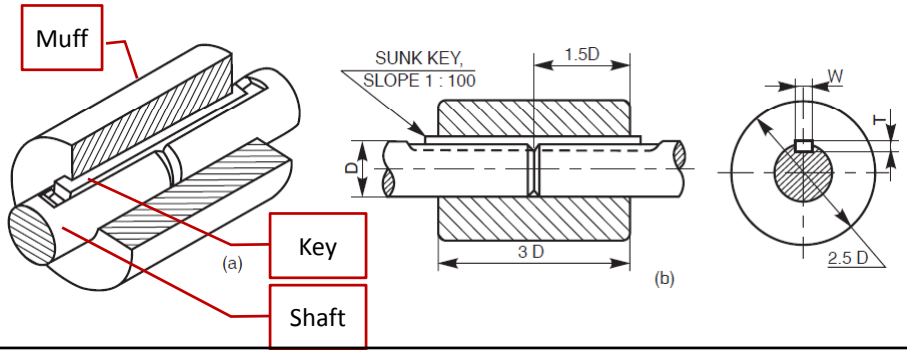
ME251A- Engineering Design and Graphics

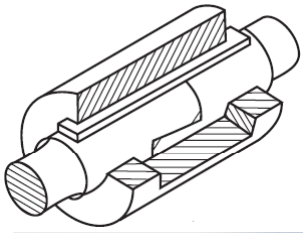
Couplings

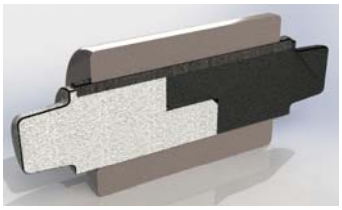
- Couplings are used to directly transfer rotary motion from one shaft to another
- Types
  - Fast or rigid coupling
  - Flexible coupling
  - Loose or disengaging (clutch)

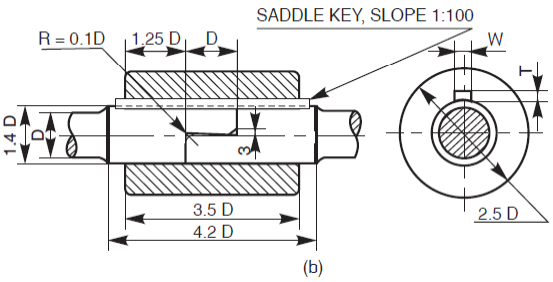
- Box or muff coupling (rigid type)



Half-lap coupling (rigid)



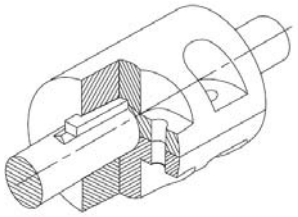


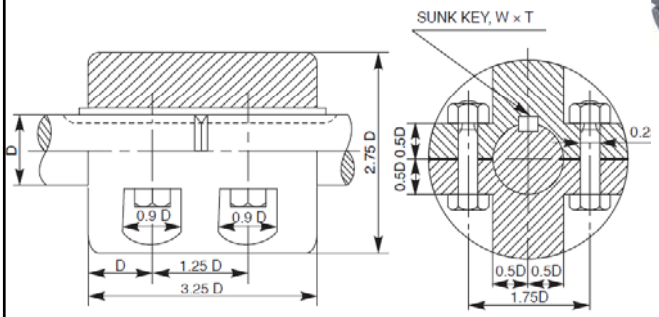


- The taper in the shaft ends prevents them from axially separating
- Good for situations involving large axial loads

Split muff coupling (rigid)

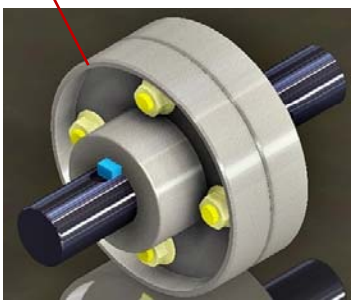
- The muff is made in two semi-cylindrical halves joined together by bolts
- Keys are placed in position then the muff is assembled
- Torque is transmitted by key as well as by clamping friction
- Used in heavy duty applications



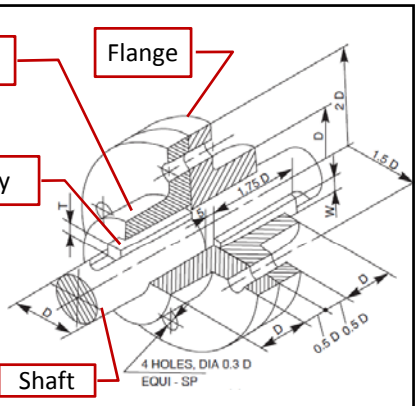


Flanged coupling

- Extensively used type
- **Shafts should be aligned very well**

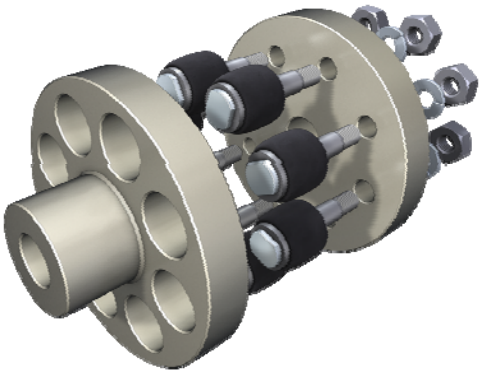


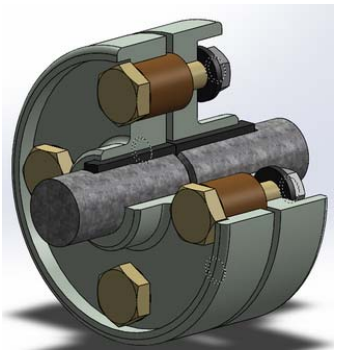
Protected type flange coupling



Pin-type flexible coupling

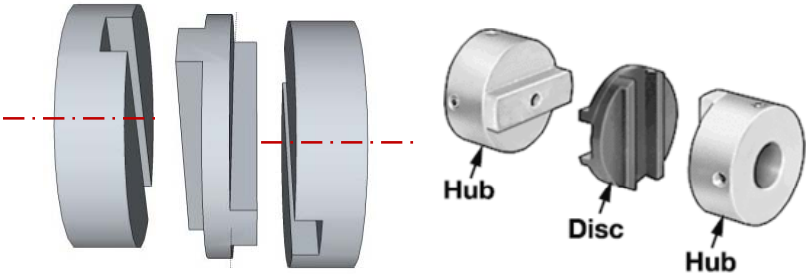
- The pins are rigidly fastened to one of the flanges
- They are covered with rubber washers (bushes) and kept loose in the other flange
- The rubber bushes act as shock-absorbers and tolerate some misalignment





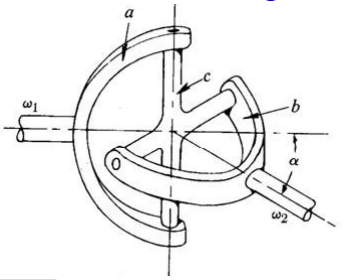
Oldham's coupling

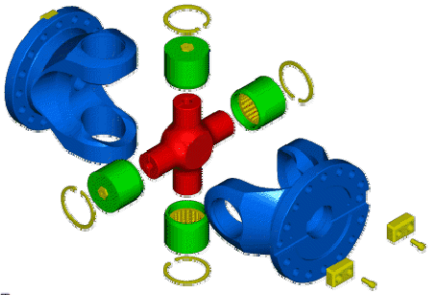
- Used when shaft axis are parallel but offset
- The center piece is slides in the slots
- Center piece sometimes made of plastic as it wears out and has to be replaced

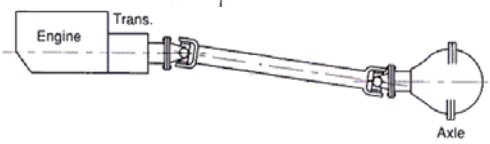


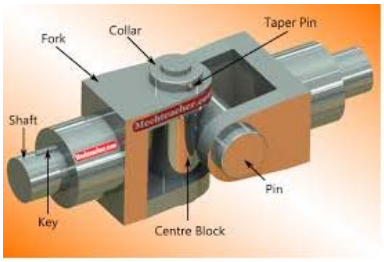
Universal coupling or Hooke's joint

- Used for connecting two shafts having axis intersecting



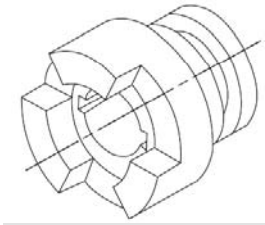


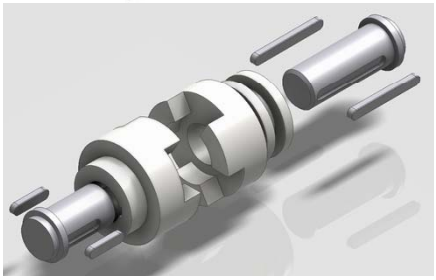




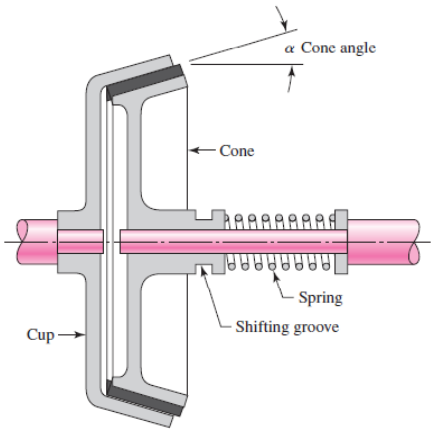
Engaging and disengaging type

Claw coupling



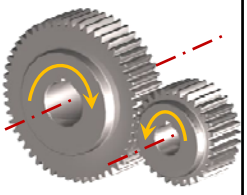


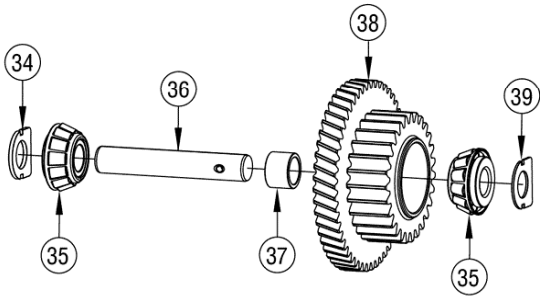
Cone clutch

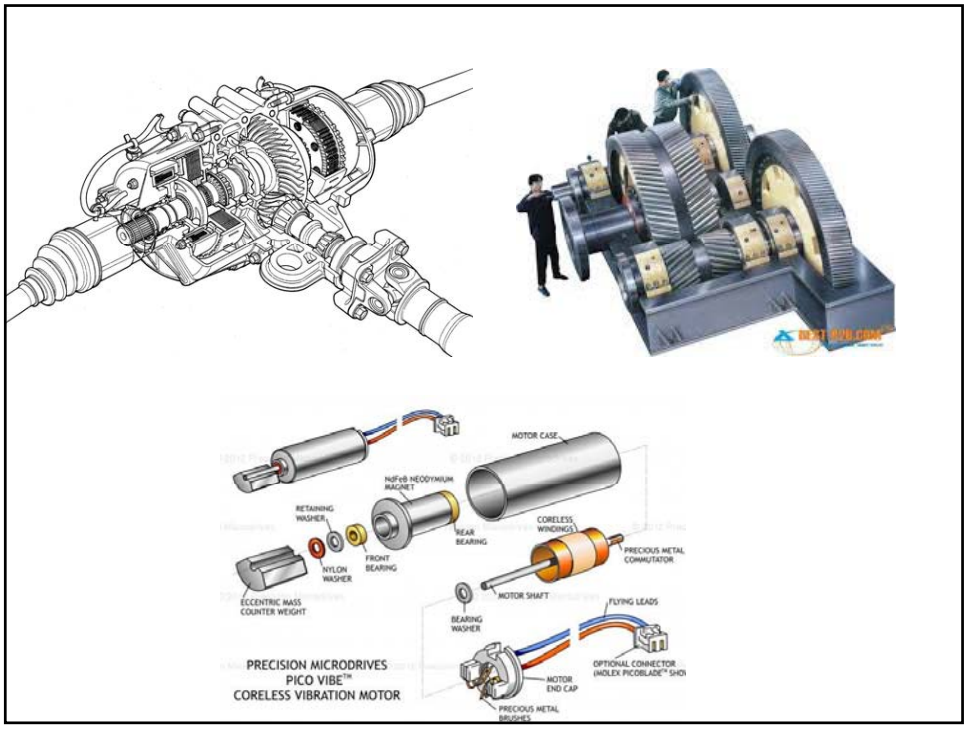


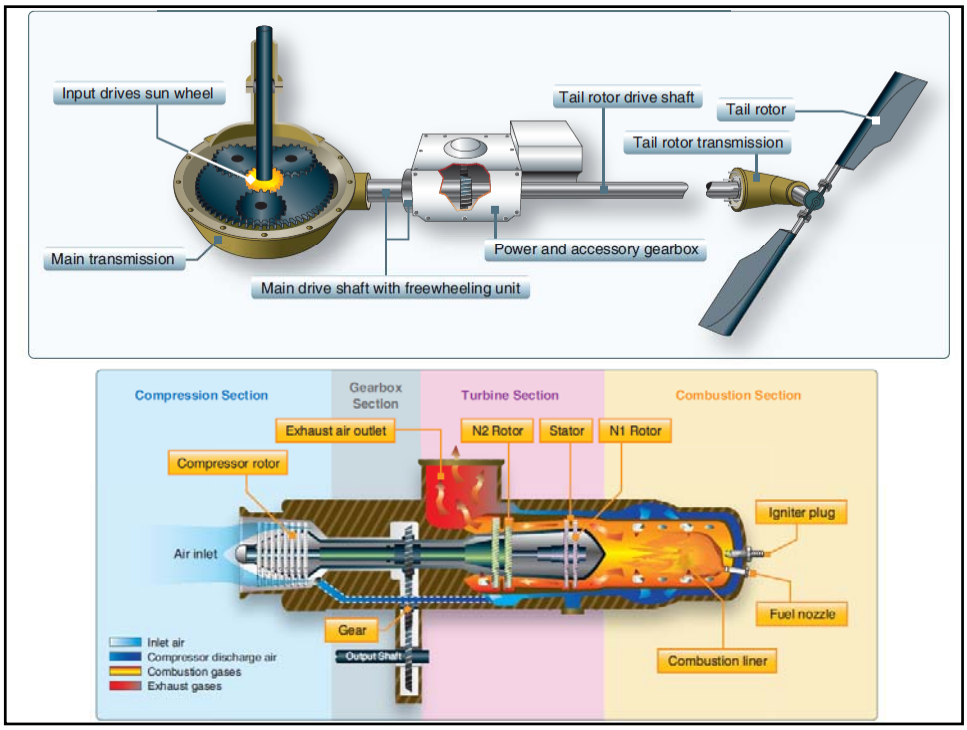
Shafts/Gears/Bearings

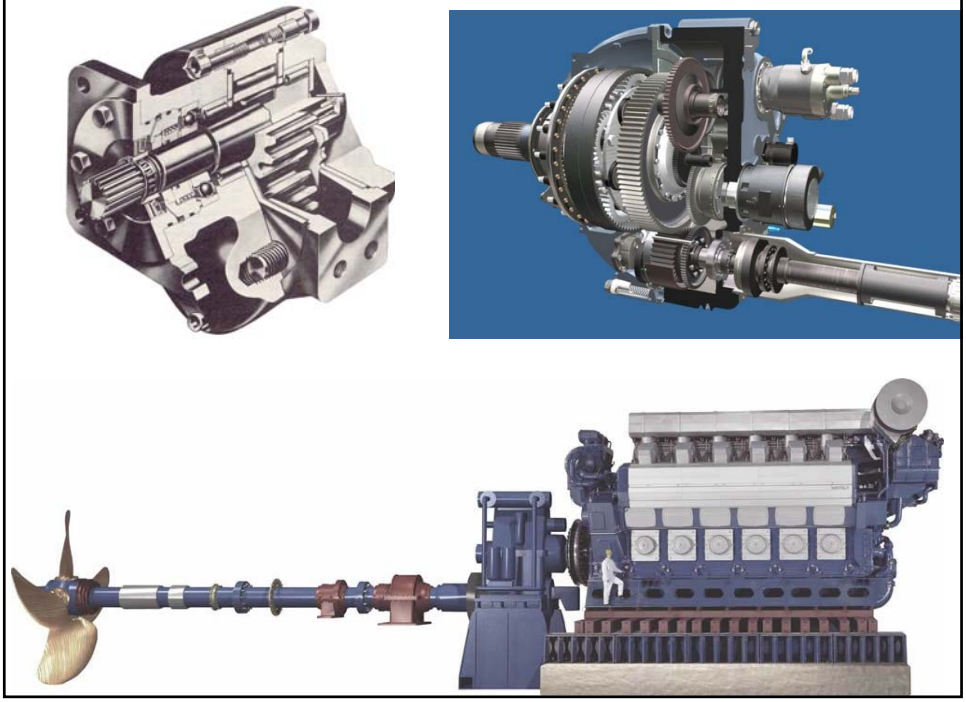
- **Gears:** Mechanical elements used for transmitting power with change in speed
- **Shafts:** Used for mounting elements such as gears, pulleys, flywheels and also transmit power and motion
- **Bearings:** Support the shaft at the same time allow rotation with very low friction



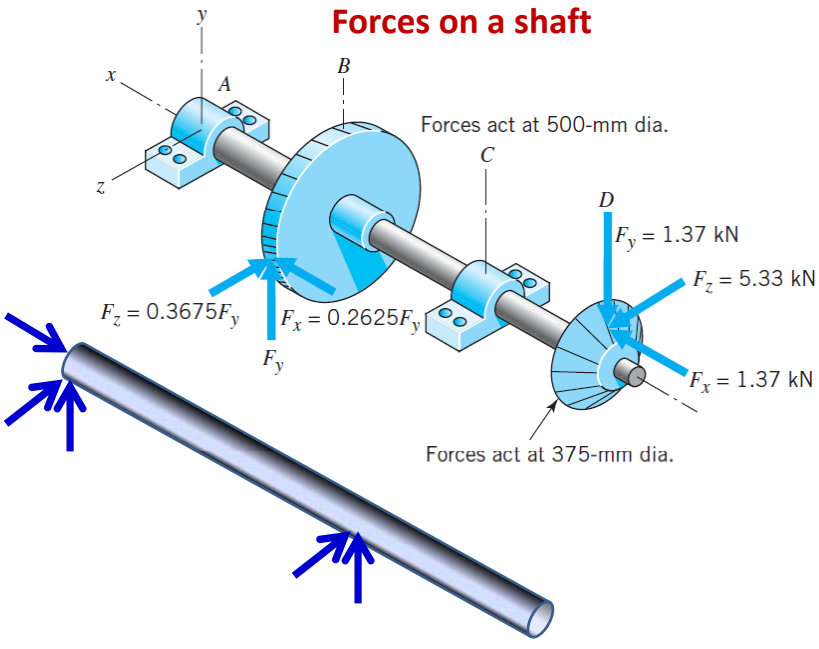



MOTOR CASE
NdFeB NEODYMIUM MAGNET
RETAINING WASHER
REAR BEARING
CORELESS WINDINGS
PRECIOUS METAL COMMUTATOR
NYLON WASHER
FRONT BEARING
ECCENTRIC MASS COUNTER WEIGHT
MOTOR SHAFT
FLYING LEADS
BEARING WASHER
OPTIONAL CONNECTOR (MOLEX PICOBLADE™ SHOI
MOTOR END CAP
PRECIOUS METAL BRUSHES
PRECISION MICRODRIVES
PICO VIBE™
CORELESS VIBRATION MOTOR


Input drives sun wheel
Tail rotor drive shaft
Tail rotor
Tail rotor transmission
Main transmission
Power and accessory gearbox
Main drive shaft with freewheeling unit
Compression Section
Gearbox Section
Turbine Section
Combustion Section
Exhaust air outlet
N2 Rotor
Stator
N1 Rotor
Compressor rotor
Igniter plug
Air inlet
Fuel nozzle
Gear
Output Shaft
Combustion liner
Inlet air
Compressor discharge air
Combustion gases
Exhaust gases



Forces on a shaft



Bearings

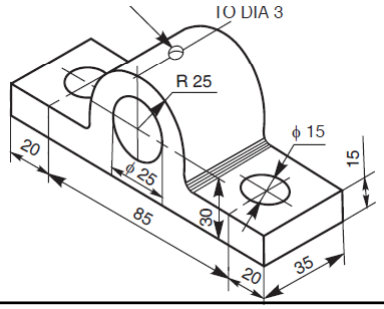
- Bearings provide support for shafts
  - Allows free rotation of the shaft with very little friction
  - Resists the radial and axial loads acting on the shaft
- Types of bearings based on construction
  - Sliding bearings
  - Rolling element bearings (anti-friction bearings)
- Types of bearing based on load capacity
  - Radial bearings
  - Thrust bearings

Sliding bearings

- The rotating shaft has a sliding contact with the bearing
- The friction is relatively high and hence lubrication is required
- Journal bearings
  - The part of the shaft which is in contact with the bearing is called **Journal**
  - Used for supporting **radial loads**
- Examples of journal bearings
  - Solid bearing
  - Bushed bearing
  - Pedestal bearing
  - Bracket and hanger bearing

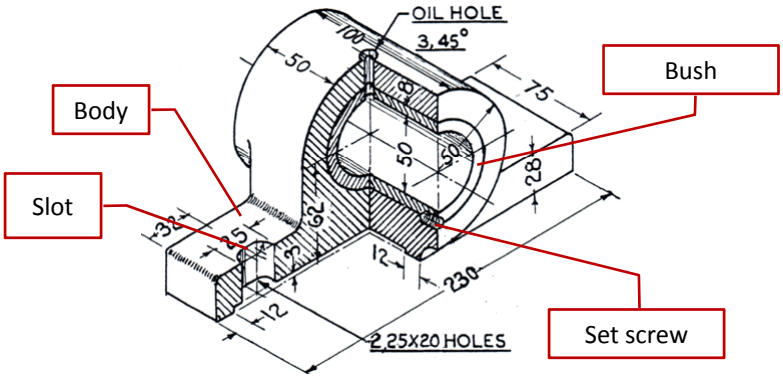
Solid bearing

- Simplest among journal bearings
- Usually made of cast iron
- Consists of one block in which a hole is bored
- The journal rotates in this hole
- The whole bearing has to be replaced once the hole surfaces are worn out
- Used for light service



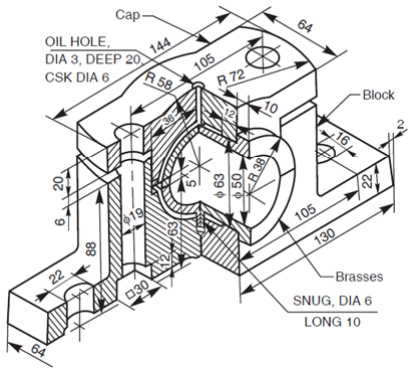
Bushed bearing

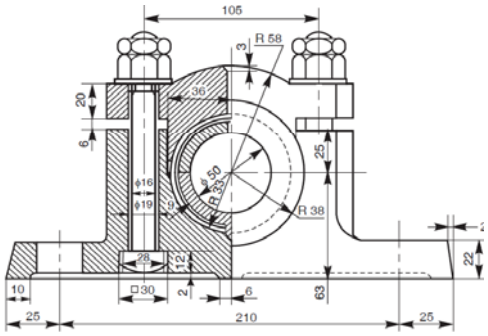
- Consists of i) **body** and ii) **bush**
- Body made of cast iron
- Bush is made of a soft material like brass, bronze of gun metal
- A set screw fitted such that half of it is in the body and half in the bush prevents the bush from rotating and sliding



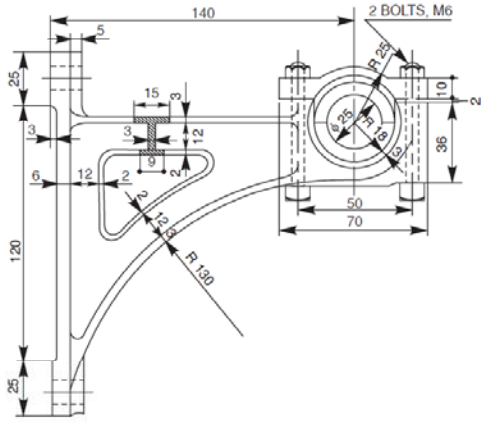
Pedestal bearing (plummer block)

- Used with long shafts needing intermediate supports
- Bush is split into two halves (brasses) for easy removal in the case of a long shaft when the bearing is an intermediate support
- The bush has flanges at either ends to prevent it from sliding
- A snug is used to prevent rotation of the bush

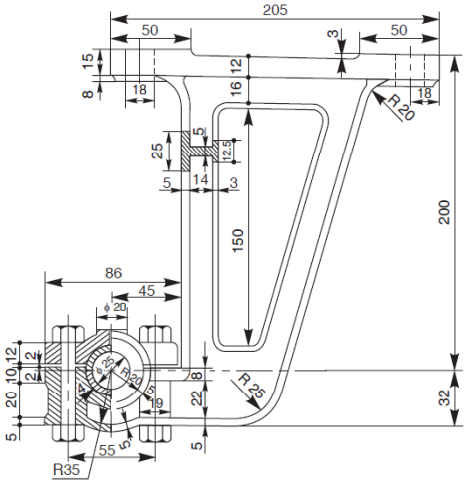




Bracket and hanger bearing



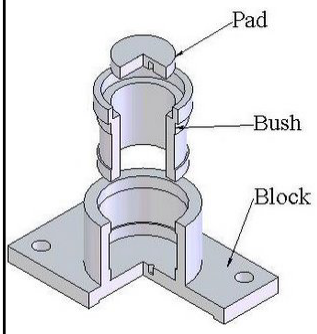
Wall bracket with pedestal bearing

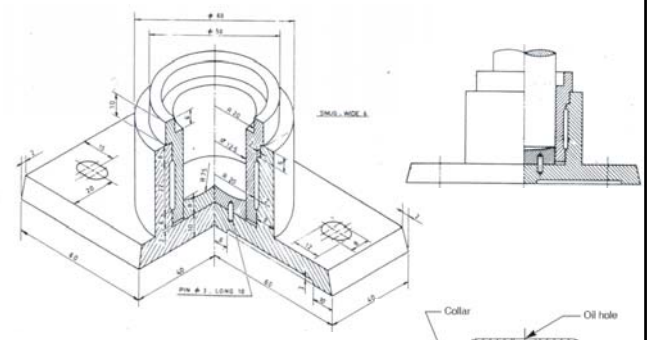


Hanger with pedestal bearing

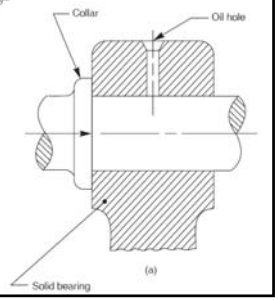
Thrust bearing (sliding type)

- Foot-step bearing: Vertical shafts



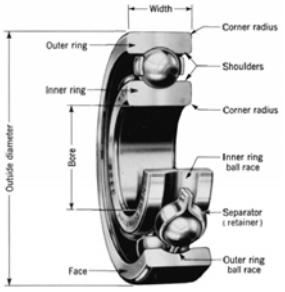


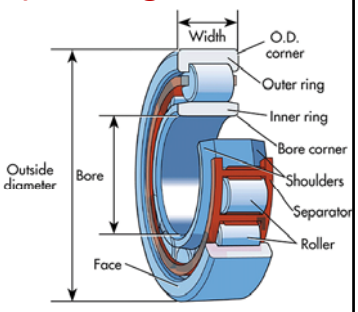
- Collar thrust bearing: Horizontal shafts



Rolling element (anti-friction) bearings

Deep groove ball bearing





Cylindrical roller bearing

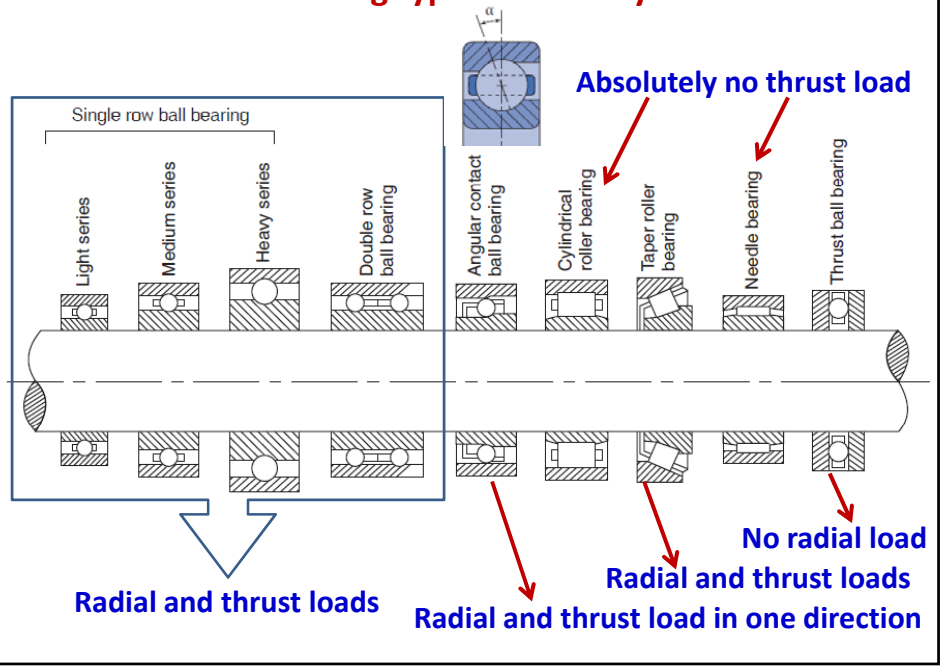
Needle bearing

Spherical roller bearing

Tapered roller bearing

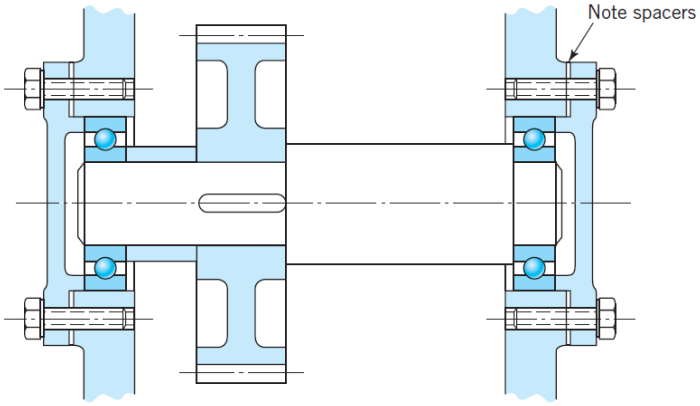
Rolling element thrust bearings

Bearing types- Summary



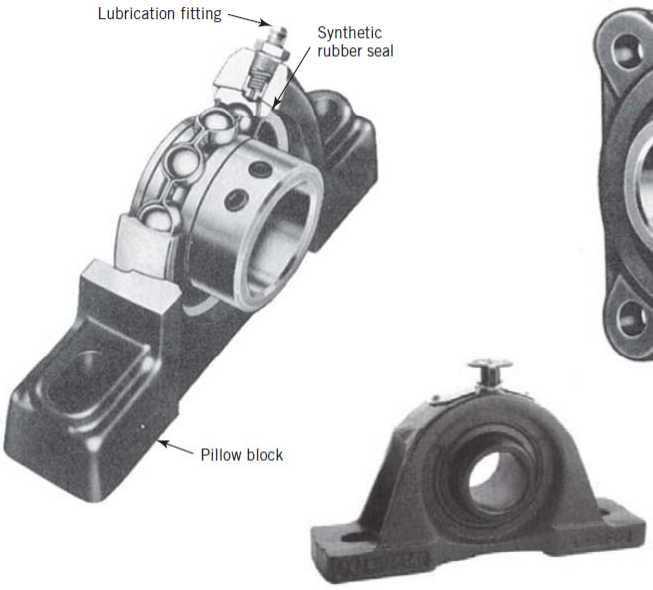
Shaft bearing assembly

- The inner race is shrunk-fit on to the shaft (no slipping)
- Outer race is a through fit in the housing
- Left bearing takes thrust directed to left whereas right bearing takes the thrust directed to right



Bearing mounts

Pillow Block Installation



Flanged bearing