Rolling-Element Bearings

- Types
  - Ball Bearings
  - Roller Bearings

- Selection of rolling-element bearings

Comparing Rolling to Journal

- Rolling Bearing are better because:
  - low starting and good operating friction
  - radial and thrust loads
  - no self-excited instabilities
  - less space axially
  - can seal lubricant in bearing

- Journal Bearings are better because:
  - fatigue failure not a problem
  - less space radially
  - less noise
  - more tolerant to misalignment
  - less expensive, except for oiling system
  - less operating friction

Ball Bearings vs Roller Bearings

<table>
<thead>
<tr>
<th>Ball Bearings versus Roller Bearings</th>
<th>Ball</th>
<th>Roller</th>
</tr>
</thead>
<tbody>
<tr>
<td>High speed</td>
<td>Higher radial load support</td>
<td></td>
</tr>
<tr>
<td>Axial thrust</td>
<td>Usually separable</td>
<td></td>
</tr>
</tbody>
</table>

A) Ball Bearings

- good for smaller sizes, lighter loads
B) Roller Bearings

- good for larger sizes, heavier loads
- handle shock and impact loading well

![Roller Bearings Image]

Rolling Element Comparisons

Selection of Rolling Element Bearings

Once a bearing type suited to the application is chosen, selection of appropriate-size bearing depends on the magnitude of loads and the desired fatigue life.

**Basic Dynamic Load Rating (C):**

$$ L = \left( \frac{C}{P} \right)^{1/3} $$

- Ball Bearings
- Roller Bearings

$L$ = Expected bearing life (expressed in millions of revolutions)
$C$ = Dynamic load rating (Capacity)
$P$ = Constant applied load

**Basic Static Load Rating ($C_0$):**

see Figure 10-23, pp. 662 for Ball Bearings

Rolling Element Analysis

- Calculate $P$
- Specify the number of cycles
- Calculate $C$
- Choose a bearing from the manufacturer’s catalog based on $C$, $C_0$

Selection of Rolling Element Bearings

**Combined Radial and Thrust Loads:**

$$ P = XVF_r + YF_a $$

If

$$ \frac{F_a}{F_r} \leq e $$

then $X = 1$ and $Y = 0$

$X$ = Radial factor (see Figure 10-24)
$Y$ = Thrust factor (see Figure 10-24)
$V$ = Rotation factor (see Figure 10-24)
$F_r$ = Radial load
$F_a$ = Axial load
$e$ = Minimum ratio between axial and radial loads (see Figure 10-24)

Bearing Selection

Ex: Figure 10-23
Dimensions and Load Ratings for 6300 Series Ball Bearings (FAG Bearings Corp.)