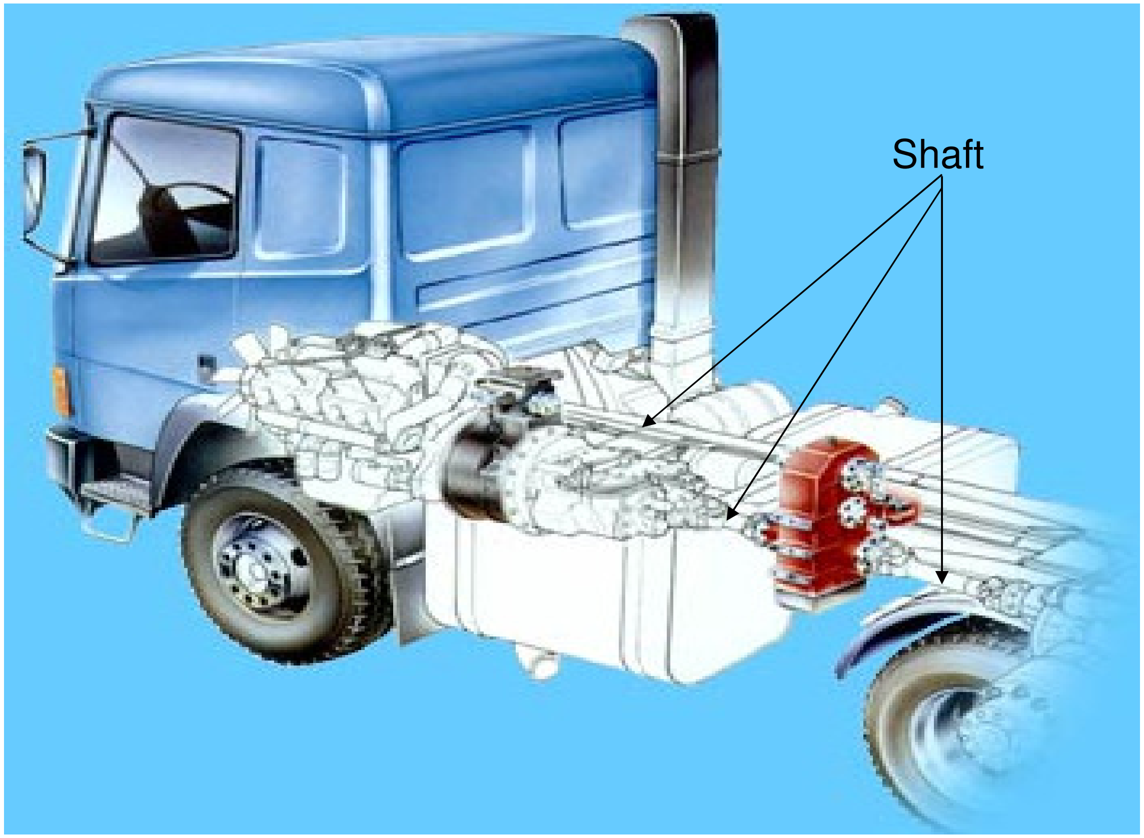
MACHINE ELEMENTS

Shaft, Gear, Bearing, Bolt&Nut, Washer, Pin, Rivet, Key, Pulley&Belt

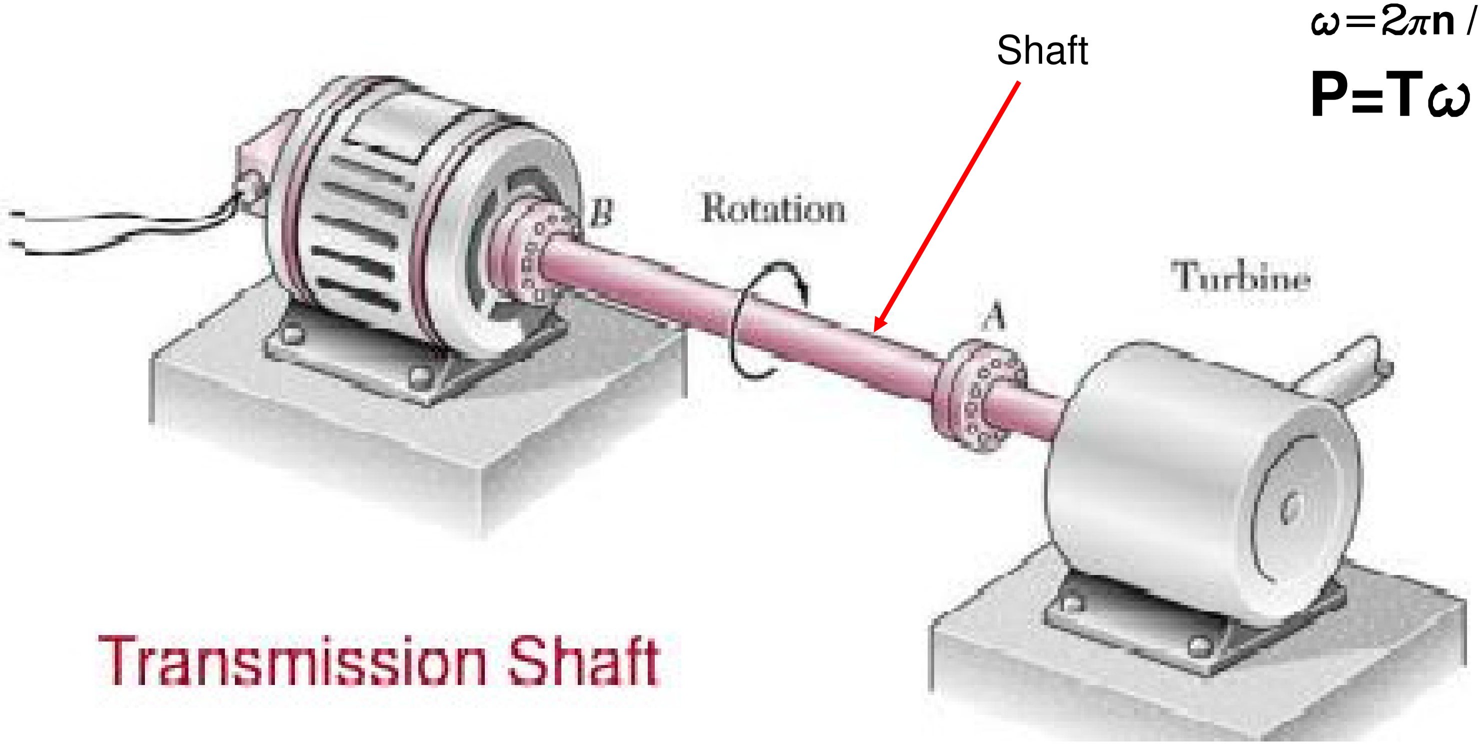
A **shaft** is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power.

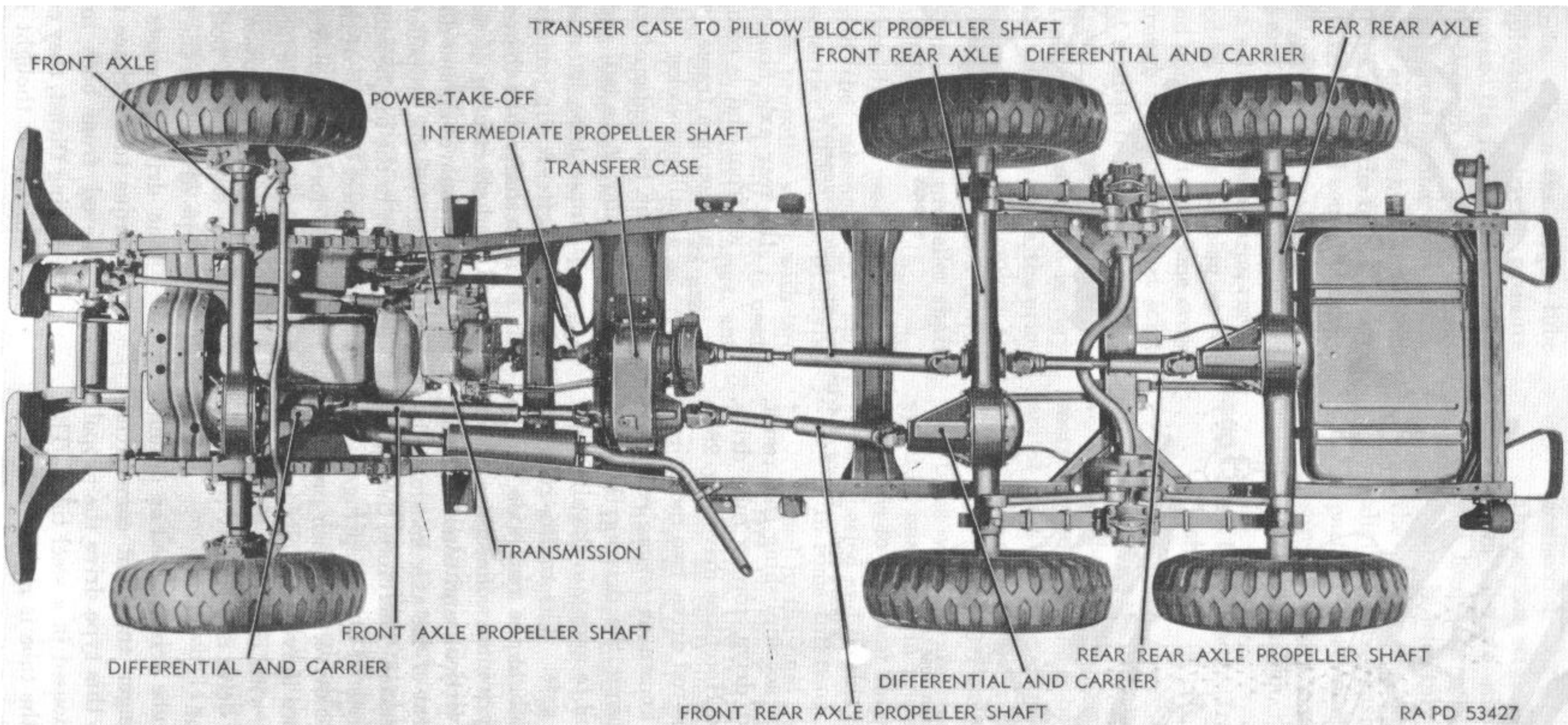


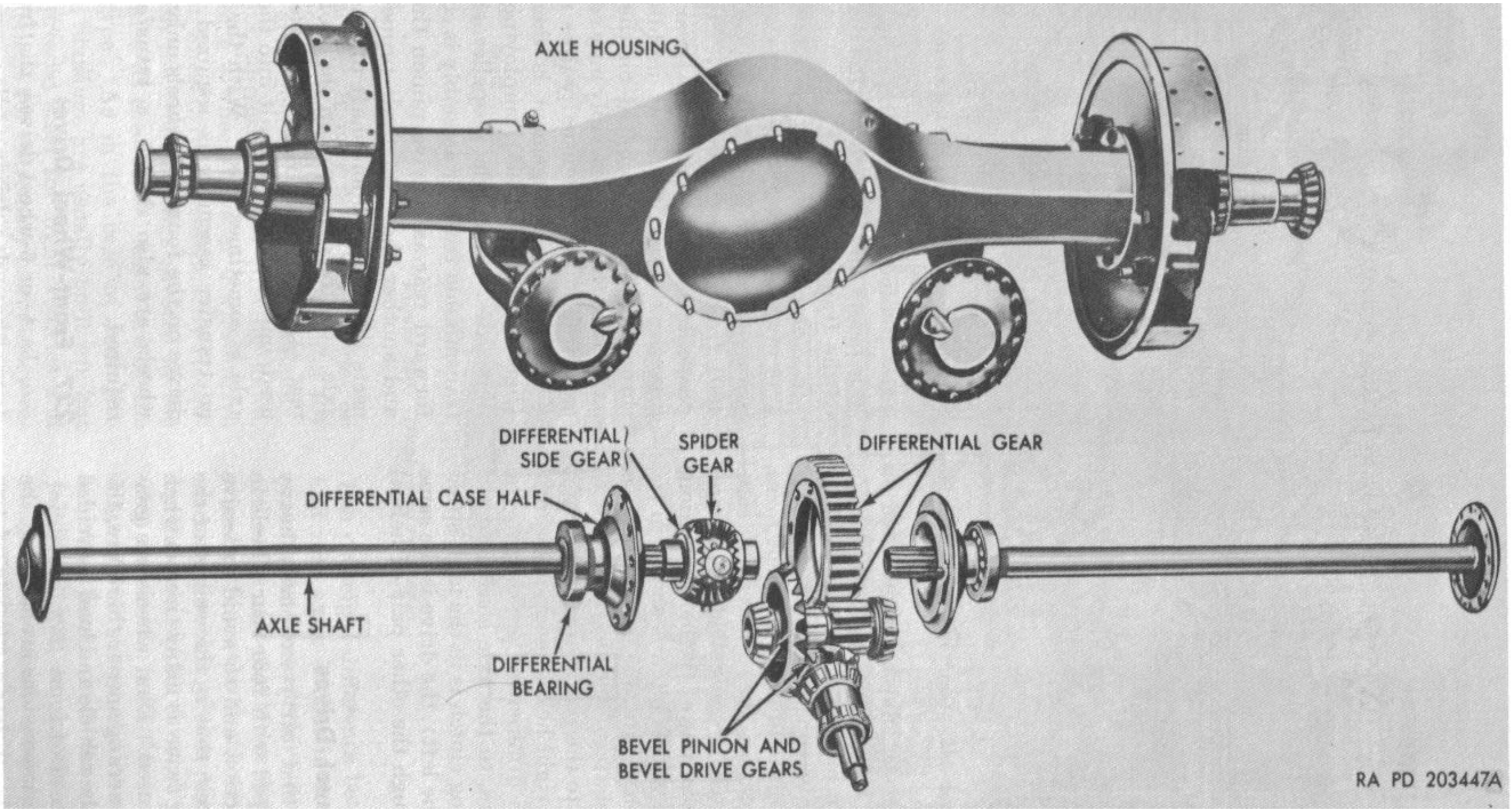
$$V = r\omega$$

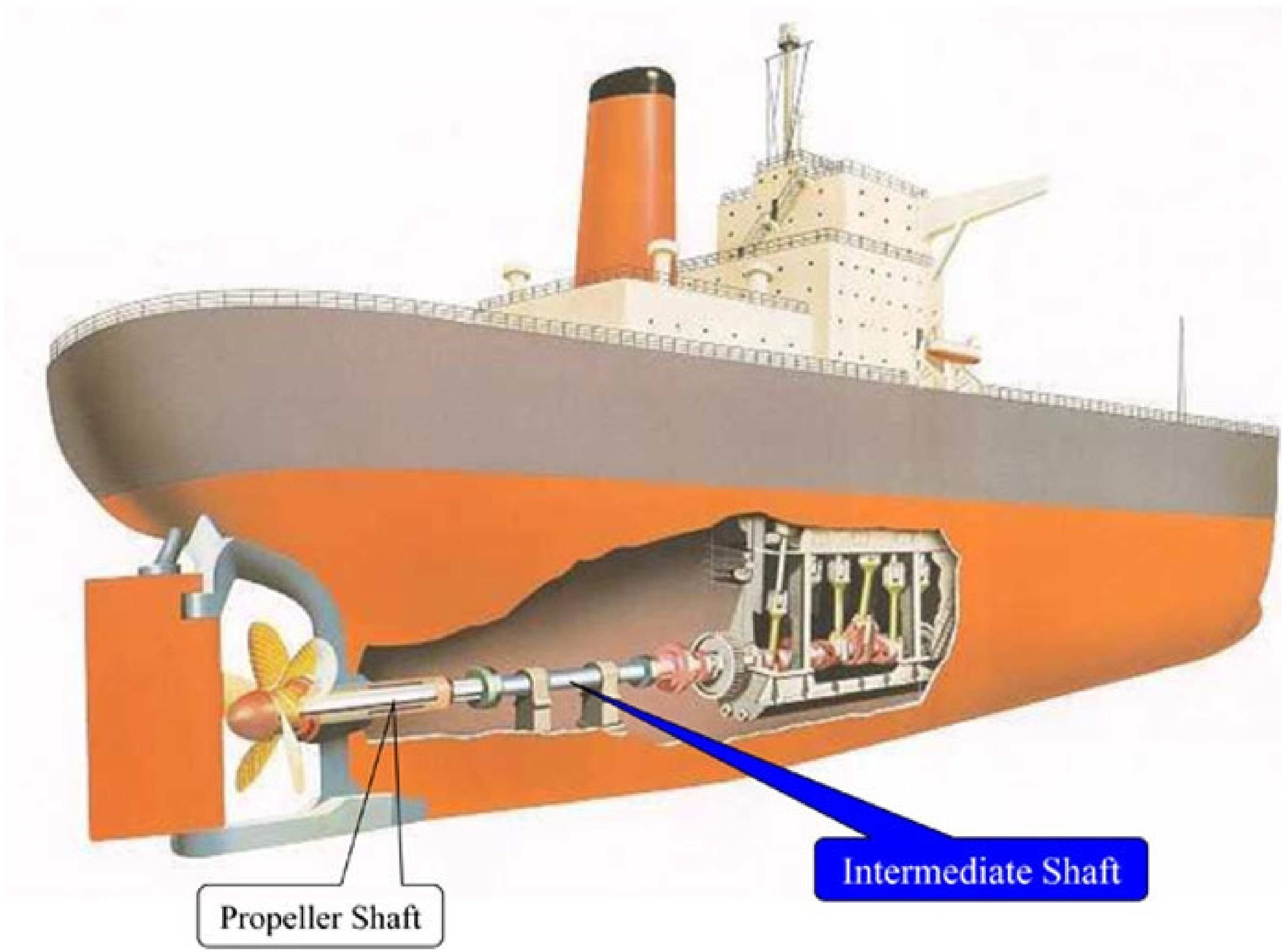
$$\omega = 2\pi n / 60$$

$$P = T\omega$$

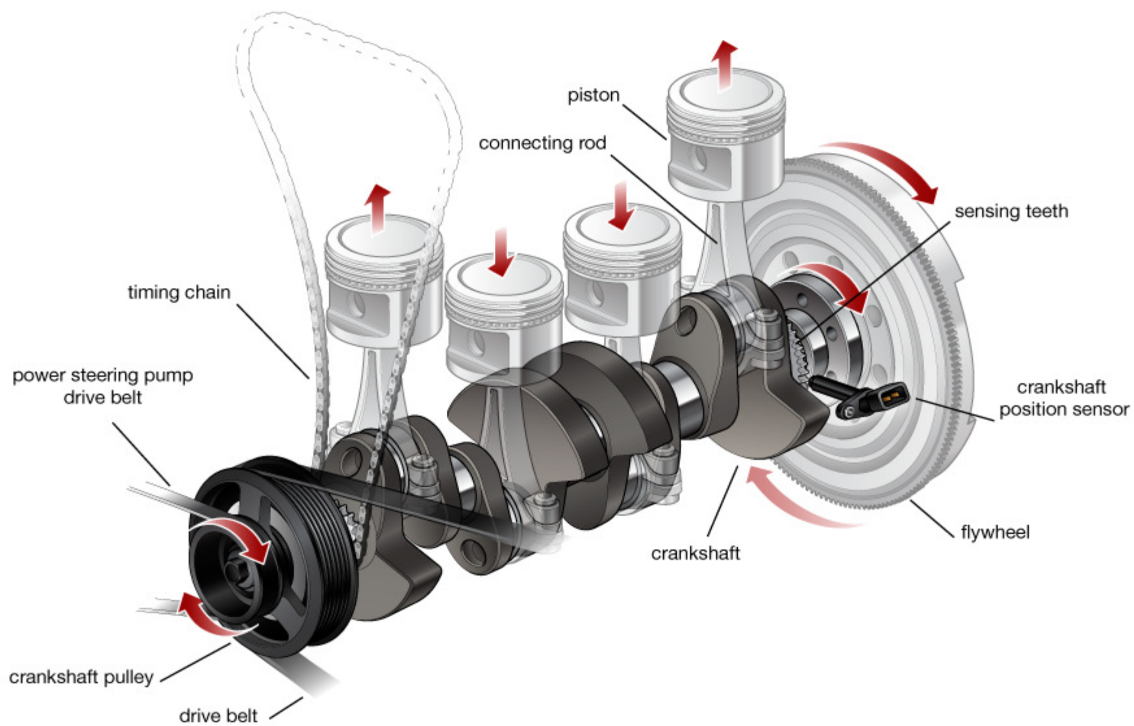


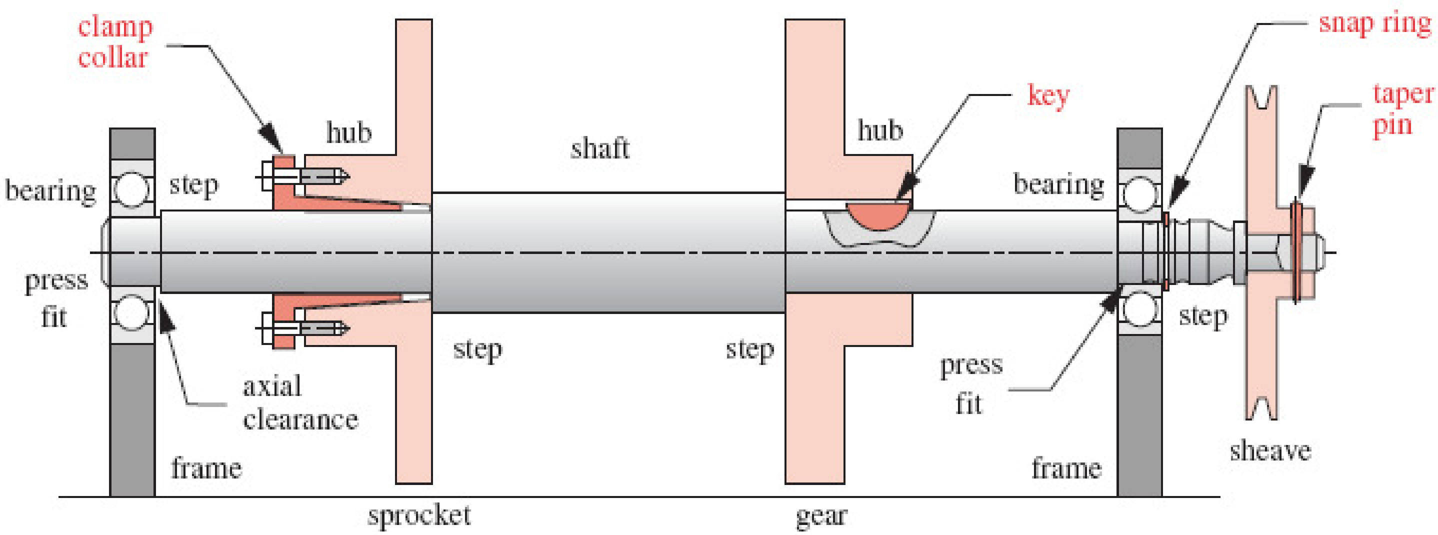

TRANSFER CASE TO PILLOW BLOCK PROPELLER SHAFT
REAR REAR AXLE
FRONT AXLE
FRONT REAR AXLE
DIFFERENTIAL AND CARRIER
POWER-TAKE-OFF
INTERMEDIATE PROPELLER SHAFT
TRANSFER CASE
TRANSMISSION
FRONT AXLE PROPELLER SHAFT
DIFFERENTIAL AND CARRIER
REAR REAR AXLE PROPELLER SHAFT
DIFFERENTIAL AND CARRIER
FRONT REAR AXLE PROPELLER SHAFT
RA PD 53427


AXLE HOUSING
DIFFERENTIAL SIDE GEAR
SPIDER GEAR
DIFFERENTIAL GEAR
DIFFERENTIAL CASE HALF
AXLE SHAFT
DIFFERENTIAL BEARING
BEVEL PINION AND BEVEL DRIVE GEARS
RA PD 203447A


Intermediate Shaft
Propeller Shaft

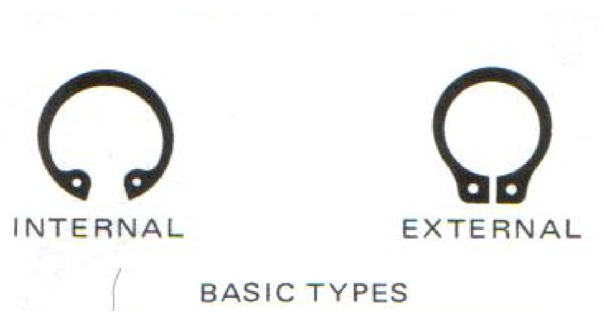
Crank Shaft


piston
connecting rod
sensing teeth
timing chain
power steering pump drive belt
crankshaft position sensor
flywheel
crankshaft
crankshaft pulley
drive belt



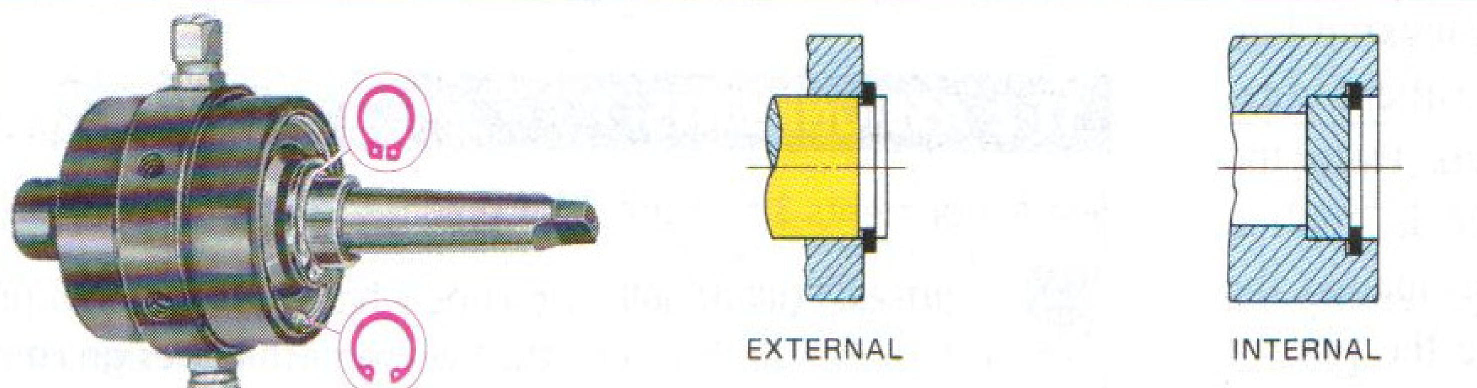
clamp collar
hub
shaft
hub
key
snap ring
taper pin
bearing
step
bearing
press fit
step
step
step
press fit
axial clearance
frame
frame
sheave
sprocket
gear

Emniyet Segmanları
(Retainning Rings)

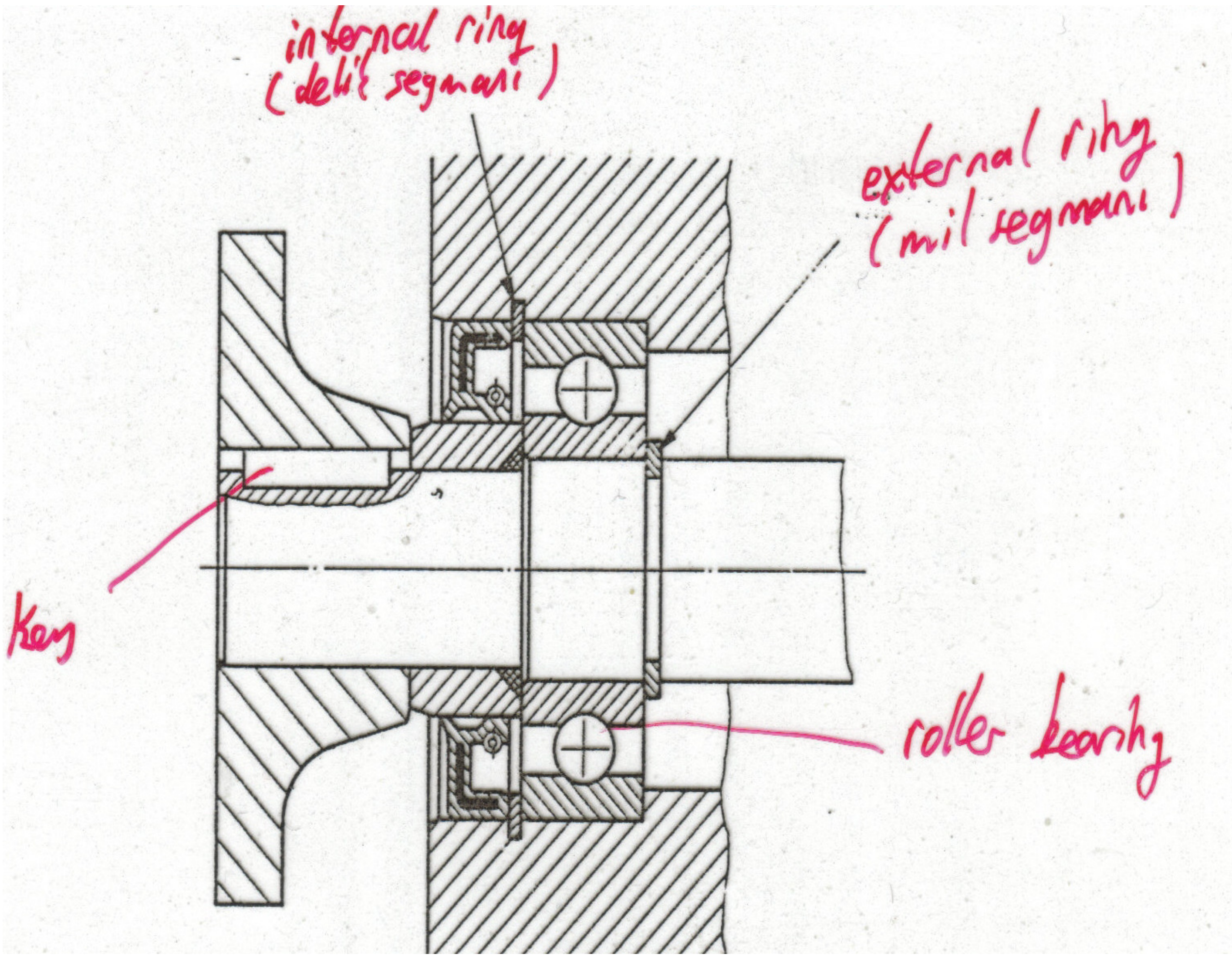


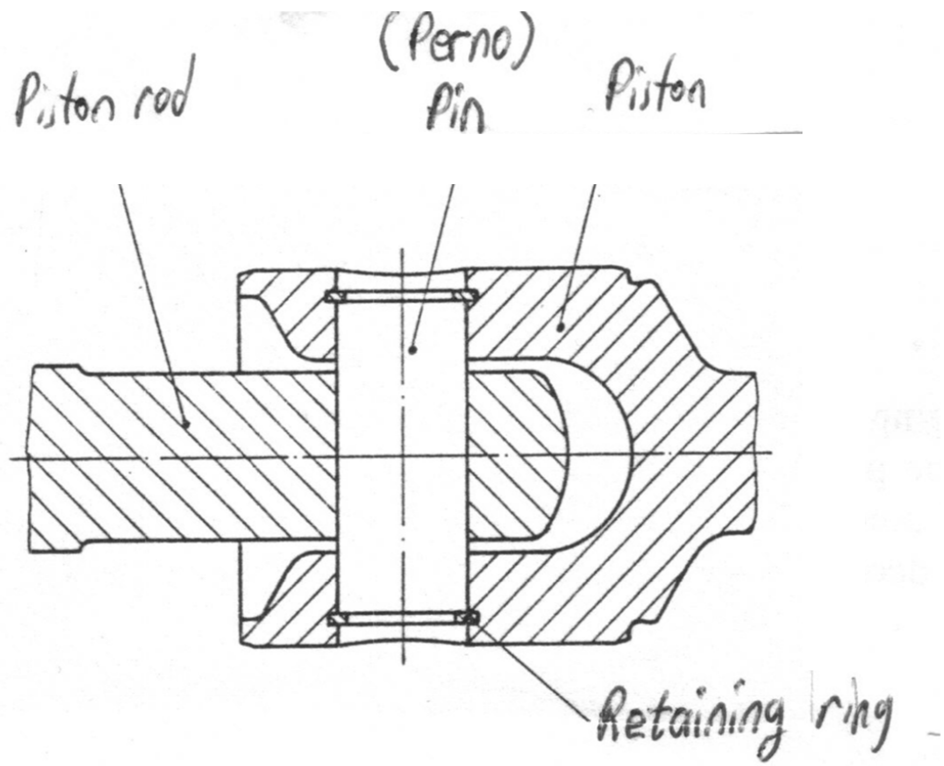
Retaining rings, or **snap rings**, are used to provide a removable shoulder to accurately locate, retain, or lock components on shafts and in bores of housings

They are easily installed and removed, and since they are usually made of spring steel, retaining rings have a high shear strength and impact capacity.



(A) AXIAL AND RADIAL ASSEMBLY (B) AXIAL ASSEMBLY


internal ring
(delik segmanı)
external ring
(mil segmanı)
key
roller bearing



Circlip Pliers

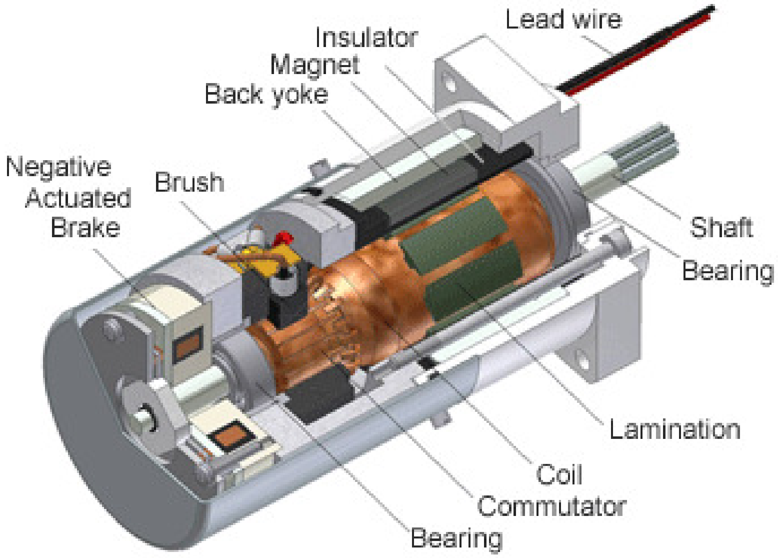
Bearings

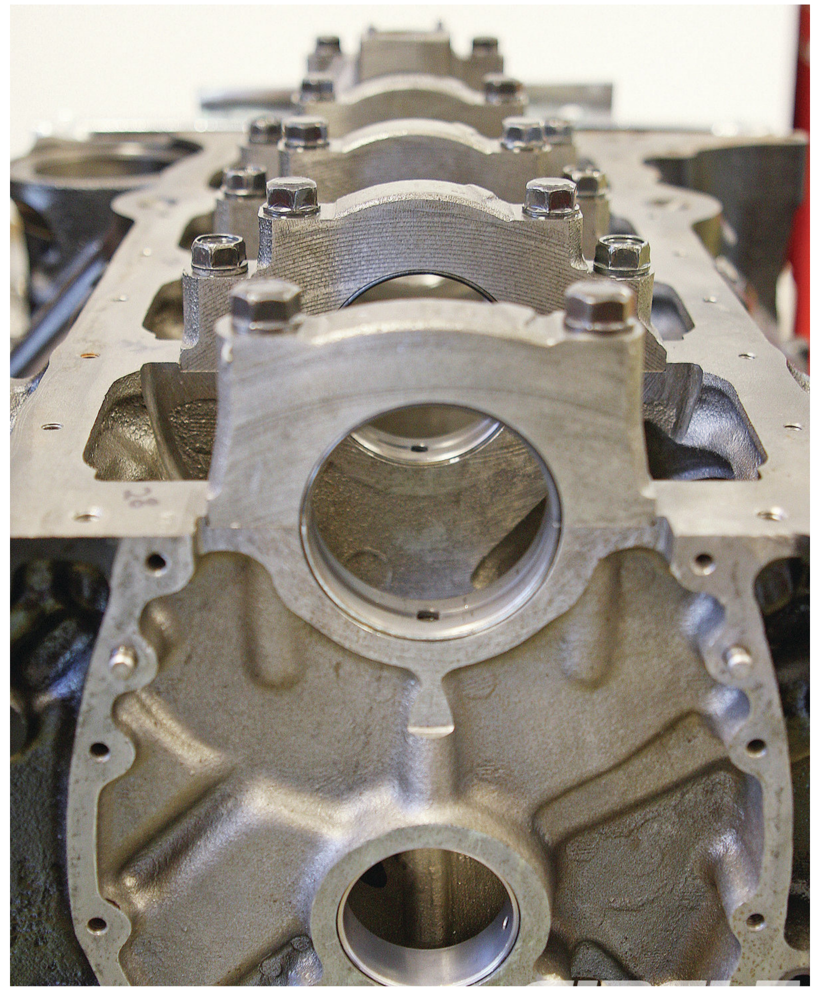
(YATAKLAR, KIZAKLAR)

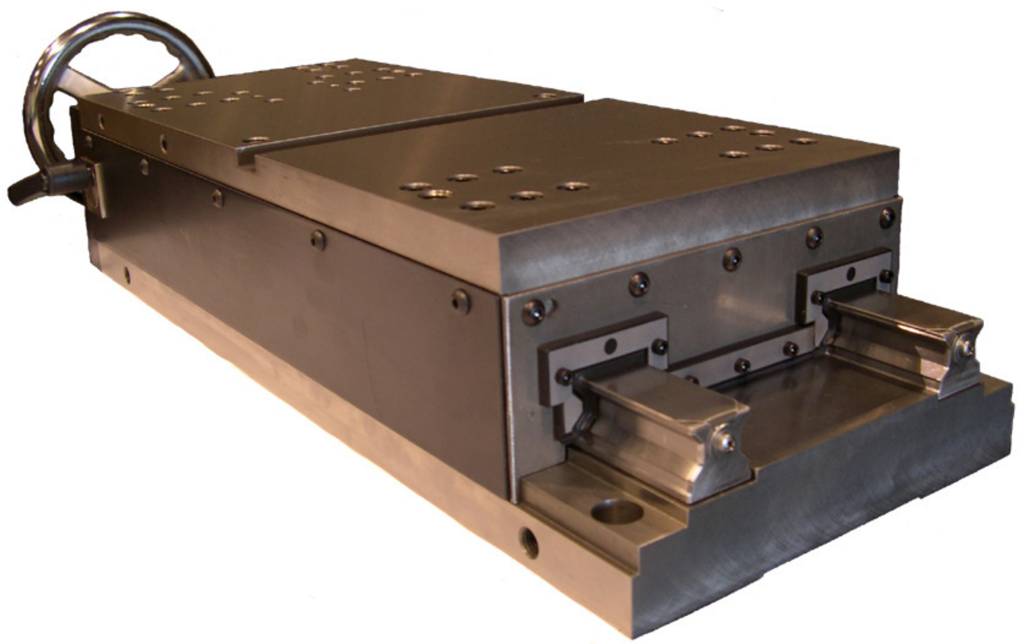
BEARINGS

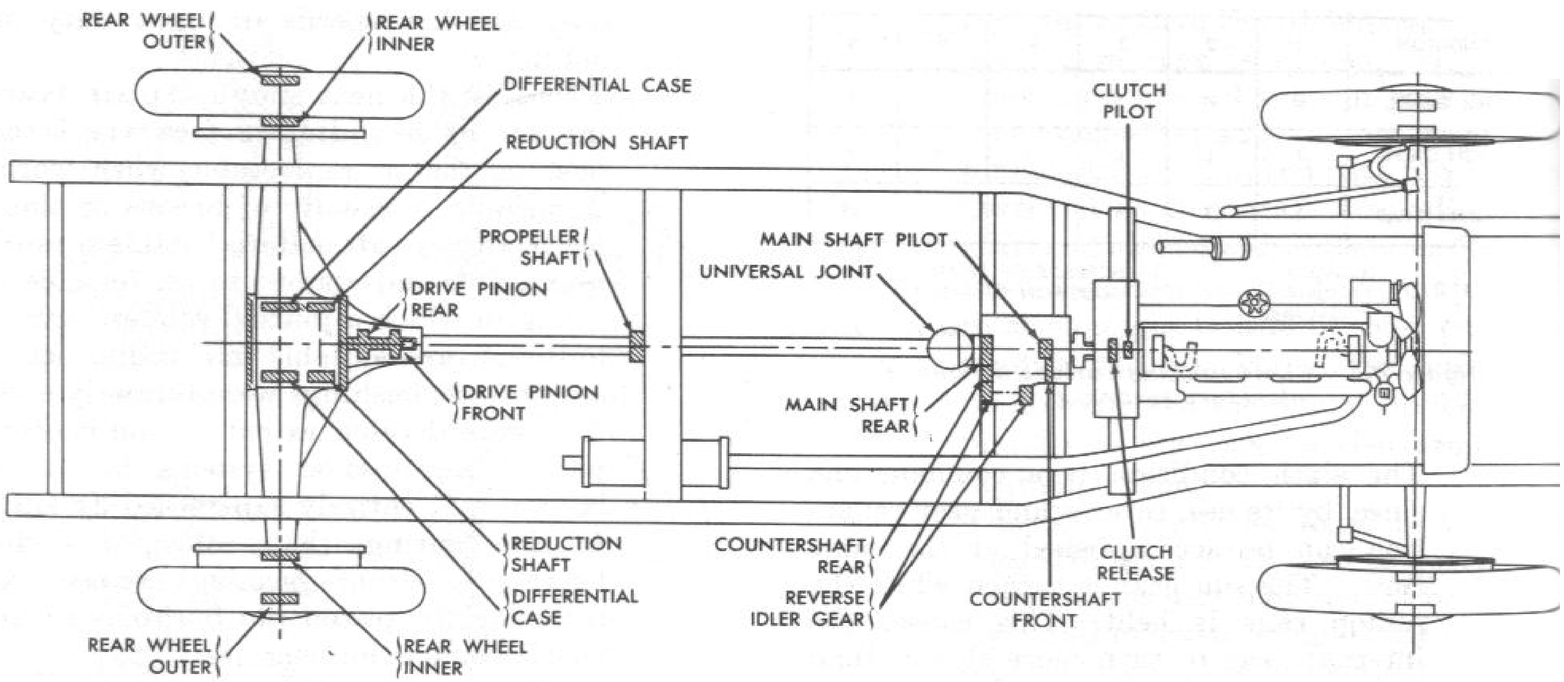
Bearings permit smooth, low-friction movement between two surfaces. The movement can be either rotary (a shaft rotating within a mount) or linear (one surface moving along another).

Bearings can employ either a sliding or a rolling action. Bearings based on rolling action are called **rolling-element bearings**. Those based on sliding action are called **plain bearings**.


Lead wire
Insulator
Magnet
Back yoke
Negative
Actuated
Brake
Brush
Shaft
Bearing
Lamination
Coil
Commutator
Bearing

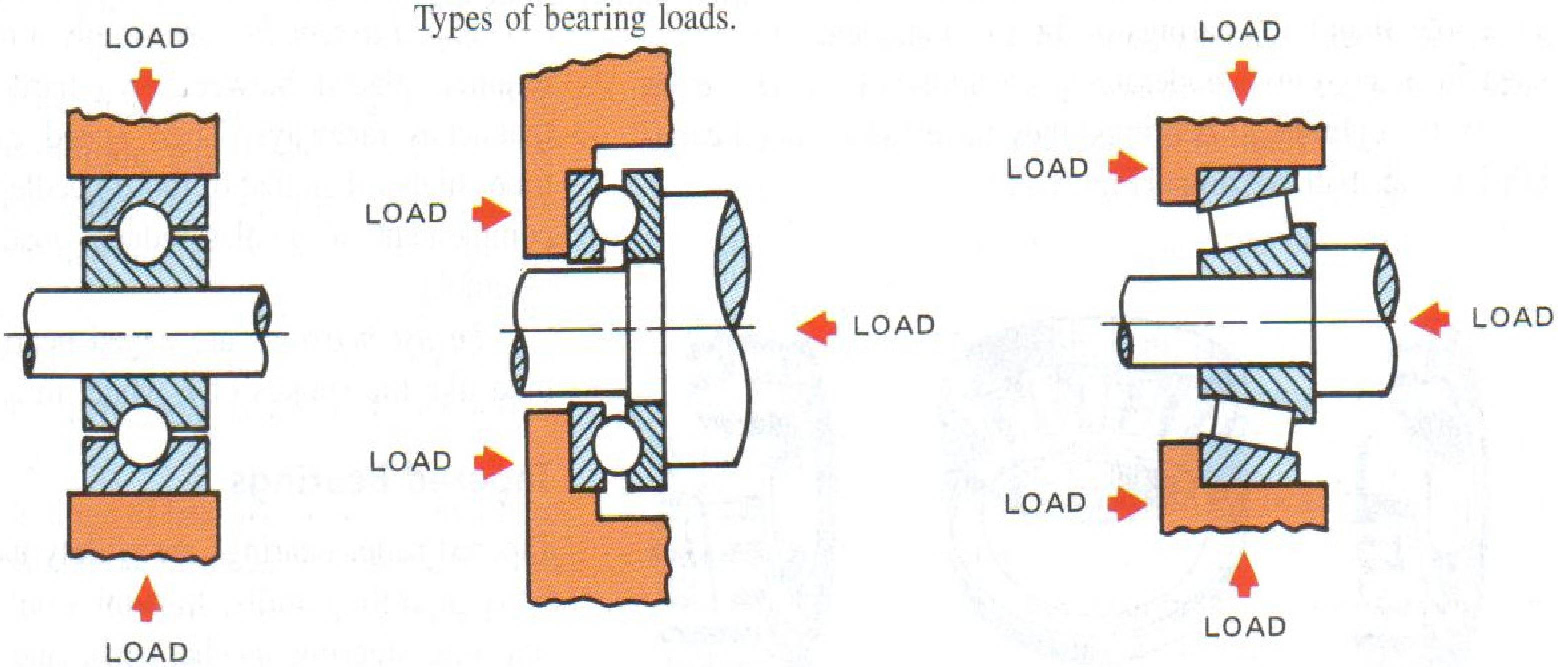






Locations of antifriction bearings in a truck power train.

Types of bearing loads.



(A) RADIAL (B) THRUST (C) COMBINATION RADIAL AND THRUST

Plain Bearings   or Sleeve Bearings or Bushings

A plain bearing is any bearing that works by sliding action, with or without lubricant. This group encompasses essentially all types other than rolling-element bearings.

Plain bearings are often referred to as *sleeve bearings* or *thrust bearings,* terms that designate whether the bearing is loaded axially or radially.

Lubrication is critical to the operation of plain bearings, so their application and function are also often referred to according to the type of lubrication principle used. Thus, terms such as *hydrodynamic, fluid-film, hydrostatic, boundary-lubricated,* and *self-lubricated* are designations for particular types of plain bearings.

Although some materials have an inherent lubricity or can be lubricated by virtue of a film of slippery solid, most bearings operate with a fluid film—usually oil but sometimes a gas.

By far the largest number of bearings are oil-lubricated. The oil film can be maintained through pumping by a pressurization system, in which case the lubrication is termed **hydrostatic**. Or it can be maintained by a squeezing or wedging of lubricant produced by the rolling action of the bearing itself; this is termed **hydrodynamic** lubrication.

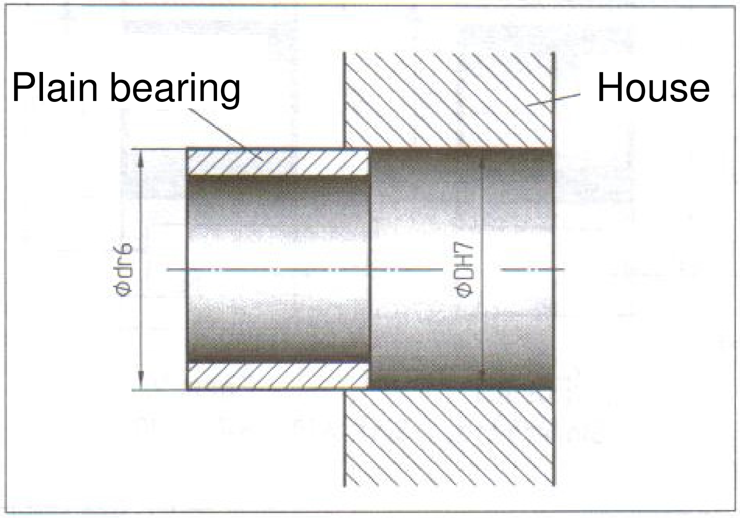
Bearing Types

Journal or Sleeve Bearings There are cylindrical or ring-shaped bearings designed to carry radial loads
The terms *sleeve* and *journal* are used more or less synonymously since sleeve refers to the general configuration and journal pertains to any portion of a shaft supported by a bearing. In another sense, however, the term *journal* may be reserved for two-piece bearings used to support the journals of an engine crankshaft.

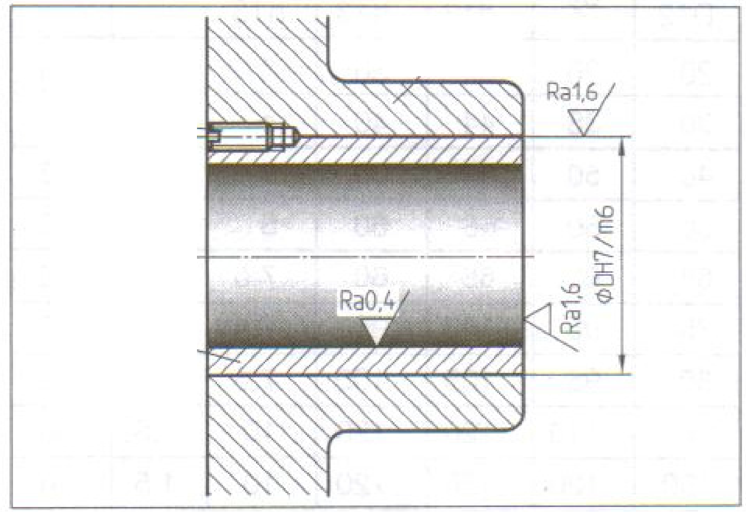
The simplest and most widely used types of sleeve bearings are cast-bronze and porous-bronze (powdered-metal) cylindrical bearings. Cast-bronze bearings are oil- or grease-lubricated. Porous bearings are impregnated with oil and often have an oil reservoir in the housing.

Plastic bearings are being used increasingly in place of metal. Originally, plastic was used only in small, lightly loaded bearings where cost savings was the primary objective. More recently, plastics are being used because of functional advantages, including resistance to abrasion, and because they are available in large sizes.

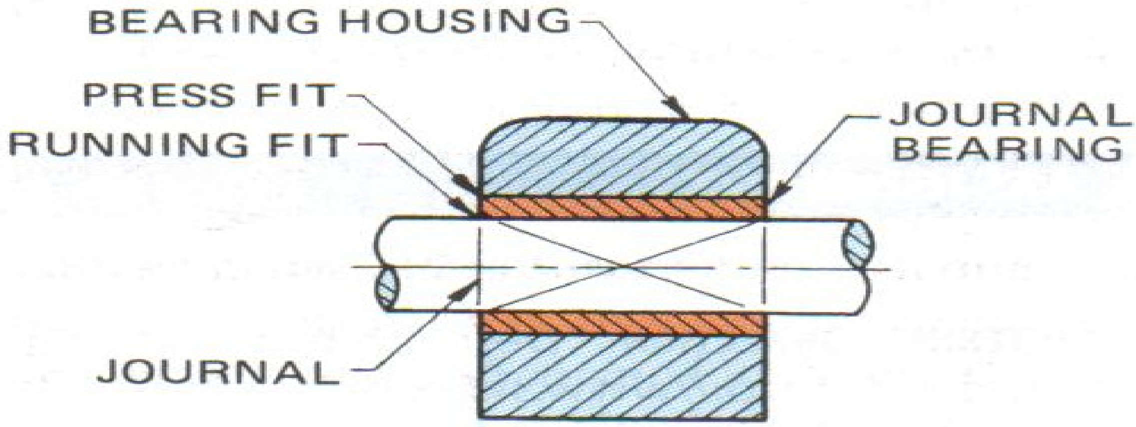
Thrust Bearings This type of bearing differs from a sleeve bearing in that loads are supported axially rather than radially



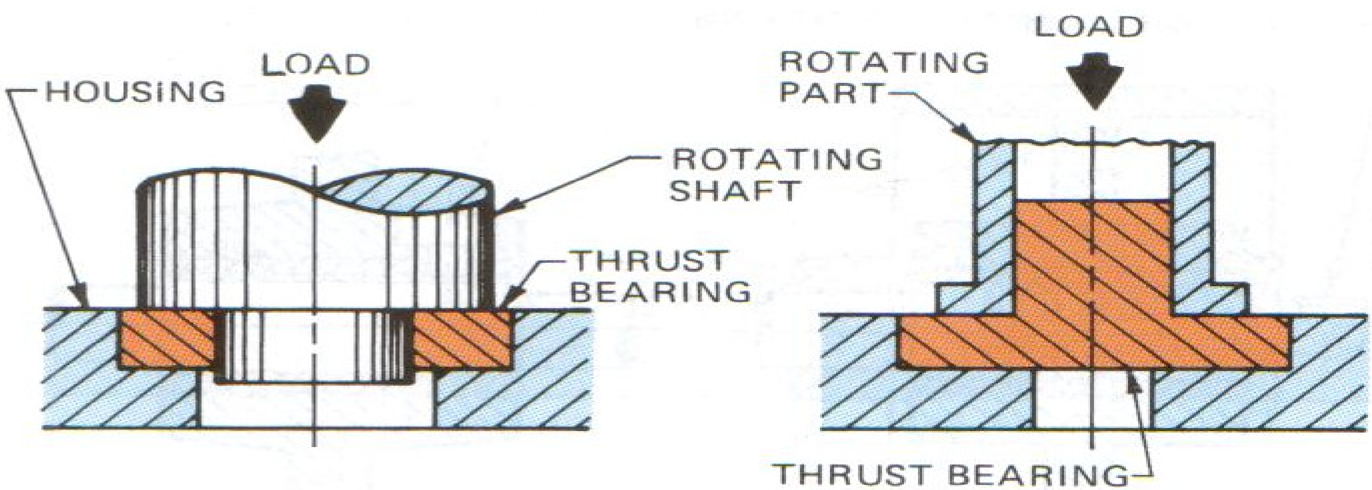
Plain bearing
House
Φdr6
ΦDH7



Ra1,6
Ra0,4
Ra1,6
ΦDH7/m6



Journal or sleeve bearing.

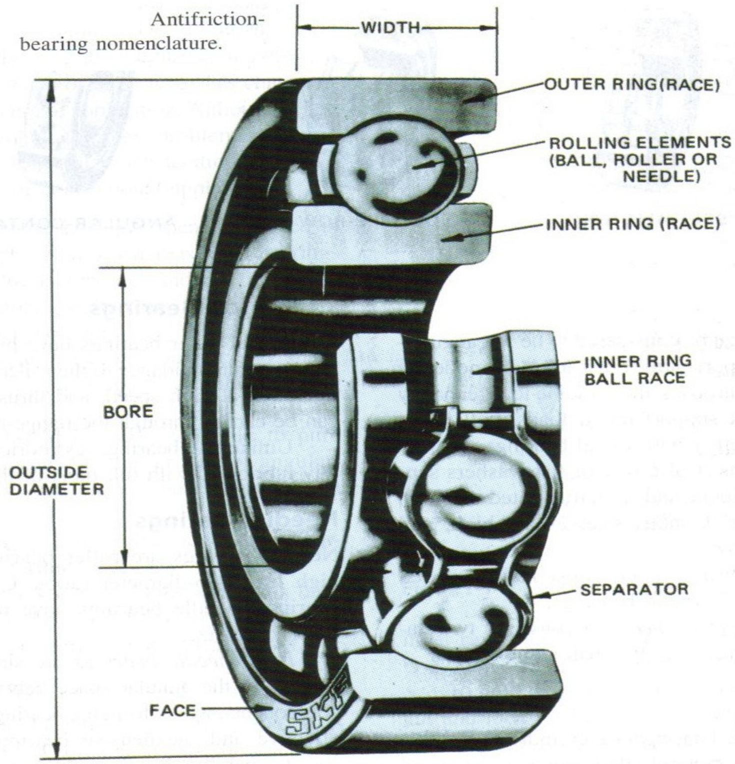


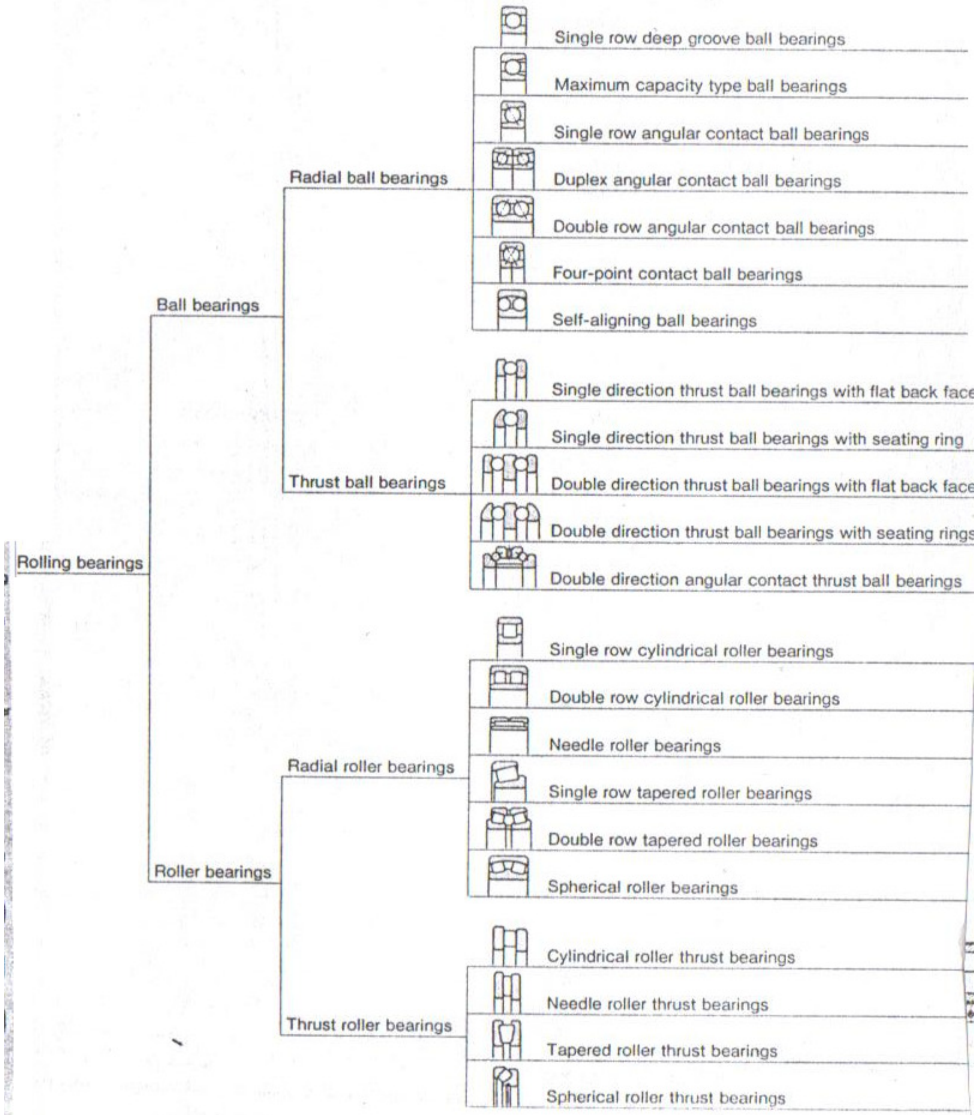
Thrust bearings.

ANTIFRICTION BEARINGS

Ball, roller, and needle bearings are classified as **antifriction bearings** since friction has been reduced to a minimum. They may be divided into two main groups: radial bearings and thrust bearings. Except for special designs, ball and roller bearings consist of two rings, a set of rolling elements, and a cage. The cage separates the rolling elements and spaces them evenly around the periphery (circumference of the circle).

Antifriction-bearing nomenclature.

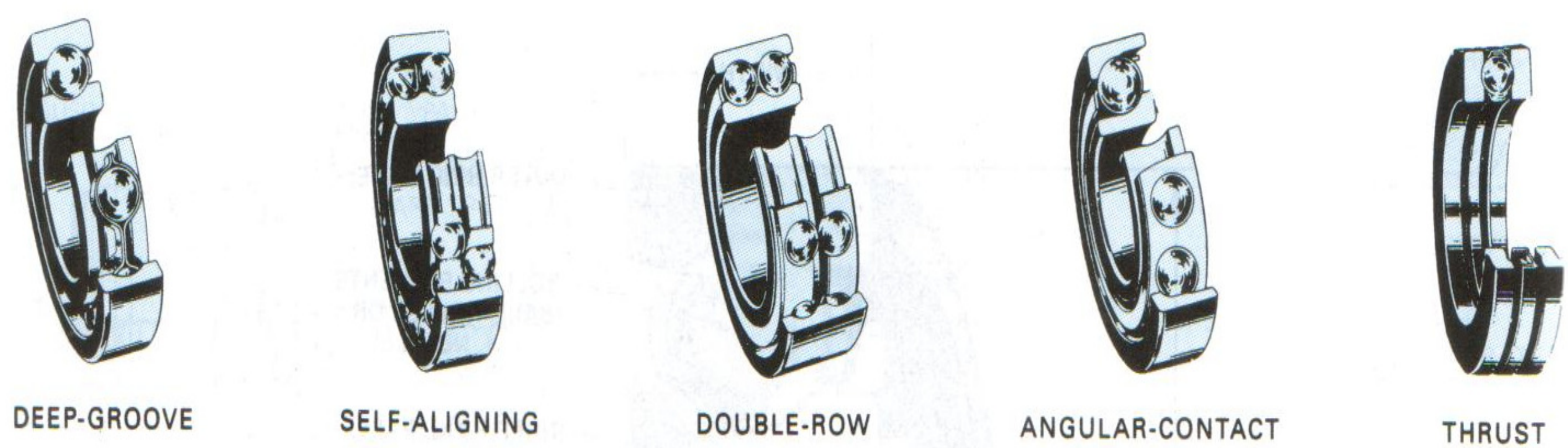




Classification of Rolling Bearings

Ball Bearings

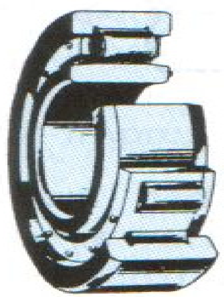
Ball bearings fall roughly into three classes: radial, thrust, and angular-contact. *Angular-contact bearings* are used for combined radial and thrust loads and where precise shaft location is needed. Uses of the other two types are described by their names: *radial bearings* for radial loads and *thrust bearings* for thrust loads



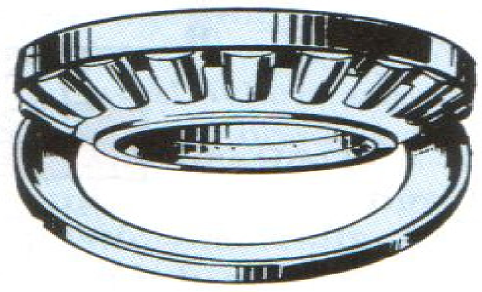
Ball bearings.

Roller Bearings

The principal types of roller bearings are cylindrical, needle, tapered, and spherical. In general, they have higher load capacities than ball bearings of the same size and are widely used in heavy-duty, moderate-speed applications. However, except for cylindrical bearings, they have lower speed capabilities than ball bearings

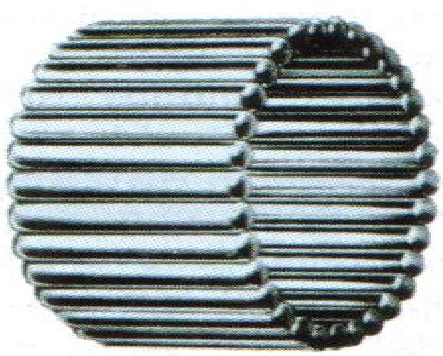


(A) CYLINDRICAL



(B) TAPERED

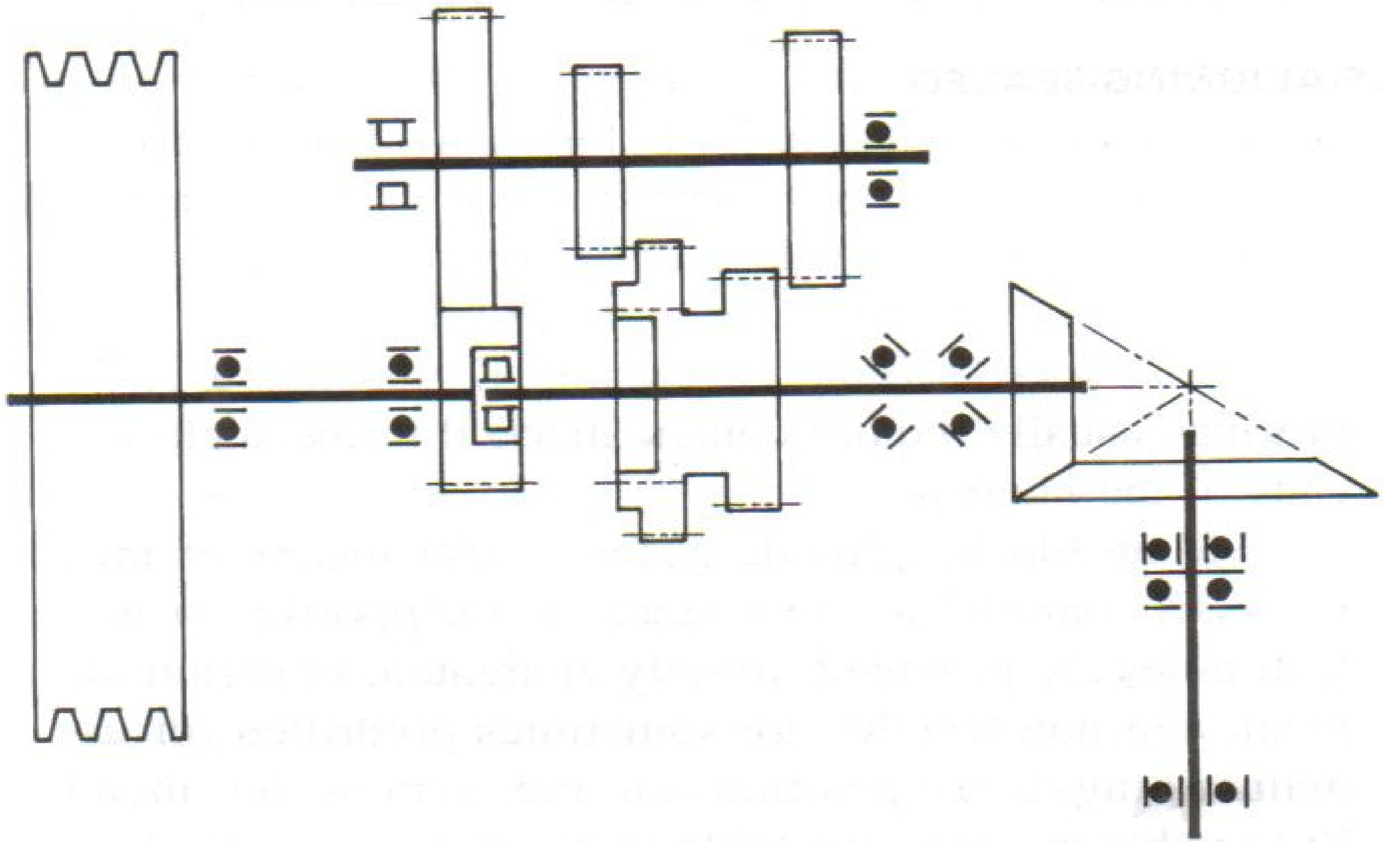
(C) SPHERICAL



LOOSE

CAGED

(D) NEEDLE



Schematic representation of bearings.

Bearing Selection

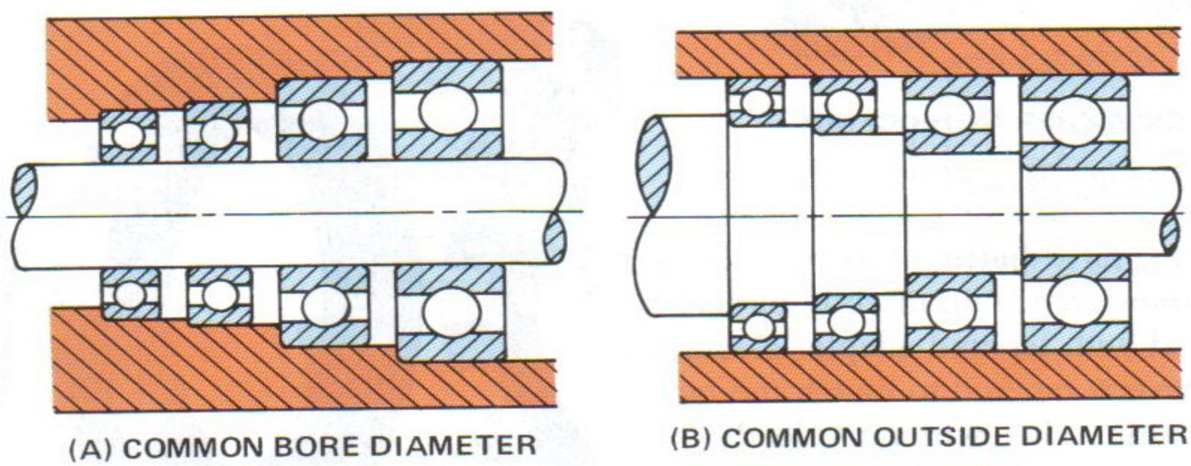
Machine designers have a large variety of bearing types and sizes from which to choose. Each of these types has characteristics that make it best for a certain application. Although selection may sometimes present a complex problem requiring considerable experience, the following considerations are listed to serve as a general guide for conventional applications.

1. Ball bearings are normally the less expensive choice in the smaller sizes and lighter loads, whereas roller bearings are less expensive for the larger sizes and heavier loads.
2. Roller bearings are more satisfactory under shock or impact loading than ball bearings.
3. If there is misalignment between housing and shaft, either a self-aligning ball or a spherical roller bearing should be used.
4. Ball thrust bearings should be subjected only to pure thrust loads. At high speeds, a deep-groove or angular-contact ball bearing will usually be a better choice even for pure thrust loads.
5. Self-aligning ball bearings and cylindrical roller bearings have very low friction coefficients.
6. Deep-groove ball bearings are available with seals built into the bearings so that the bearing can be prelubricated and thus operate for long periods without attention.

Shaft and Housing Fits

If a ball or roller bearing is to function satisfactorily, both the fit between the inner ring and the shaft and the fit between the outer ring and the housing must be suitable for the application. The desired fits can be obtained by selecting the proper tolerances for the shaft diameter and the housing bore.

Bearings may be mounted directly on the shaft or on tapered adapter sleeves. When the bearing is mounted directly on the shaft, the inner ring should be located against a shaft shoulder of proper height. This shoulder must be machined square with the bearing seat, and a shaft fillet should be used.



Standard bearing sizes.

Dişli Çarklar
(Gears)

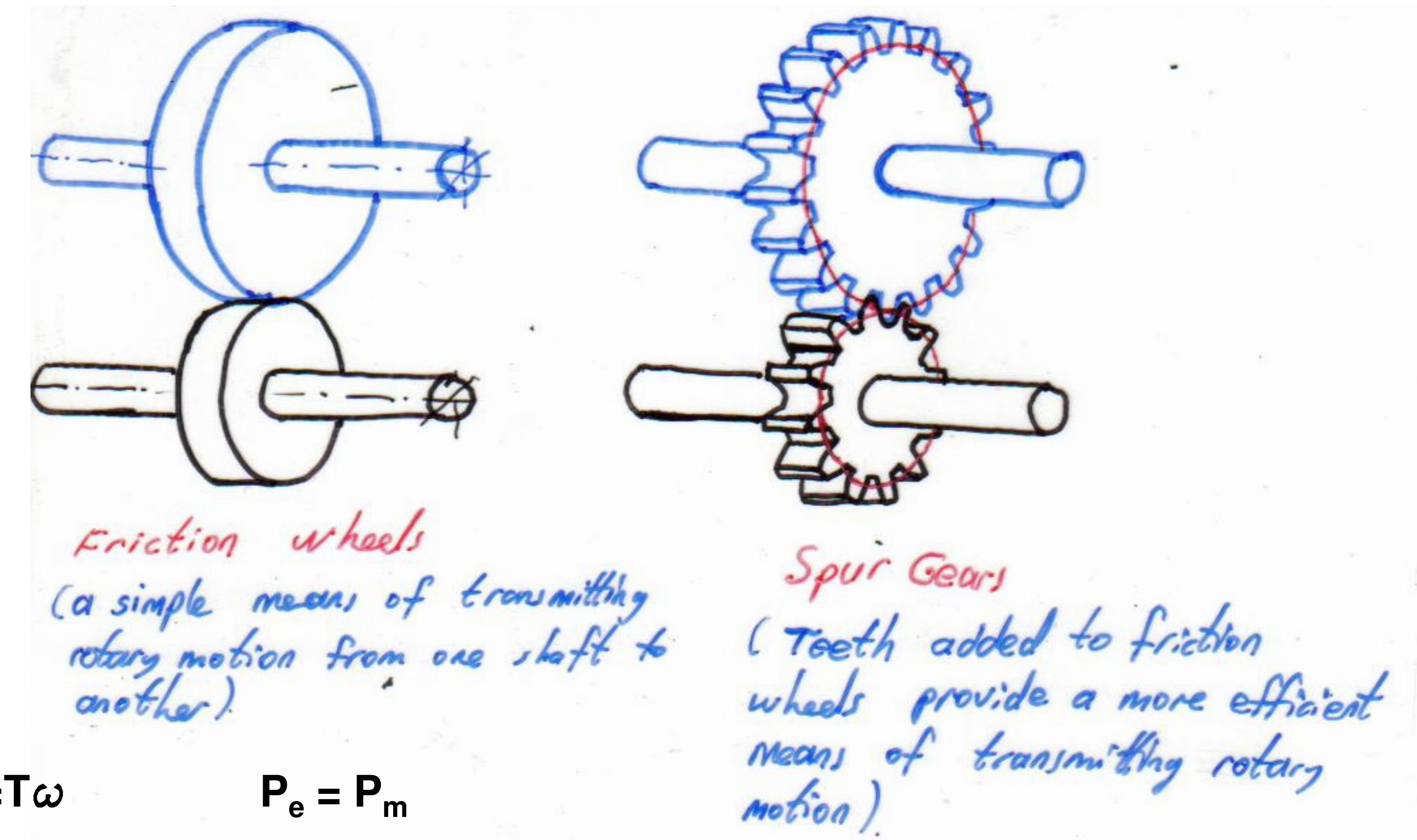
GEAR DRIVES

The function of a gear is to transmit motion, rotating or reciprocating, from one machine part to another and where necessary to reduce or increase the revolutions of a shaft. *Gears* are rolling cylinders or cones having teeth on their contact surfaces to ensure positive motion

There are many kinds of gears, and they may be grouped according to the position of the shafts that they connect. **Spur gears** connect parallel shafts, **bevel gears** connect shafts whose axes intersect, and **worm gears** connect shafts whose axes do not intersect. A spur gear with a rack converts rotary motion to reciprocating or linear motion. The smaller of two gears is known as the **pinion**.

Mechanical Advantage= F_{out} / F_{in}

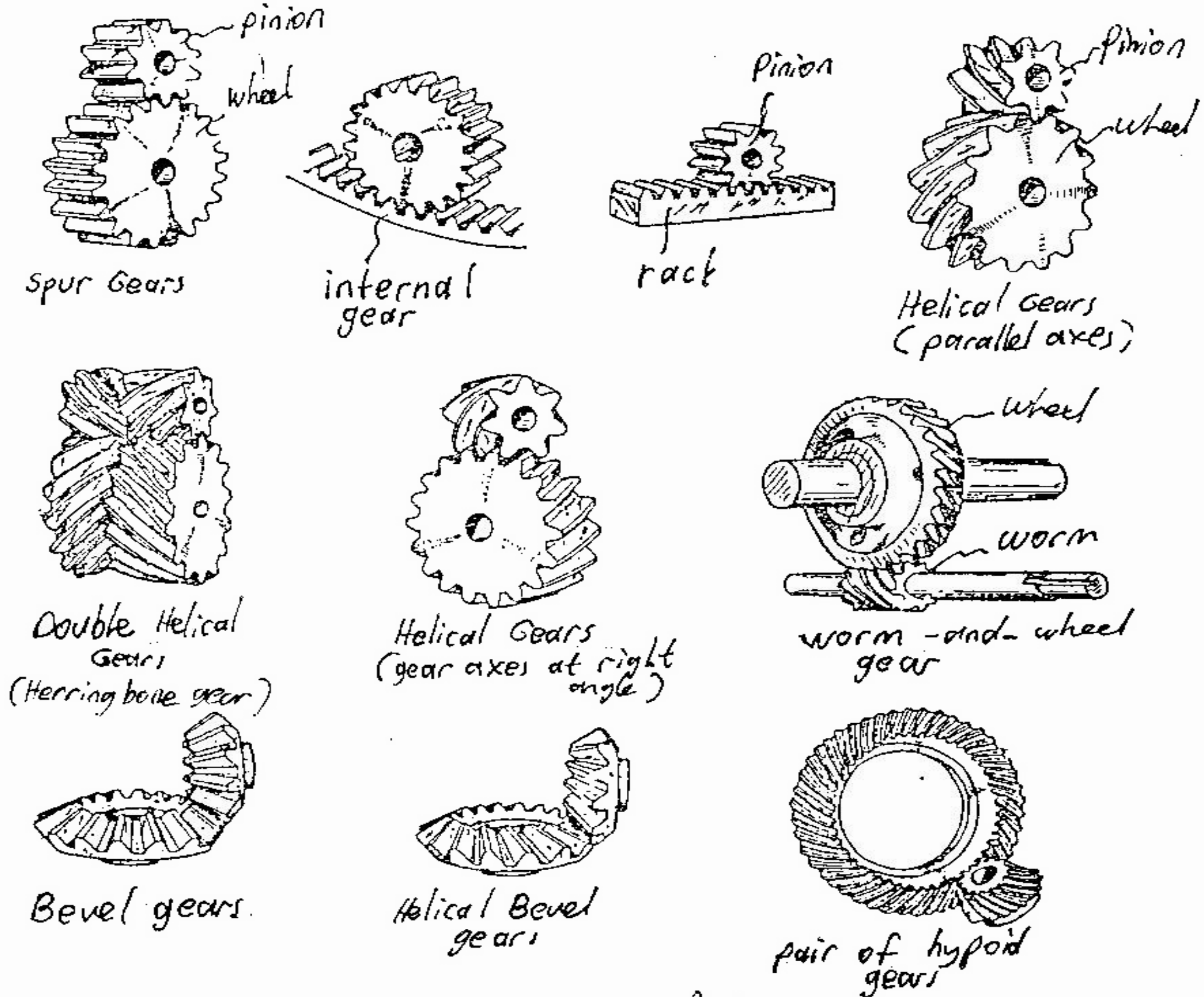
Mechanical Advantage= T_{out} / T_{in}



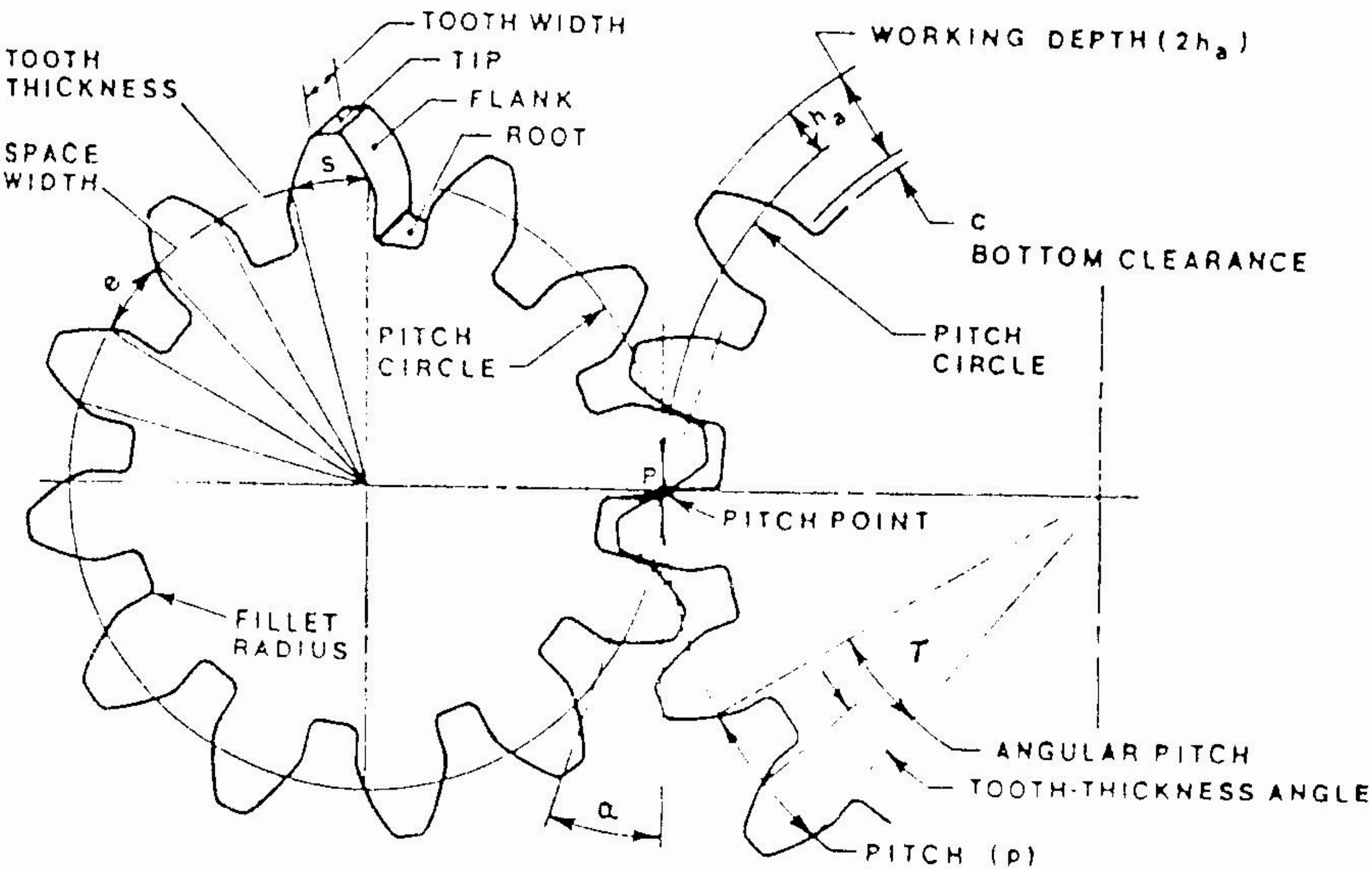
$V=r\omega \rightarrow \quad r_e\omega_e = r_m\omega_m$ **$P=T\omega$** **$P_e = P_m$**

$\omega=2\pi n / 60$

$$\frac{r_m}{r_e} = \frac{\omega_e}{\omega_m} = \frac{n_e}{n_m} = \frac{T_m}{T_e}$$

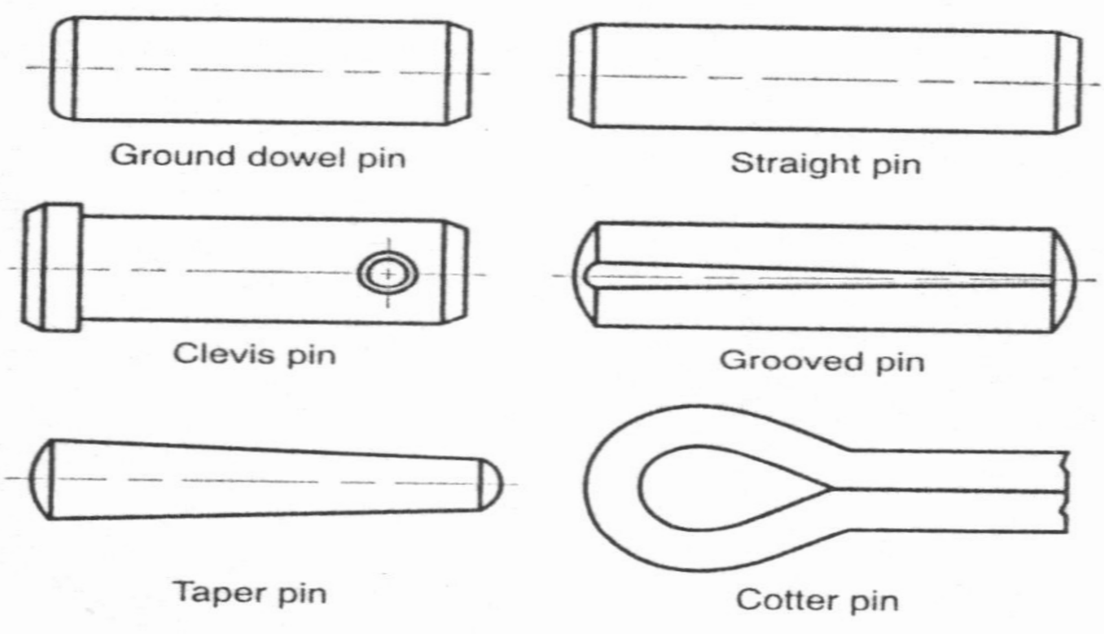


Various Types of Gears



Involute-gear definitions

PINS (Pimler Pernolar)



Pin Types

Fasteners

- Permanent
  - Rivets
  - Welds
- Removable
  - Screws
  - Bolts
  - Studs
  - Nuts
  - **Pins**
  - Keys

Semipermanent Pins

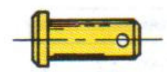
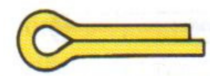
Semipermanent pin fasteners require application of pressure or the aid of tools for installation or removal. The two basic types are machine pins and radial locking pins.

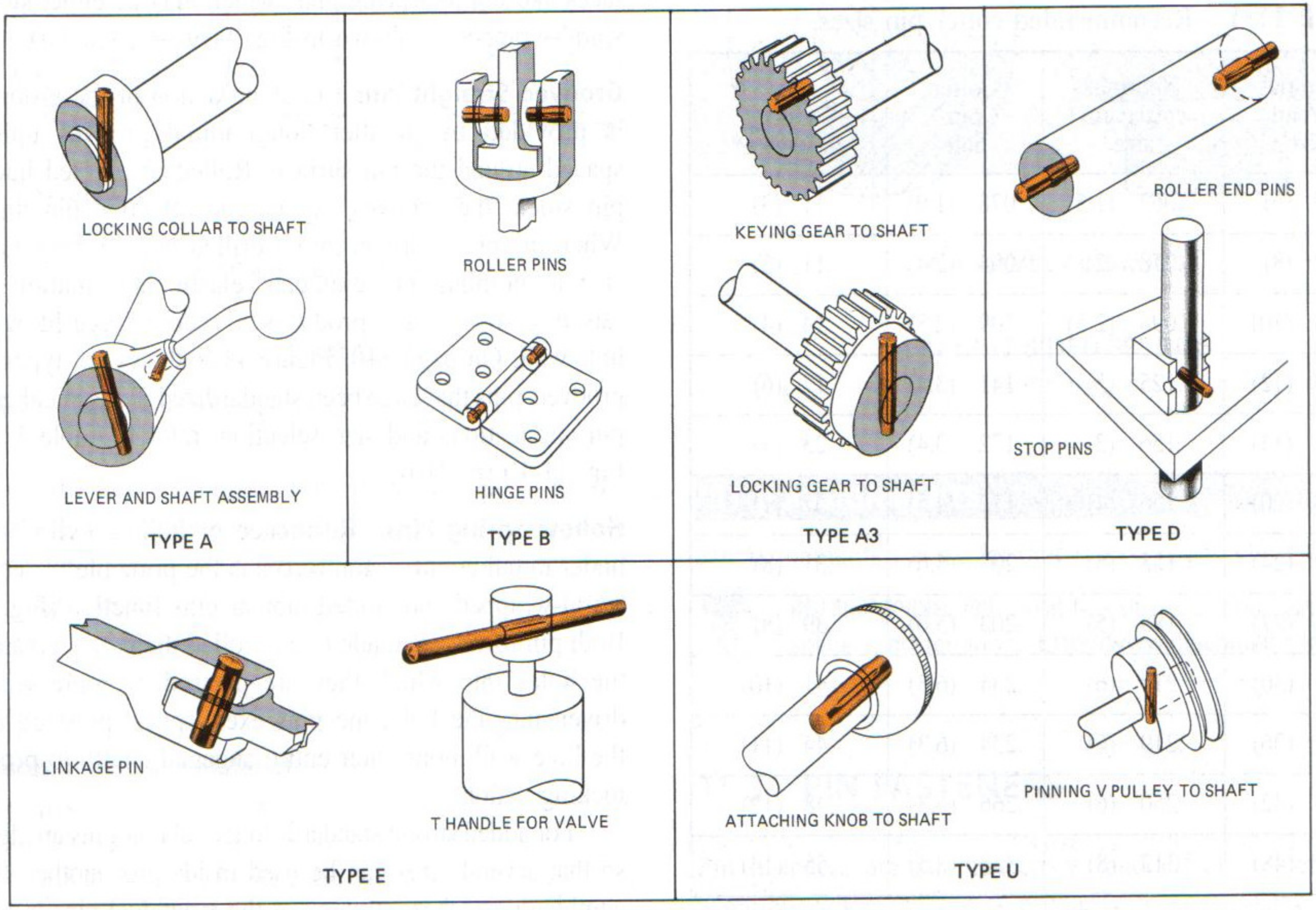
The following general design rules apply to all types of semipermanent pins:

- Avoid conditions in which the direction of vibration parallels the axis of the pin.
- Keep the shear plane of the pin a minimum distance of one diameter from the end of the pin.

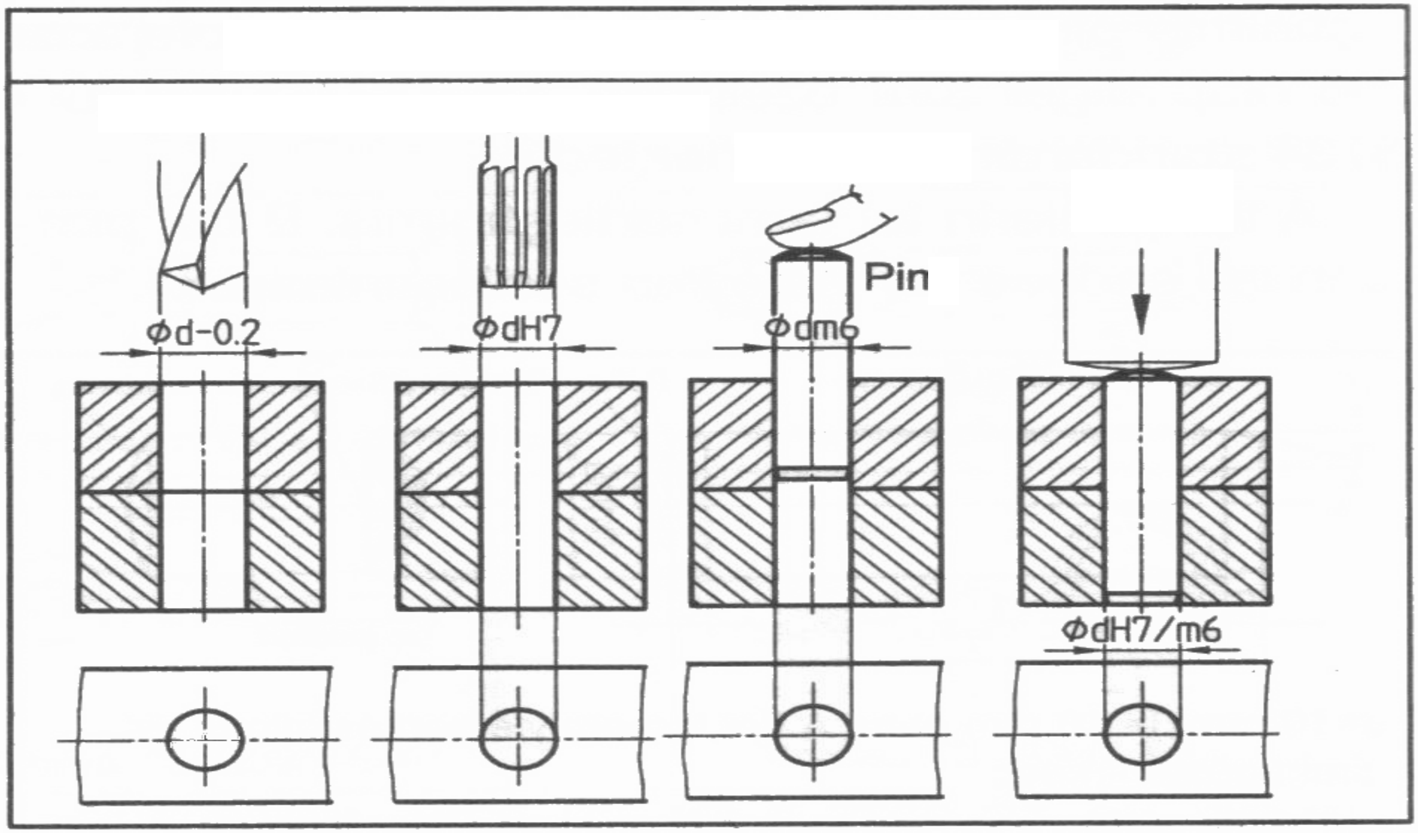
Machine Pins

Four types are generally considered to be most commonly used: hardened and ground dowel pins and commercial straight pins, taper pins, clevis pins, and standard cotter pins.

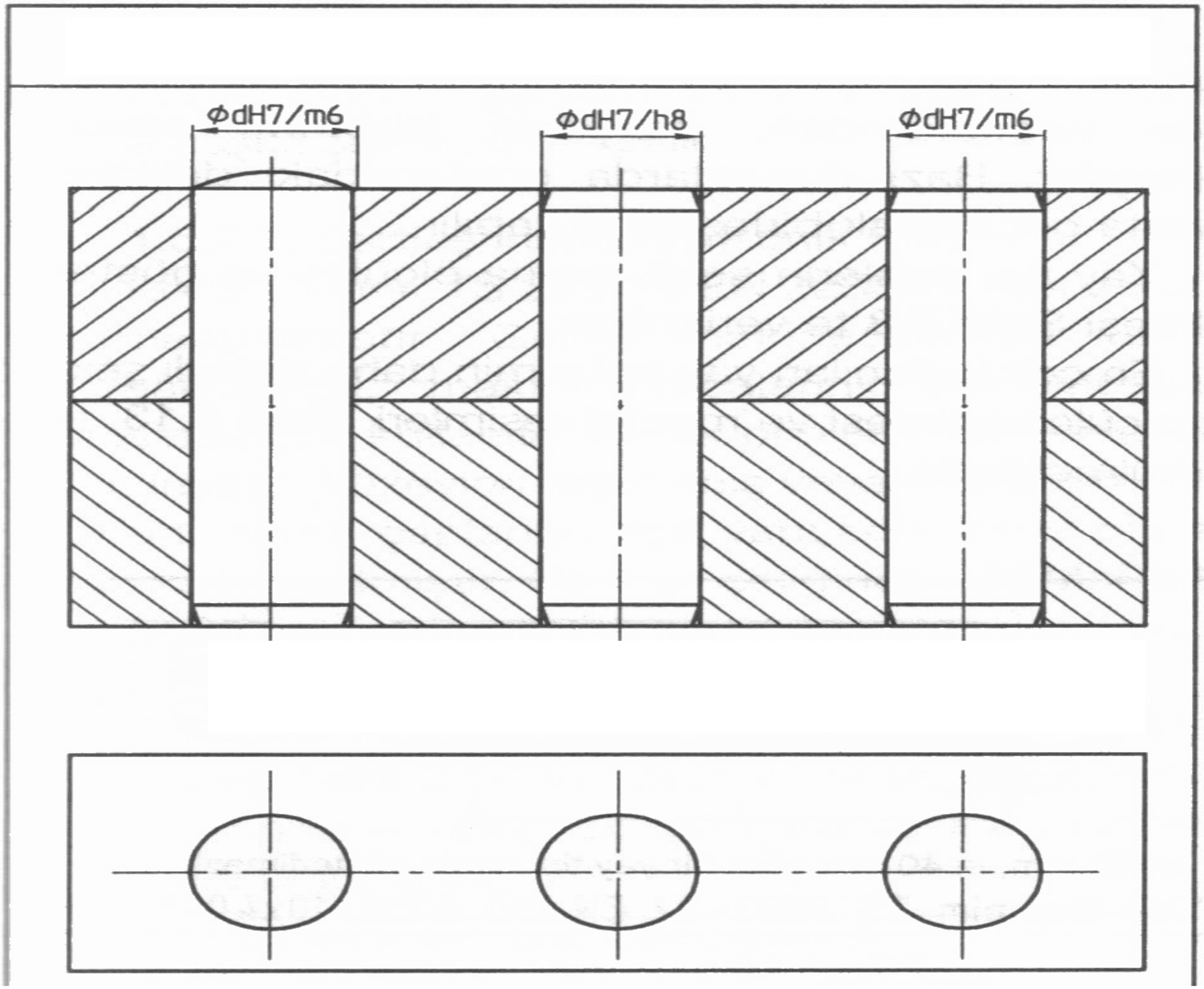
HARDENED AND GROUND DOWEL PIN	TAPER PIN	CLEVIS PIN	COTTER PIN
			
Standardized in nominal diameters ranging from .12 to .88 (3 to 22mm). 1. Holding laminated sections together with surfaces either drawn up tight or separated in some fixed relationship. 2. Fastening machine parts where accuracy of alignment is a primary consideration. 3. Locking components on shafts, in the form of transverse pin key.	Standard pins have a taper of 1:48 measured on the diameter. Basic dimension is the diameter of the large end. Used for light-duty service in the attachment of wheels, levers, and similar components to shafts. Torque capacity is determined on the basis of double shear, using the average diameter along the tapered section in the shaft for area calculations.	Standard nominal diameters for clevis pins range from .19 to 1.00 (5 to 25mm). Basic function of the clevis pin is to connect mating yoke, or fork, and eye members in knuckle-joint assemblies. Held in place by a small cotter pin or other fastening means, it provides a mobile joint construction, which can be readily disconnected for adjustment or maintenance.	Sizes have been standardized in nominal diameters ranging from .03 to .75 (1 to 20mm). Locking device for other fasteners. Used with a castle or slotted nut on bolts, screws, or studs, it provides a convenient, low-cost locknut assembly. Hold standard clevis pins in place. Can be used with or without a plain washer as an artificial shoulder to lock parts in position on shafts.



Groove pin applications.



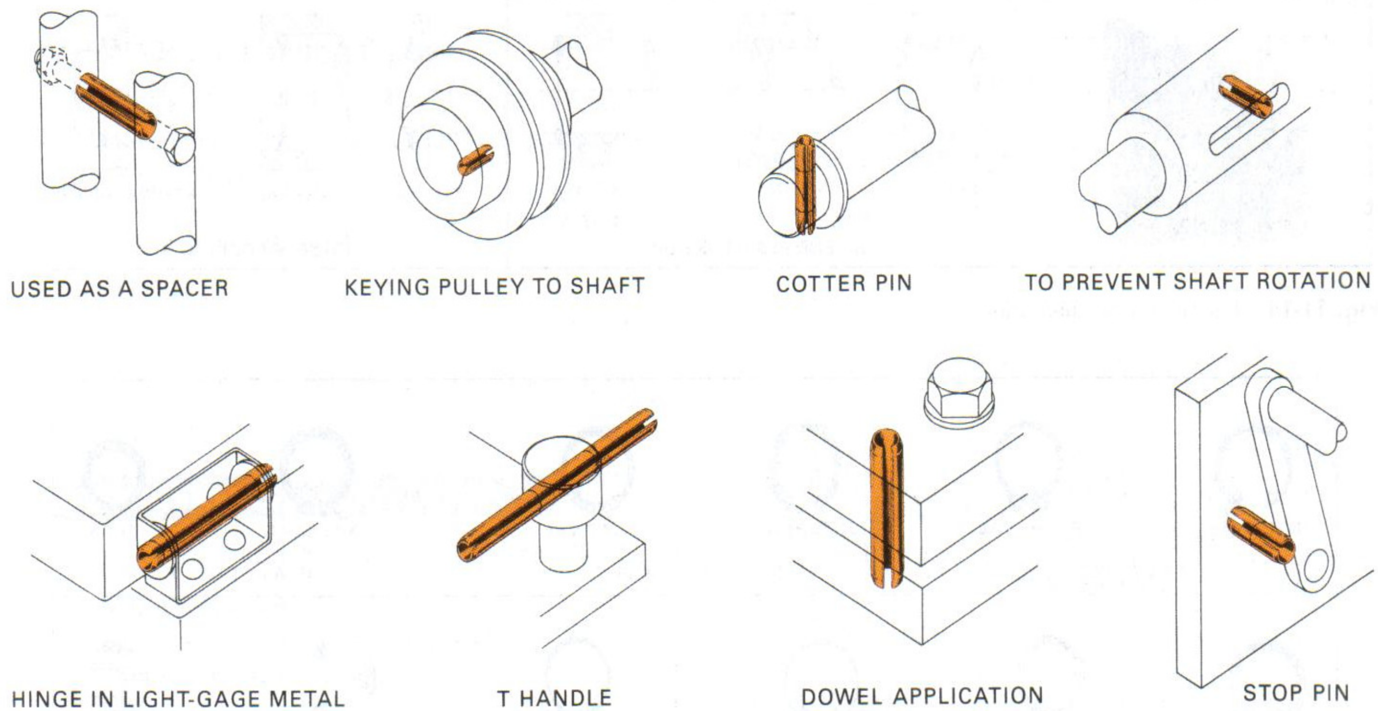
Pin
Φd-0.2
ΦdH7
Φdm6
ΦdH7/m6



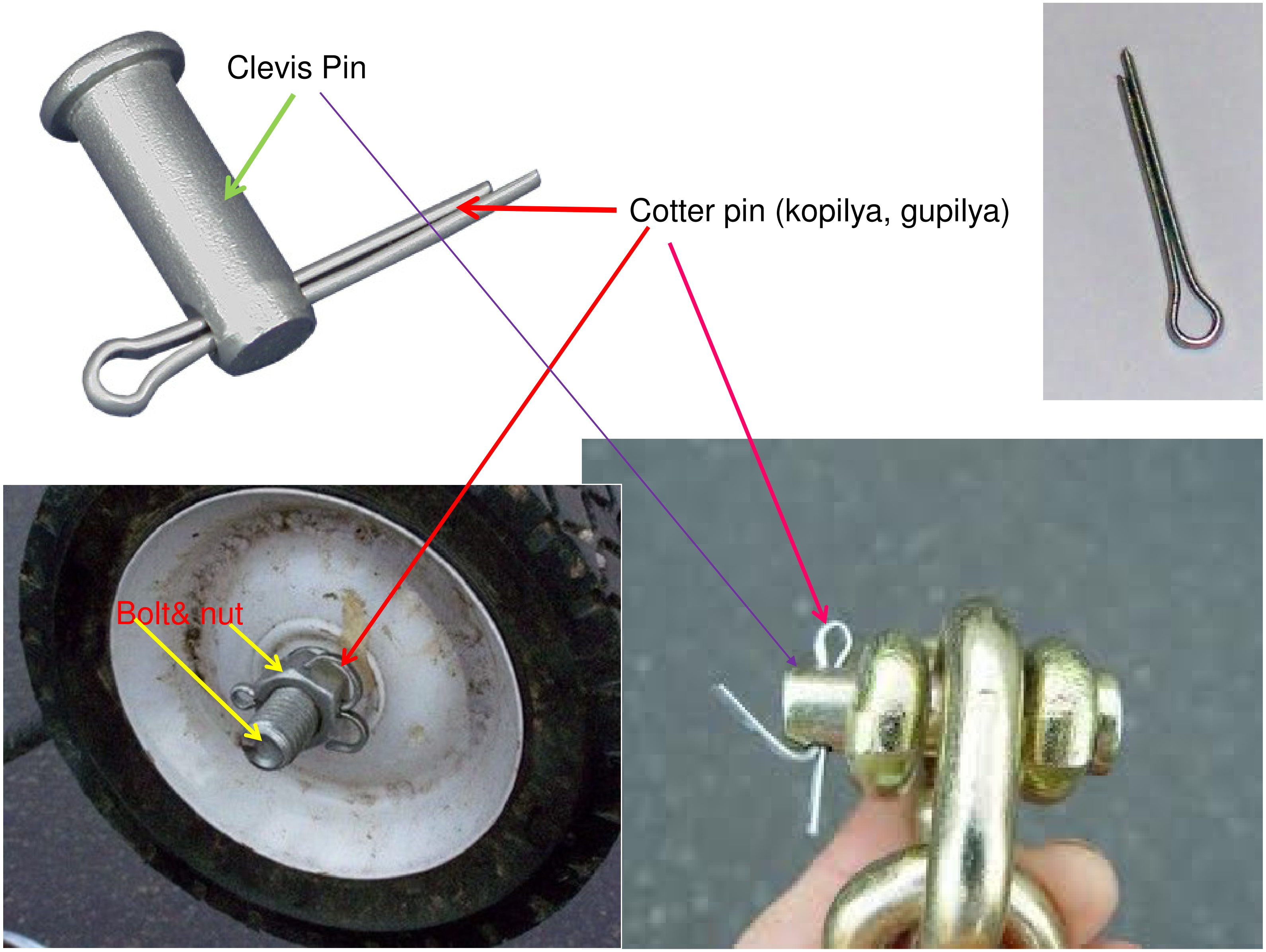
ΦdH7/m6
ΦdH7/h8
ΦdH7/m6

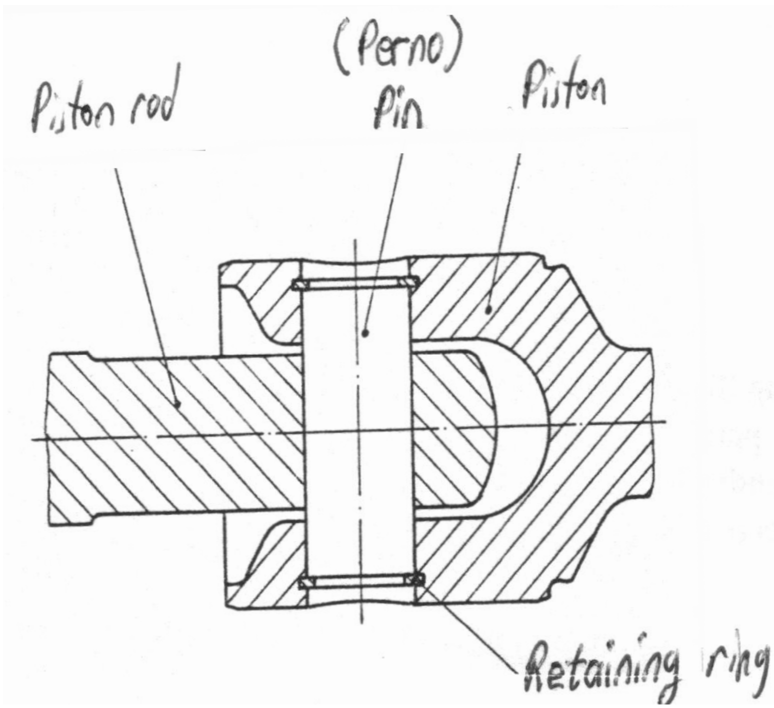
Hollow Spring Pins Resilience of hollow cylinder walls under radial compression forces is the principle under which spiral-wrapped and slotted tubular pins function

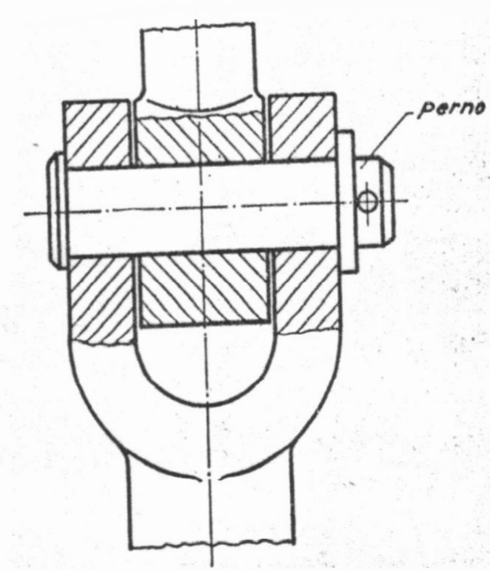
Both pin forms are made to controlled diameters greater than the holes into which they are pressed. Compressed when driven into the hole, the pins exert spring pressure against the hole wall along their entire engaged length to produce a locking action.



Spring pin applications.

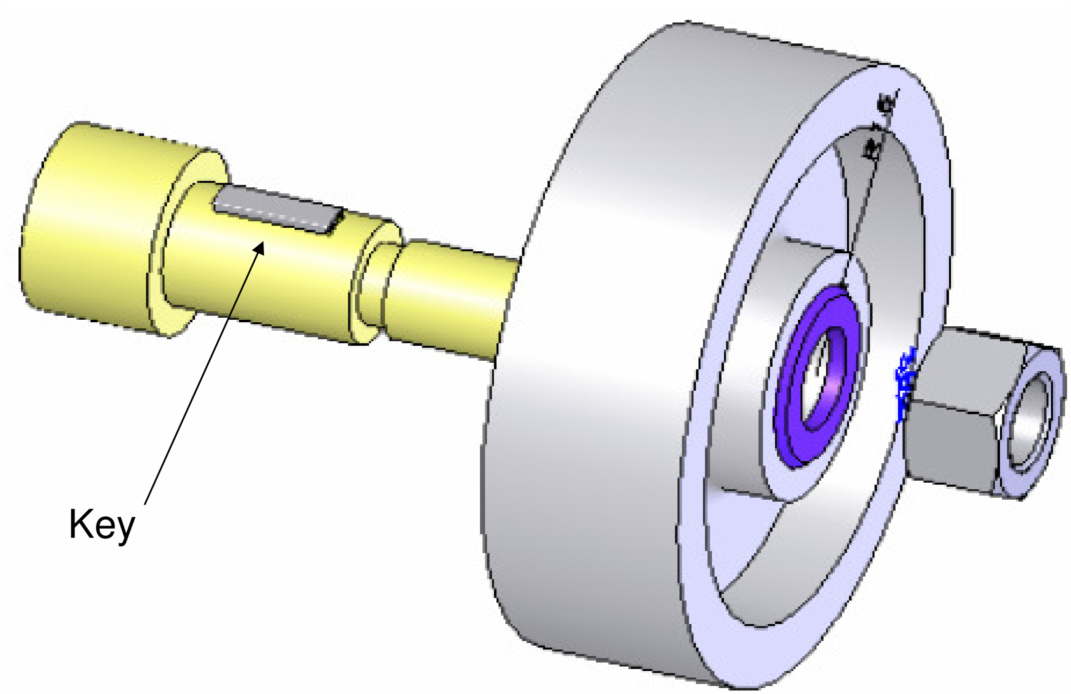

Clevis Pin
Cotter pin (kopilya, gupilya)
Bolt& nut

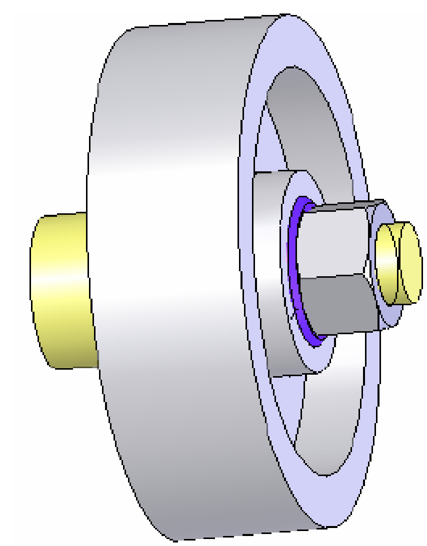

Piston rod
(Perno)
Pin
Piston
Retaining ring

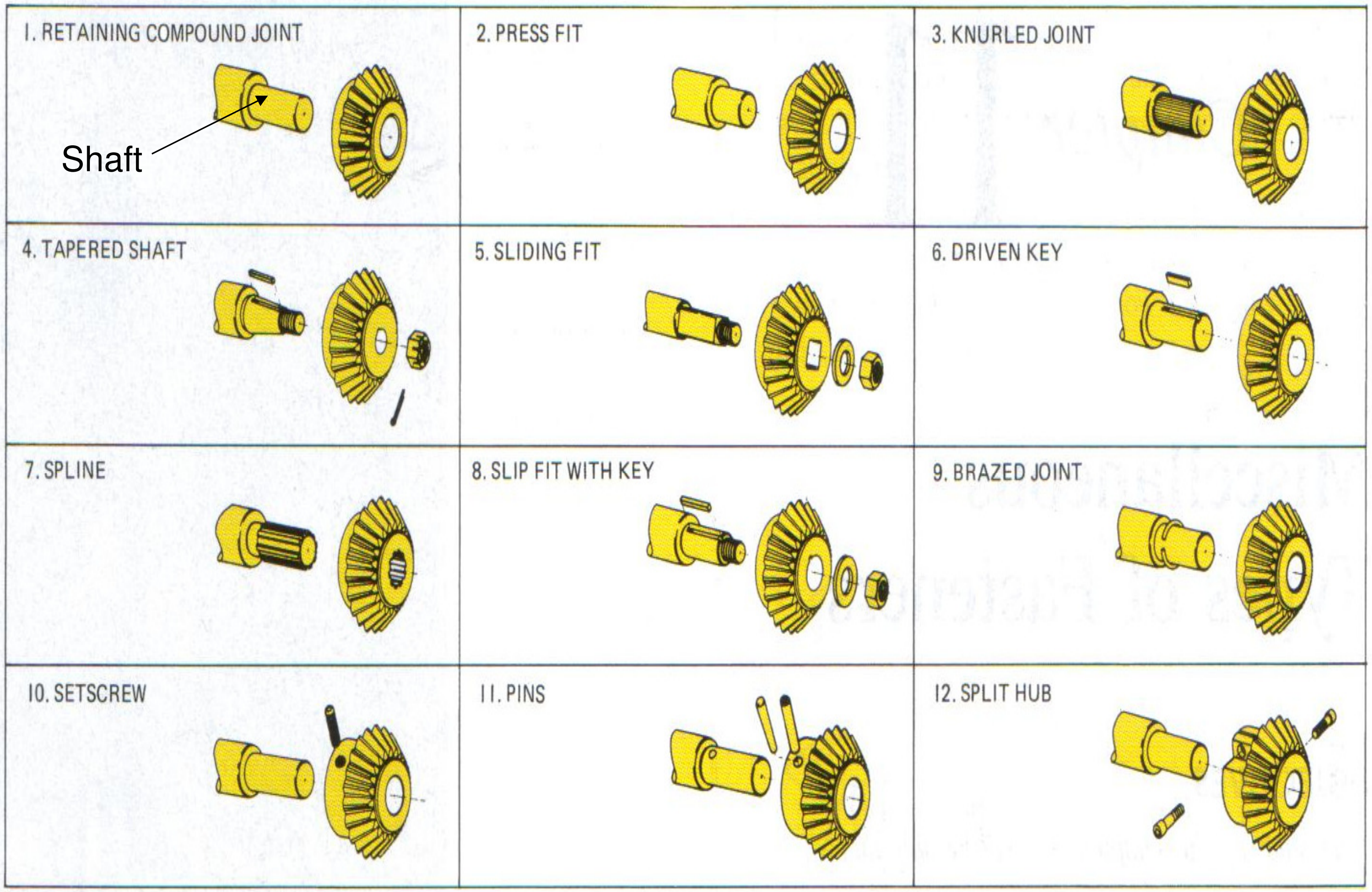

perno

KEYs

KAMAlar







Miscellaneous types of fasteners.

Keys

A **key** is a piece of steel lying partly in a groove in the shaft and extending into another groove in the hub. The groove in the shaft is referred to as a **keyseat**, and the groove in the hub or surrounding part is referred to as a **keyway**

A key is used to secure gears, pulleys, cranks, handles, and similar machine parts to shafts, so that the motion of the part is transmitted to the shaft, or the motion of the shaft to the part, without slippage. The key may also act in a safety capacity; its size can be calculated so that when overloading takes place, the key will shear or break before the part or shaft breaks or deforms.

There are many kinds of keys.

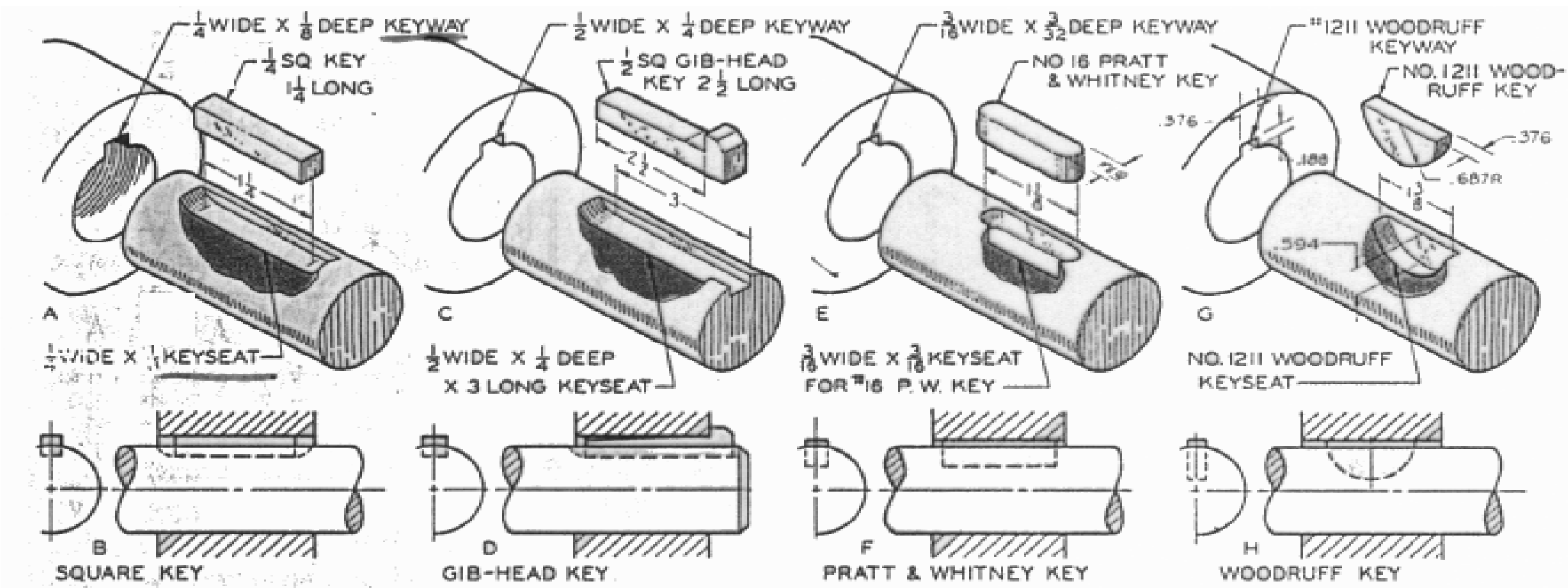
Square and flat keys are widely used in all sorts of mechanical devices. The width of the square and flat key should be approximately one-quarter the shaft diameter,

These keys are also available with a 1:100 taper on their top surfaces and are then known as *square-tapered* or *flat-tapered* keys. The keyway in the hub is tapered to accommodate the taper on the key.

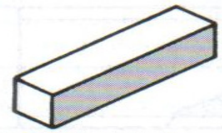
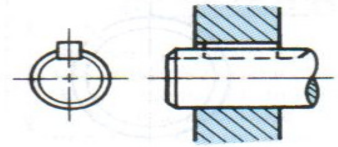
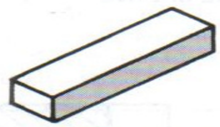
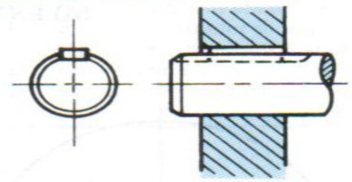
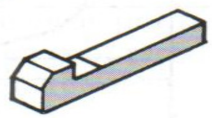
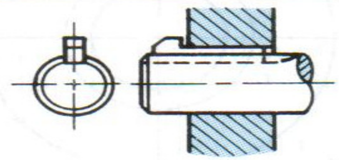
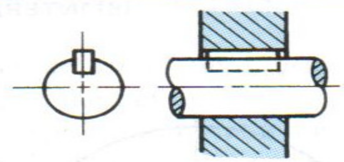
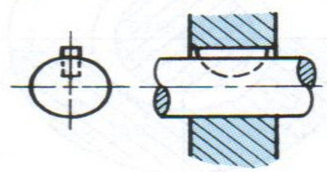
The gib-head key is the same as the square- or flat-tapered key but has a head added for easy removal.

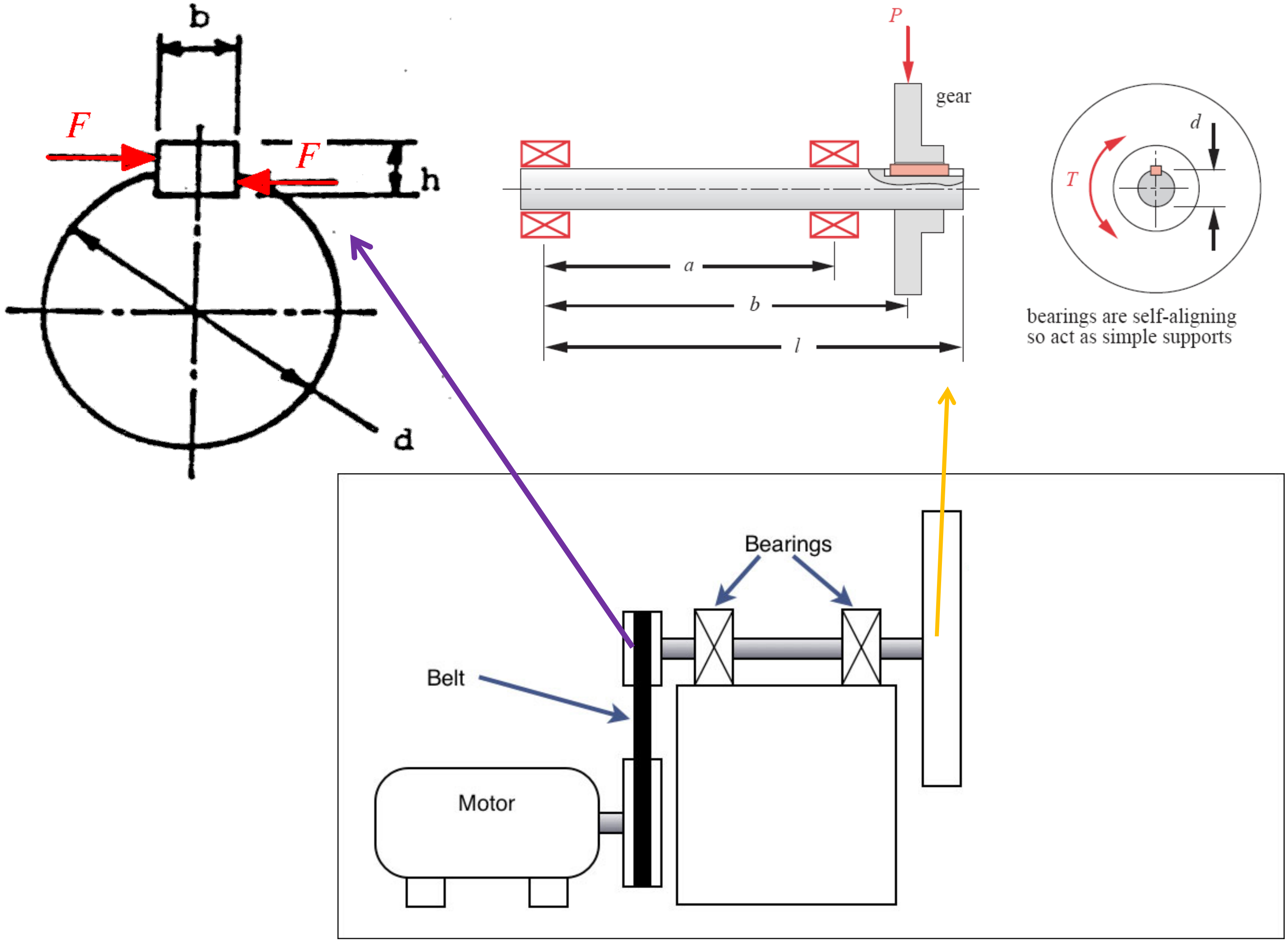
The Pratt and Whitney key is rectangular with rounded ends. Two-thirds of this key sits in the shaft; one-third sits in the hub.

The Woodruff key is semicircular and fits into a semicircular keyseat in the shaft and a rectangular keyway in the hub.



Standard keys used to hold parts on a shaft.

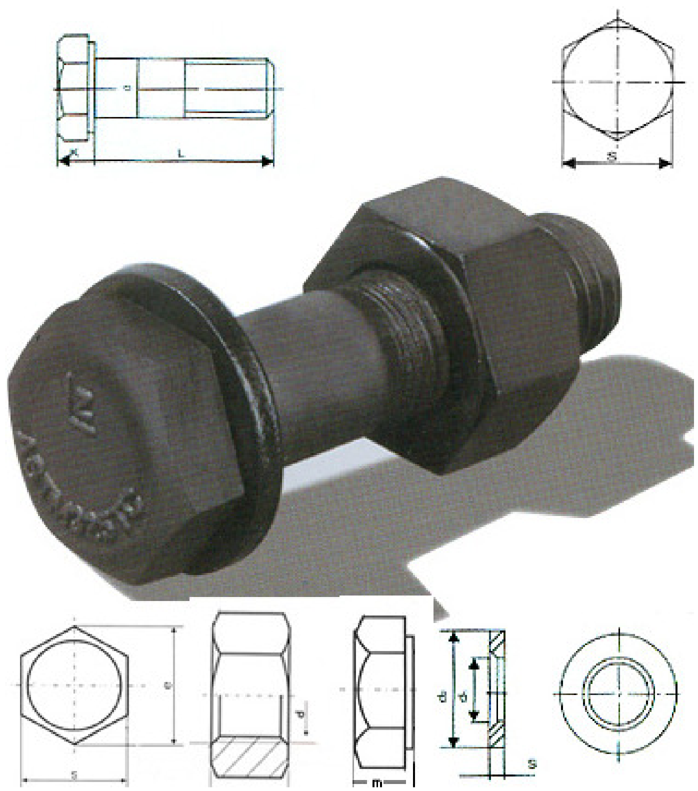
TYPE OF KEY	ASSEMBLY SHOWING KEY, SHAFT, AND HUB
SQUARE  .25 SQUARE KEY, 1.25 LG OR .25 SQUARE TAPERED KEY, 1.25 LG	
FLAT  .188 X .125 FLAT KEY, 1.00 LG OR .188 X .125 FLAT TAPERED KEY, 1.00 LG	
GIB-HEAD  .375 SQUARE GIB-HEAD KEY, 2.00 LG	
 NO. 15 PRATT AND WHITNEY KEY	
 NO. 1210 WOODRUFF KEY	


b
F
F
h
d
P
gear
a
b
l
T
d
bearings are self-aligning
so act as simple supports
Bearings
Belt
Motor

ASSEMBLY ELEMENTS

Screw Threads, Threaded Parts

Fasteners

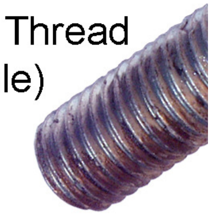


A thread is a helical ridge of uniform section formed on the inside or outside of a cylinder or a cone. Threads are used for several purposes.

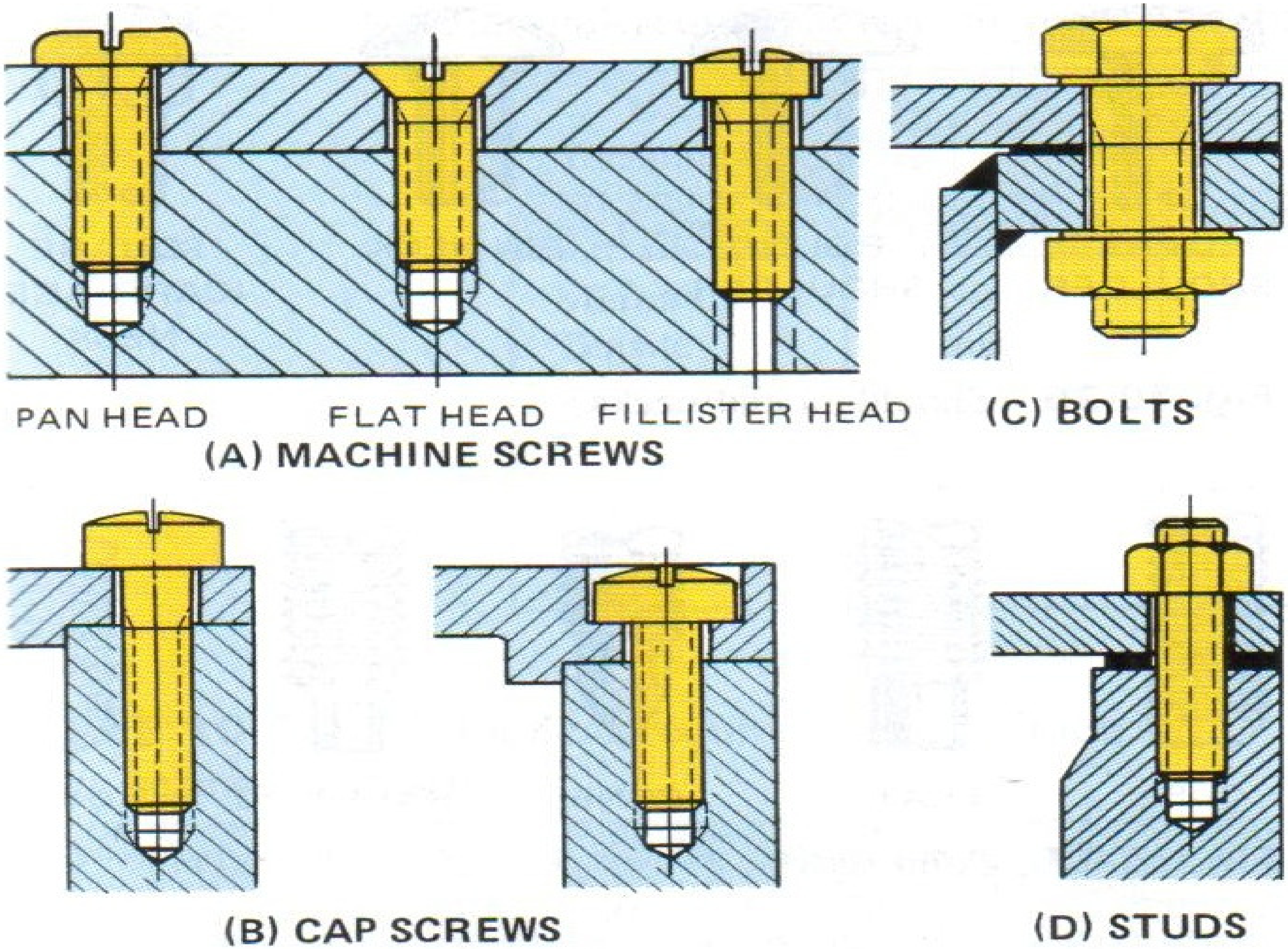
1. For fastening devices such as screws, bolts, studs, and nuts.
2. To provide accurate measurement as in a micrometer.
3. To transmit motion. eg. The threaded lead screw on the lathe causes the carriage to move along when threading.
4. To increase force. Heavy work can be raised with a screw jack.

Fasteners

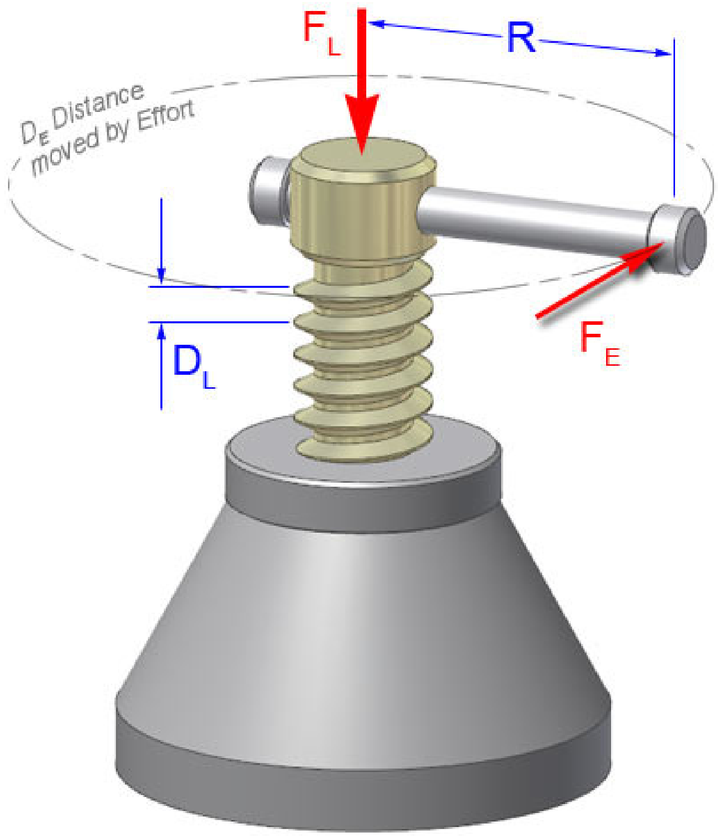
- Permanent
  - Rivets
  - Welds
- Removable
  - Screws
  - Bolts
  - Studs
  - Nuts
  - Pins
  - Keys


External Thread
(Male)

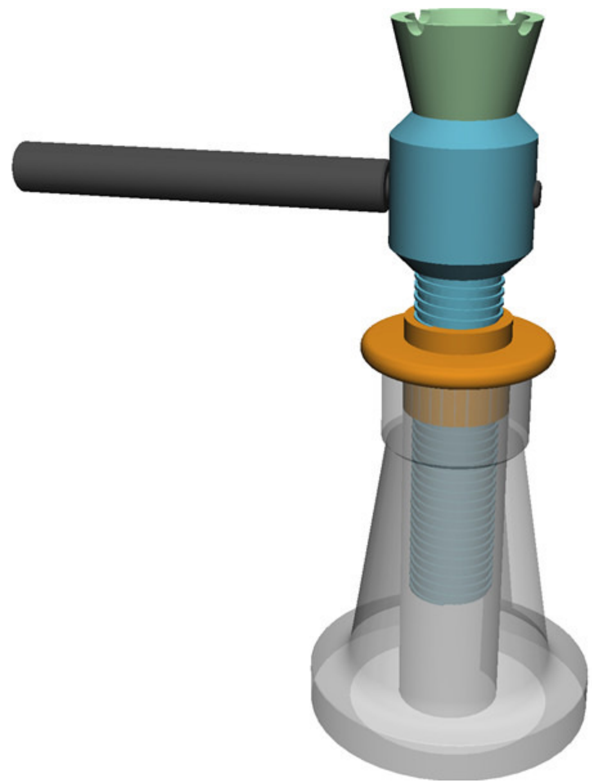

Internal Thread
(Female)

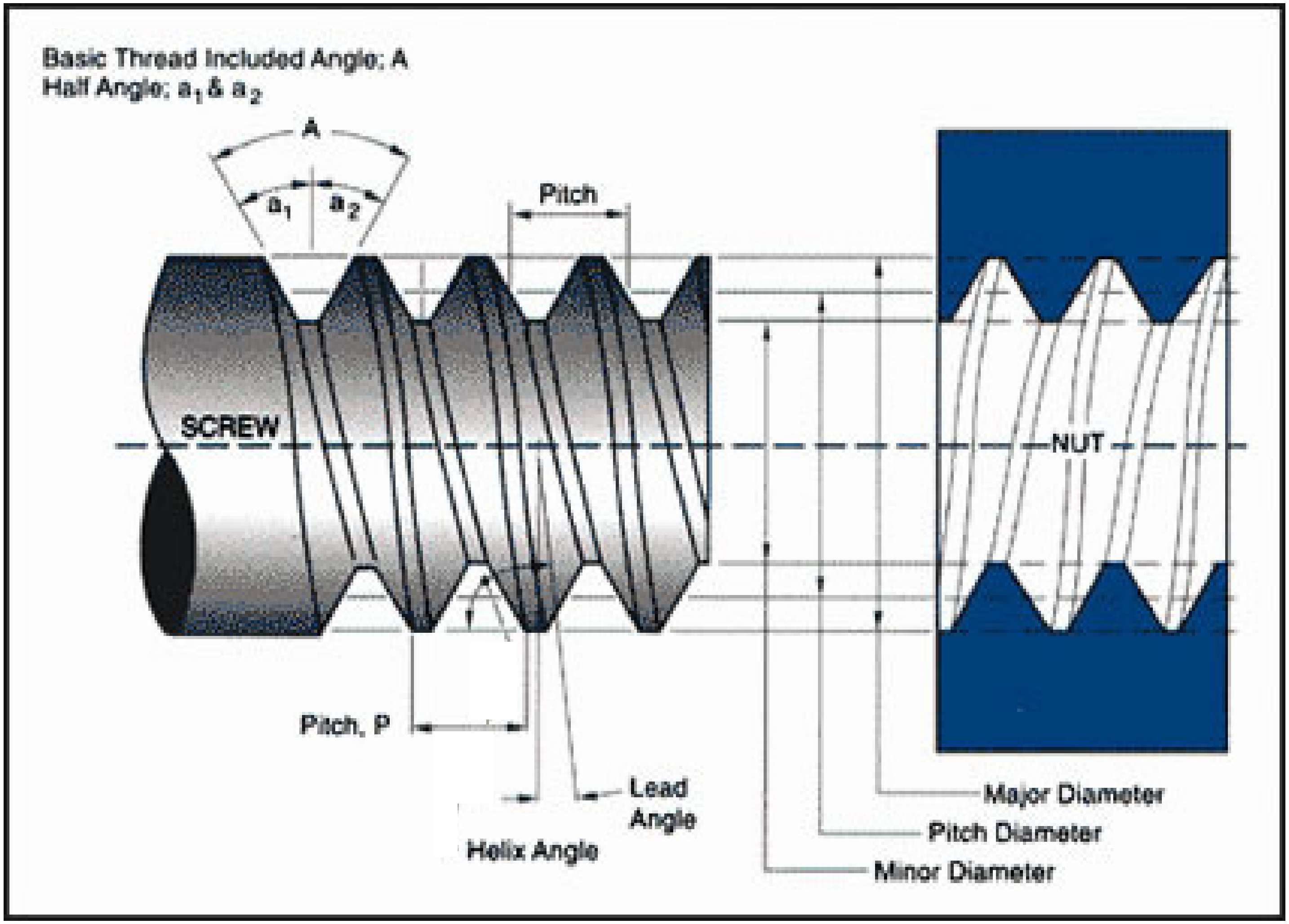


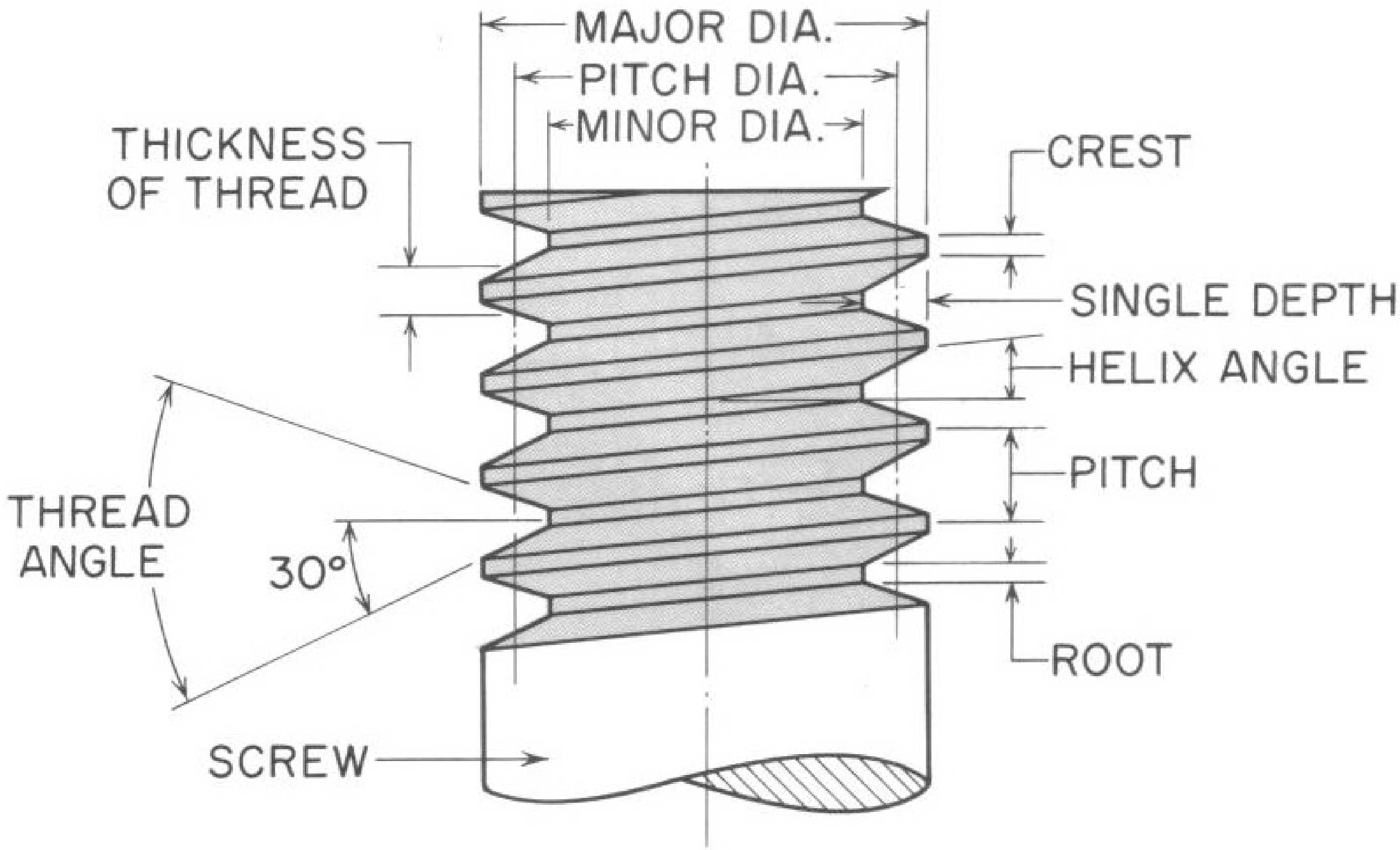
Fastener applications.



Mechanical Advantage=?




Basic Thread Included Angle; A
Half Angle; a1 & a2
A
a1
a2
Pitch
SCREW
NUT
Pitch, P
Lead
Angle
Helix Angle
Major Diameter
Pitch Diameter
Minor Diameter

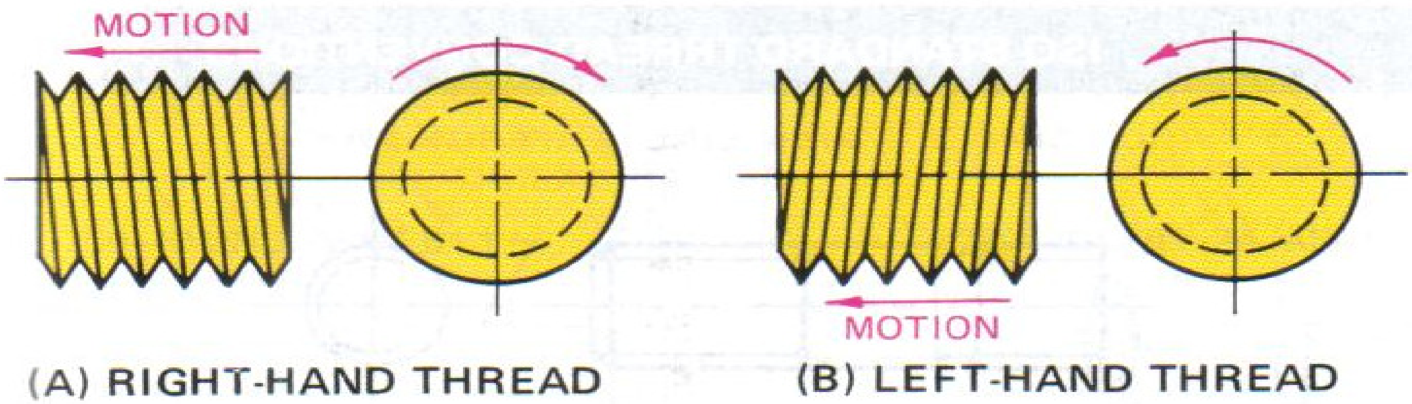


The main parts of a screw thread.

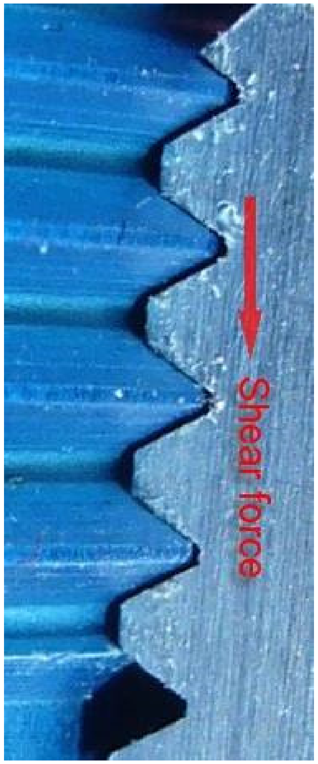
Right- and Left-Hand Threads

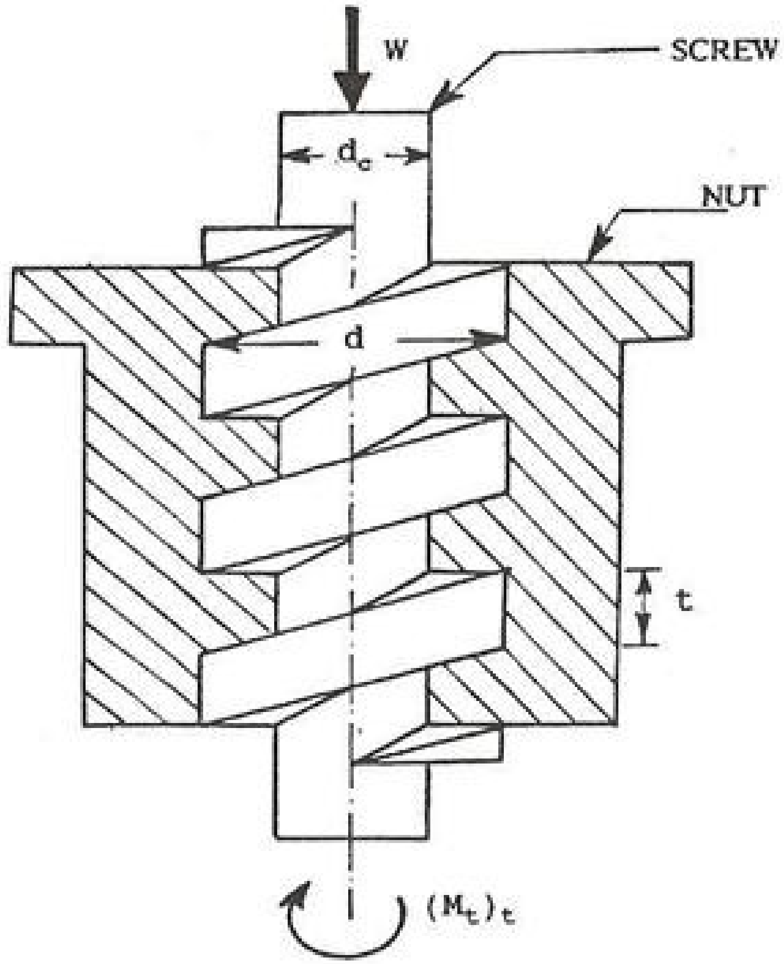
Unless designated otherwise, threads are assumed to be right-hand. A bolt being threaded into a tapped hole would be turned in a right-hand (clockwise) direction

For some special applications, such as turnbuckles, left-hand threads are required. When such a thread is necessary, the letters LH are added after the thread designation.



Right- and left-hand threads.

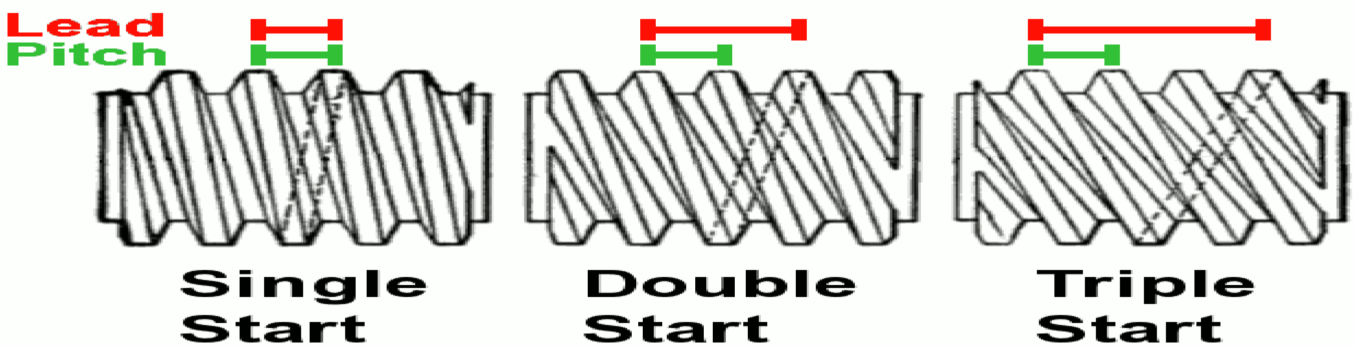

Shear force

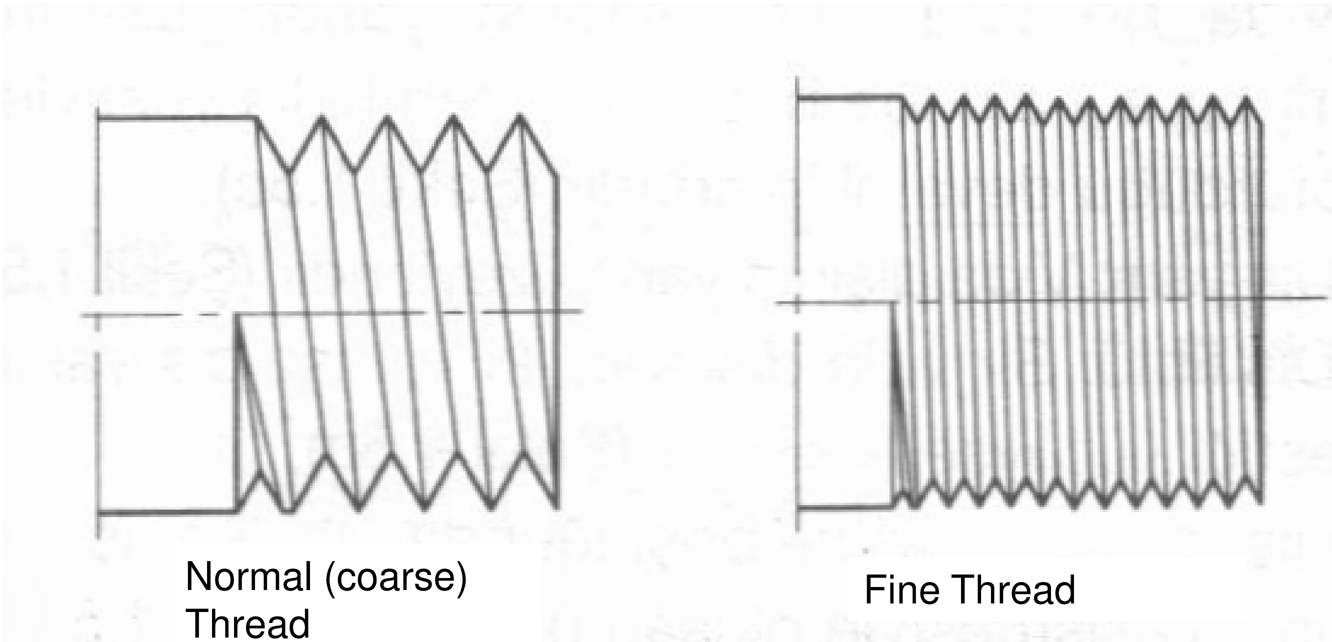

W
SCREW
d_c
NUT
d
t
$(M_t)_t$

Single and Multiple Threads

Most screws have single threads. It is understood that unless the thread is designated otherwise, it is a single thread. The single thread has a single ridge in the form of a helix The lead of a thread is the distance traveled parallel to the axis in one rotation of a part in relation to a fixed mating part (the distance a nut would travel along the axis of a bolt with one rotation of the nut).

In single threads, the lead is equal to the pitch. A double thread has two ridges, started 180° apart, in the form of helices, and the lead is twice the pitch. A triple thread has three ridges, started 120° apart, in the form of helices, and the lead is three times the pitch. Multiple threads are used when fast movement is desired with a minimum number of rotations, such as on threaded mechanisms for opening and closing windows.

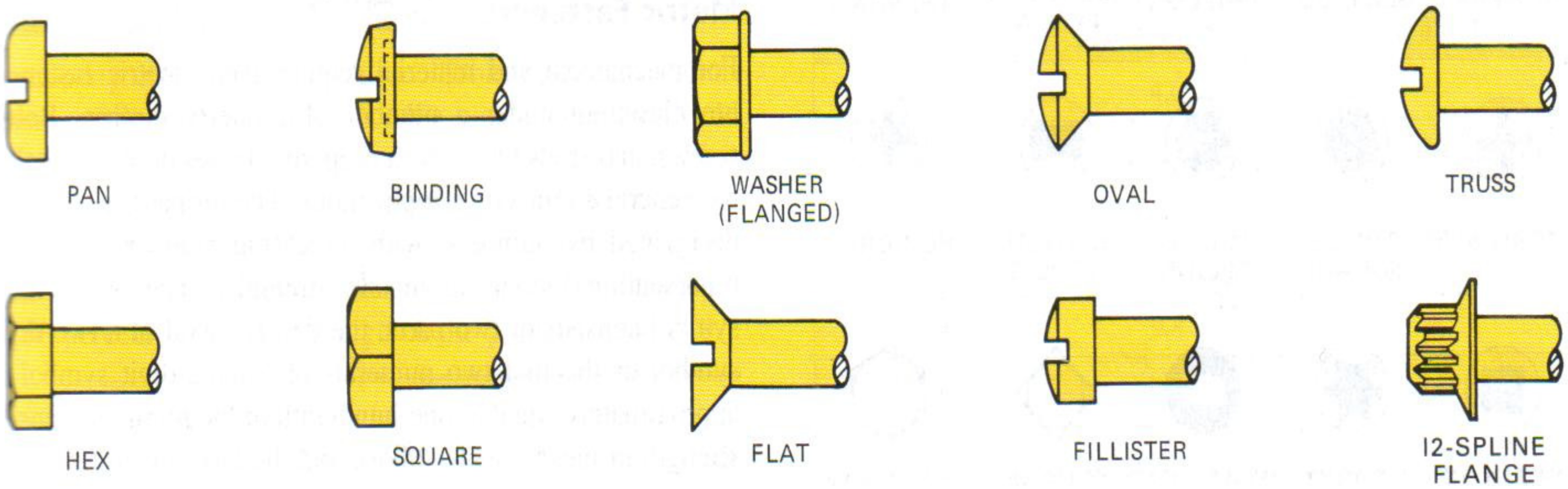


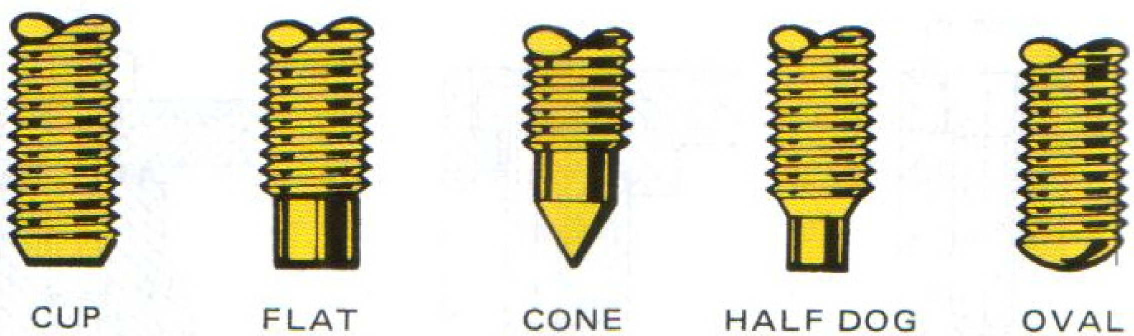


Coarse-Thread Series This series is intended for use in general engineering work and commercial applications.

Fine-Thread Series The fine-thread series is for general use where a finer thread than the coarse-thread series is desirable. In comparison with a coarse-thread screw, the fine-thread screw is stronger in both tensile and torsional strength and is less likely to loosen under vibration.

Common Head Styles

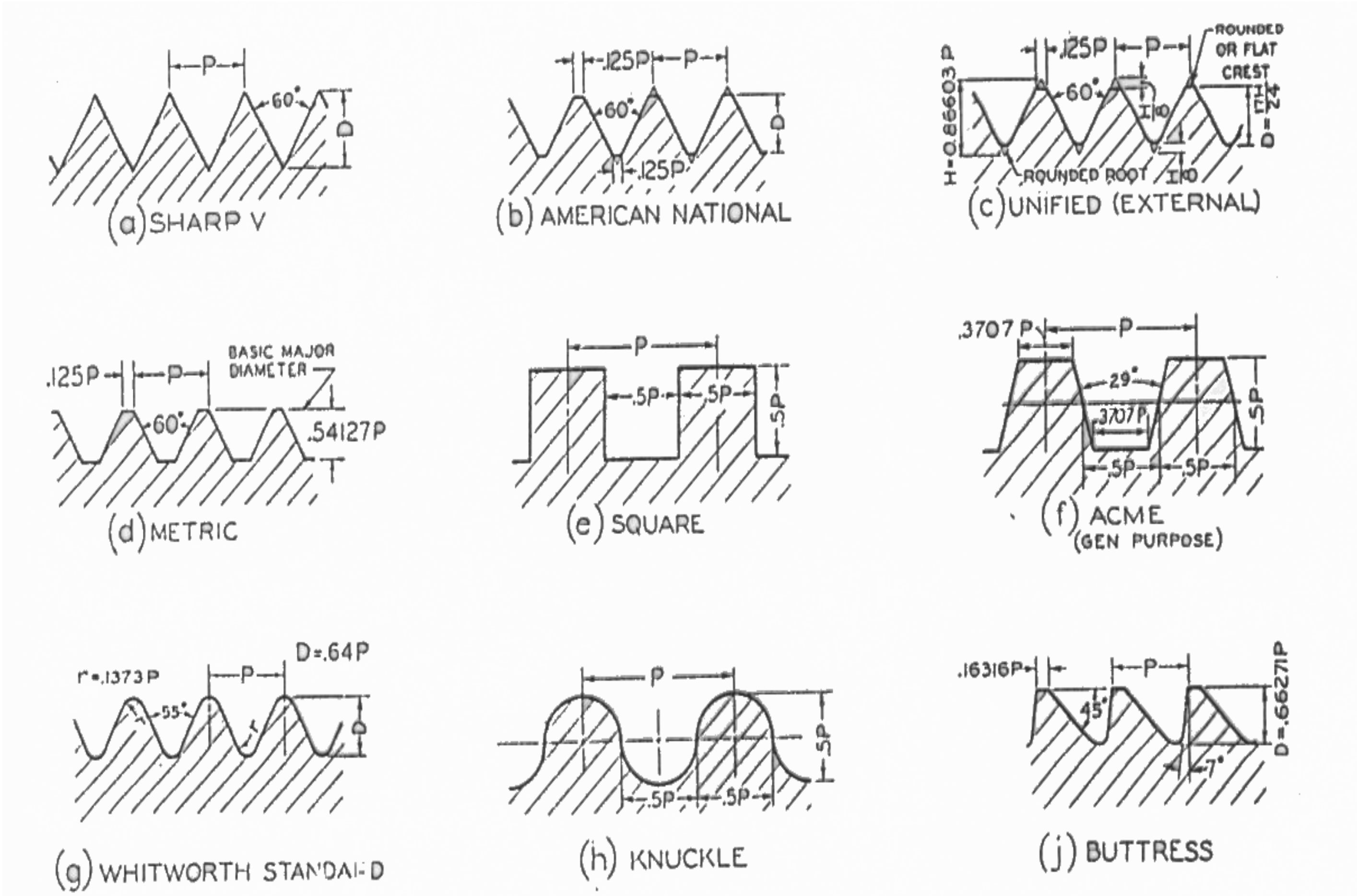




Point styles.

History of Threaded Fasteners

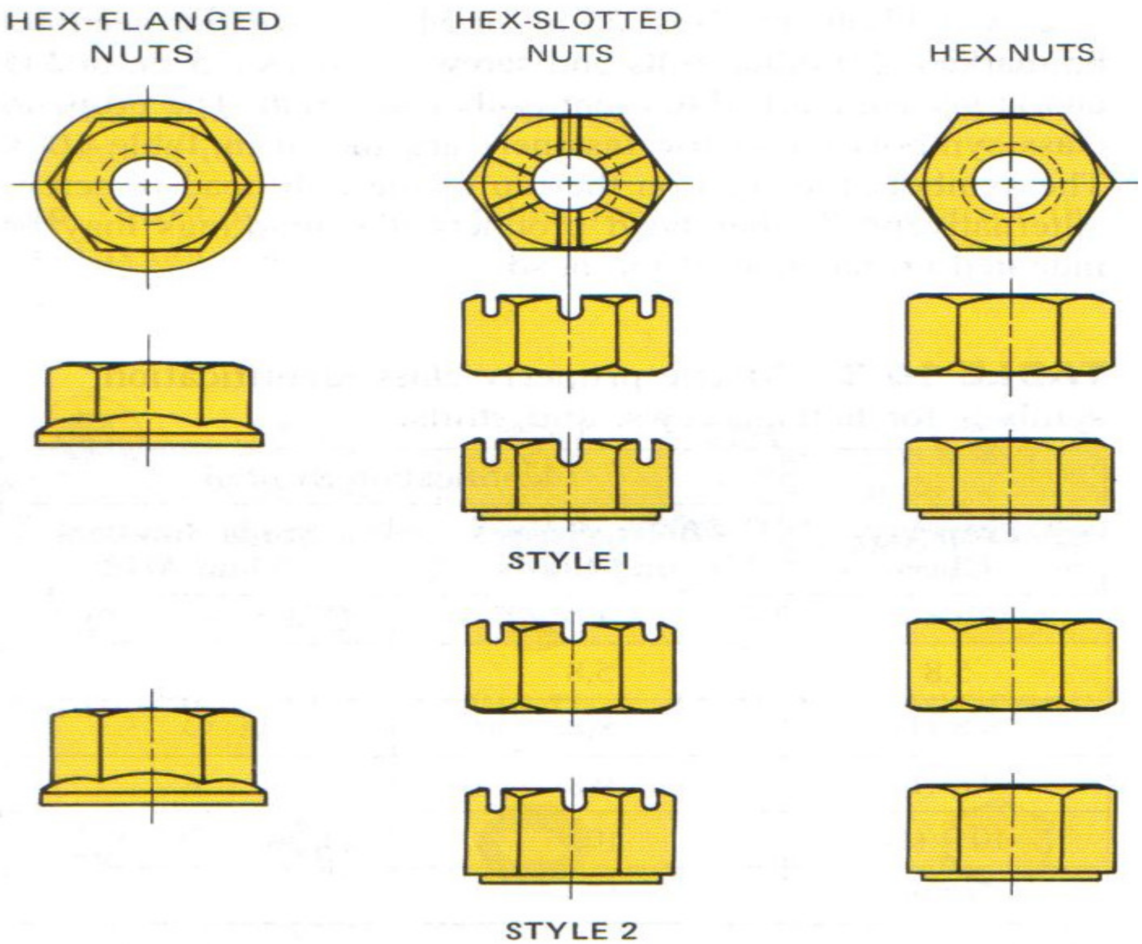
*The earliest records of screws are found in the writings of Archimedes (278-212 B.C.)
*Until 1841 there was no standard thread form, no interchanging of parts. A nut had to be tied to its own bolt!
*In England, Sir Joseph Whitworth made the first attempt to set up a uniform standard in 1841.
* The initial attempt to standardize screw threads in the USA came in 1864. The system was designed by William Sellers. It was known as the "Sellers thread" or the "United States thread". This system fulfilled the need for general-purpose thread for a period; but with the coming of automobile, the airplane, and other modern equipment, it became inadequate.
*In 1935 the American Standard thread with the same 60^0 V form of the old Sellers thread was adopted in the USA. Still there was no standardization among countries.
* In 1948, an agreement was reached on the unification of he American and British screw threads among the Americans, British and Canadians. The new thread was called the "Unified Screw Thread"
*In 1946, an International Organization for Standardization (ISO) committee established a single international system of metric screw threads



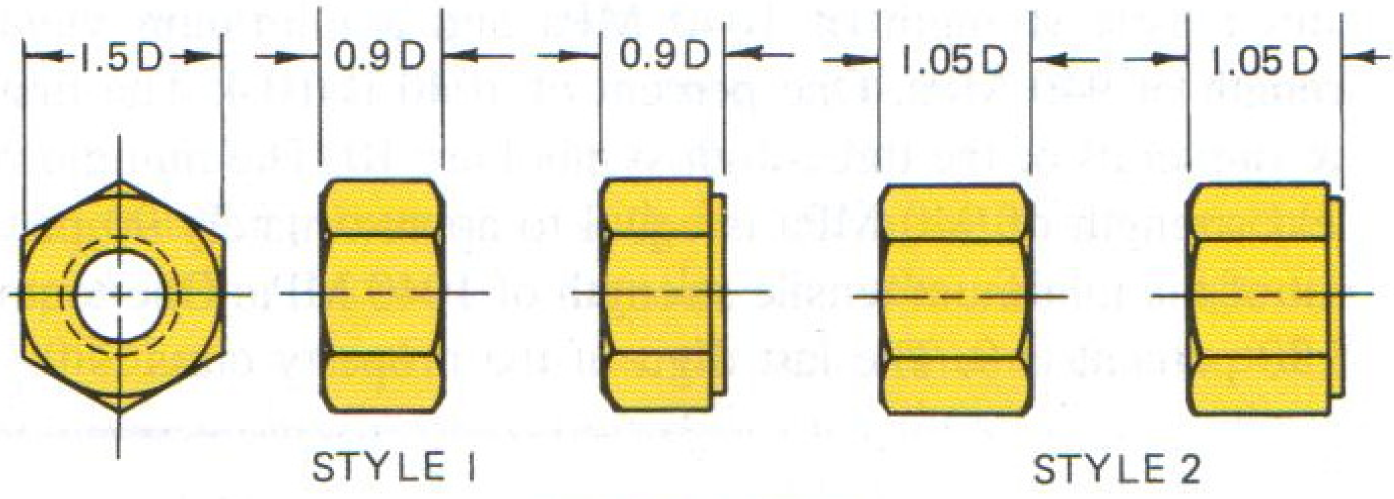
Screw Thread Forms.

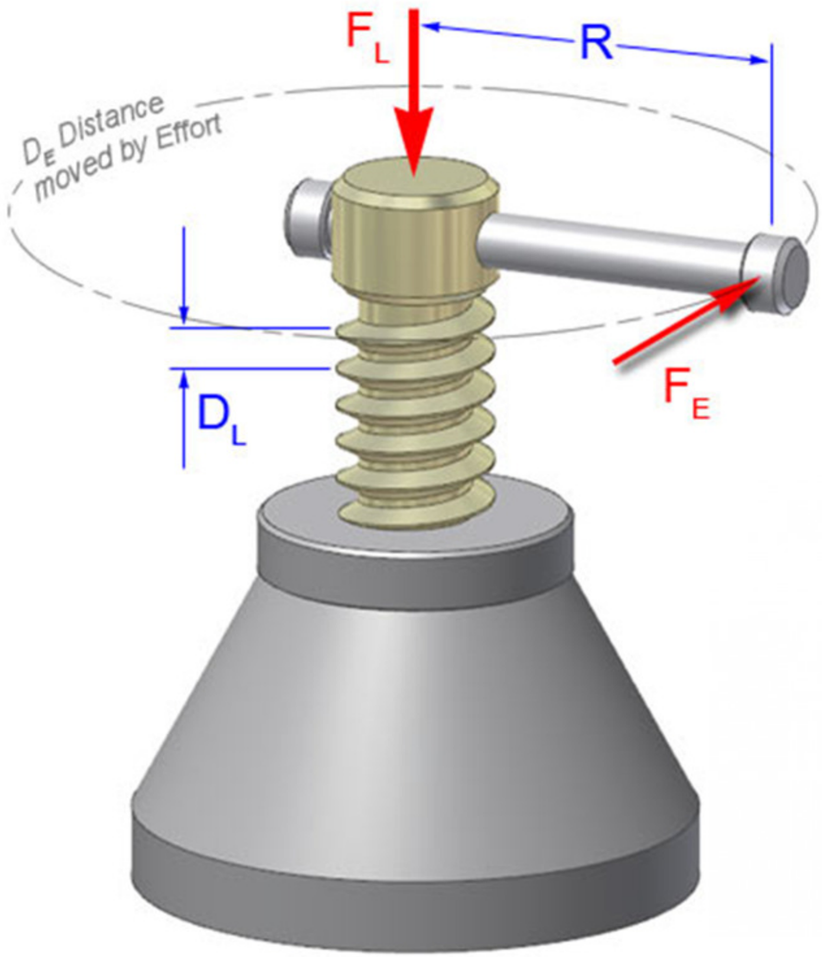
Nuts

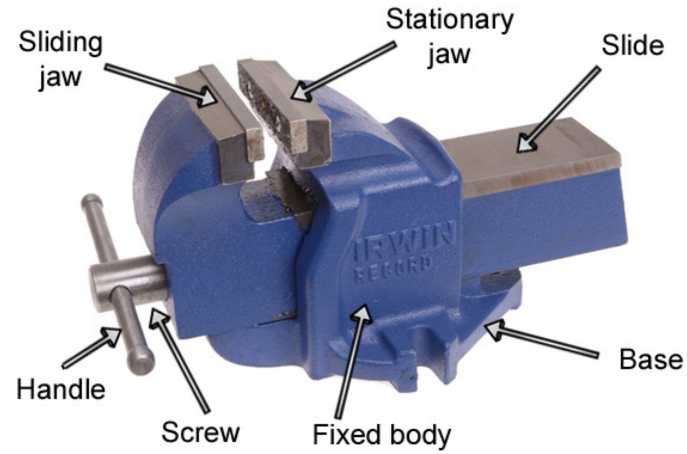
The customary terms *regular* and *thick* for describing nut thicknesses have been replaced by the terms *style 1* and *style 2* for metric nuts. The design of style 1 and 2 steel nuts shown in Fig.



Hex-nut styles.


1.5 D
0.9 D
0.9 D
1.05 D
1.05 D
STYLE 1
STYLE 2


F_L
R
D_E Distance moved by Effort
D_L
F_E


Sliding jaw
Stationary jaw
Slide
Handle
Screw
Fixed body
Base

Self-Locking and Back-Driving of Power Screws

Self-locking refers to a condition in which the screw cannot be turned by the application of any magnitude of force applied axially (not as a torque) to the nut. In other words, a self-locking screw will hold the load in place without any application of torque. It does not need a brake to hold the load. This is a very useful situation. For example, if you jacked up your car with a screw jack that was not self-locking, as soon as you let go of the jack handle the car would run the jack back down. You would have to be pretty fast with the lug wrench to change a tire in that case.

The opposite situation to self-locking is a screw that can be back driven, which means that pushing axially on the nut will cause the screw to turn. While of no value for a jack application, this is a useful feature in other situations. One example is a so-called *Yankee screwdriver,* which has a high-lead thread on its barrel that is attached to the blade. The handle is the nut. As you push down axially on the handle, the barrel turns, driving the wood screw into place. Any application in which you want to convert linear motion to rotary motion is a candidate for a back-drivable lead screw.

The condition of self-locking for a power or lead screw is easily predicted if the coefficient of friction in the screw-nut joint is known. The relationship between the friction coefficient and the screw's lead angle determines its self-locking condition. A screw will self-lock if

$$\mu \geq \frac{L}{\pi d_p} \cos\alpha, \qquad \text{or} \qquad \mu \geq \tan\lambda \cos\alpha$$

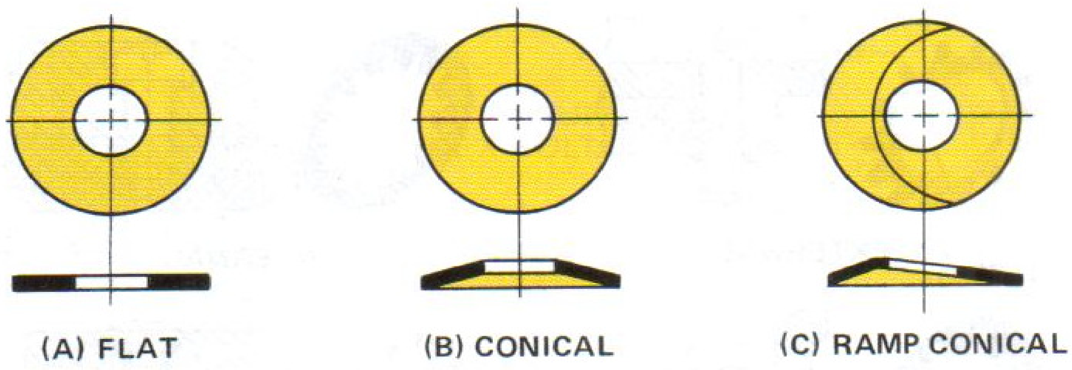
If it is a square thread $\cos\alpha = 1$, and this reduces to

$$\mu \geq \frac{L}{\pi d_p}, \qquad \text{or} \qquad \mu \geq \tan\lambda$$

Note that these relationships presume a static-loading situation. The presence of any vibration from dynamic loading or other sources can cause an otherwise self-locking screw to back down. Any vibrations that cause relative motion between screw and nut will inevitably cause slippage down the thread's incline.

Washers

Washers are one of the most common forms of hardware and perform many varied functions in mechanically fastened assemblies. They may be needed just to span an oversize clearance hole, to give better bearing for nuts or screw faces, or to distribute loads over a greater area. Often, they serve as locking devices for threaded fasteners. They are also used to maintain a spring-resistance pressure, to guard surfaces against marring, and to provide a seal.



Flat and conical washers.

Lock washers prevent a fastener from loosening due to vibration or stress.

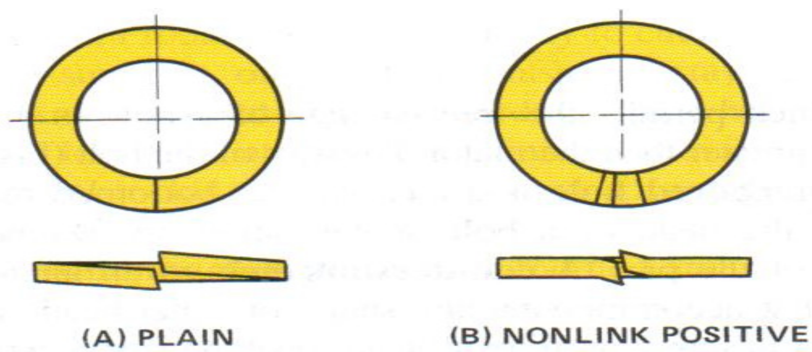
Classification of Washers

Washers are commonly the elements that are added to screw systems to keep them tight, but not all washers are locking types. Many washers serve other functions, such as surface protection, insulation, sealing, electrical connection, and spring-tension take-up devices.

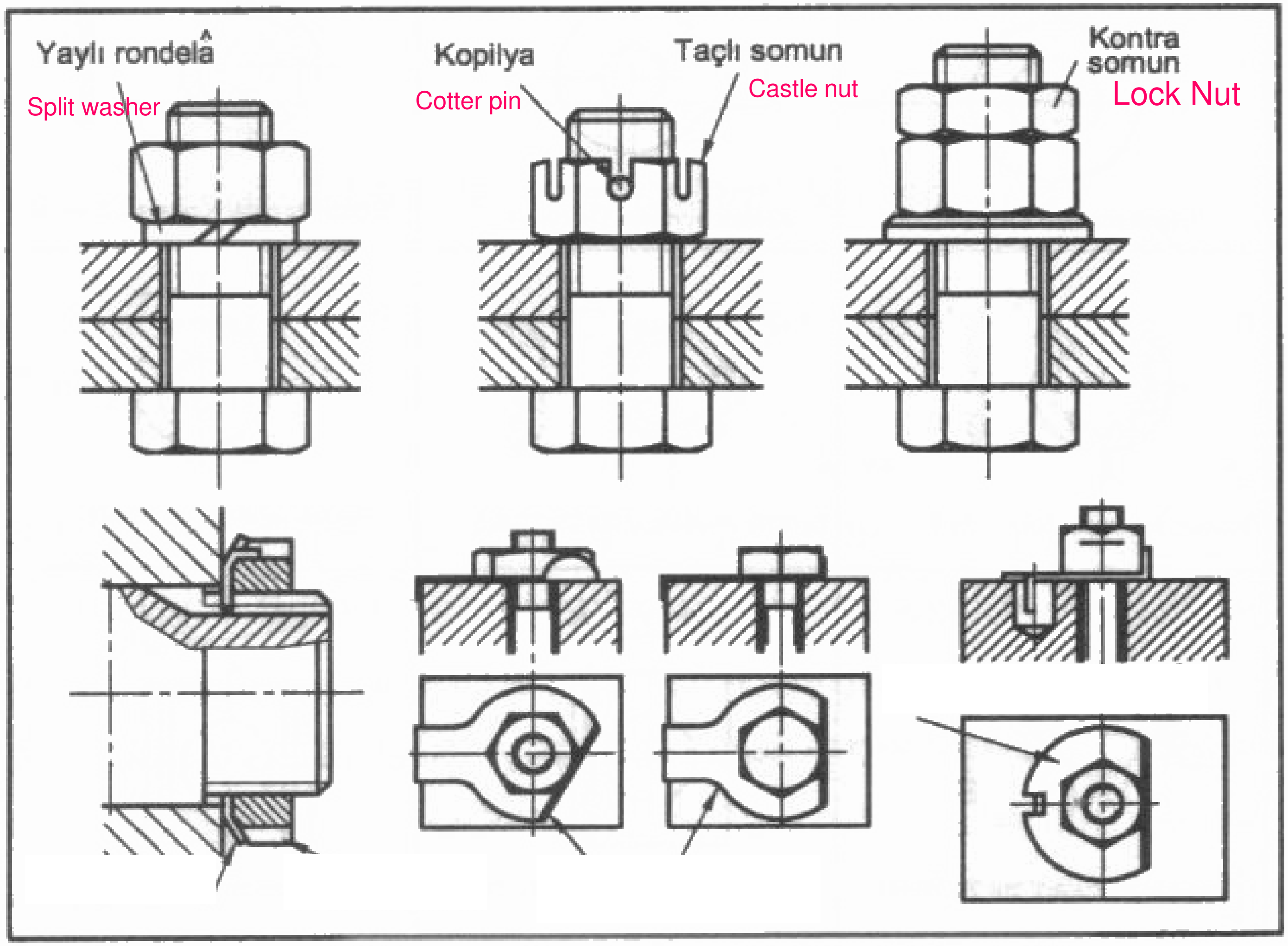
Flat Washers Plain, or flat, washers are used primarily to provide a bearing surface for a nut or a screw head, to cover large clearance holes, and to distribute fastener loads over a large area—particularly on soft materials such as aluminum or wood

Conical Washers These washers are used with screws to effectively add spring take-up to the screw elongation.

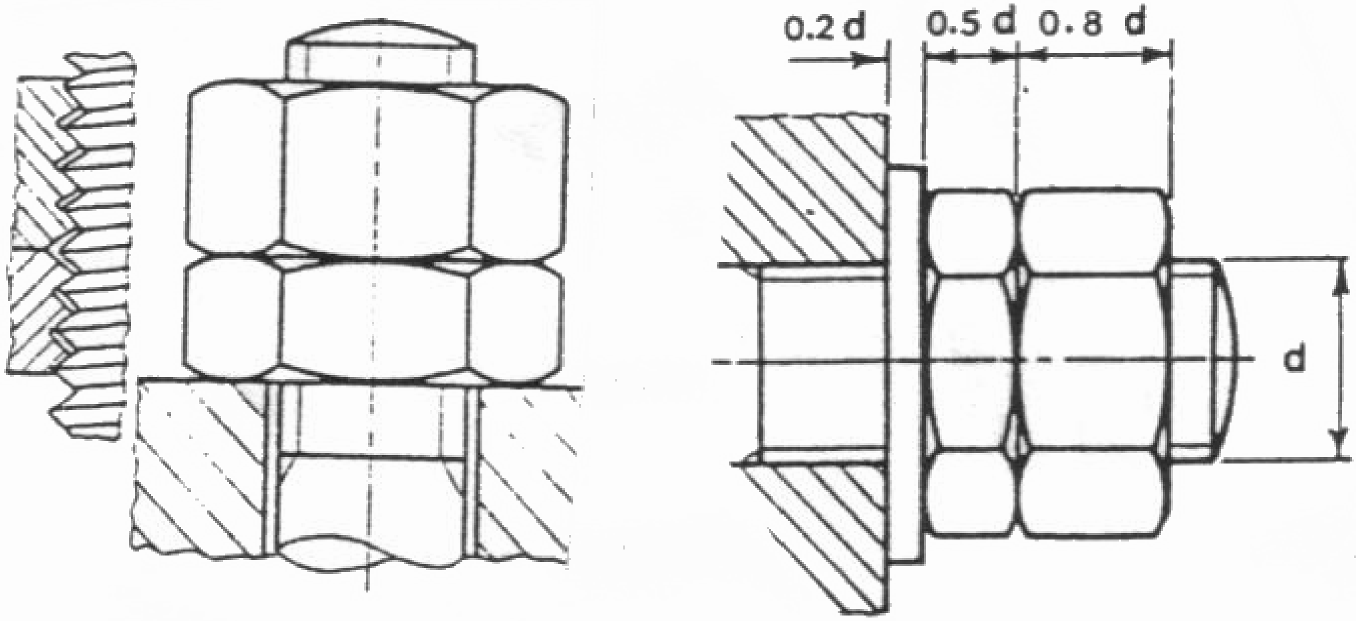
Helical Spring Washers These washers are made of slightly trapezoidal wire formed into a helix of one coil so that the free height is approximately twice the thickness of the washer section



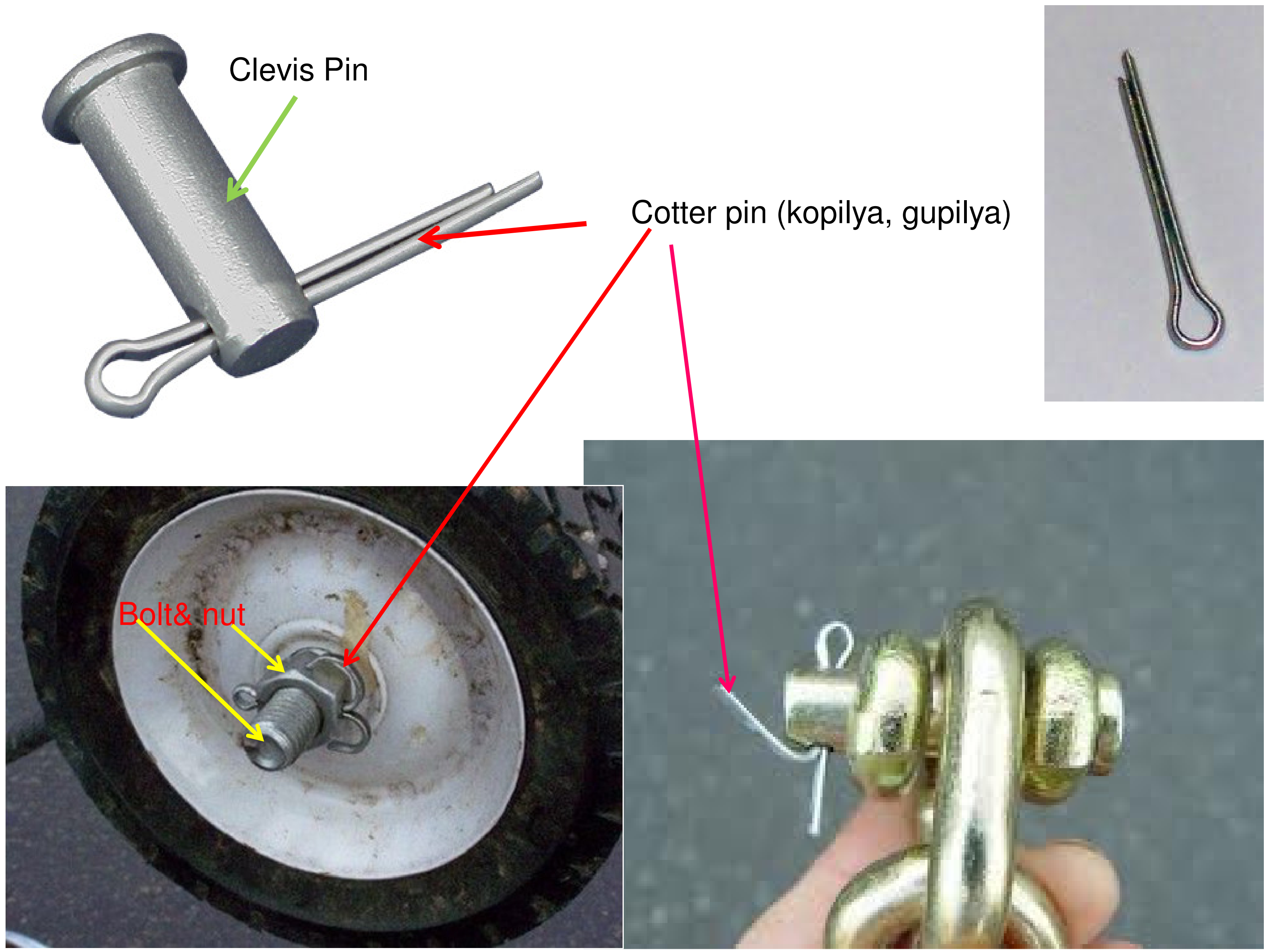
Helical spring washers.

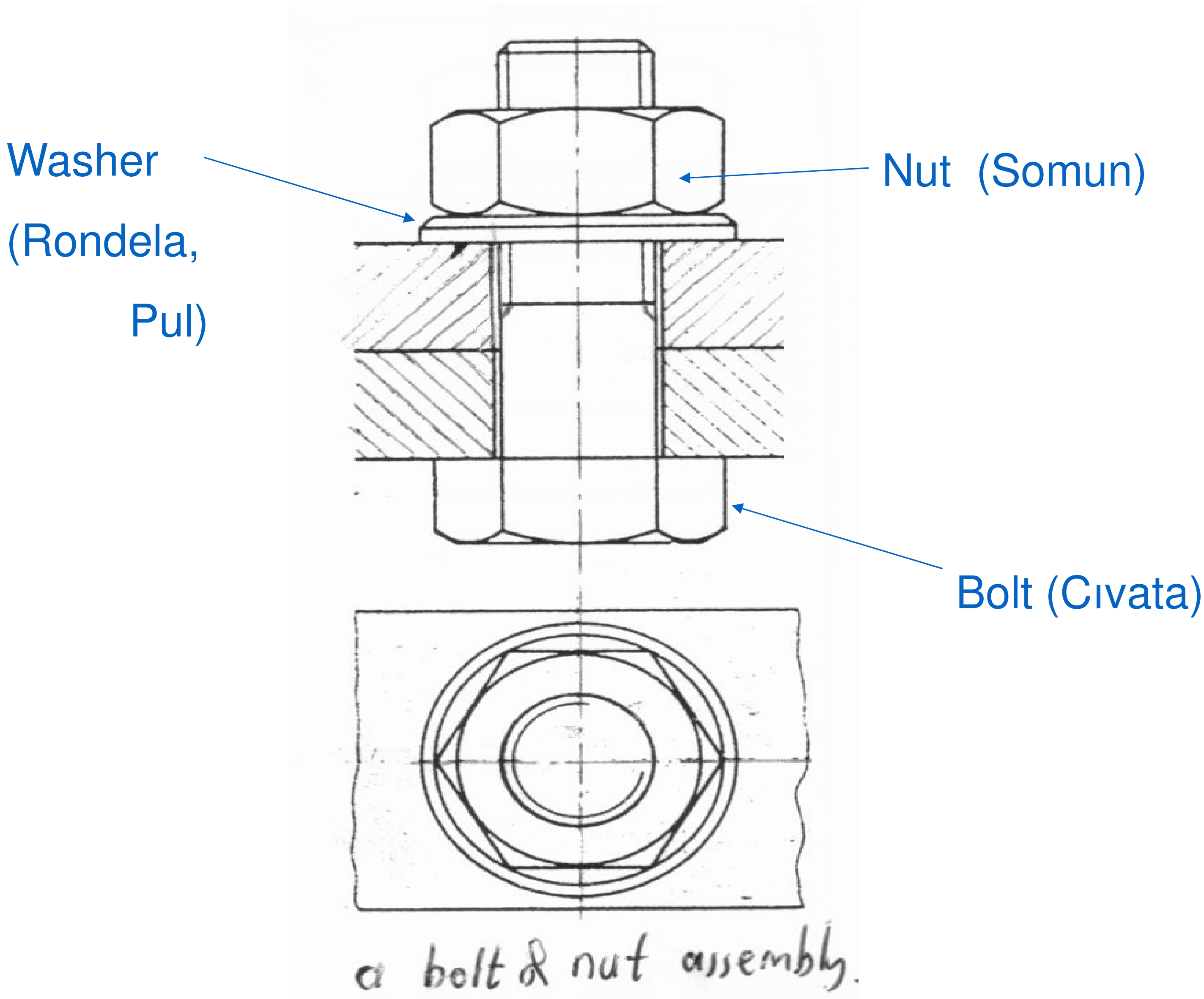


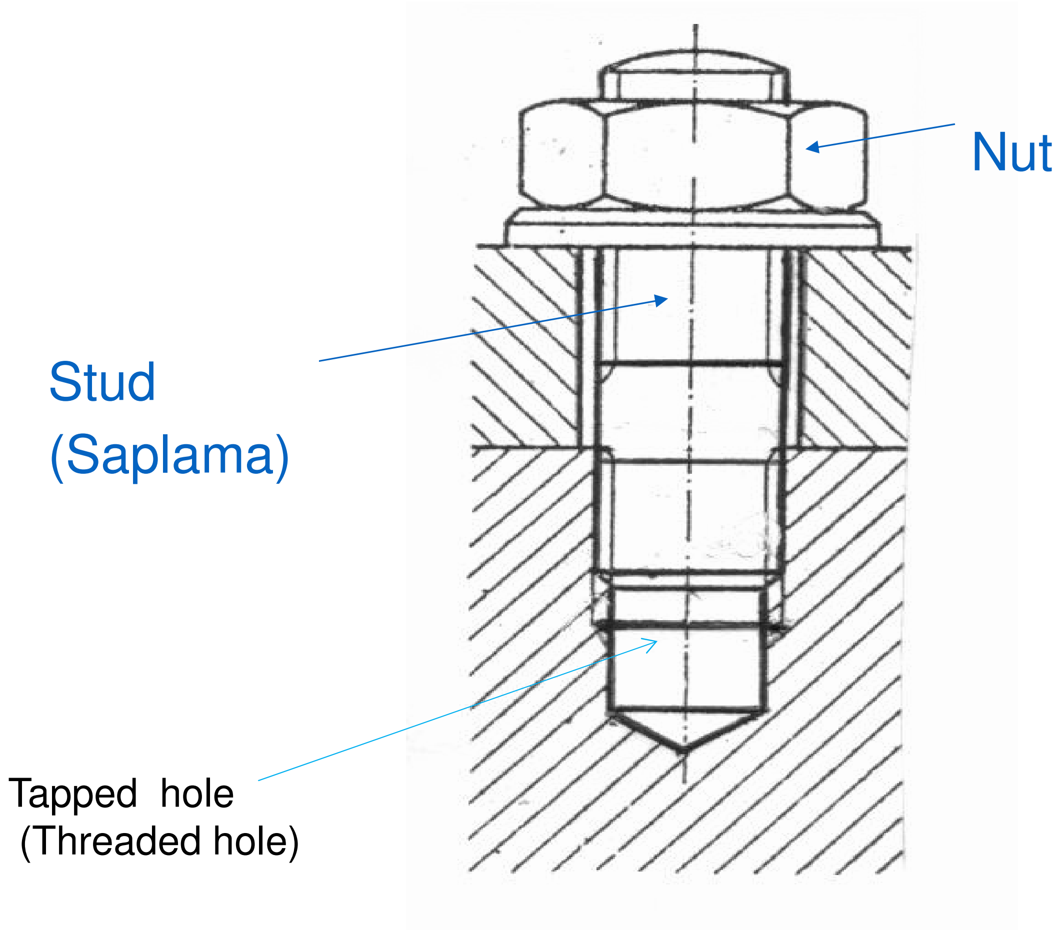
Various Locking Techniques



Lock nut

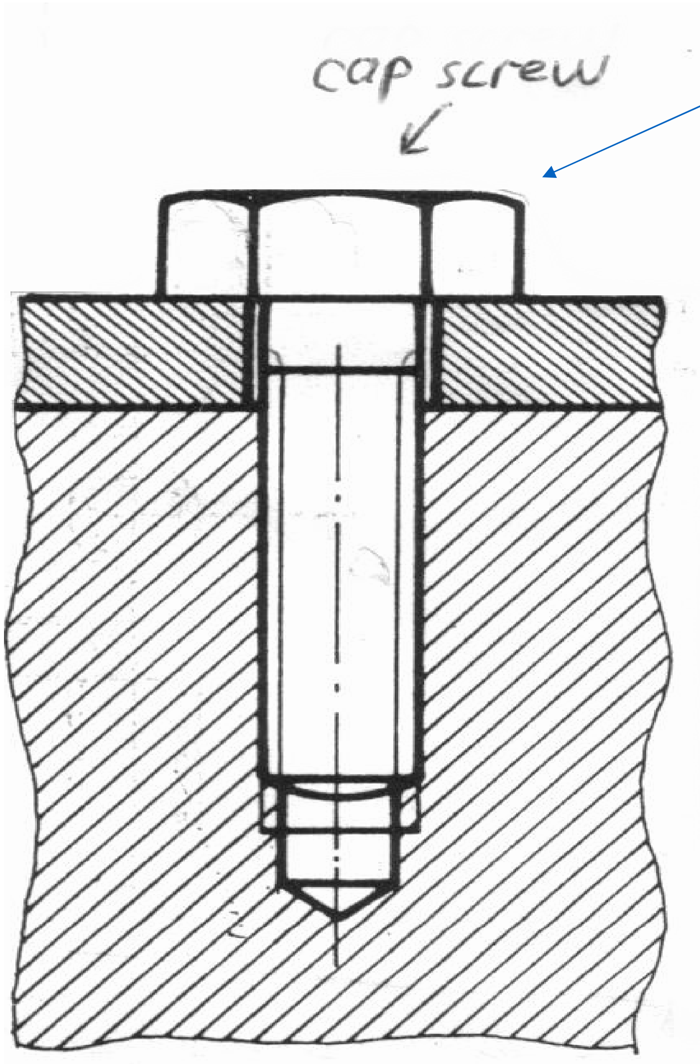

Clevis Pin
Cotter pin (kopilya, gupilya)
Bolt& nut

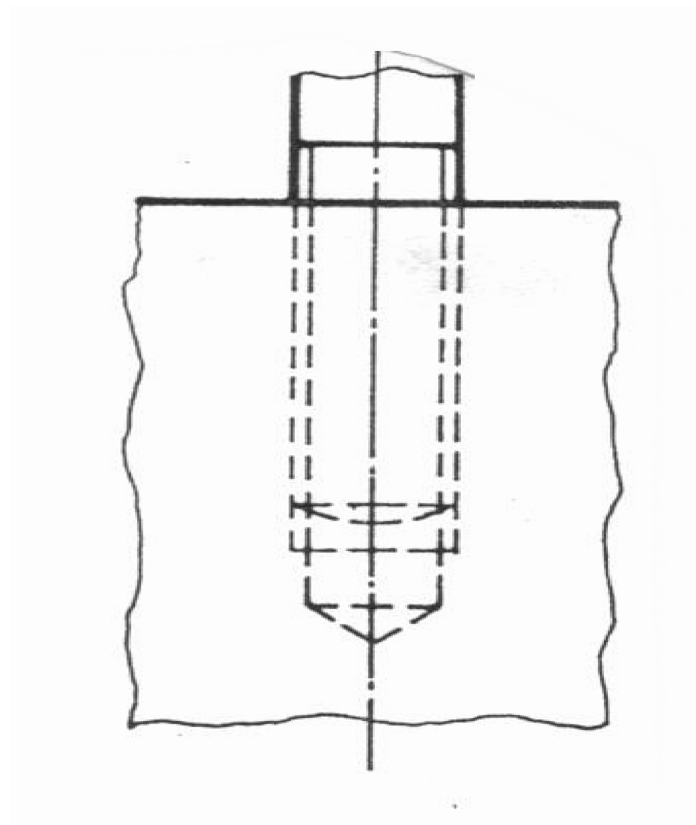

Washer
(Rondela,
Pul)
Nut (Somun)
Bolt (Cıvata)
a bolt & nut assembly.



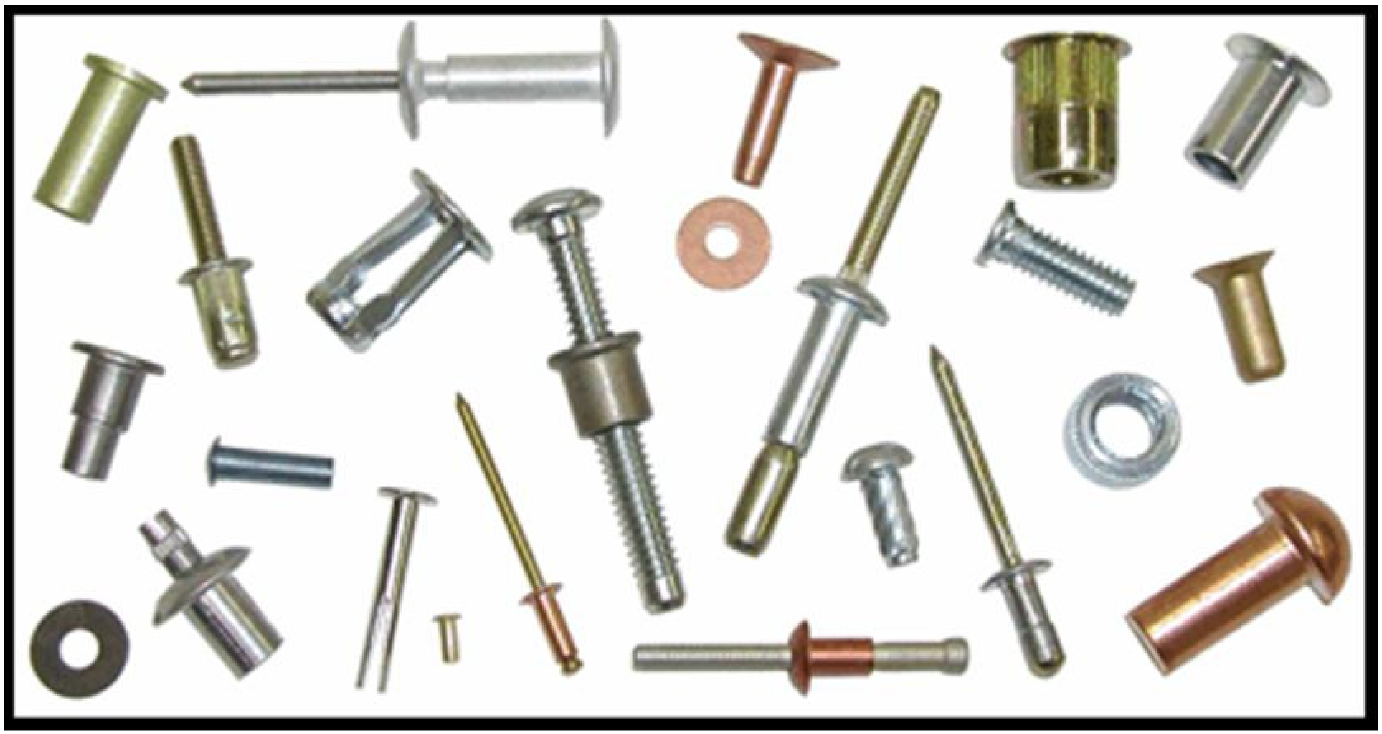
a stud assembly

Cıvata



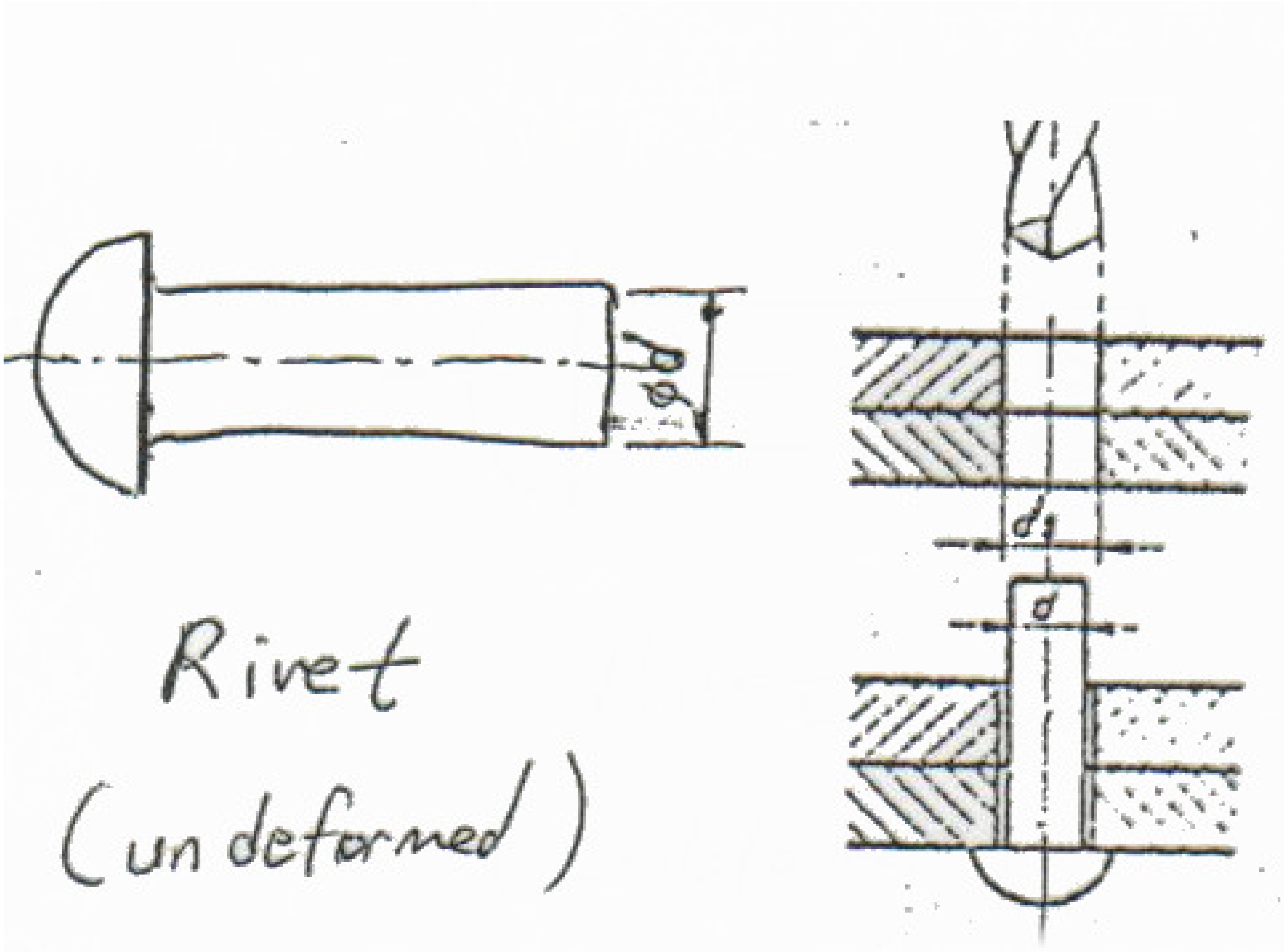


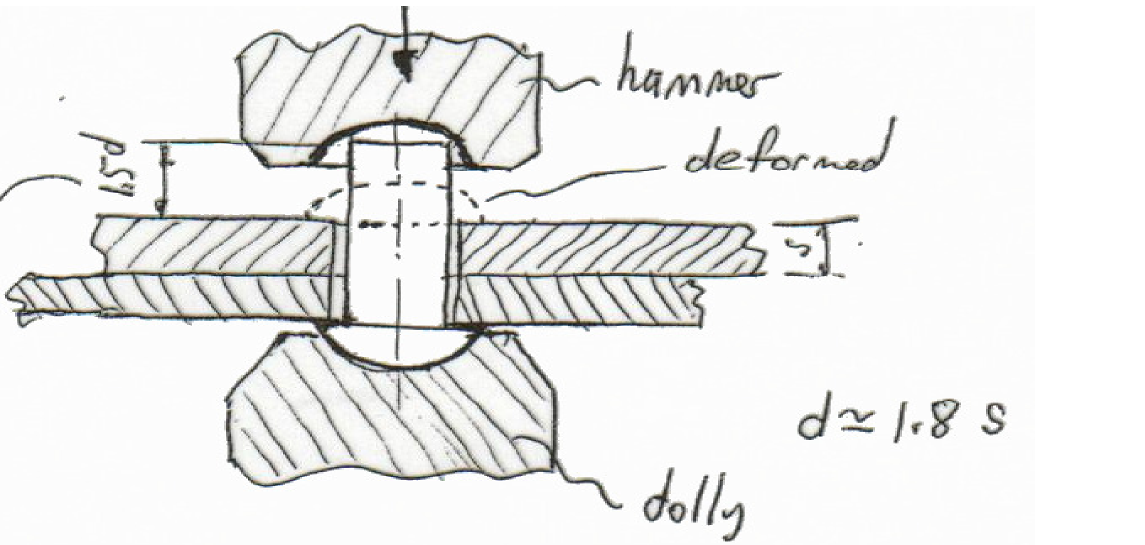
PERÇİNLER
(Rivets)



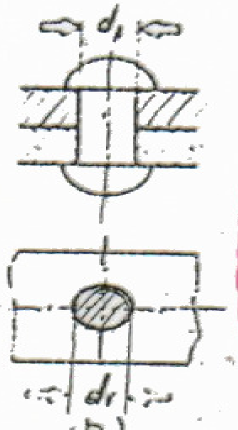
Rivets are metal pins with a head and are used to attach assembled parts permanently. Rivets are available in a variety of head styles and generally are used for sheet metal, such as the skin of an aircraft attached to the frame, or ship parts. Larger rivets are used in steel structures, such as bridges, ships, and boilers.

Basically, a **rivet** is a ductile metal pin that is inserted through holes in two or more parts, and having the ends formed over to securely hold the parts.


Rivet
(undeformed)
d1
d



$d \simeq 1.8\, s$



For button heads if $d < 20$

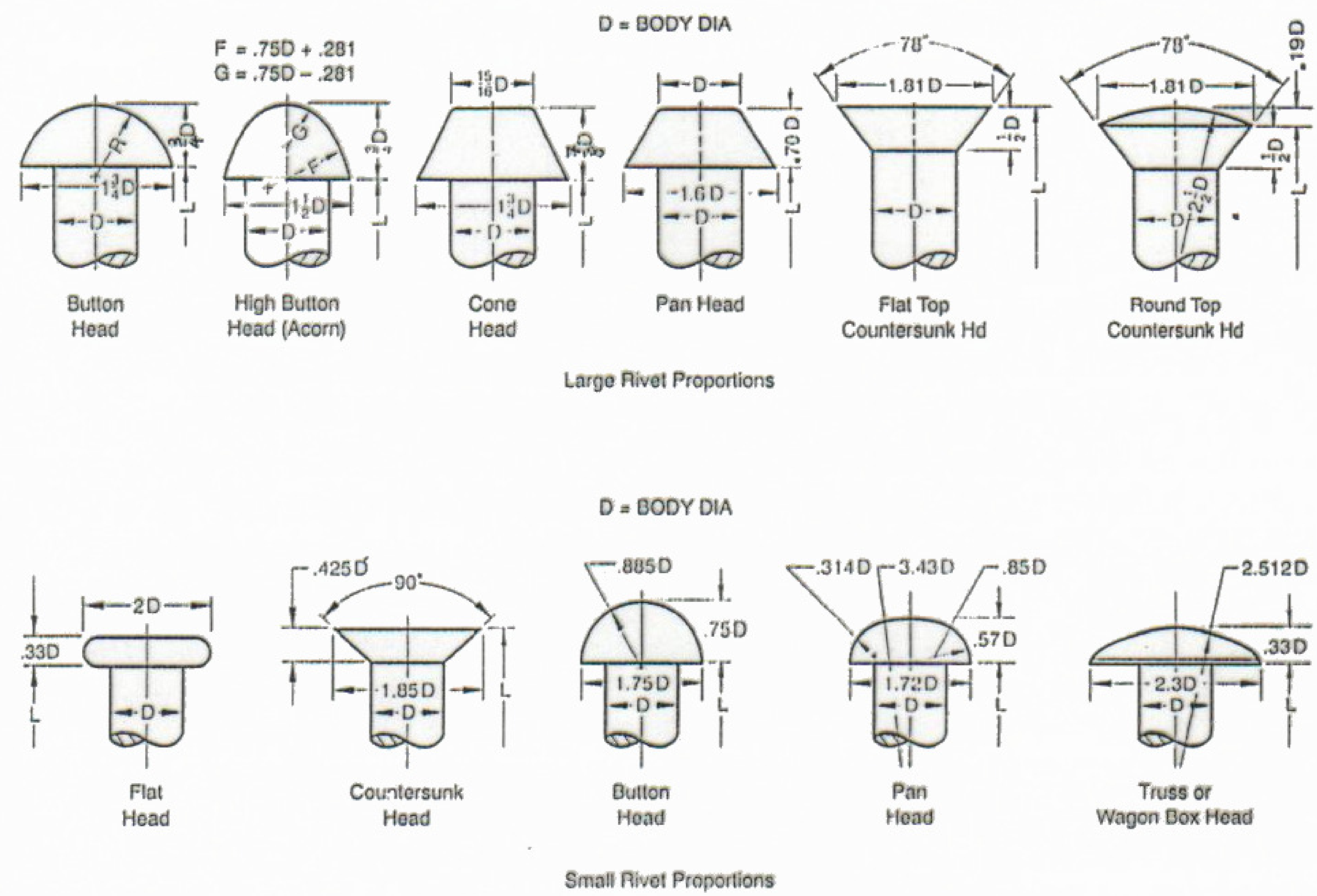
if $d > 20 \Rightarrow 1.7d$

round top countersunk heads $\longrightarrow 1.2d$

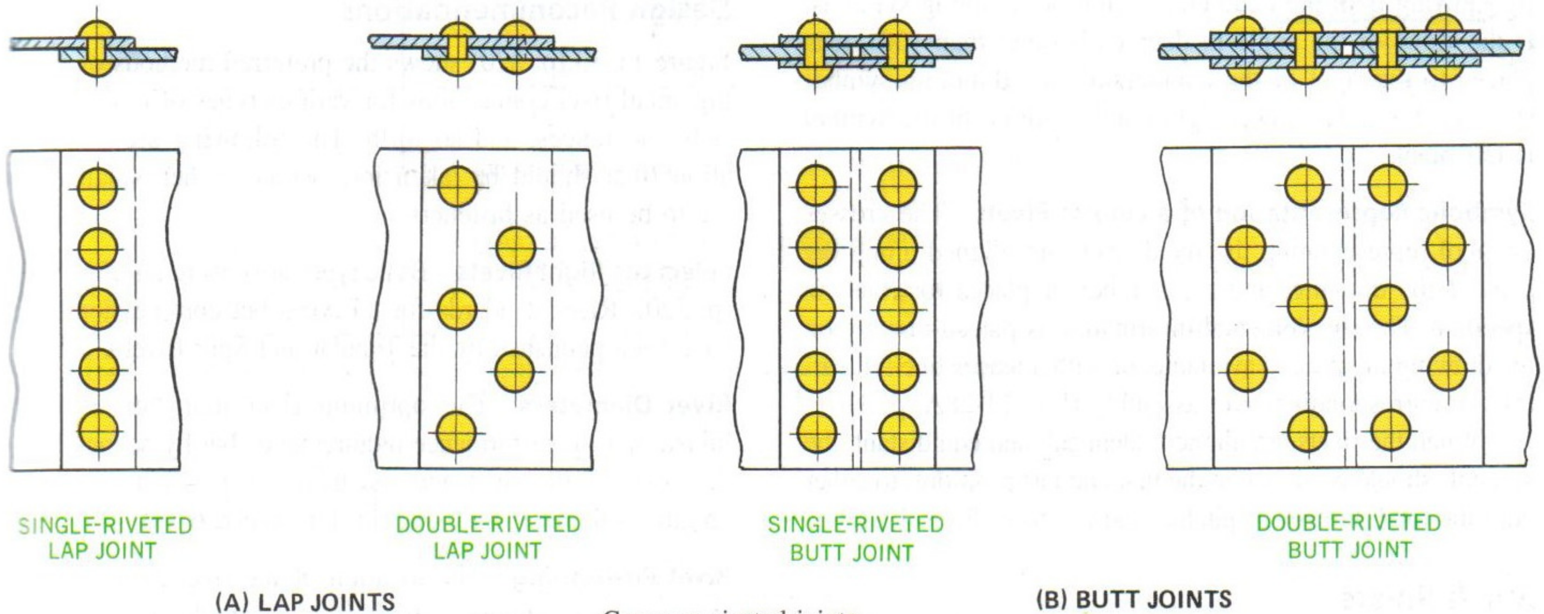
countersunk heads $\longrightarrow (0.5 \sim 0.7)d$

$d_1 = d_{rivet} + (0.2 \sim 0.5)$ [mm] if $d_{rivet} < 10$

$+ 1$ [mm] if $d_{riv.} > 10$

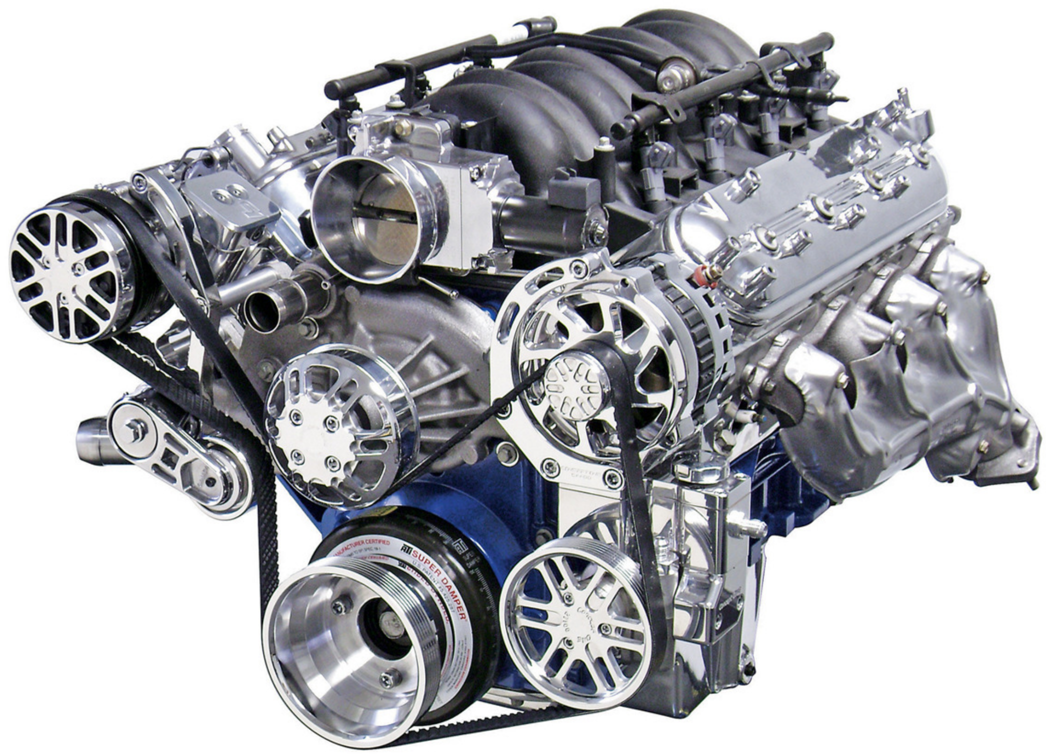


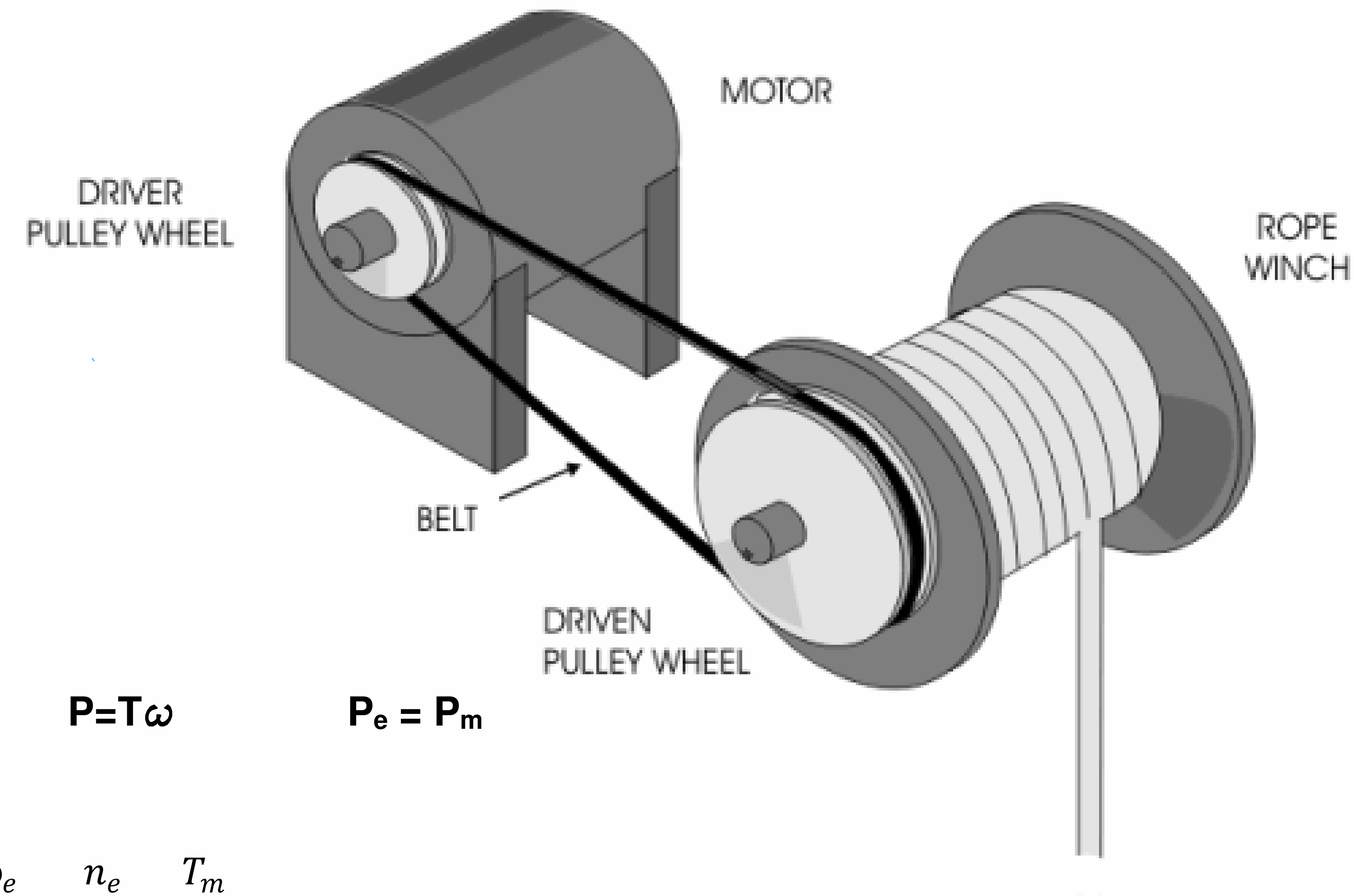
Standard Large and Small Rivets and Proportion Representations



Common riveted joints.

PULLEY- BELT MECHANISM

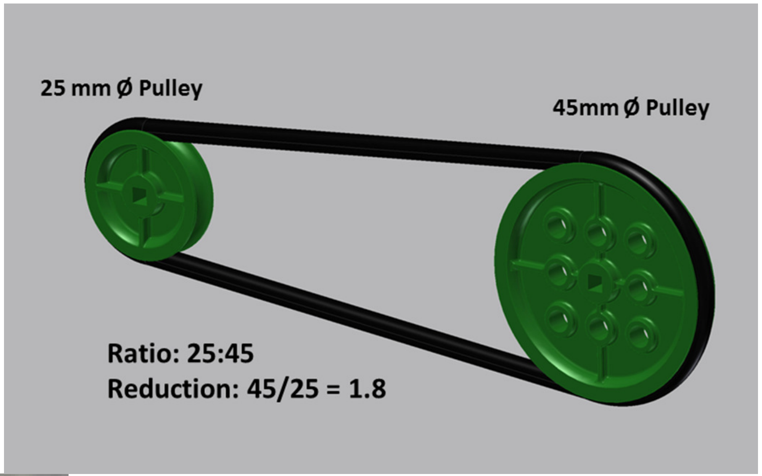




$V = r\omega \rightarrow$ $r_e\omega_e = r_m\omega_m$ $P = T\omega$ $P_e = P_m$

$\omega = 2\pi n / 60$

$$\frac{r_m}{r_e} = \frac{\omega_e}{\omega_m} = \frac{n_e}{n_m} = \frac{T_m}{T_e}$$


25 mm Ø Pulley
45mm Ø Pulley
Ratio: 25:45
Reduction: 45/25 = 1.8