**

If the stress applied to the hub is too large, the hub may be deformed. Select the appropriate external diameter size from the hub’s minimum external diameters in the table below in the design phase.

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**Torque and Thrust Coefficients**

If torque and thrust are applied to the ETP-E Plus at the same time, the rated values of it, in the chart on the right. Those values can be obtained based on the coefficients in the figure on the right.

**Calculation example:**

- When using the ETP-E-35S-N at 10°C:
  - Maximum rated torque, T, and thrust, F, at 10°C, T = 4500(N·m) and F = 30000(N).
  - The maximum rated torque, Tmax, when the maximum thrust, Fmax = (10000(N) can be applied as shown below.

   \[ \text{Thrust coefficient} K_3 = \frac{\text{Fmax}}{T \times \text{temperature coefficient} K_3} \]

   \[ \text{Maximum rated torque, } \text{Tmax} = \frac{\text{Fmax}}{K_3 \times \text{temperature coefficient} K_3} \]

   \[ \text{K3 = } \text{18000/30000} \times 1.0 = 0.6 \]

   \[ \text{Tmax} = \frac{4500}{0.6} = 7500 \text{ (N·m)} \]

   The relationship between K1 and K2 can be obtained from the following formula:

   \[ K_1 = K_2 \times K_3 \]

   \[ \text{K2 = } \frac{T \times \text{temperature coefficient} K_3}{\text{Thrust coefficient} K_3} \]

   \[ \text{T} = \frac{4500}{0.6} = 7500 \text{ (N·m)} \]

   \[ \text{K2 = } \frac{7500}{0.6} = 12500 \text{ (N·m)} \]

   \[ \text{K3 = } \frac{4500}{0.6} = 7500 \text{ (N·m)} \]

   \[ \text{K1 = } \frac{7500}{0.6} = 12500 \text{ (N·m)} \]

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**Material Yield Stress, f_y (N/mm²)**

<table>
<thead>
<tr>
<th>Type of steel</th>
<th>Material Yield Stress, f_y (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>210</td>
</tr>
<tr>
<td>120</td>
<td>235</td>
</tr>
<tr>
<td>140</td>
<td>260</td>
</tr>
<tr>
<td>160</td>
<td>290</td>
</tr>
<tr>
<td>180</td>
<td>320</td>
</tr>
<tr>
<td>200</td>
<td>350</td>
</tr>
</tbody>
</table>

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**Shaft Center Pressure**

- P1: Contact pressure at 20°C × temperature coefficient K3

- The operating temperature range is from -10°C to 85°C.
## Items Checked for Design Purposes

### Mounting Shaft Tolerance, Mounting Hub Tolerance, and Surface Roughness

<table>
<thead>
<tr>
<th>Model</th>
<th>Mounting shaft tolerance</th>
<th>Mounting hub tolerance</th>
<th>Surface roughness</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETP-E PLUS 1N</td>
<td>H7</td>
<td>H7</td>
<td>3.2μm or less</td>
</tr>
<tr>
<td>ETP-E PLUS 6C</td>
<td>H7</td>
<td>H7</td>
<td>3.2μm or less</td>
</tr>
</tbody>
</table>

### Operating Temperature Range

<table>
<thead>
<tr>
<th>Model</th>
<th>Operating temperature range (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETP-E PLUS 1N</td>
<td>−30 to 85</td>
</tr>
<tr>
<td>ETP-E PLUS 6C</td>
<td>−30 to 85</td>
</tr>
</tbody>
</table>

### Concentricity and Balance

<table>
<thead>
<tr>
<th>Model</th>
<th>Concentricity/itch (μm)</th>
<th>Balance (rpm/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETP-E PLUS 1N</td>
<td>0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>ETP-E PLUS 6C</td>
<td>0.02</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### Number of Attachments and Detachments

The number of attachments/detachments only applies if you prevent foreign particles from adhering to the pressure screw and make sure oil containing molybdenum-based antifriction material always remains on the pressure screw's surface. In addition, be sure to use a torque wrench and do not use an impact wrench that has large torque fluctuation.

<table>
<thead>
<tr>
<th>Model</th>
<th>No. of attachments/detachments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETP-E PLUS 1N</td>
<td>10,000</td>
</tr>
<tr>
<td>ETP-E PLUS 6C</td>
<td>20,000</td>
</tr>
<tr>
<td>ETP-E PLUS 11N</td>
<td>30,000</td>
</tr>
<tr>
<td>ETP-E PLUS 15N</td>
<td>40,000</td>
</tr>
<tr>
<td>ETP-E PLUS 19N</td>
<td>50,000</td>
</tr>
</tbody>
</table>

### Keyway Shape where the ETP-E PLUS Cannot Be Detached due to a Deformation of the Sleeve

The ETP-E PLUS cannot be used if the shaft and hub have a keyway as shown in the figure below. Note that you can use the ETP-E PLUS for the shaft and hub with a keyway if you completely fill the keyway with epoxy putty for metal and then shape it.

### Allowable Range of Edge

The performance of the ETP-E PLUS is based on the case where the shaft and the hub have the effect for the entire standard shaft length (Ls) and the entire standard hub length (Lh), respectively. Accordingly, make sure in the design phase that the shaft and the hub have the effect for the respective entire standard length. If the length of the shaft and hub is limited due to design reasons, make sure that it is less than the dimension Ls in the figure below. If it exceeds the dimension Ls, stress concentrates on the sleeve edge and the sleeve is deformed, so there is a possibility that the ETP-E PLUS cannot be detached.

### Mounting

1. Wipe the rust, dust, and oil off from the surface of the shaft and hub with a cloth or alcohol solution. In particular, if grease remains, wipe it off completely. If oil remains on the surface of the ETP-E PLUS, wipe it off with a cloth, etc.
2. If the oil is wiped off, the friction coefficient basically changes. Never allow oil containing molybdenum-based antifriction material to contact the surface.
3. Attach the ETP-E PLUS to the hub and mount them to the shaft. If accurate positioning of the shaft and hub is needed, adjust the position of both before tightening the pressure screw.
4. Never tighten the pressure screw before mounting the ETP-E PLUS to the shaft and hub.
5. Lighten the pressure screw to the specified torque using a torque wrench.

### Removal

1. Before starting work, ensure safety by making sure no torque and thrust are applied to the ETP-E PLUS and there is no risk of a fall due to the self-weight of the shaft and hub.
2. The ETP-E PLUS does not have a self-locking mechanism. The connecting force is instantaneously released by loosening the pressure screw.
3. Loosen the pressure screw until the connecting force is released. The pressure screw should only be loosened. Do not remove it.
Customization Examples

Case of an Application to a Slitter Knife Holder
This is a hydraulic slitter knife holder. This holder is used to position the rotating knives to cut tin, iron, aluminum plates, or paper sheet in any position. Positioning in the shaft direction can be performed arbitrarily with 1 bolt. For the angular deflection caused by detachment and attachment, a micrometer (μm) level repeatable accuracy can be maintained.

Case of an Application to the Integration of a Gear
A very accurate concentricity can be maintained by integrating the gear into the device. Positioning in the shaft and fitting directions can be performed easily.

Customization of the Sleeve Length to Meet the Customer’s Requirement
If the customer makes a request, the standard sleeve length can be customized (reduced) to enable it to be fitted to the thin part of the mating hub.

Case of an Application to a Holding Jig
This can be mounted to a work bench as a holder for assembly and machining to ensure stable work. Furthermore, work pieces can be held with an extremely high repeatable hold position accuracy.

FAQ

Q1 Can I use the ETP bushings for the shaft and hub with keyways in them?

1 You can use the ETP bushing by completely filling the keyway with epoxy putty for metals and then shaping it. If you use the device with keyways on the shaft and hub, the sleeve may be deformed and the device may become unable to be detached and attached again.

Q2 Can I use the ETP bushing when the shaft and hub do not overlap the entire sleeve length?

2 Because sleeve deformation is not controlled for the part where the sleeve and axis/hub do not touch, the deformation volume grows large and problems occur such as plastic deformation occurring in the sleeve or specifications not being satisfied due to insufficient friction. For details, check “Allowable Range of Edge” (PN).

Q3 Can the rated torque be transmitted even if thrust load is applied?

3 The allowable torque and allowable thrust force listed are each the maximum allowable values when each is operating independently. When torque and thrust force are applied simultaneously, check the “Torque and Thrust Coefficients” (PN), derive the synthetic load and confirm that it is below the allowable torque.

Q4 If an ETP bushing slips once, can it be reused?

4 Whether or not it can be reused depends on the degree of slip. If the degree of slip is small, it can be reused. However, if you reuse it, you need to check it to make sure there is no scratch on the surface of the ETP bushing, shaft, and hub, and there is no deformation on the ETP bushing main body. And, if you reuse it, you need to remove the cause of the slip.