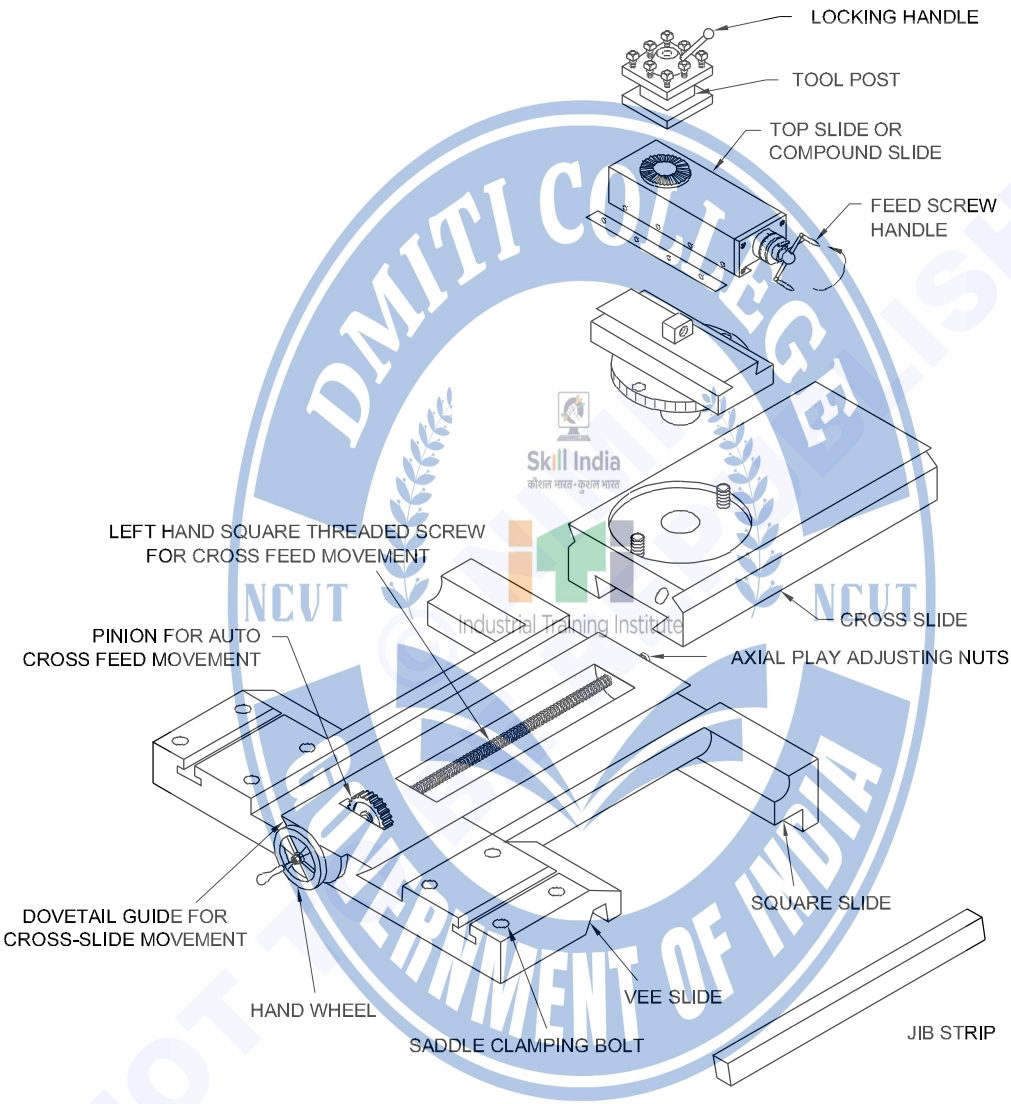
Dismantle, overhauling & assemble cross slide & hand slide of lathe carriage

Objectives: At the end of this exercise you shall be able to
- **dismantle the compound rest from the cross slide**
- **remove out the carriage unit from the machine bed**
- **assemble and test for functions.**

Fig 1



Job sequence

- Unscrew the tool posts locking handle (Fig. 1A) and remove the tool post (1B) from the compound slide.
- Rotate the feed screw handle of the top slide (Fig. 1C) in anticlock wise direction to get it released from the dovetails of the compound slide.
- Take out the jib from the dovetail of the top slide. (Fig 1D)
- Unscrew both the clamping nuts (Fig 2) from the T.bolts, provided on the swivel base of the compound slide and take out the unit.
- Remove the graduated collar (Fig 2) of the compound slide by removing the taper pin.

Fig 1

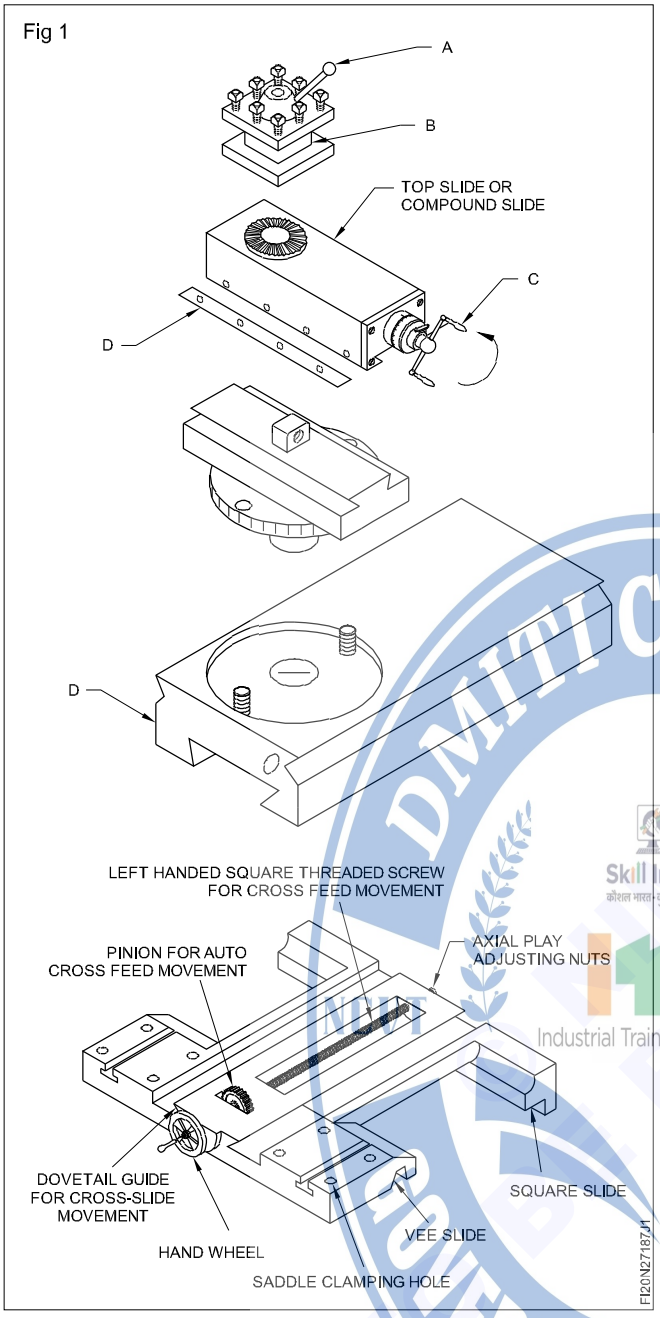
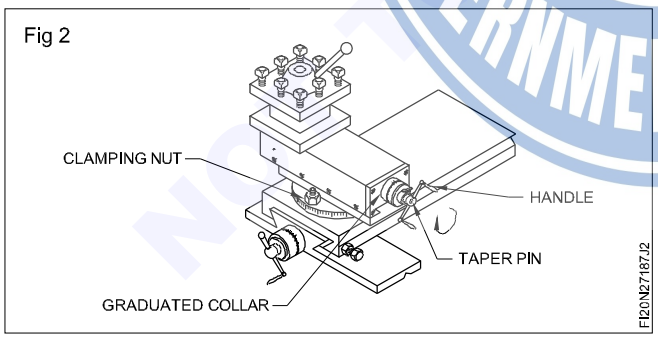
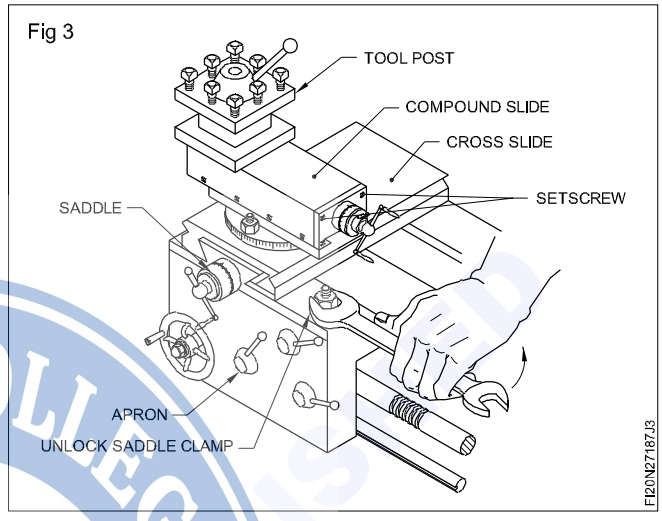


Fig 2



- Disengage the lead screw from the cross-slide.
- Unscrew the lock nuts from the cross-slide feed screw to remove the graduated collar.
- Take out the jib strip from the dovetails of the cross-slide so that it can be made to slide out easily.
- Unscrew and remove the saddle clamp. (Fig 3)

Fig 3



- Slide way the tailstock unit and take it out of the bed.
- Slide away the saddle unit towards the right end to take it out of the machine bed.
- Clean the parts with kerosene oil, wipe them with banian cloth and keep the parts in tray.
- Inspect the components visually for damage and wear.
- Lubricate the parts with lubricating oil.
- Assemble the parts in the reverse sequence to complete the process of overhauling.
- Check the function.

Simple repair of machinery: Making of packing gaskets

Objectives: At the end of this exercise you shall be able to
- **mark and cut the profile and prepare gasket**
- **fit new gasket and test the joints for leakage.**

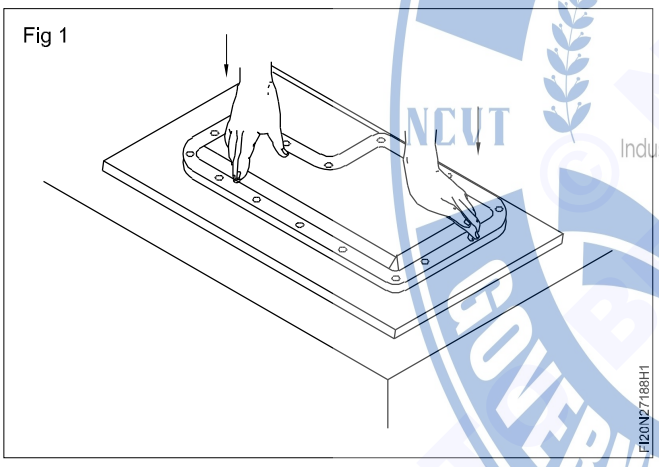
Job sequence

- Remove the cover plate and take out the damaged gasket.

Ensure that no portion of the gasket remains on the surface.

- Clean the surface of the base and the cover plate thoroughly.
- In the case of glue-bonded gaskets, surfaces should be cleaned thoroughly using a blunt scraper.
- Smear marking medium or grease on the cover plate's base surface.
- Place the gasket on to the base of the cover plate and press firmly. (Fig 1)

Fig 1



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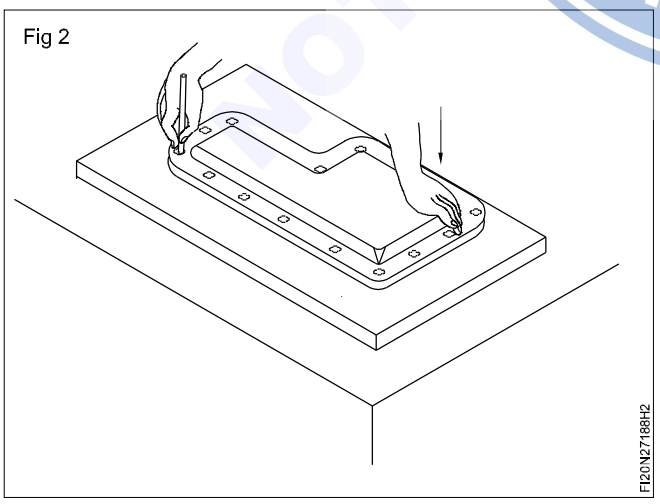
- Mark the geometrical shape of the gasket using a scriber or pencil. (Fig 2)

Fig 2



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For smaller or handy objects the article can be placed on to the gasket for marking.

- Punch out the holes using a hollow punch and a hammer or a little over- size steel ball and a hammer. (Figs 3 and 4).

Fig 3

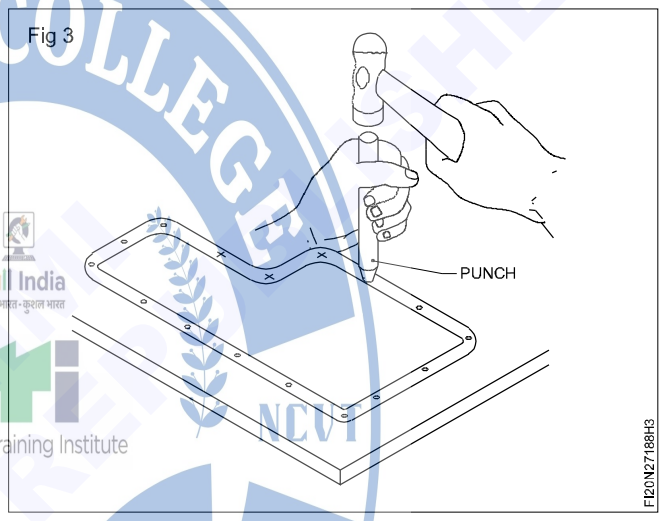

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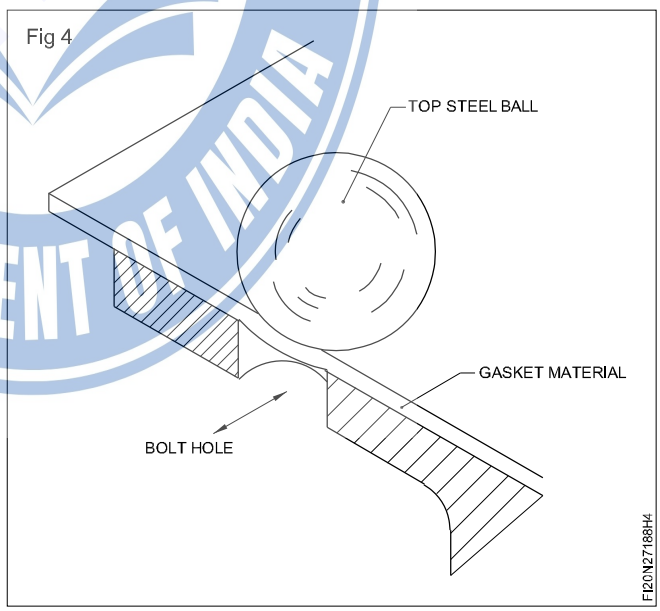
Fig 4



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- Cut out the unwanted portion of the gasket using scissors. (Fig 5)

Cut out the centre portion first and then the external profile.

- Clean the corners of the studs. (Fig 6)

Fig 5

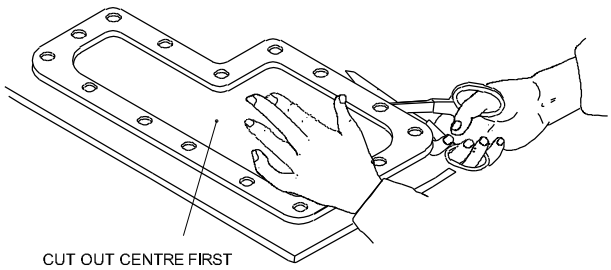
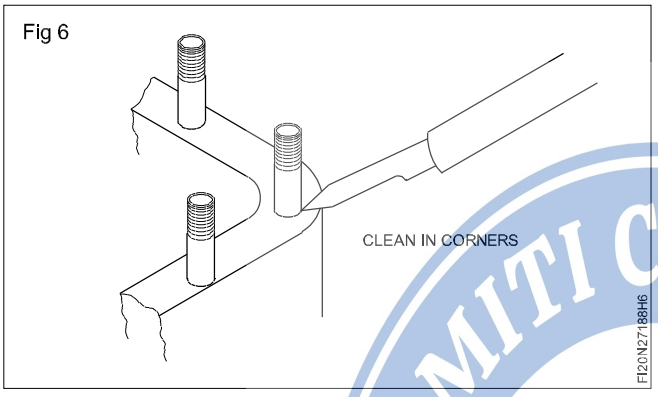
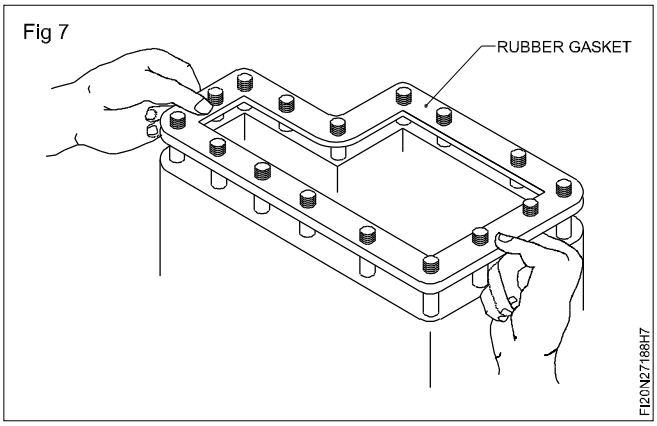


Fig 6



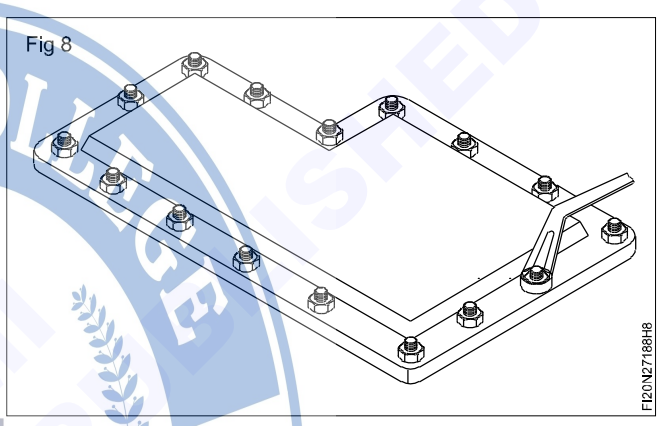
- Fit the gasket in position. (Fig 7)

Fig 7



- Replace the cover plate on to the gasket and tighten the screws evenly. (Fig 8)

Fig 8



- Test the sealed joint for leaks and functional aspects.

Check washers, gasket, clutch, keys, jibs, cotter, Circlip etc and replace / repair if needed

Objectives: At the end of this exercise you shall be able to
- **replace washer on gasket**
- **replace clutch and keys**
- **replace jib, cotter and circlip**
- **replacing the above components.**

Fig 1

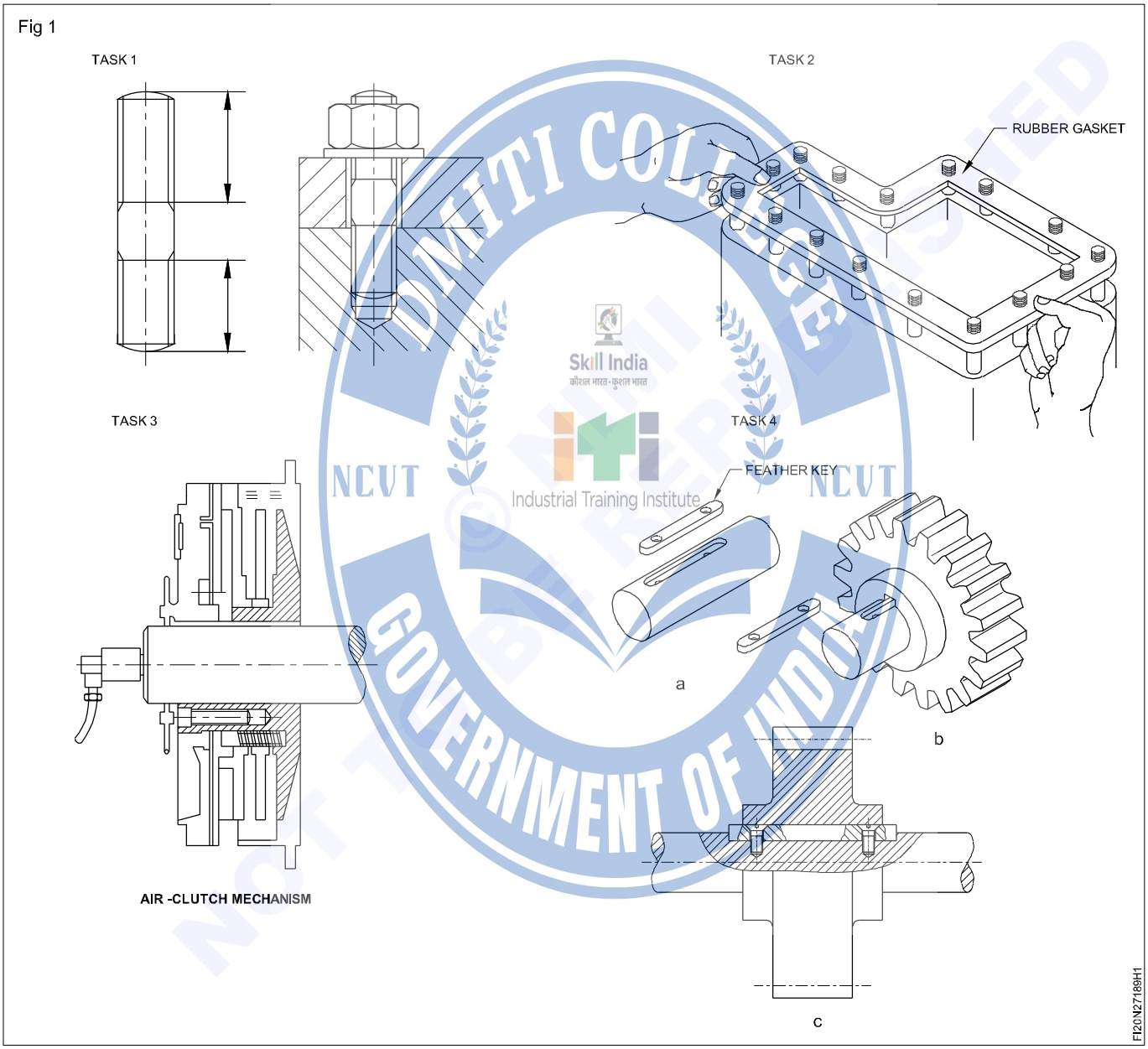
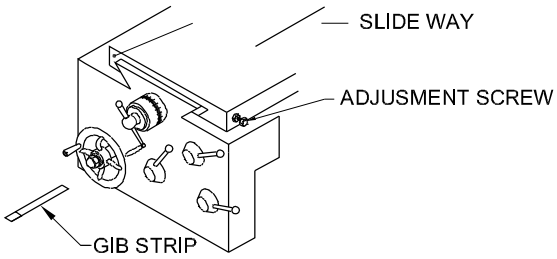
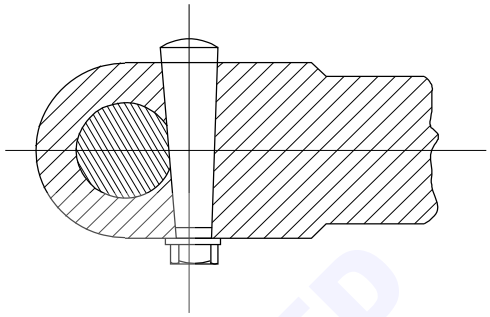


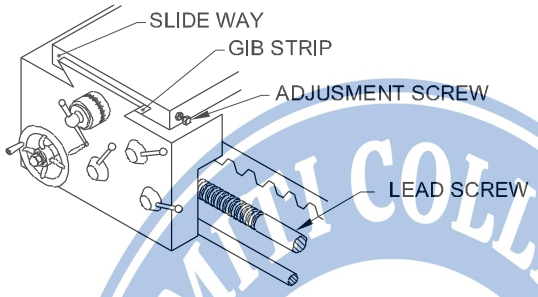
Fig 2

TASK 5

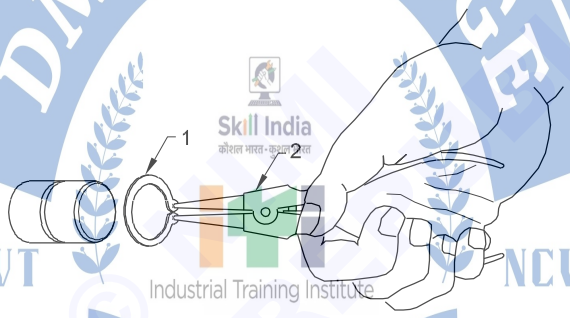


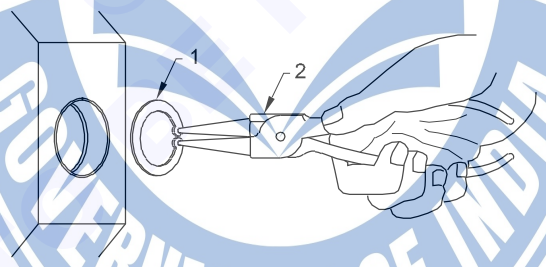
TASK 6





TASK 7





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Job Sequence

TASK 1: **Replacing washer**

- Remove nut using correct size spanner.
- Remove the worn out washer from the assembly.
- Place the correct size washer.
- Tight the nut with washer.

— — — — — — —

TASK 2: **Replacing gasket**

- Remove the damaged gasket.
- Clean the surface of the base and the cover plate.
- Place the gasket on the base plate and press firmly.
- Assemble the unit.
- Detailed assemble explained in Ex. No. 1.7.188

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TASK 3: **Adjusting the clutch**

- Remove the both side covers of feed gear box using allen keys after switch off the power supply.
- Remove the terminals by using suitable spanner.
- Use a bend tubular spanner to remove the carbon brushes.
- Remove the circlip form the spline shaft.
- Take out the clutch with spline shaft from the unit by using M 12 bearing puller set.
- Place the assembly on work bench, clean it properly.
- If not getting proper engaging and disengaging of clutch, dismantle the clutch unit and remove clutch plate.
- Identify the following electrical and mechanical faults.
- Check the gap with feeler gauge between clutch plates and ensure that the gap should be as mentioned by the original equipment manufacturer.
- Check the spline shaft and ensure that the splines are proper.
- Assemble all the parts and once again check the unit on a work bench.
- If found satisfactory working of clutch assembly mount it in to the feed gear box of machine.
- Seated the circlip, carbon brushes and terminal.
- Fix the side covers by using allen key and check the working of clutch assembly by switch on the machine.

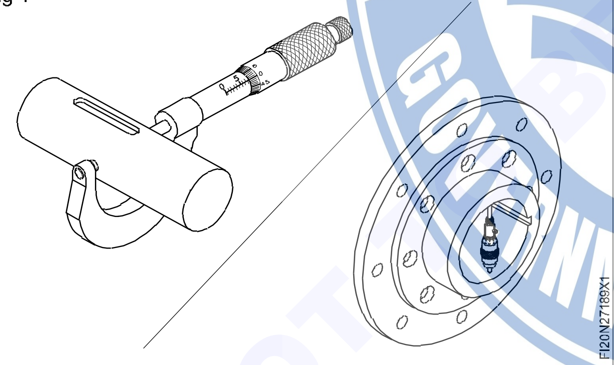
TASK 4: **Replacing key**

- Assemble hub and shaft with parallel key.
- Assemble hub and shaft with tapered (Gib Head) key.

Parallel key fitting

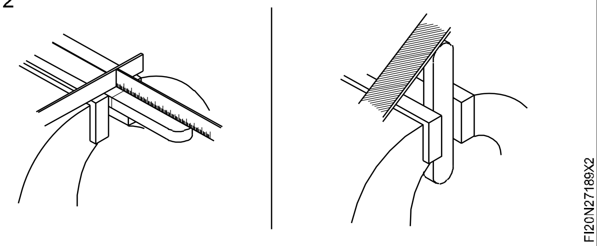
- Deburr the keyways in the shaft and the Hub, clean the keyways.
- Check the dimensions of shaft and Hub and keyways using precision instruments. Outside dia of shaft. inside dia of hub, length, with and depth of keyways as per the drawing (Fig 1).

Fig 1



- Select a length of key steel of suitable cross section depending on the size of the keyway.
- File radius at one end of the key and cut to a length plus 1mm of the keyway and the other end of the key (Key2).

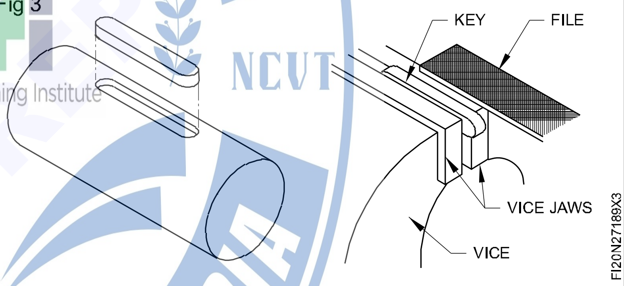
Fig 2



Ensure that the key is chamfered all around in its bottom side edges.

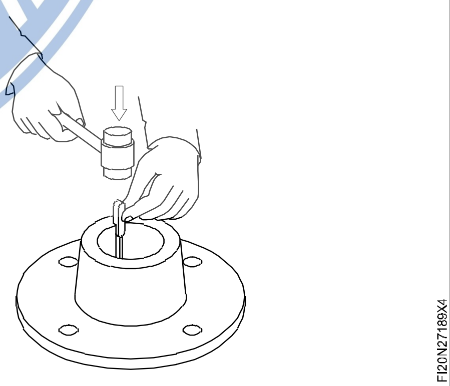
- Check the key width to duit the keyway in the shaft. Draw file the key. so that it is slight tap fit / light keying fit (K7-h6) with the keyway on the shaft. (Fig 3)

Fig 3



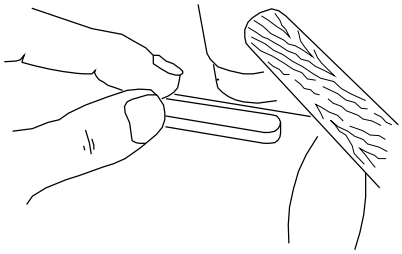
- Check the key for slight tap fit with the keyway in the Hub. (Fig 4)

Fig 4



- Apply Prussian blue on all the sides and bottom portion of the key so that proper bearing of key on the keyway is ascertained.
- Insert the key in the keyway of the shaft and tap with a light weight soft hammer.(Fig 5)

Fig 5



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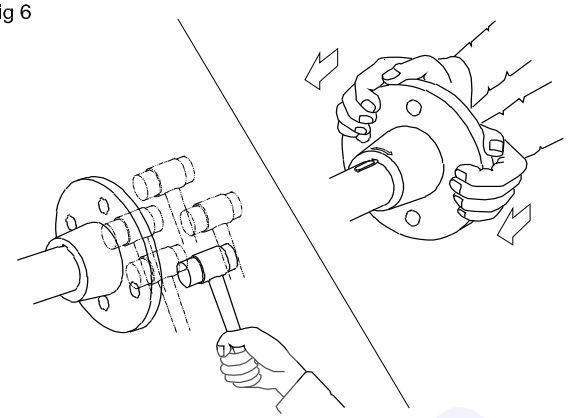
- Tap the hub on the shaft, and remove the hub from the shaft, check the key and note the high spot where the key has made contact with the keyway of the hub.
- Lightly file the high spots away, the top of the way should be approximately 0.1mm clear.
- Repeat the fitting and filing operation until the hub is fit on to the shaft to the desired position. (Fig 6)

Fig 6



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TASK 5: **Replace/ adjust jib**

- Remove the adjusting screws from the dovetail slide.
- Dismantle the gib from the cross-slide.
- Clean the slide surfaces, adjusting screws, nuts and gib thoroughly.
- Inspect all the parts for check any damage.
- Lubricate the slideways.
- Assemble the gib.
- Tighten the adjusting screws to give the correct freedom required in the assembly.
- Lock the movement of the adjusting screw by the check- nut.

TASK 6: **Replace cotter**

- For removing cotter from work unit, loose the nut slightly then slowly strike with soft hammer.
- Then loose the nut completely pull the cotter pin.
- Insert the new cotter pin in the hole strike with hammer.
- After tightening the pin fix the nut.

TASK 7: **Replace circlip**

- Assemble external circlip using cone and compresson bush.
- Assemble internal circlip using cone and compression pin.
- Assemble external and internal circlips using pliers.
- Dismantle external and internal circlips using pliers.

During assembly, circlip is to be spread or closed as far as it is necessary for positioning on the shaft or installing in the housing bore.

Assemble external circlip using cone and compressor bush

- Circlips without assembly holes are best assembled by means of cones Figs (1) & (2)
- Place the cone over the shaft in which the circlip is to be fixed.
- Place the circlip over the cone.
- Place the compressions bush over the circlip.
- Press the compression bush by suitable means depending upon the size of the circlip, slowly and smoothly until the circlip is seated in the groove.

Fig 1

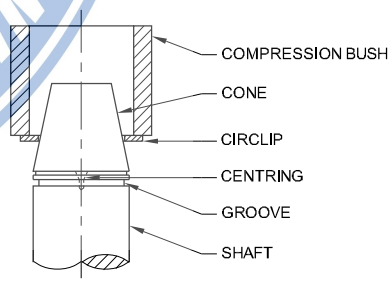

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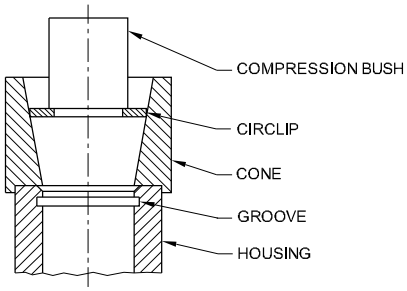
Fig 2



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Assemble internal circlip using cone and compression pin

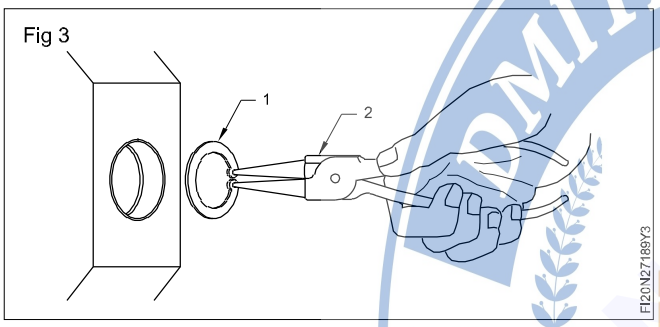
- Place the cone over the bore in which circlip is to be provided as shown in Fig 2
- Place the internal circlip in the tapered bore of the cone.
- Place the compression pin over the circlip.
- Press the compression pin slowly and smoothly until the circlip is seated in the groove in the bore.

Assemble and dismantle circlip using pliers

- Select suitable circlip pliers depending upon the circlips to be used. (External or Internal)
- Remove all sharp edges from the circlip and check for the crack, if any.

Assemble internal circlip (Fig 3)

Fig 3

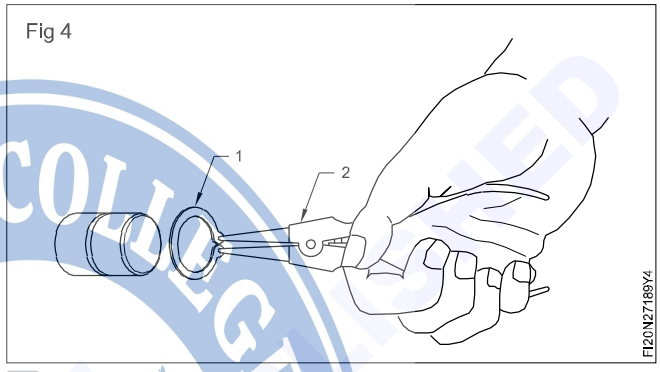


- Hold the internal circlip (1) with help of an internal circlip piler (2).
- Press the circlip (1) with the help of the plier (2) so that its diameter will be smaller than the hole diameter.
- Insert the circlip in this position, in such a manner that it will sit squarely in the groove.
- Take out the plier (2).

Assemble external circlip (Fig 4)

- Hold an external circlip (1) with the help of an external circlip plier (2).
- Press the external circlip plier (2) so that the circlip (2) will enlarge in diameter.

Fig 4



- Slide the circlip on the shaft in the enlarge position, until it is set in the shaft groove.
- Ensure that the circlip sits squarely in groove (3).
- Take out the plier.
- For dismantling the internal and external circlips the above procedure can be reversed and applied.

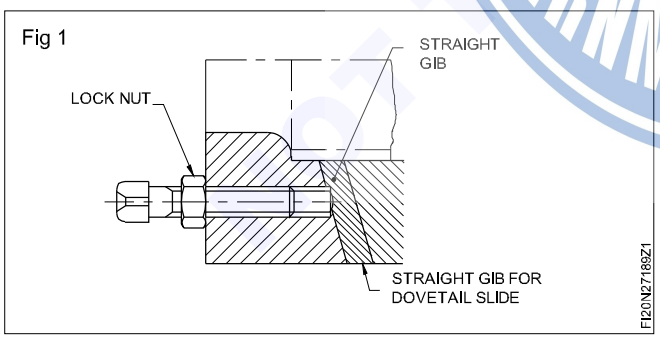
Skill Sequence

Adjust the gib strip

Objective: This shall help you to
- **adjust and align the gib strip in a lathe.**

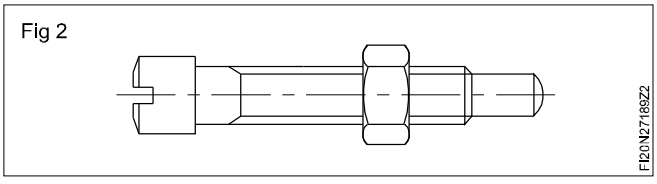
Loosen the lock- nuts. (Fig 1)

Fig 1



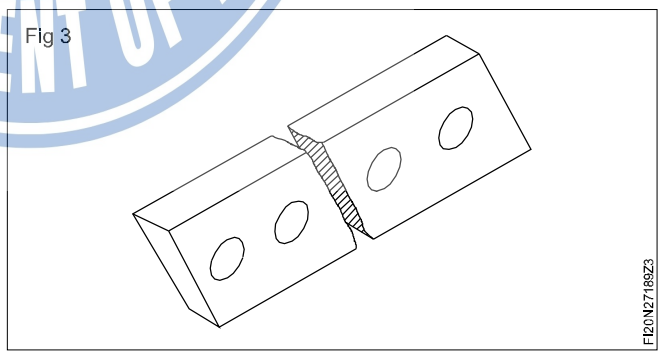
Remove the set screws. (Fig 2)

Fig 2



Pull the gib out. (Fig 3)

Fig 3



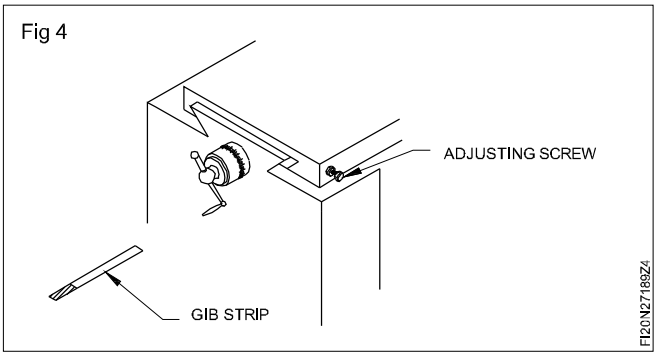
Check the straightness of he gib using Prussian blue.

Scrape the gib to get even surface to prevent stick- slip motion of the cross - slide.

Lubricate all the parts.

Assemble the gib into the dovetail slide and position it. (Fig 4)

Fig 4



Adjust the screws and eliminate the clearance between the slides for getting the correct freedom required in the assembly.

Lock the movement of the adjusting screws by the check nut.

Hold the gib in correct position firmly while locking with check-nuts.

Check the function of the cross- slide.

Use hollow punches, extractor, drifts, various types of hammer and spanners etc for repair work

Objectives: At the end of this exercise you shall be able to
- **select the holes for repairing**
- **use the types of spanners**
- **use the types of hammers**
- **use of extractor and punches.**

Fig 1

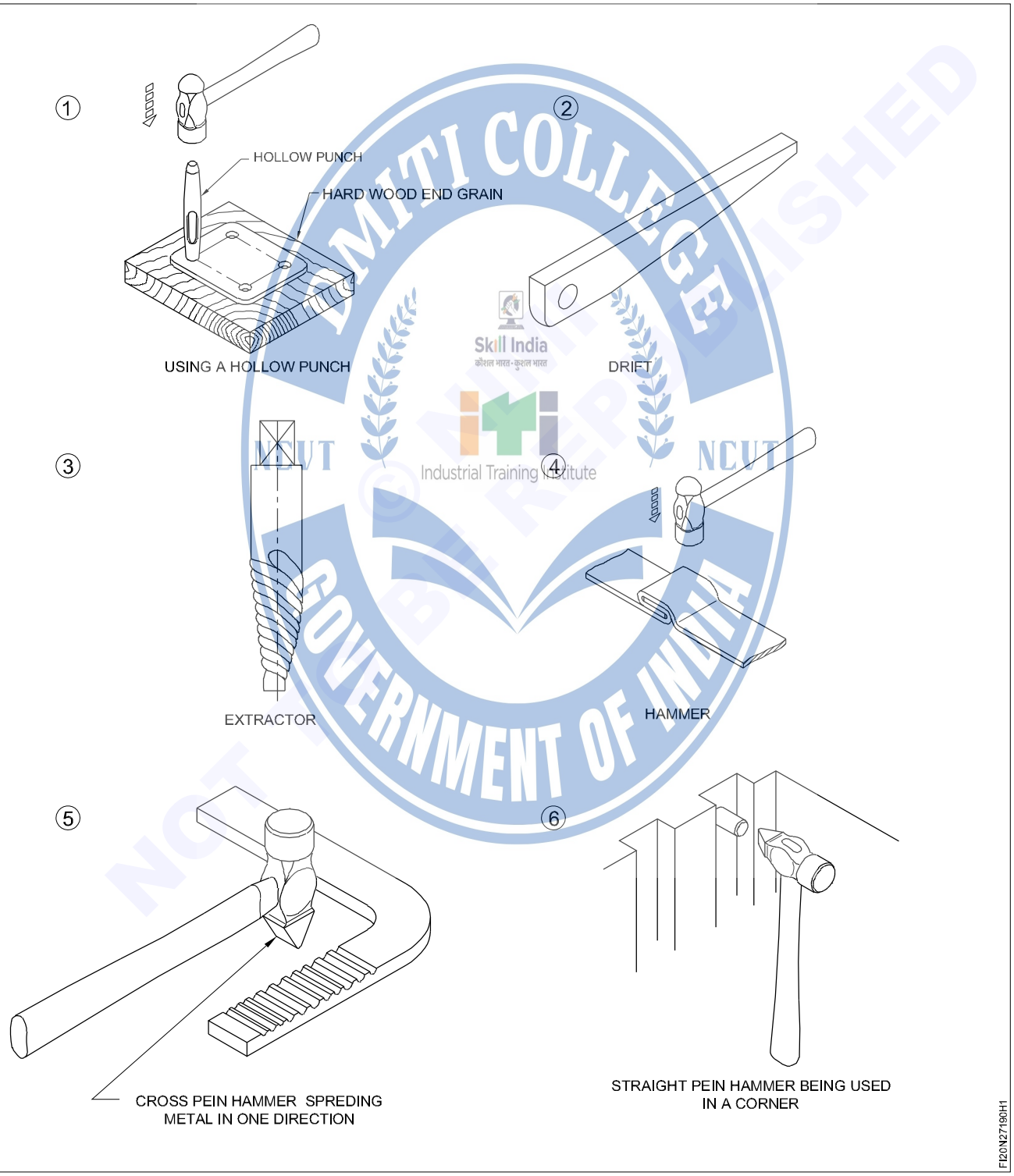
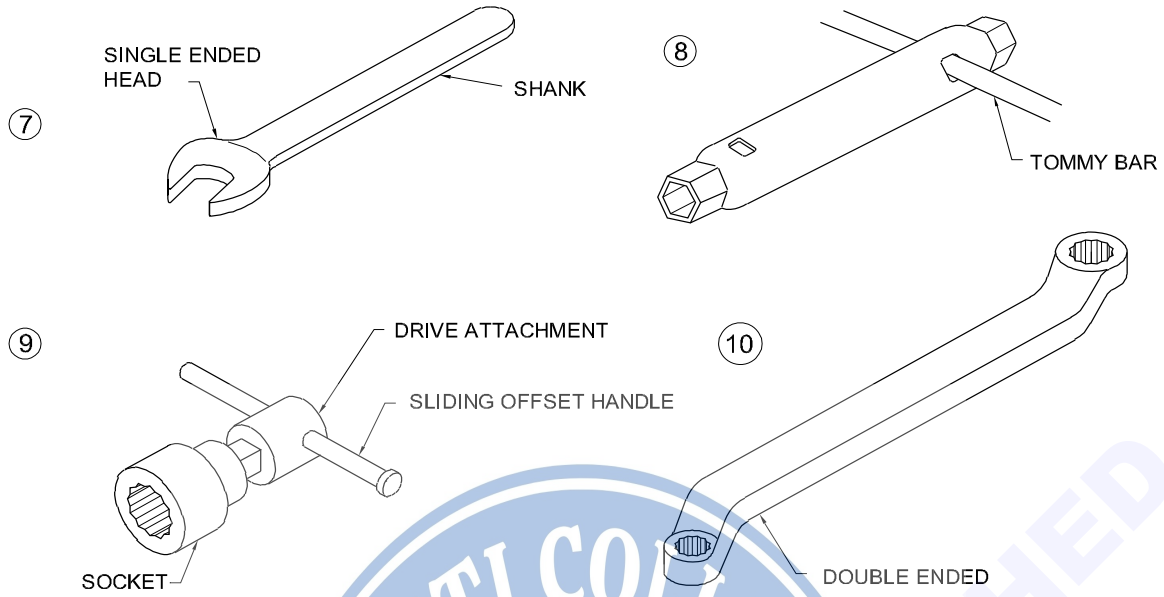


Fig 2



Job sequence

Instructor shall display all the tool shown in Fig 1 - 10 in the section and brief their names and uses.

- Trainees will note down all the tools names and thier uses.
- Record it in Table 1.

Table 1

Sl.No	Name of the tool	Uses
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

- Get it checked by the instructor.

Dismantling, assembling of different types of bearing and check for functionality

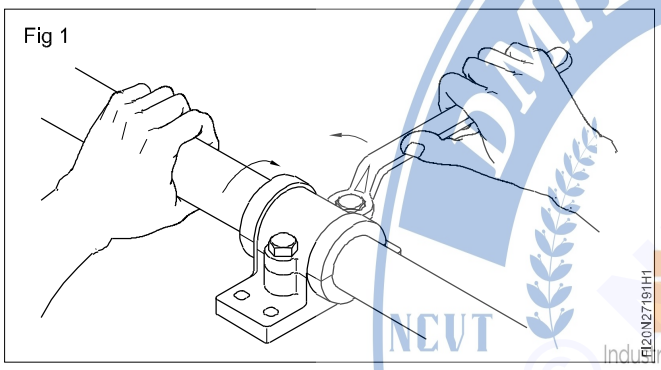
Objectives: At the end of this exercise you shall be able to
- **dismount a shaft from pedestal block**
- **mount a shaft on pedestal block**
- **dismount ball bearing (interference fit on the shaft)**
- **dismount ball bearing (interference fit in the housing)**
- **mount ball bearing.**

Job sequence

TASK 1: **Dismatling and assembiling bush bearing**

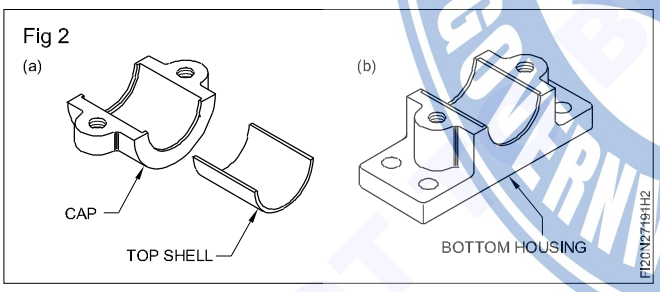
- Dismantle the cap of the block by using proper ring spanner. Hold the shaft with left hand and remove the fastening nut by right hand as shown in Fig 1.

Fig 1



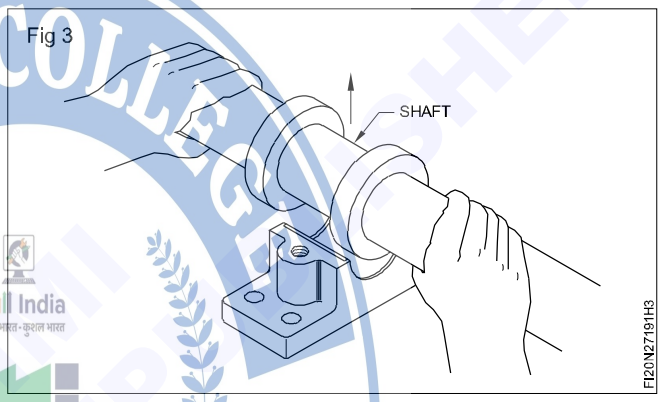
- Remove top shell along with cap Fig. 2a and then remove the shaft and bottom housing as shown in Fig 2b.

Fig 2



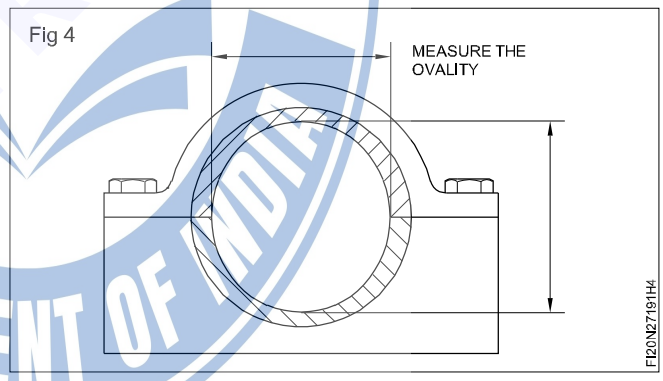
- Thoroughly clean shells, cap, shaft seating (Journal) and housing bottom with kerosene by using small brush. Wipe out all above components with clean banian cloth. Do not use cotton waste to wipe out component.
- Check shells and Journal for any damage, scoring mark etc. Check cap, bottom housing and fastening bolt and nut for any damage and wear. Replace the damaged components with new one before starts assembling. (Fig 3). If it is not possible to replace shaft, it should be built by metal deposition and machined.

Fig 3



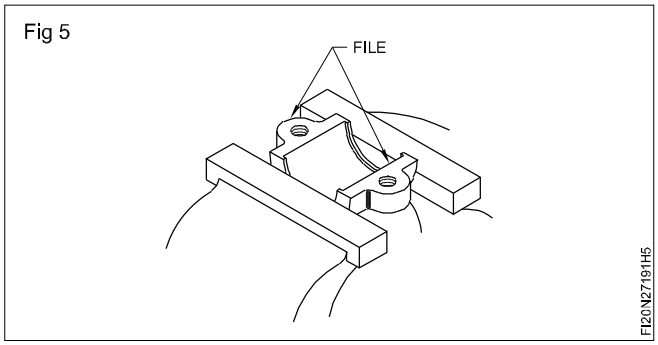
- Check ovality of the bearing bore by fixing cap on the bottom housing as shown in Fig 4.

Fig 4



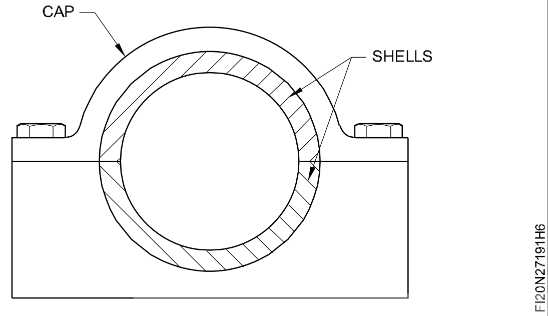
- To remove the ovality. Remove the cap by unscrewing fastening bolts. File the bearing caps equally with flat file to compensate for the ovality by holding the cap into the vice as shown Fig 5.

Fig 5



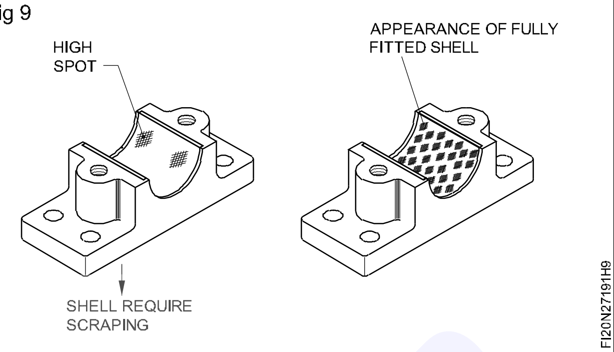
- Fit the two halves of the bearing back together and make sure that, when the bolts are fitted, the load is taken by the caps and not by shells. (Fig 6)

Fig 6



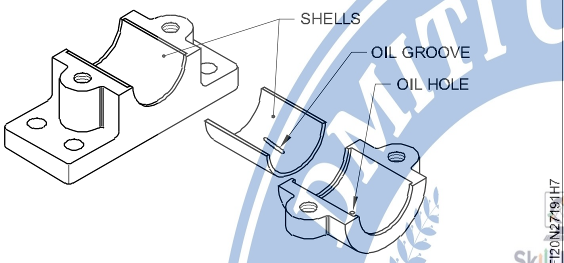
- If the number of colour marking on the bottom shell is more, it indicate shaft having proper contact with bottom shell otherwise scrape the shell to have more number of colour marking. (Fig 9)

Fig 9



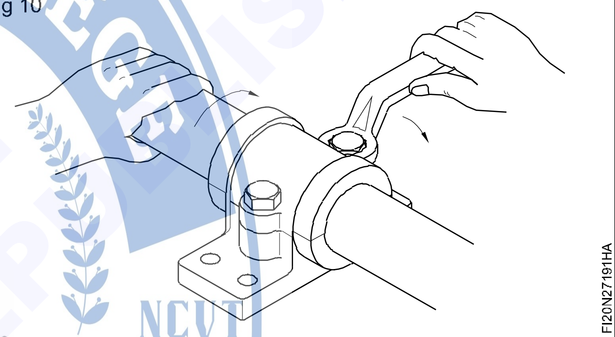
- Fit the shells to their housings. Check that they fit correctly and the oil holes align with those of the housings as shown in Fig 7.

Fig 7



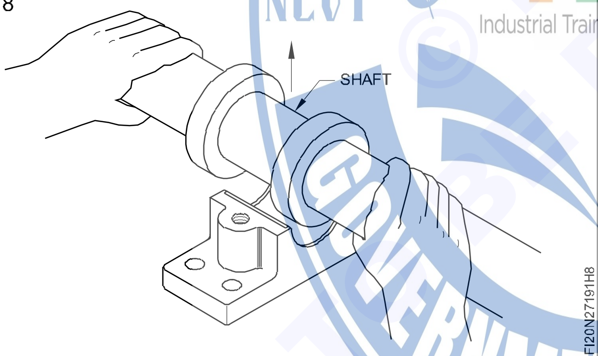
- Coat all the parts with the correct grade lubricant. Place the Journal on the bottom housing, place top shell and cap on the shaft. Tighten the bolt firmly by holding the shaft. (Fig. 10).

Fig 10



- Apply marking medium around the Journal area and place it into bottom shell for uniform contact. (Fig.8)

Fig 8



- After mounting pedestal block clear all tools around the work spot.

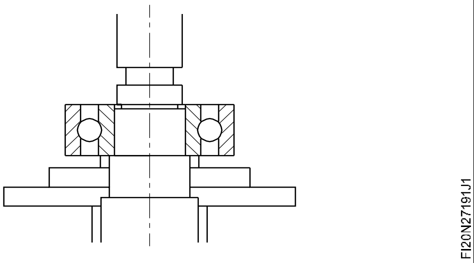
TASK 2: **Dismantling and assembling ball bearing**

For ball bearings having interference fit on the shaft

Method I using press

- place the bearing with the shaft on a arbour press or hydraulic press. (Fig 1)

Fig 1



- place a ring or two parallel blocks of equal size to support the inner ring of the bearing. (Fig 2)
- put a dummy between the ram and the shaft
- Gently press the shaft to come out of the bearing. (Fig 2)
- Support the extracted shaft by hand to prevent damage.
- Never apply direct hammer blows on the bearing. (Fig 3)

Fig 2

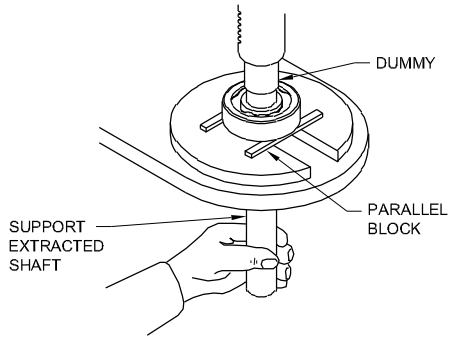
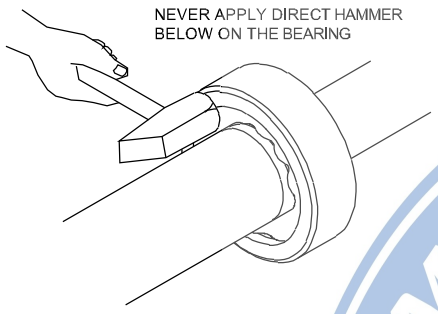


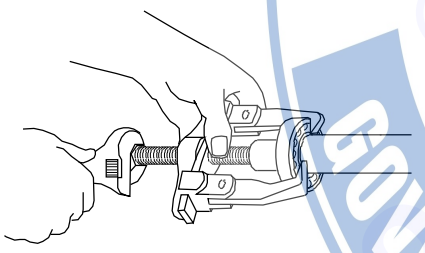
Fig 3



Method II using bearing puller

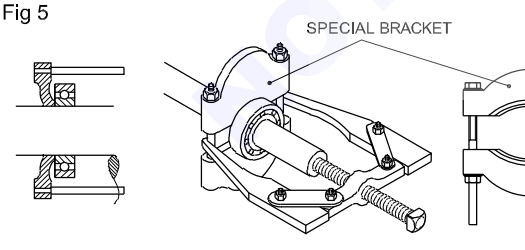
- Fit the bearing pullers spindle on the centre hole of the shaft. (Fig. 4).
- Place the legs of the bearing.
- Slowly tighten the spindle of the puller by a spanner so that the puller is ready to take the strain (Fig 4)

Fig 4



- For dismounting the bearing special type of puller with bracket attachment shown in (Fig 5) is used so that pulling force is applied on the inner ring of the bearing.

Fig 5



- Use a keeper puller plate along with the puller when pullers legs tend to engage with the outer ring of the bearing. (Fig 6)
- Rotate the outer ring or the puller during dismounting if the pullers legs has to engage the outer ring of the bearing, when the bearing is to be used again. (Fig 7)

Fig 6

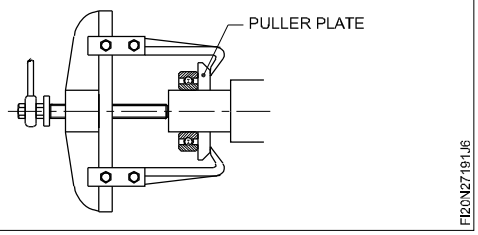
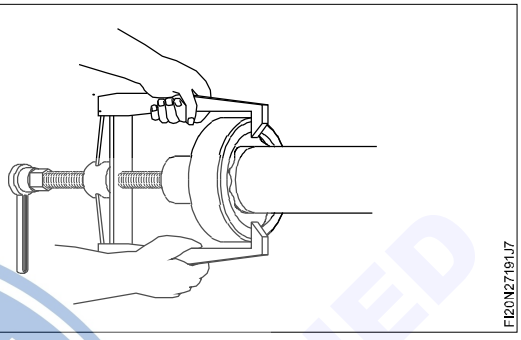


Fig 7

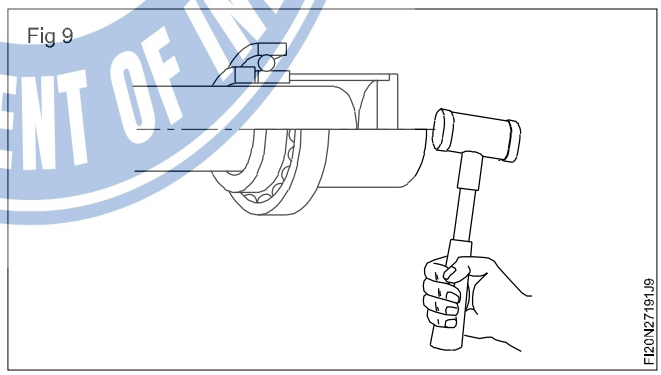


- Small bearings can be removed by using a puller or with a metallic sleeve using mild hammer blows.
- To dismount small and medium size bearings, use a hammer and a sleeve a butting the lock nut or the inner ring. (Fig 8)

Fig 8

- Place the sleeve against inner ring if the nut is located inward.
- Use hammer blows for dismounting. (Fig 9)

Fig 9



For all bearings having interference fit in the housing

- Place the wheel on two wooden blocks and fit a suitable sleeve on the face of the bearing. Apply pressure on the sleeve to drive out the bearing. This type of dismounting can be done for a housing without any shoulder. (Fig 10)
- Similarly, for a housing with a shoulder between the bearings a soft metal drift is used to strike the bearing

in different positions to drive out. (Fig 11). A suitable puller is also used for dismantling.

Fig 10

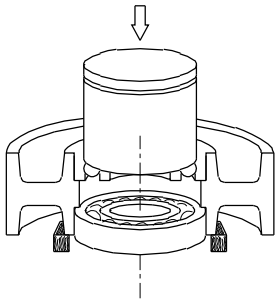


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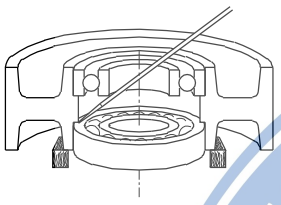
Fig 11



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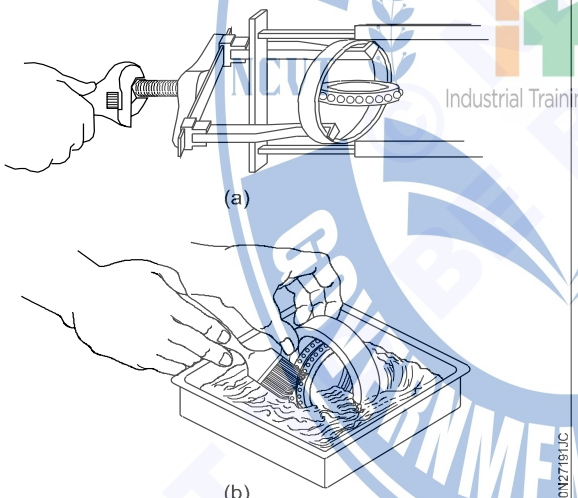
- For dismounting self aligning ball bearing, swivel the inner race as shown in Fig 12a. Fit the legs of the puller on the outer race and tighten the screwed spindle to extract the bearing.
- After dismounting clean the bearing with soft bristle brush using kerosene oil or naphtha. (Fig 12b)

Fig 12



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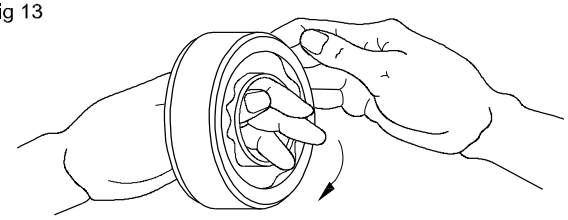
- Wipe off the bearing with banian cloth.

Do not use cotton waste for cleaning or wiping off bearings.

- Inspect visually about corrosion, damage in cage, raceways, rolling elements and outer and inner races.
- Insert the bearing around the fingers of your hand and rotate gently to check that the bearing to rotating smoothly without any distraction and noise. (Fig 13).
- Lubricate the bearing.
- Replace the seal, if any.
- Mounting ball bearings
- Clean and measure the shaft diameter (for shaft fit by vernier micrometer and for housing fit by vernier inside micrometer) to check the necessary interference fit.

Fig 13



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- Lubricate the shaft for mounting.
- Place the correct size sleeve on the inner ring of the bearing. (Fig 14).
- Apply hammer blows using common hammer.
- Slowly drive in bearing until you get the metallic sound.
- Similar process should be adopted for the housing fit by selecting proper sleeve to sit on the outer ring. (Fig 15)
- Use a arbour press whenever possible.

Fig 14

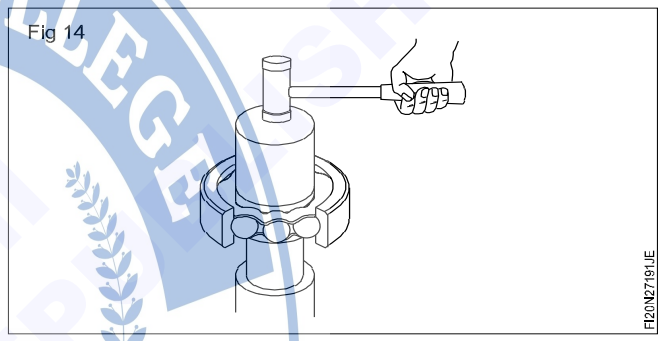

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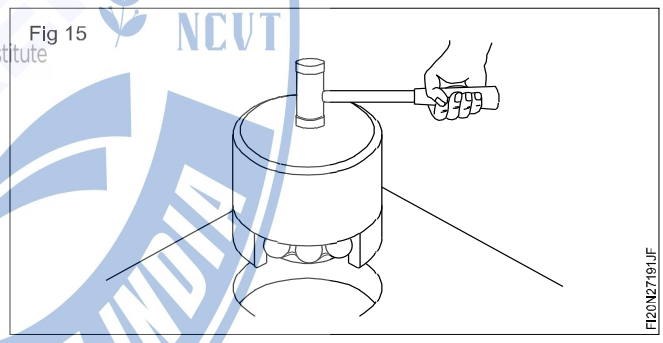
Fig 15



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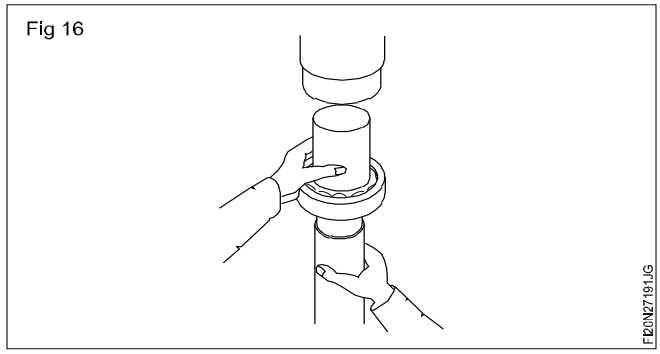
- The use of a arbour press or hydraulic press is particularly suitable, when small bearings are frequently mounted. Lubricate the shaft and place a mounting sleeve between the bearing and press resting it on the ring with interference fit. The end faces should be flat, parallel and burr free.
- Drive in the bearing into the shaft, by applying the force by the press. (Fig 16)

Fig 16

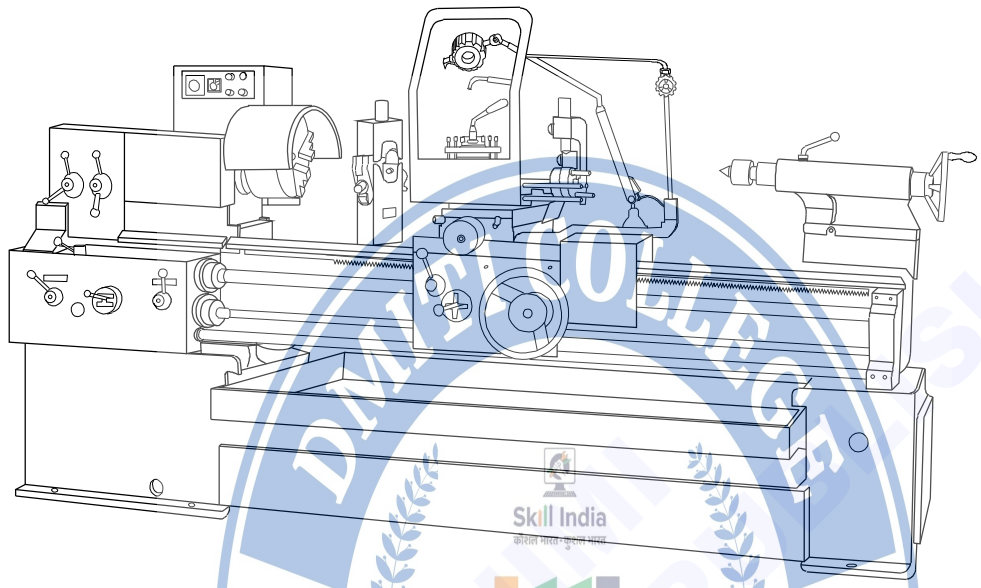


FI20N27191JG

Perform routine check of machine and do replenish as per requirement

Objectives: At the end of this exercise you shall be able to
- **check the machine running condition**
- **check the oil level**
- **check the sliding movement.**

Fig 1



Job sequence

- Turn the machine off from the main power point and fit your tag, Out of order, to avoid someone can try to use the machine during your maintenance procedure.
- **Open side cover and check:**
  - Driving belts, if the belts are damaged, excessive cracks, or an excessive wear, they must be replaced.
  - Check tension of belts.
  - Check brake conditions (on models with pedal brake).
- **Turn the lathe ON and:**
  - Run the lathe for a couple of minutes.
  - Check level of lubricant oil on vison main gear box.
  - Refill if required with gear oil.
- **During running test check that:**
  - All the automatic feeding movement are working properly.
  - Check tail stock locking condition.
  - Both lever must lock properly.
  - Check top bench lubrication manual pump.
  - Pull or pouch lever to verify that oil is coming to the sliding bench.
  - Check level of lubricant oil of tank bench lubrication.
- **Check level of coolant, refill if required:**
- **Lubrication, period - lubricant:**
- **Some point will be required to lubricate with gun oiler.**
  - Head stock - twice a year.
  - Compound slides, by gun oiler - daily.
  - Apron & carriage- handle pump - daily.
  - Tail stock nipple - by gun oiler - daily.
  - Change gear nipple - by gun oiler - daily.
  - Lead screw nipple - by gun oiler - daily.
  - Bed ways - by gun oiler - daily.
- **Coolant:**
  - Empty tank and fill up with new coolant every 4 months.
  - Avoid contact with coolant during the refilling process, you must wear rubber gloves.
  - Test bottom of coolant tank to verify if there are solids.
  - Remove solids and try always to keep coolant tank clean.
  - Run the lathe and test coolant is supplied properly.

- **Electric:**
  - Check the main power cable for its conditions. If it is damaged, must be replaced.
  - Verify conditions of all external switches.
  - All switch with damage must be repair or replace it.
  - Check conditions of all limit switches. They must be strong in position. A loose or damage limit switch can generate a continuous fault on the machine.

- **Centre point alignment:**
  - Once a year, depending the precision required would be convenient to verify alignment of centre tailsotck with centre of headstock.
  - Alignment can be obtain by fitting a total parallel bar between centres, and the with a dial indicator verify parallelism between centres.

Inspection of machine tools such as alignment, levelling

Objective: At the end of this exercise you shall be able to
- **inspect drilling machine tool such as alignment, levelling**

Job sequence

- Lock the table of the pillar drilling machine in mid - position.
- Level the machine using a precision spirit level and a straight edge.
- Check the flatness of the table surface and the base plate of the machine.
- Check the run out of the internal taper of the spindle using a dial test indicator and test mandrel.
- Check the straightness of the pillar in two different planes.
- Check the squareness of the table surface in two different planes.

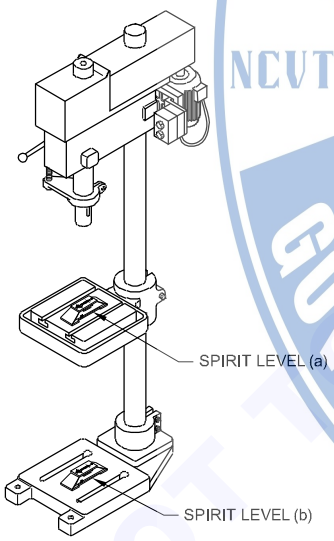
Skill sequence

Geometrical test for pillar type drilling machine

Objective: This shall help you to
- **carry out the preventive maintenance of drill machine.**

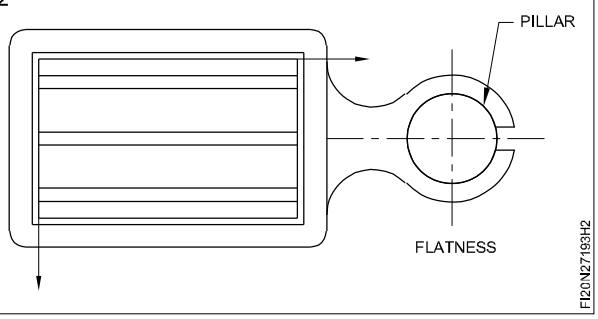
Levelling of the machine at two different positions (a) and (b) should be done before conducting the geometrical test. The permissible deviation is 0.03 per 300 mm. (Fig 1)

Fig 1



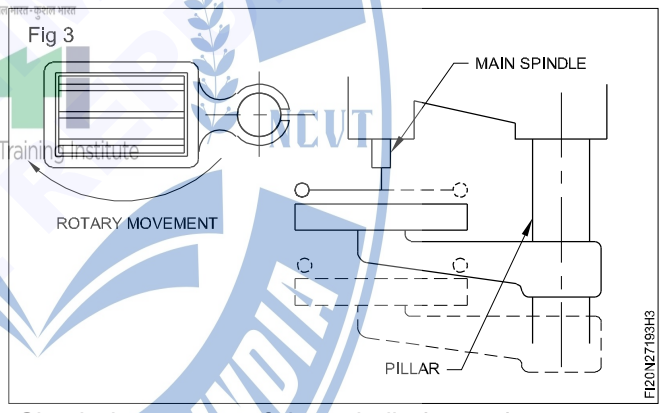
Check the flatness of the work table surface and the base plate if it is machined. (Fig 2)

Fig 2



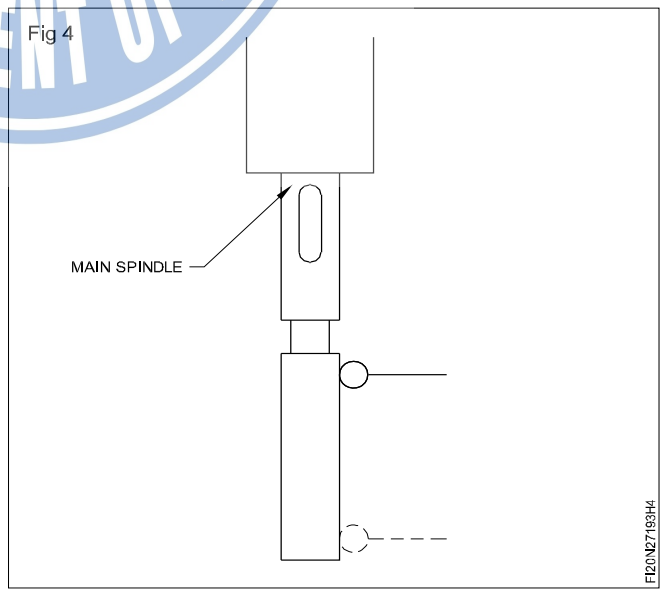
Check the rotation of table, if the machine is provided with rotary movement. (Fig 3)

Fig 3



Check the run out of the spindle internal taper at two positions.(Fig 4)

Fig 4



Check the straightness of the pillar and squareness of the spindle axis to the table surface (Fig 5) in two different planes.

Fig 5

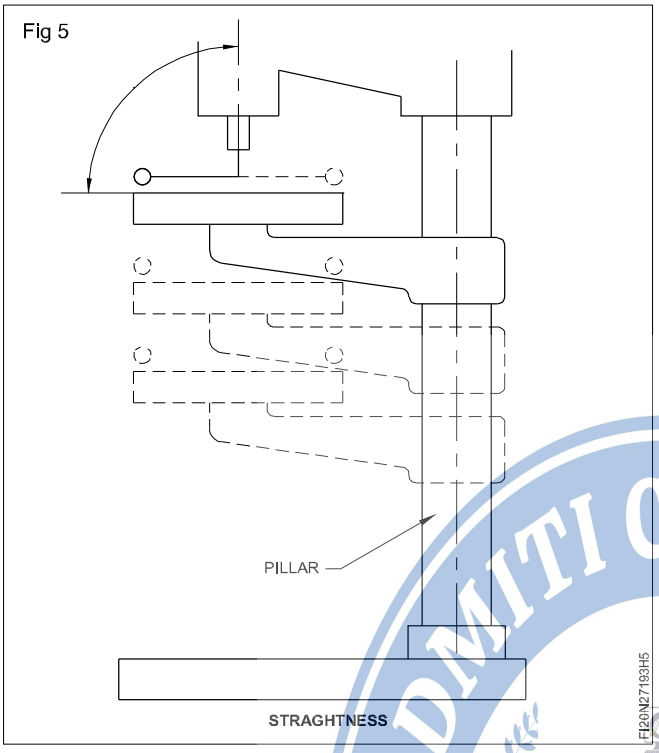
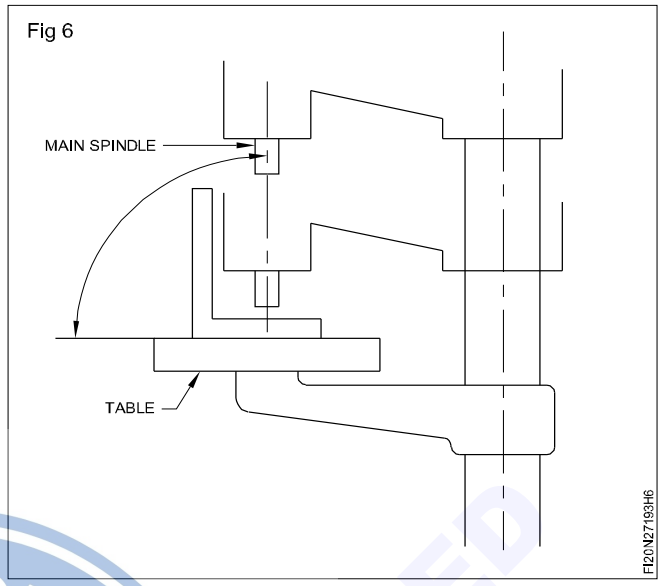


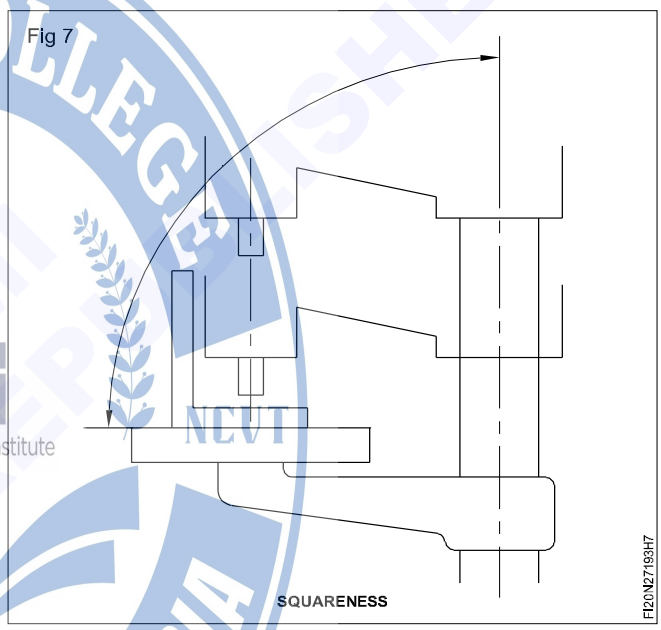
Fig 6



Check the squareness of the table surface to the vertical movement of the spindle housing in two planes. (Fig 6)

Check the squareness of the table surface to the vertical movement of the spindle head of machines having an elevated spindle head. (Fig 7)

Fig 7



Lubricating the parts

Apply lubrication oil in main spindle, cam of rotating table, gear box and pillar. Daily by using a oil can with oil.

Inspect the following items and tick in the appropriate column and list the remedial measures for the defective items.

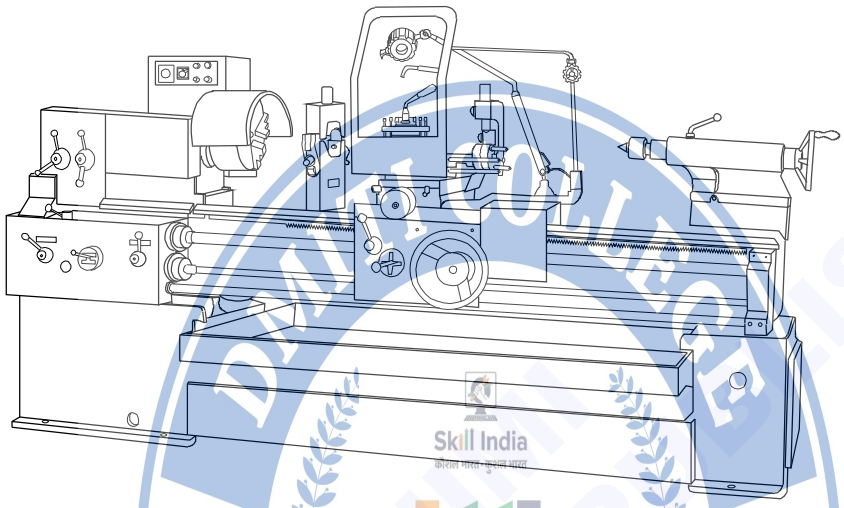
Items to be checked	Good working/Satisfactory	Defective	Remedial measures carried out
Level of the machine			
Belt and its tension			
Bearing sound			
Exposed gears			
Working in all the speeds			
Working in all feeds			
Lubrication system			
Coolant system			
Spindle & its travel			
Arm & its movement			
Electrical controls			
Safety gaurds			

Accuracy testing of machine tools such as geometrical parameters

Objectives: At the end of this exercise you shall be able to

- **check the level of a centre lathe**
- **check the true running of a lathe spindle**
- **check the alignment of the main spindle and the tailstock spindle of a lathe**
- **check the parallelism of the tailstock sleeve with respect to bedways.**
- **perform practical test on turned component.**

Fig 1

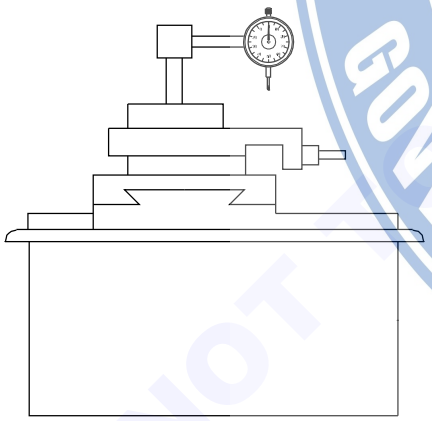


FIN20N27194-H1

Job sequence

- Fix the dial gauge on the carriage. (Fig 1)

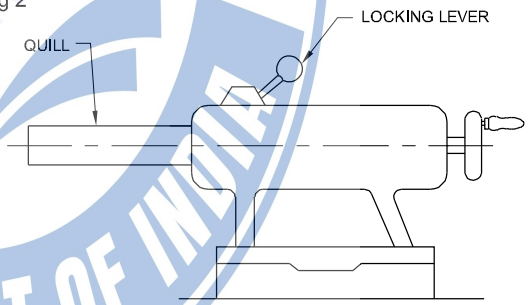
Fig 1



FI20N27194-J1

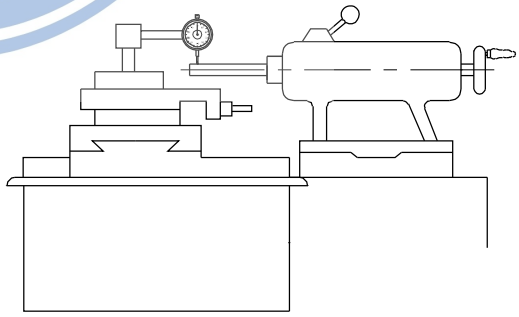
- Project the quill of the tailstock to the maximum extent possible and lock it. (Fig 2) Check the quill in the vertical and horizontal positions by a dial test indicator.
- Clamp the quill during each measurement. If it is not clamped it will affect the measurement.
- Place the dial plunger to contact over the free end of the quill in the vertical plane. (Fig 3)

Fig 2



FI20N27194-J2

Fig 3

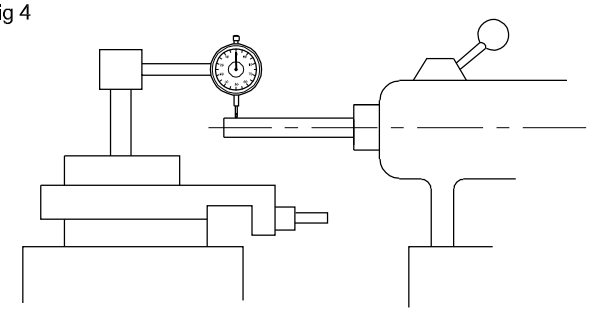


FI20N27194-J3

Ensure that the dial is set at the topmost point of the quill.

- Set the dial at the zero position. (Fig 4)

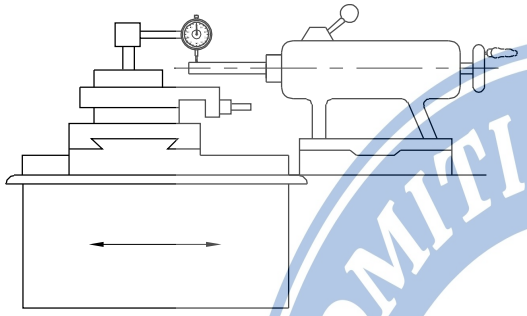
Fig 4



FI20N27194-J4

- Move the carriage slowly towards the entire length of the quill. (Fig 5)

Fig 5

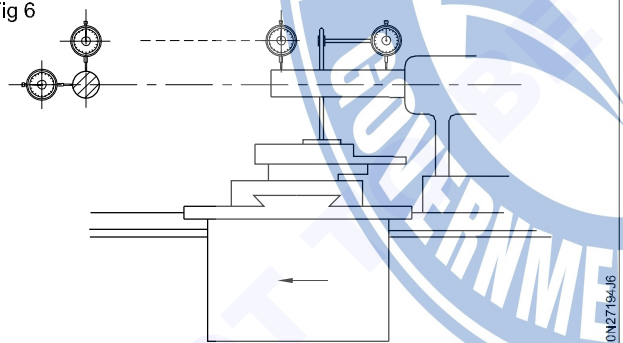


FI20N27194-J5

- Note the dial reading at the extreme end of the quill.
- Verify the deflection of the dial reading and compare the value with the test chart supplied. (IS: 6040)

For checking in the horizontal plane, set the dial horizontally and repeat the above procedure. (Fig 6)

Fig 6



FI20N27194-J6

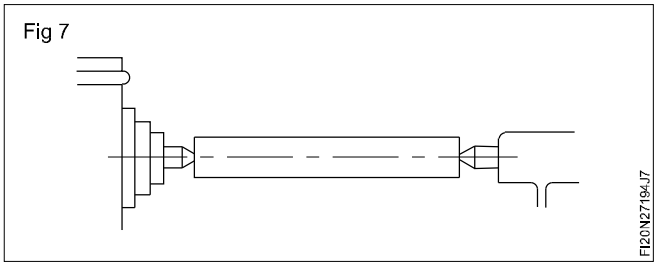
- Fix the test mandrel into the tailstock spindle. Repeat the same procedure to test the accuracy of the tailstock spindle bore in the vertical and horizontal positions as shown in the figure.

Checking the tail stock

- Insert a hollow test mandrel (300 to 500 mm long) in between the centres. (Fig 7)

Ensure that the spindle bearing is at its working temperature.

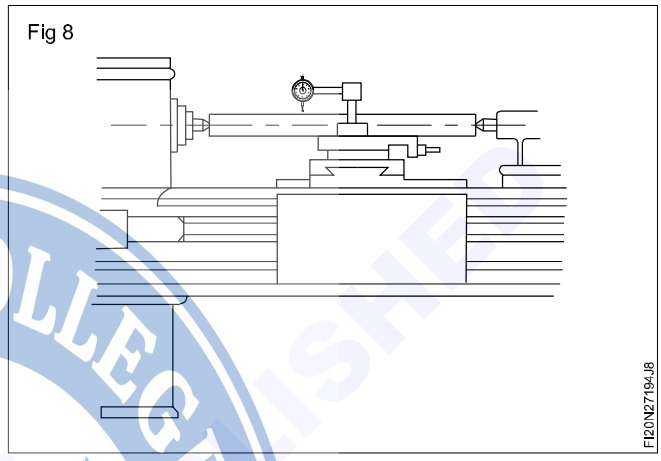
Fig 7



FI20N27194-J7

- Fix the dial gauge on the saddle, the plunger touching a position of the mandrel and set it to zero.(Fig 8)

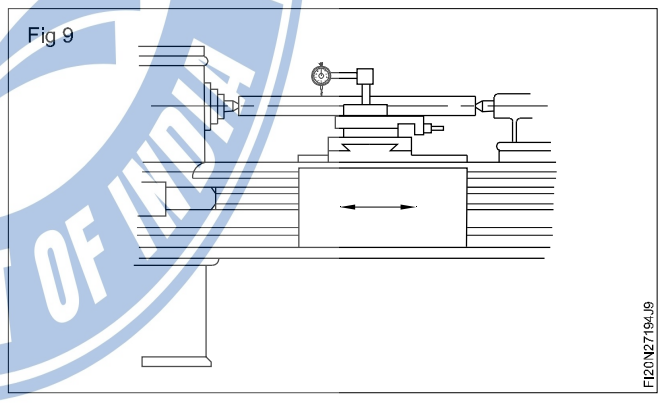
Fig 8



FI20N27194-J8

- Move the carriage from one end to the other end of the mandrel to check the mandrel is in correct alignment in the horizontal position.
- Rest the dial plunger at right angles (radially) to the surfaces to be tested.
- Set the dial plunger at the top of the mandrel and move the saddle along the bed slowly to the entire length of the mandrel. (Fig 9)

Fig 9



FI20N27194-J9

- Observe the reading of the dial as the saddle moves along the beds and note for variation, if any.

The tailstock centre must be higher than the spindle centre within the permissible limit.

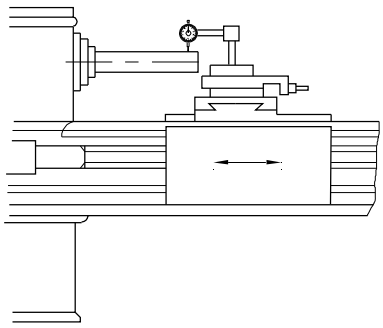
- Verify the deflection of the dial gauge reading and compare the value with the test chart. (IS: 6040)

Checking the true running of a spindle

- Locate the taper shank of the test mandrel in the spindle taper.

- Hold a dial gauge, stationary in the carriage, its plunger contacting the mandrel near its free end (Fig 10) and set it to '0' position.

Fig 10



FI20N27194JA

Rest the dial gauge plunger at right angles (radially) to the surface to be tested.

- Rotate the spindle along with the mandrel slowly by hand.
- Observe and note the reading of the dial gauge.
- Move the dial gauge near the spindle nose. Rotate the spindle along with the mandrel slowly by hand and note the reading.
- Take readings of the dial gauge while the spindle is slowly rotated. Verify the deflection of the dial reading and compare the value with the test chart. (IS: 6040)

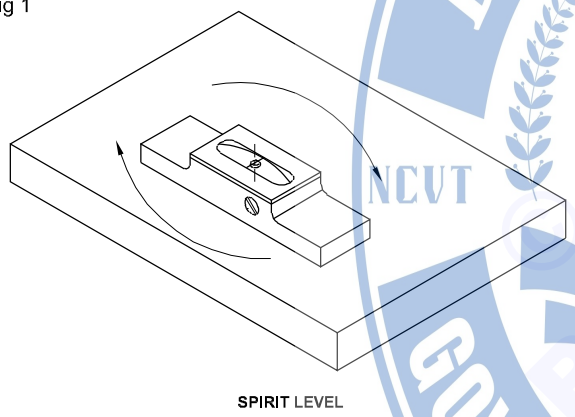
Skill sequence

Adjustment of the spirit level with the plane surface

Objective: This shall help you to
- **adjust the spirit level with the plane surface.**

Move the spirit level on the plane surface until the bubble is in the centre of the scale.(Fig 1)

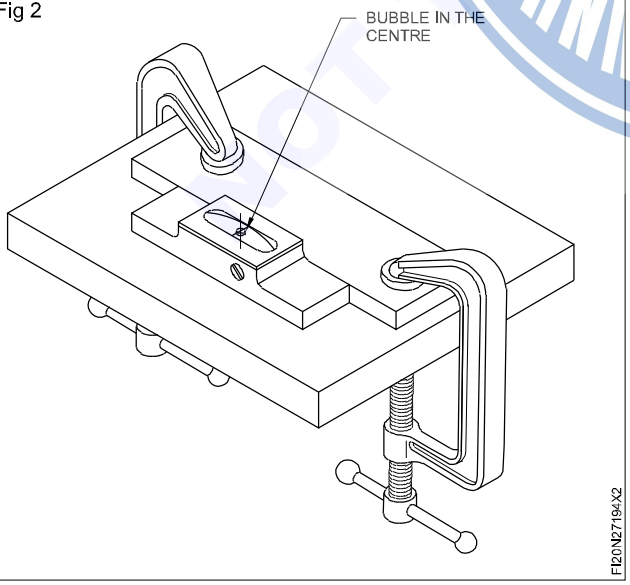
Fig 1



FI20N27194X1

Place a straight edge against the level and clamp to the plate.(Fig 2)

Fig 2



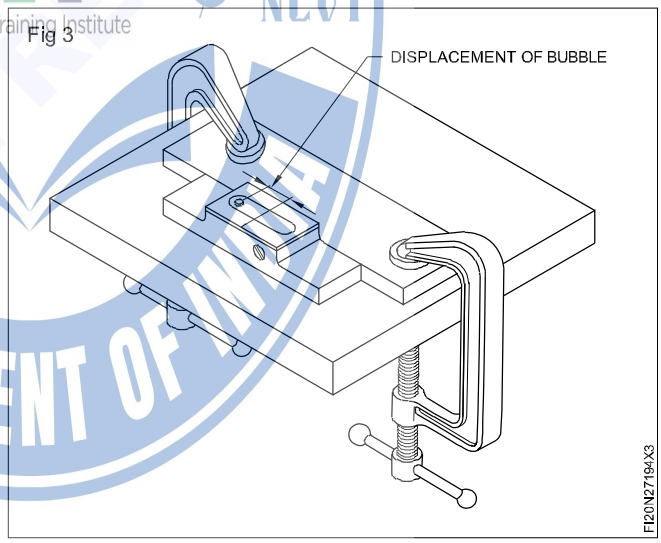
FI20N27194X2

Turn the level through 180° (end for end) and place against the straight edge and note the displacement of the bubble. (Fig 3)

Adjust the vial to half of the total displacement of the bubble. (Fig 4)

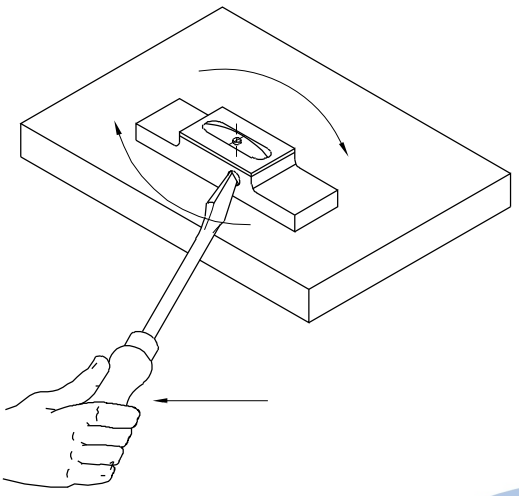
Repeat the above sequence until the level is turned end for end without displacement of the bubble.

Fig 3



FI20N27194X3

Fig 4



FI20N27194X4

Level the lathe bed

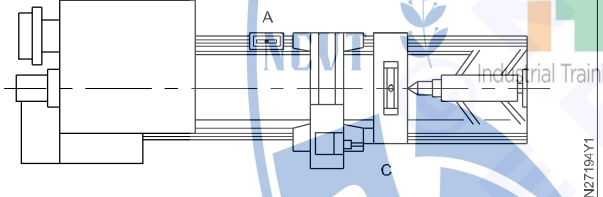
Objective: This shall help you to

- **level the lathe horizontally with the help of a spirit level.**

Position the carriage in the middle of the bed.

Keep the spirit level on the rear slideway (i.e. the slideway opposite the operator's side) longitudinally at the position 'A'.(Fig 1)

Fig 1



LEVELLING A LATHE BED

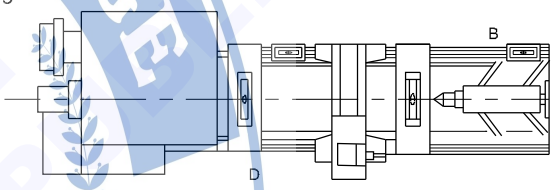
FI20N27194Y1

Keep the second spirit level transversally at the position 'C'. (Fig 1)
Take the readings of both the spirit levels.

Adjust the level of the bed till both the spirit levels show the same readings.

Keep the spirit levels longitudinally and transversally at positions 'B' and 'D'. (Fig 2)

Fig 2



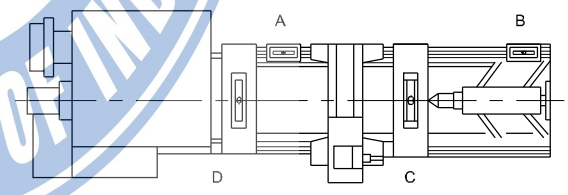
LEVELLING A LATHE BED

FI20N27194Y2

Adjust the bed till both the spirit levels show the same readings.

Repeat the sequence of operation till both the spirit levels show the same reading in all the positions A, B, C & D. (Fig 3)

Fig 3



LEVELLING A LATHE BED

FI20N27194Y3