Torque Transmission Components
Torque Transmission

Functions of automobile drive-train

- Speed reduction
- Transmit torque to and from wheels
- Distribute torque to wheels in fixed or variable ratio
- Accommodate wheel position changes due to steering and road bumps
Keys, Splines, and Hubs

• Transfer torque while maintaining the angular correspondence

• Keyway slot or pocket for the key to fit in

• Spline ridges or teeth on a drive shaft that mesh with grooves in a hub
Cardan & Constant Velocity Joints

- Cardan joints output at non-uniform rotary speed
- Double Cardan Joint to cancel-out velocity difference
- Constant Velocity joints prone to wear by contaminants
Bevel Gears

- Axes of the two shafts intersect
- Tooth-bearing faces of the gears conically shaped
- Spiral bevel gears for heavy load at high speed
Differential Gear Box

- Delivery the power from engine to wheels
- Vehicle turning in corner, allow the inner and outer drive wheels turn at different RPM
Bearing
Hole and Shaft Pair

Loosely fitted
- Shaft vibrates and collides with hole
- Concentricity cannot be maintained
- Noisy operation

Tightly fitted
- Energy waste by frictional lost
- Overheat caused by friction
- Wear caused by shaft rubbing against hole
- Difficult or impossible to lubricate
Plain Bearing

- Also known as bushing, journal bearing, or sleeve bearing
- Allow constrained relative motion
- Surfaces in rubbing contact, often with a lubricant such as oil or graphite
- With suitable lubrication, give entirely acceptable accuracy, life, and friction at minimal cost
Rolling-element Bearing

• Carries load by placing round elements between the two pieces

• Relative motion of the pieces causes the round elements to roll with very little rolling resistance and with little sliding
Thrust bearing

Designed to support a high axial load

- **Ball thrust bearings** composed of ball bearings supported in a ring, used where there is little radial load

- **Tapered roller bearings** consist of small tapered rollers converge at a point on the axis of the bearing
Bearing Types

- Ball bearing
- Cylindrical roller bearing
- Tapered roller bearing
- Spherical roller bearing
- Angular contact ball bearing
- Thrust ball bearing
- Thrust roller bearing
## Radial Load and Bearing Fit

<table>
<thead>
<tr>
<th>Bearing rotation and load</th>
<th>Illustration</th>
<th>Ring load</th>
<th>Fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner ring: Rotating</td>
<td><img src="image1" alt="Static load" /></td>
<td>Rotating inner ring load</td>
<td>Inner ring: Tight fit</td>
</tr>
<tr>
<td>Outer ring: Stationary</td>
<td><img src="image2" alt="Static load" /></td>
<td>Static outer ring load</td>
<td>Outer ring: Loose fit</td>
</tr>
<tr>
<td>Load direction: Constant</td>
<td><img src="image3" alt="Static load" /></td>
<td>Static inner ring load</td>
<td>Inner ring: Loose fit</td>
</tr>
<tr>
<td>Outer ring: Rotating</td>
<td><img src="image4" alt="Unbalanced load" /></td>
<td>Rotating outer ring load</td>
<td>Outer ring: Tight fit</td>
</tr>
</tbody>
</table>
• Standard dimension tolerances for bearing shaft diameters and housing bore diameters are governed by ISO 286
• Bearing fits are determined by the dimensional tolerance of the shaft diameter and housing bore diameter