FITS, LIMITS AND TOLERANCE

@ Consider a shaft and a pulley

→ During Machining the workpiece to be cutted, the workpiece and the machine temperature increase leading to thermal expansion.

Example :- Minimum value (80 − 0.5) up to (80.0) thus the value will be.

79.5 − 80.

→ It's impossible to manufacture a component of exact size or shape or form due to surrounding substance due to temperature

→ Tollerance is intended to allow for a reasonable inaccuracy in size form or position withought affecting much the functionability.

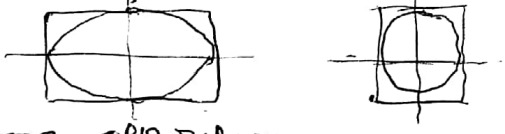
→ Tollerance is defined as.

- Maximum deviation from a given basic size if the component or the assembly is functioning as planned

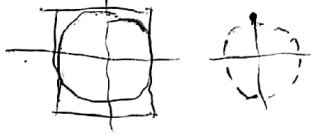
Errors can be..

i) Size

ii) Errors of form.



iii) Errors of position.



TOLERENCE OF THE SIZE.

→ It is indicated by the maximum permitted deviation size which are called limits of size.

→ To be sure that the assembly of matching parts / components will fit network correctly the designer must ensure that all parts will fit together in the required manner

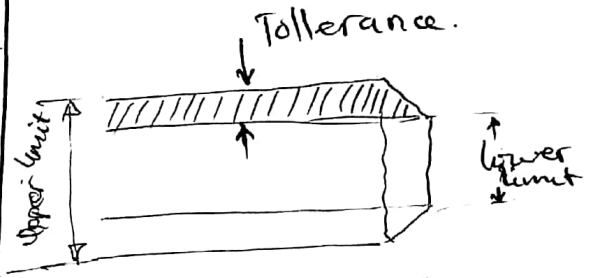
TERMINOLOGIES.

→ Dimension - This is the means of specifying the size of the part

→ Normal base dimension - This is the dimension to which the deviation are being referred to

→ Limits of size - It is the extreme dimension to which it's permicible for the considered size to go

→ Tolerance - This is the difference between the high limit and lower limit of size for a given dimension.



Tollerance = Upper limit − lower limit.

GROUPS OF ALLOWABLE TOLLERANCE

→ Unilateral tollerance figures having the same sign

→ Bilateral tollerance - figures having different sign.

→ Unilateral is used whereve have machine part.

* Bilateral is used where we do not have Mating parts

ALLOWABLE TORRELANCE CAN be grouped in to two groups.

→ Unilateral torrelance.

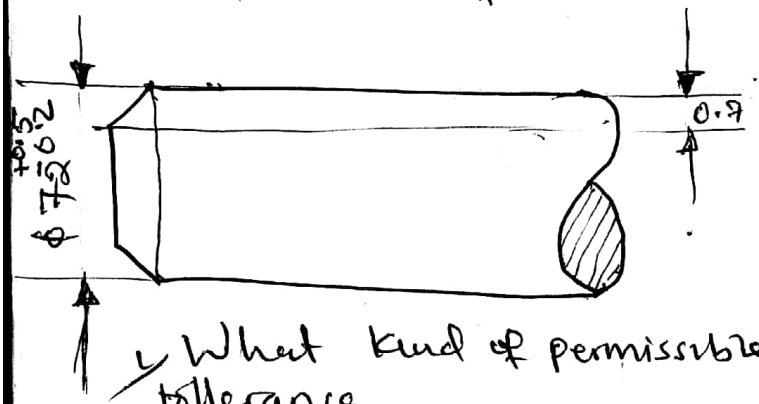
· When permissible tollerance are of the same sign. either all +ve or all -ve $20^{+0.1}_{-0.1}$, $20^{0.0}_{0.1}$, $20^{-0.0}_{-0.2}$.

- Its generaly used while dealing with mating parts

ii) Bilateral tollerance

→ Permicible tollerance which is partly -ve and partly +ve. Are of different sign.

⇒ Consider a shaft below.



i) What kind of permissible tollerance

ii) What is the upper limit.

iii) What is the lower limit.

iv) What is the torrelance.

Soln

i) The permicible torrelance is bilateral

ii) Given $72^{+0.5}_{0.2}$

upper limit = (72 + 0.5mm)
= 72.5 mm.

iii) Lower limit = 72 − 0.2
= 71.8 mm.

iv) Tolerance = upper limit − lower limit.

Tollerance = 72.5 − 71.8 = 0.7mm.

FITS.

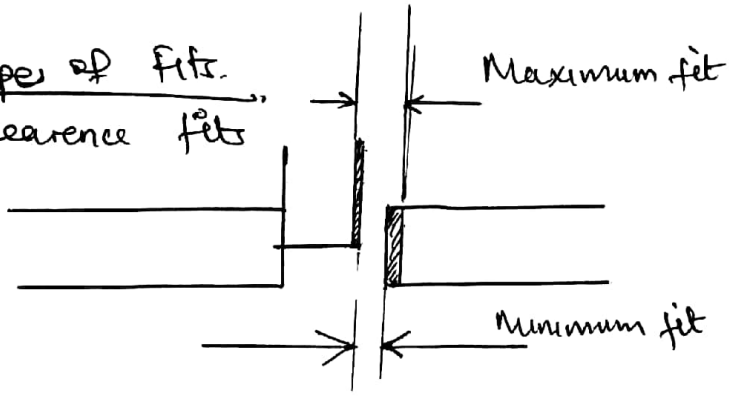
→ The fit depend on.

i) Function

ii) Dimension

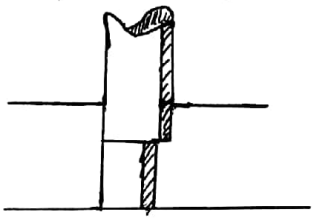
→ Type of fits.

i) clearence fits



ii) Interfearence fit

→ Always the size of the shaft bigger than size of the hole.



iii) Transition fits.

→ One condition must be satisfied that you must have an interfearence fit

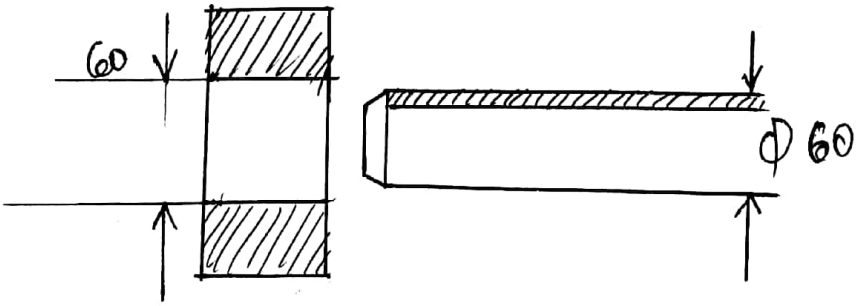
SYSTEM OF FITS.

I. A Hole basis / Unit hole.

→ The hole remain untouched and the shaft is reduced.

II. A shaft basis / Unit shaft.

→ The shaft remain untouched and the hole is enlarged.



FIT GRADES FOR SHAFT AND HOLES.

For Holes they are denoted by Capital letters

→ A, B, C, CD, E, EF, G, GF, ------ Z, ZA, ZB, ZC.

→ For Holes are denoted by small letter

When we write $40^{(+0.5)}_{(-0.4)}$ → They are called permicable tollerance

→ The types of permicible tollerance

- Unilateral – occure when both values are positive $40^{(0.5)}_{(0.1)}$
- Bilateral – occur when values are different either positive or negative $40^{(+0.5)}_{(-0.1)}$

Eg :- $\phi 50 H_6/k_6$

Female (Hole) ↑ — ↑ Male (shaft)

Example.

→ A shaft with ϕ 72 mm is to be manufactured to fit in a flat belt pulley

i) Write down the fit grade for the ~~pulley~~ assembly

ii) What type of fit is it?

iii) Fit grade for female part.

iv) Find the upper and lower limit for the hole.

Soln.

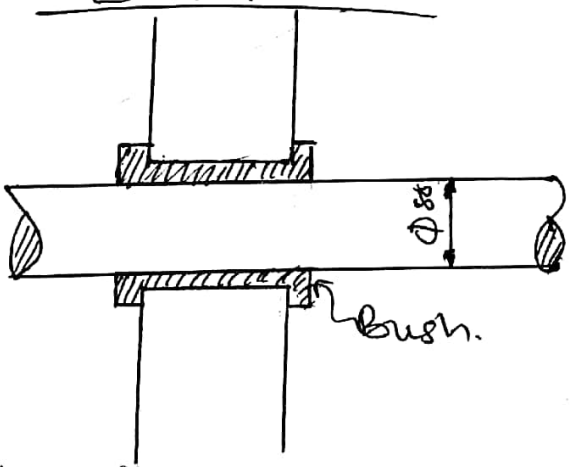
i) For our case the answer is $\phi 72 H7/k6$.

ii) The pulley lies on a transition fit

iii) The fit grade for the female part. $\phi 72 H7$ $(^{+30.0}_{0.0})$

iv) The upper and lower limit for the hole is 72

Example 02



i) Consider the figure above.

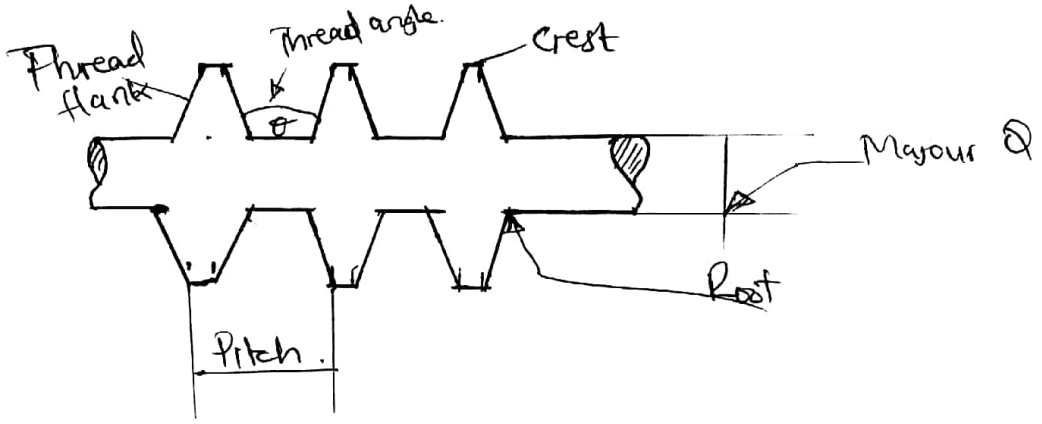
ii) Find the grade for assembly

iii) Allowable ~~size~~ size for the shaft.

→ The grade is H7. Soln.

THREADS.

→ A helical groove made on a cylindrical object or a hole



STANDARD DESIGNATION OF THREAD.

→ Prefered Numbers.

→ International System organization (ISO) uses normal metric system

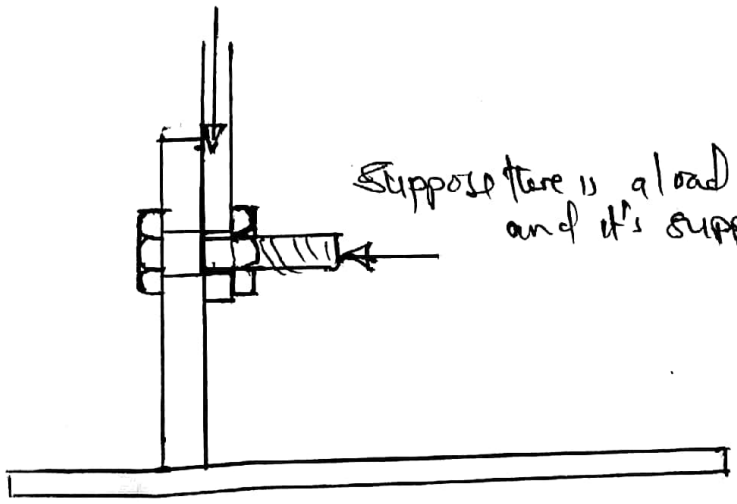
→ British system (BS). use british system.

* For the ISO system (Left Hand or Right hand)
  → You go for Standard x Mayour diameter Ø x Pitch x,
  eg M20/2.5 or M20x2.5.

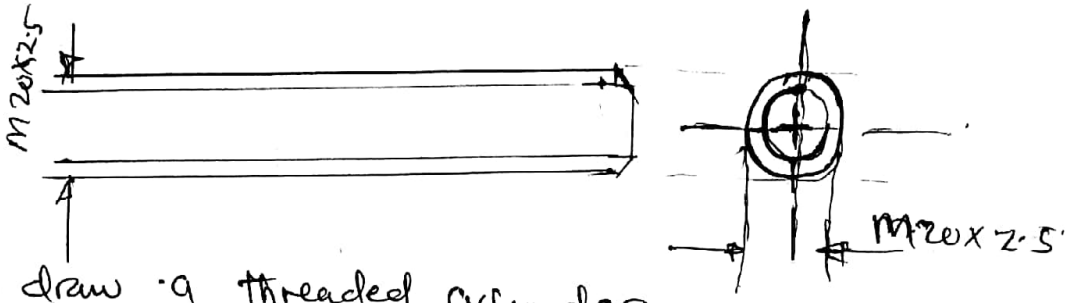
Left Hand thread and right hand thread thus when naming a thread its supposed tobe.

M20 x 25 x LH.

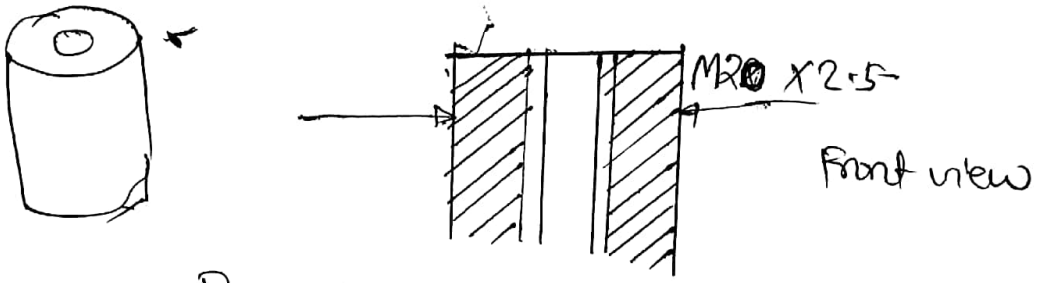
* Standard x Mayour Diameter Ø x Pitch (RH or LH) x Number of starts x. x. (thread form)

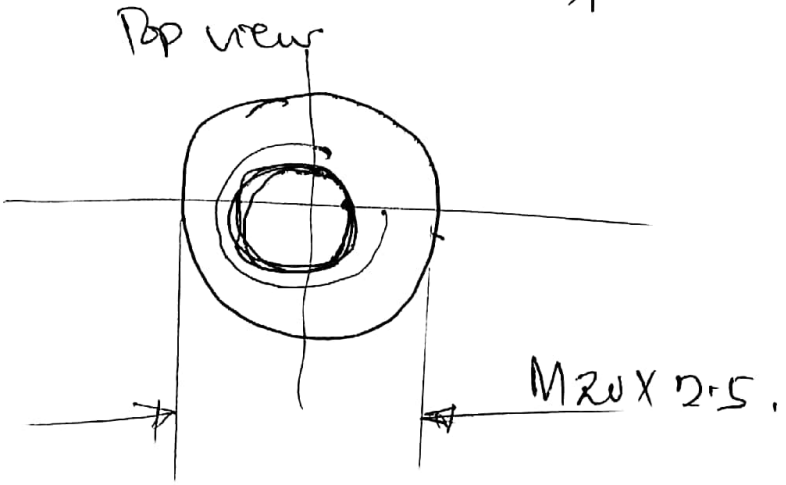


How to draw a thread section



How to draw a threaded cylinder.





DESIGNATION OF ENGINEERING ITEM.

→ Hexagonal Nut STANDARD DESIGNATION.

steps.

- You have to start with the size. (M12).
- You have to standard pitch. 1.75.
- You have to go and study the standard ISO (Hexagon nut M24 ISO 4032).

M12 X 1.75 X Hexagonal nut M24 ISO 4032.

→ Example you have M8 nut.

→ M8 X. 1.25 X ISO 4032.

STANDARD DESIGNATION OF BOLTS. (Table 120).

→ Hexagonal head bolts.
→ The Standard is M12.
→ Then you find the pitch of your bolt 1.75 pitch.
→ Then for the hexagonal nut its standard ISO is 4017.

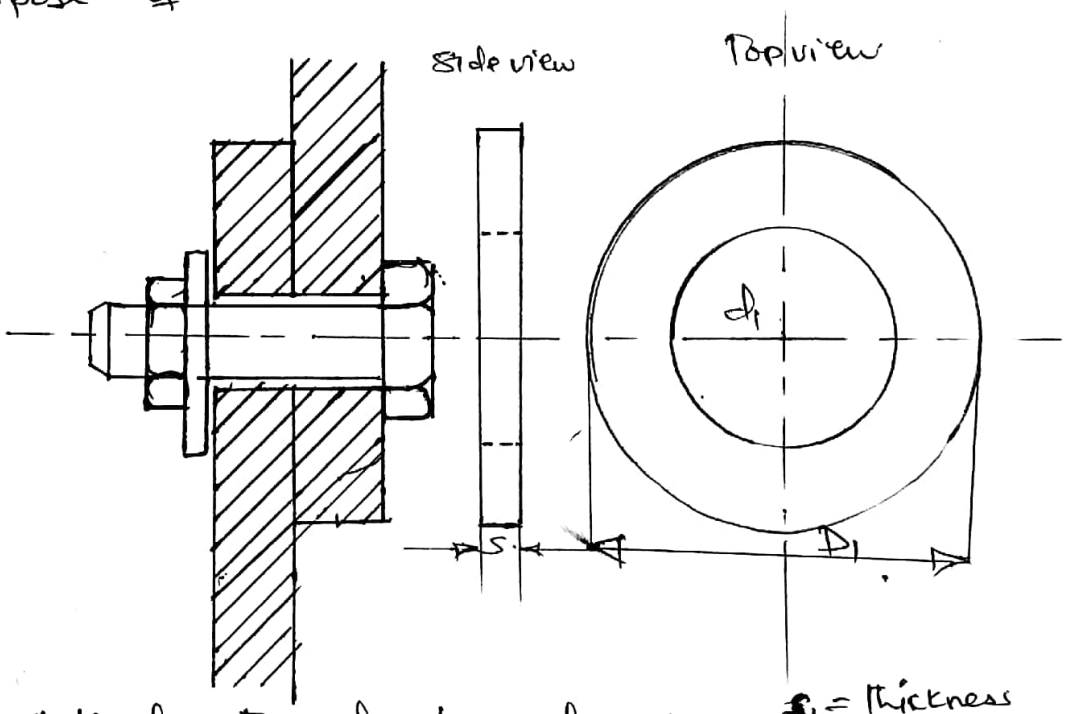
Hexagonal head bolt M12 × 1.75 × ISO 4017.

Example when the bolt is M20.

→ HEXAGONAL HEAD. M20 × 2.5 × ISO 4017.

WASHER.

⇒ The purpose of washer is to



D_1 = Outer diameter d_1 = Inner diameter S_1 = Thickness

Standard designation for a washer. (Page 122.)

→ The standard designation for a washer is

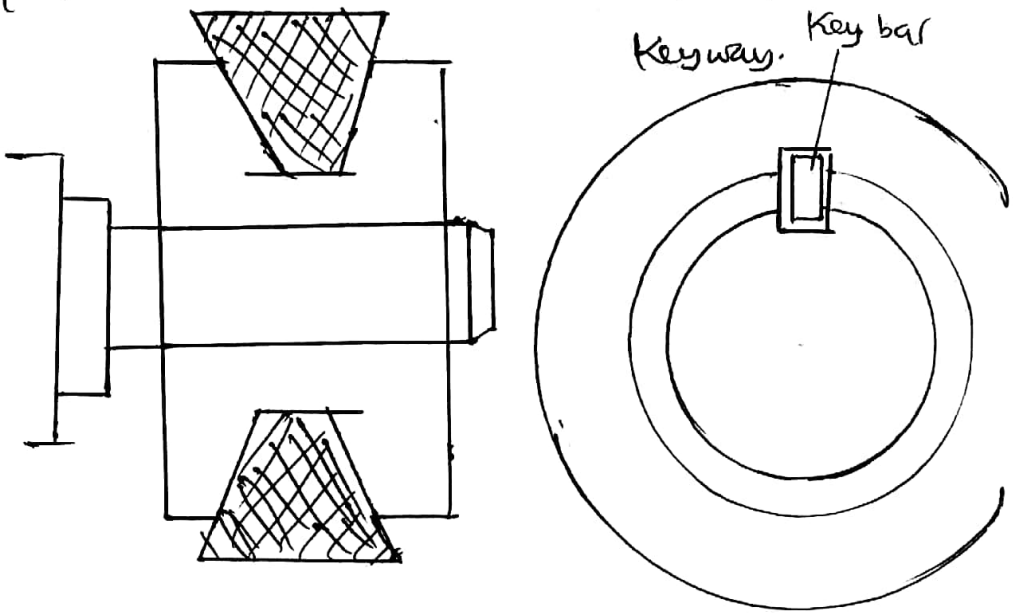
$d_1 \times D_1 \times S_1$

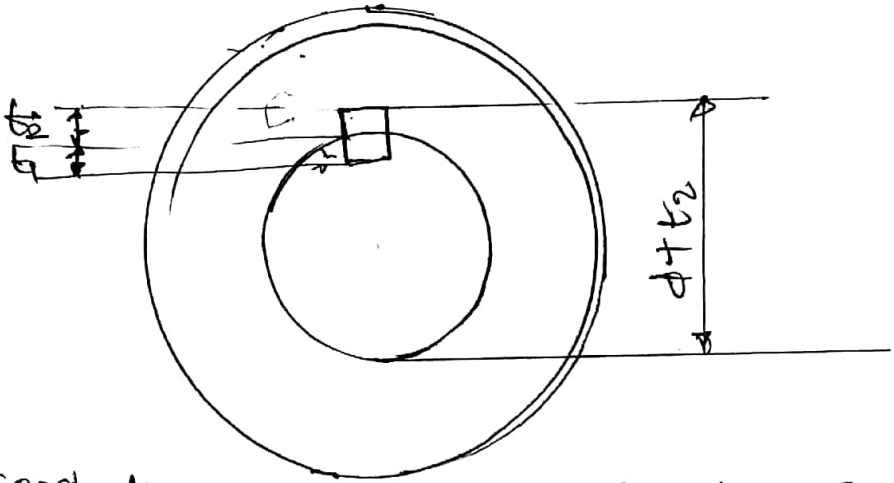
Example a standard washer for the M12 bolt.

→ Washer 13 × 24 × 2.5 ISO 4032

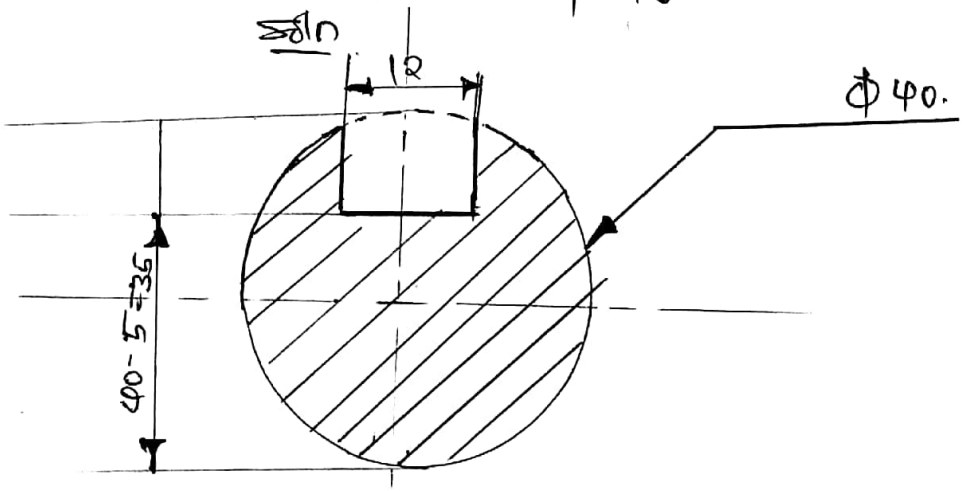
→ The ISO number for the washer is the same as for the nut

Suppose you have a sectional view of a Pulley.



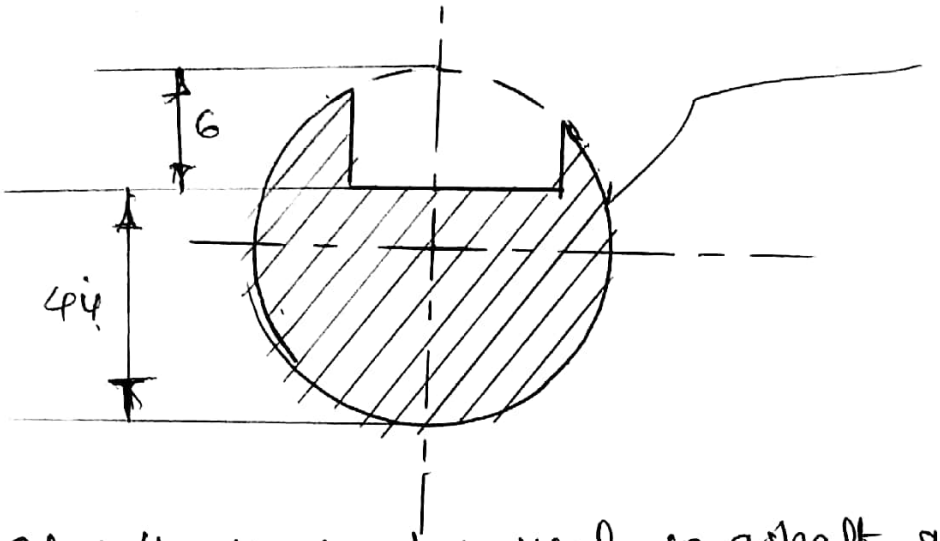


→ Example ÷ Construct a cross section Groove for a key way to be cut on shaft with ϕ 40mm.



Step find . b . where it's between 38 - 44 and value is 12
then find t = 5

Example : Sketch a groove for a key way to be cut on shaft with ϕ 50m.



Example Select the key bar to be used in a shaft and bore with the nominal size 60mm.

Soln

Standard designation of key bar.

Paraller key A x b x h x ℓ ISO NO.

~~Paraller key A~~

* Paraller key x 18 x 11 x 150 1084.

Example No 2.

→ Select the standard keybar to be used in a shaft and bore of 40mm long and a nominal ℓ size ϕ80 mm.

Soln.

Paraller key A x 22 x 14 x 150 1084.

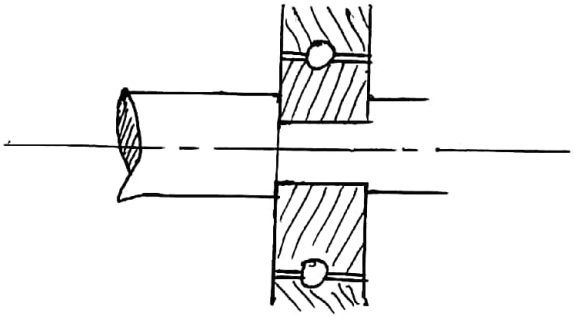
or

Paraller key A x 22 x 14 x 40 ISO 1084.

Material to be used ; Since h ≤ 25 (St 50-3K DIN 1652

CIRCLIP.

⇒ They are used to prevent axial movement of machine elements along a shaft



Consider the following

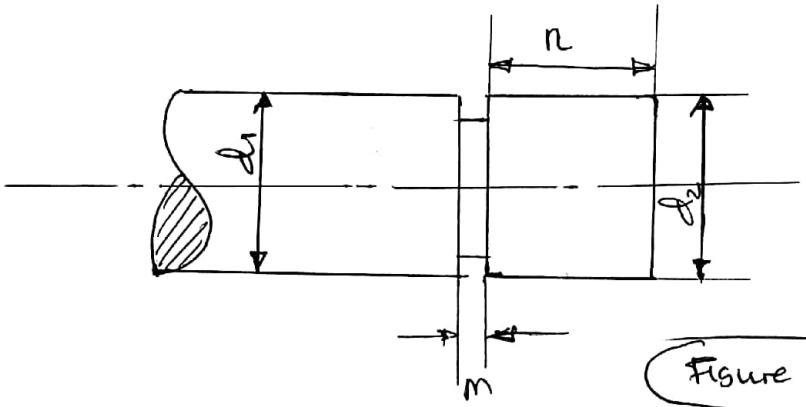
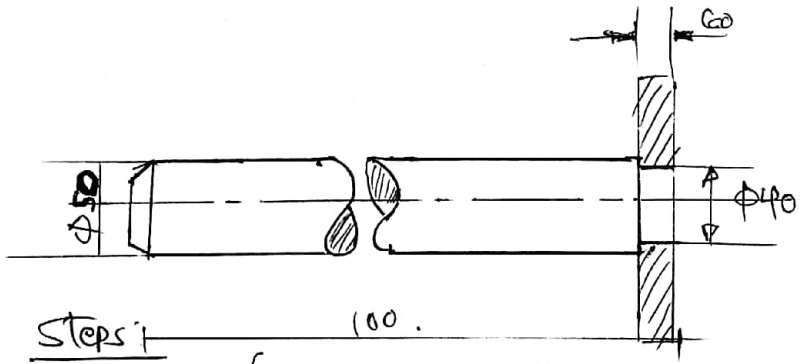


Figure (02)

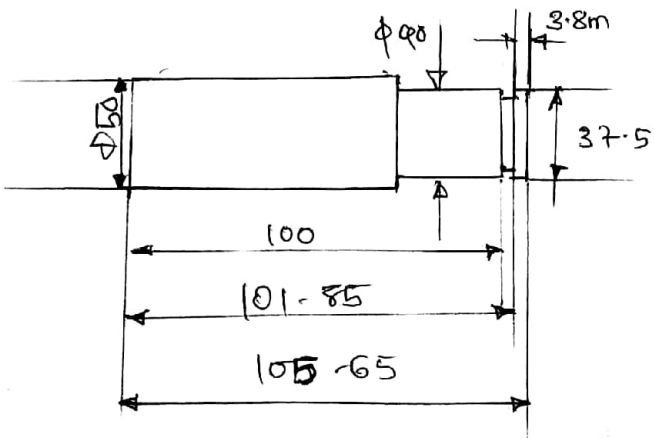
⇒ The figure below of a flywheel mounted on a shaft, the design of the shaft have to be improved so as to improve the circlip to prevent the axial movement, draw the drawing for the improved shaft



Steps:

→ Go to the table (141 page). Circlips for shaft.

→ recall from figure (2)



STANDARD DESIGNATION FOR CIRCLIP.

⇒ Circlip for shaft 40 × 1.75 DIN 471.

Example :- Write a standard designation for circlip with the diameter of Φ75 mm.

Sol^n.

$\Phi = 75m$

$d_1 = 75$

$S_1 = 2.5$

DIN 471

Thus circlip shaft 75 × 25 × DIN 471

Example :- Suppose circlip for shaft 60 × 2 DIN 471. Find the size of the shaft.

Sol^n

the size of the shaft = 60 mm.