Flaring of pipes and pipe joints

Objectives: At the end of this exercise you shall be able to
- **cut a G.I pipe using a pipe cutter**
- **remove burrs using a pipe reamer**
- **flare the end pipe**
- **joint flare nut with flare fitting and test it.**

Requirements

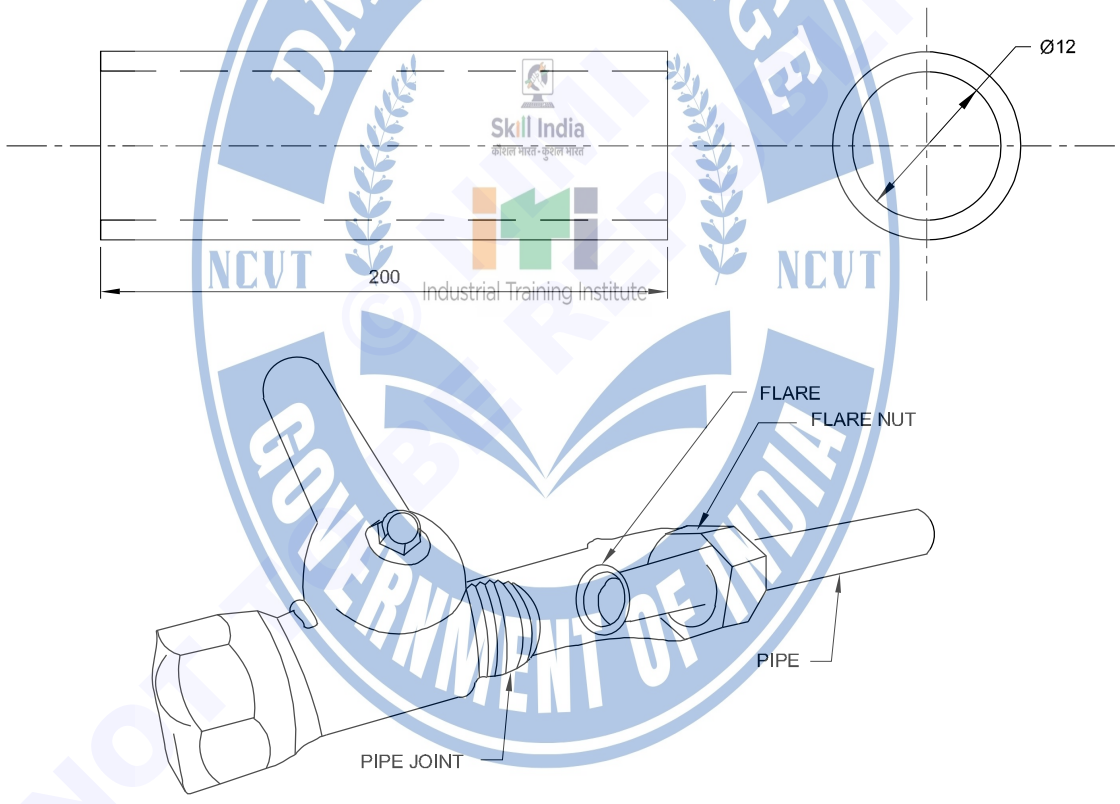
Tools/Equipments

- Flaring block with yoke
- Adjustable wrench - 200 mm
- Valve key 6 mm (cylinder valve opener)
- Pressure gauge with adapter
- Flat file smooth - 200 mm
- Cylinder with pressure

Materials

- G.I pipe
- Flare nut to suit the pipe
- Thread seal tape
- Soap solution with strirrer
- A small quantity of oil

Fig 1



Job sequence

- Check the material size and its conditions.
- File and check that end of the pipe must be exactly perpendicular to the pipe axis.
- Slightly deburr inside and outside edge of the pipe.
- Clean the pipe throughout before installing a flaring block.
- Insert and fix the pipe in to flaring block selected hole.

Examine the pipe flaring tool before starting to flare the end of a pipe.

- Tight the nuts at each end of the flaring block properly.
- Position the pipe end to at least 3.3 mm above the top of the flaring block.

This distance is calculated as pipe diameter divided by 3, in this case 12 mm, divided by 3 = 4.0mm

- Place the yoke (flaring tool) to the flaring block.

Insert the flaring nut before flaring.

- Oil the cone and slowly screw it into the end of the pipe.
- The end of the pipe will be formed into a flare.

Do not over tighten the screws.

- Unscrew and remove the flared pipe from the block.
- Check the flare end for cracks.

Because the cone was screwed down too quickly flare is cracked.

- Make sure that the flare is in correct size. If any crack or too loose while fitting flare nut, cut off the flare and start again as per above instruction, until the flare is in correct size for the flare nut.

Skill sequence

Make flare joints and test them with flare fittings

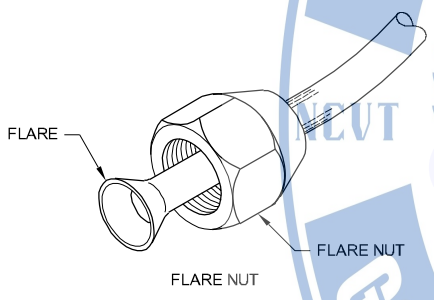
Objectives: This shall help you to
- **flare the end pipe**
- **join the flare nut with flare fitting and test it.**

Flaring

Brake line pipes / fuel pipe lines / air conditioner pipe lines are sometimes jointed to fittings by making a flared connection.

The end of the pipe is opened out to form a cone (Fig 1).

Fig 1



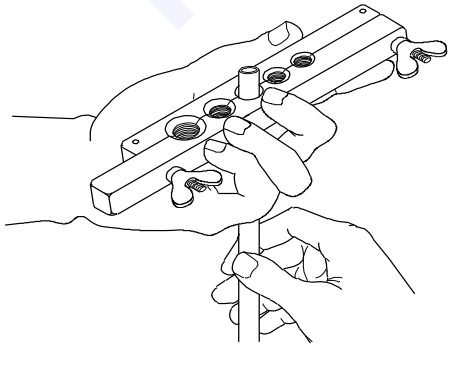
Always place the special flare nut on the pipe first before flaring.

Examine the pipe flaring tool. Make sure that you understand how it works before starting to flare the end of a pipe.

Make sure that the end of the pipe is free of rough edges before flaring.

Place the pipe in the tool (Fig 2). Make sure that you have:

Fig 2



a) Place the flare nut on the pipe

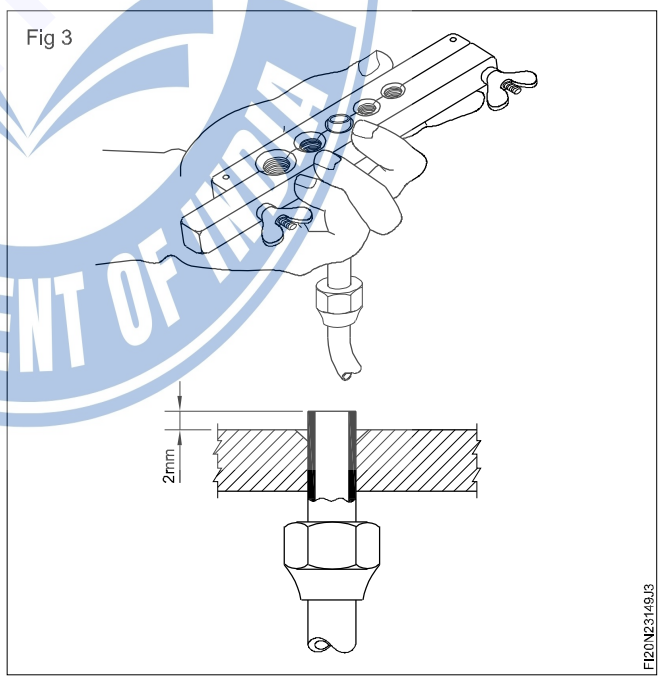
b) Chose the correct size hole in the flaring tool to fit the pipe; (there are 5 holes to fit different sizes of pipe.)

If the pipe is ¼ inch (6 mm) in diameter, position the pipe so that the end is at least 2 mm above the top of the flaring block (Fig 3). (This distance is calculated as "pipe diameter divided by 3; in this case, 6 mm divided by 3 = 2 mm).

Tighten the nuts at each end of the flaring block (see drawing).

Fit the yoke to the flaring block (Fig 3)

Fig 3



Oil the cone and slowly screw it into the end of the pipe.

The end of the pipe will be formed into a flare (Fig 4).

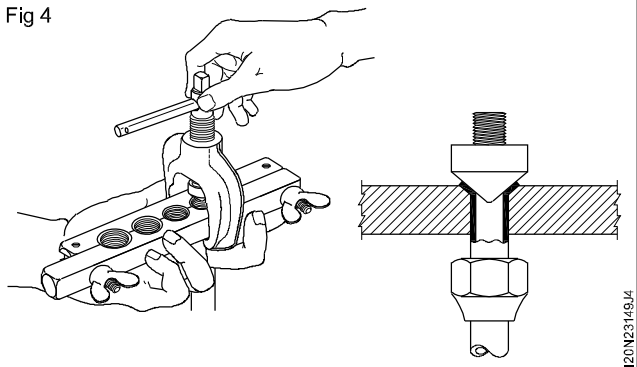
Unscrew & remove the flaring block. Remove the flared pipe from the block.

Examine the flare. If it has cracked, the cone was screwed down too quickly.

Make sure that the flare is in correct size. It should just fit inside the flare nut. If it is too loose, cut off the flare and start again as per instruction until the flare is correct size for the flare nut.

As per instruction, use 3 mm instead of 2 mm. Repeat until the flare is in correct size for the flare nut-not too loose and not too tight.

Fig 4



Observation Table - 1

Sl. No.	Skills	Remarks
1	Checking Flaring	Cracked/uneven/too small/too long/correct
2	Number of attempts	One/two/three
Note: Repeat the steps to the various sizes of G.I.pipe		

Joining with flare fittings

Put thread seal tape on the thread

Push back the flare nut and place the flared pipe on the fitting, then tighten the flare nut using adjustable wrench or suitable double end spanner.

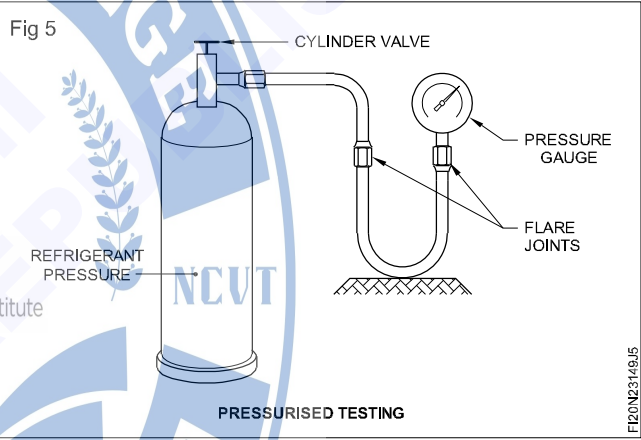
Tighten the one end of the pipe to the cylinder with the flare nut. (Fig 5)

Connect a pressure gauge at the other end of the tube with flare nut.

Do not give more pressure while tightening since this will spoil flare.

Make sure that they should not be loose in the pipe.

Fig 5



Observation Table - 2

Sl. No.	Skills	Remarks
1	Selection of correct fittings	Correct/not correct
2	Joining method	Excellent/good/fair
3	Time taken	Less/very less/more

After joining the pipe firmly, open the cylinder valve with the help of valve key or ratchet.

The pressure will be shown in the pressure gauge.

Then close the cylinder valve. Major leaks will make noise and that needs the nut to be tightened.

If there is no leak, the pressure in the pressure gauge will remain constant.

If it decreases, check the joints with soap solution foam. Leak will bubble, then tight the joints. If it stands still then there is no leak.

Observation Table - 3

Sl. No.	Skills	Remarks
1	Selection of tools	Excellent/good/average
2	Detecting leak and arresting	Excellent/good/average

Skill Sequence

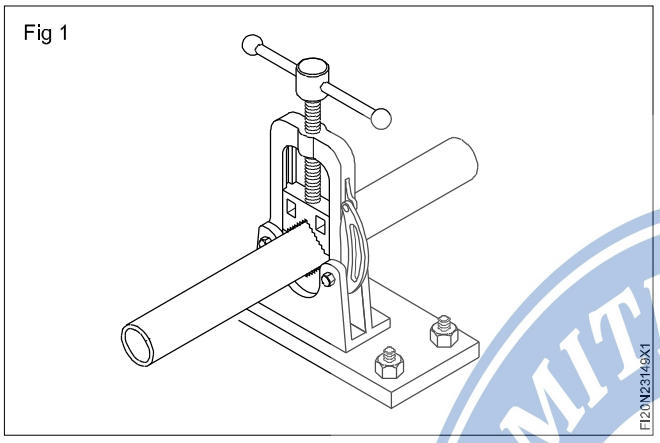
Handling of pipe flaring & cutting tools

Objective: This shall help you to
- **cut a G.I. pipe using a pipe cutter.**

Measure the required length of pipe and mark it with chalk.

Keep the pipe in the pipe vice and tighten it. (Fig 1)

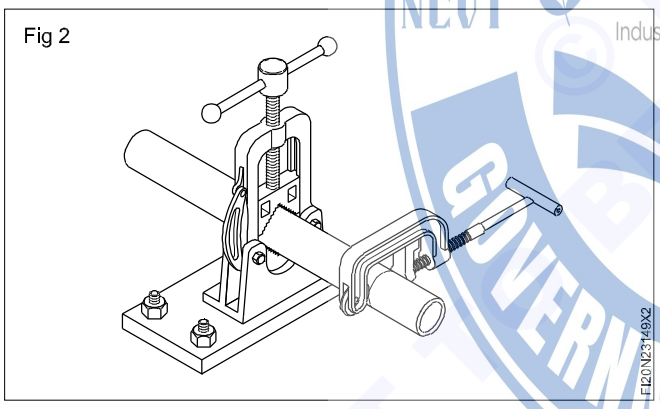
Fig 1



Fit the pipe cutter on the G.I. pipe (on the scribed line) and tighten the jacking screw so that the cutting wheel is touching the pipe. (Fig 2)

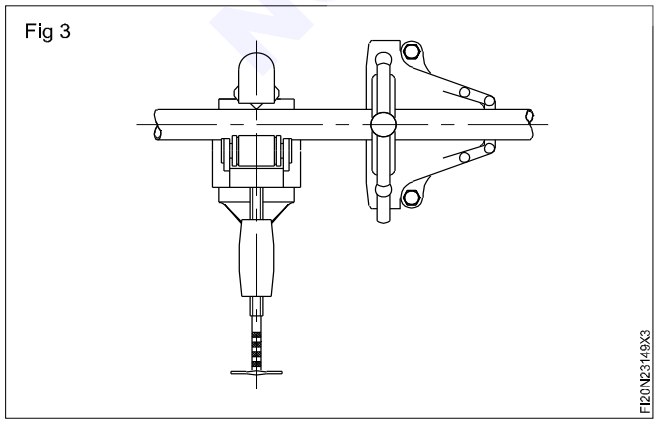
Ensure that the pipe is kept horizontal and parallel to the serrations such that the marking is visible at the top.

Fig 2



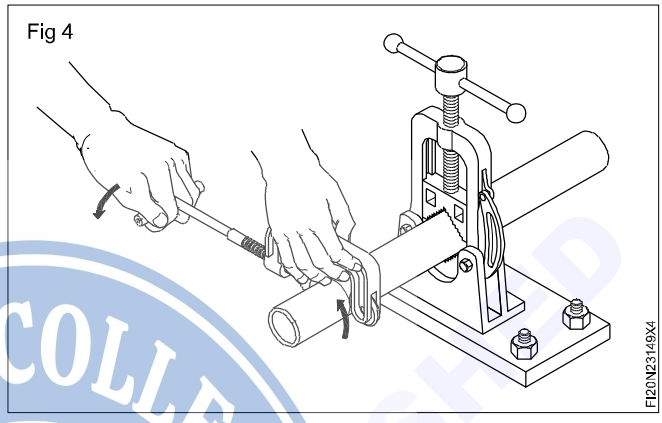
Rotate one or two turns to ensure that the cutting wheel is sitting exactly on the scribed line at 90° to the pipe (Fig 3).

Fig 3



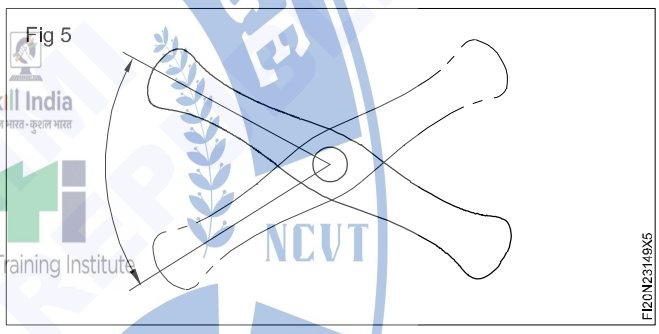
Rotate the pipe cutter around the pipe (Fig 4).

Fig 4



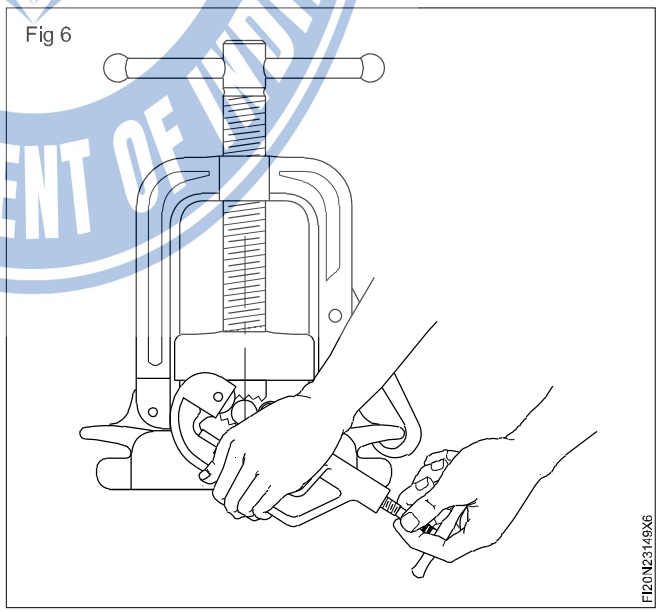
After two or three turns use the jacking screw to apply pressure on the cutting wheel (Fig 5).

Fig 5



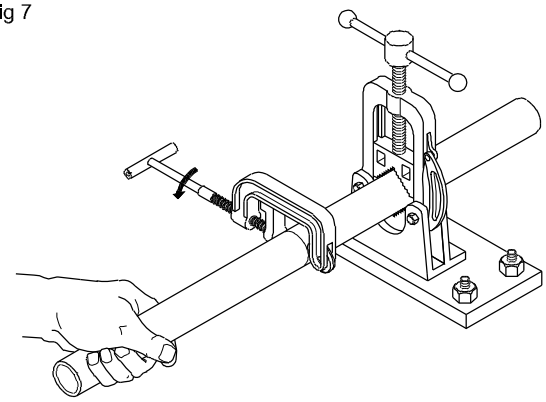
Keep rotating the pipe cutter around the pipe. Increase the pressure to the cutter by repeating the cycle until the pipe is cut through (Fig 6).

Fig 6



Support the pipe with your left hand so that the free end of the pipe does not fall. (Fig 7)

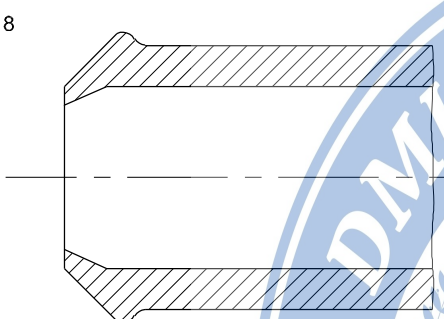
Fig 7



FI20N23149X7

The cut portion of the pipe will appear as shown in Fig 8.

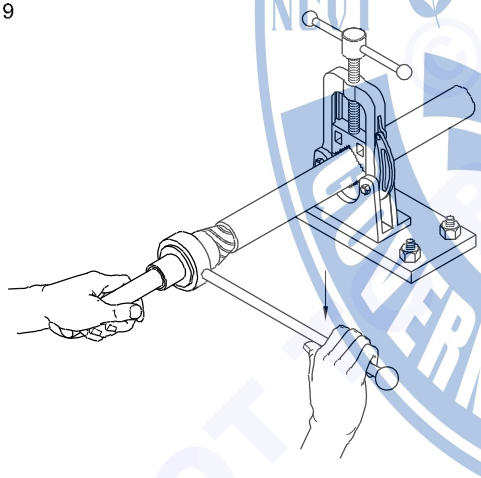
Fig 8



FI20N23149X8

Remove burrs using a pipe reamer. (Fig 9)

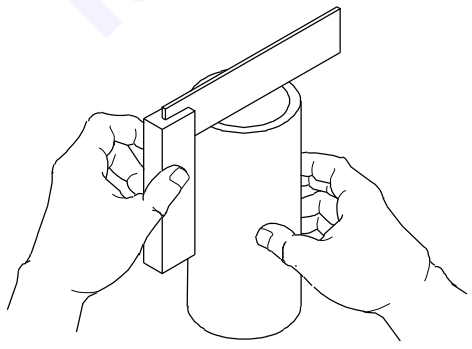
Fig 9



FI20N23149X9

Check that the pipe ends are square. (Fig 10)

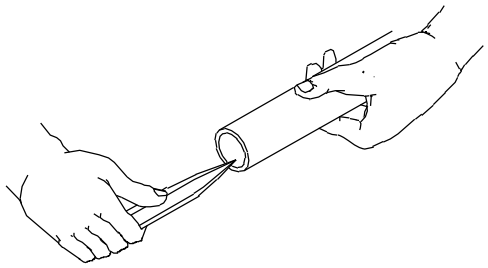
Fig 10



FI20N23149XA

Inside edge of the pipe must be slightly deburred (Fig 11).

Fig 11

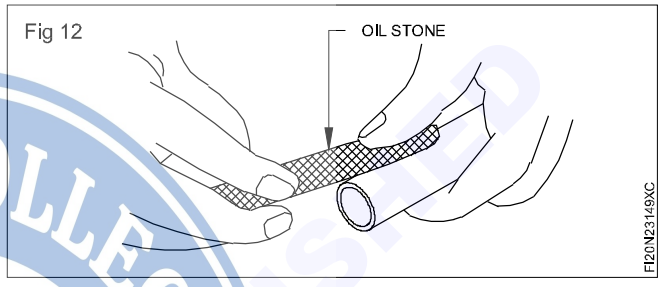


INSIDE EDGE OF THE PIPE MUST BE SLIGHTLY DEBURRED

FI20N23149XB

Outside edge of the pipe must be slightly deburred (Fig 12).

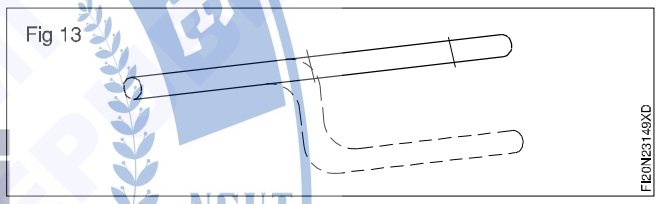
Fig 12



FI20N23149XC

With this edge as reference the pipe is marked for bending (Fig 13).

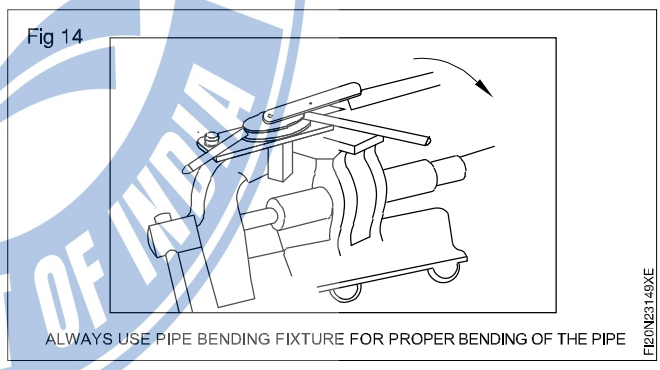
Fig 13



FI20N23149XD

Always use pipe bending fixture for proper bending of the pipe (Fig 14).

Fig 14



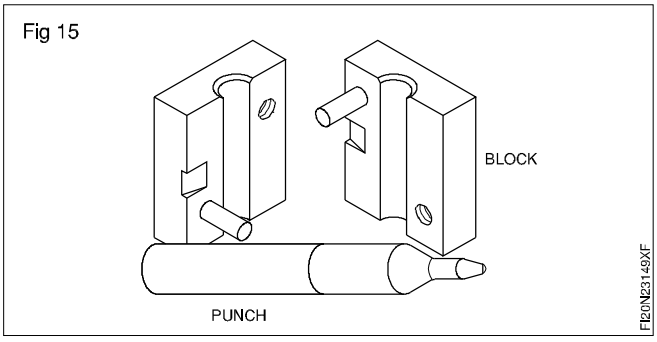
FI20N23149XE

Clean the pipe thoroughly before installing in the machine.

Prepare the pipe end for a flare fitting

Flaring with block and punch tool (Fig 15).

Fig 15



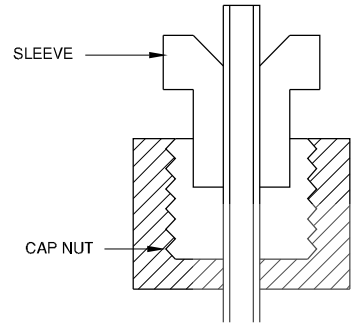
FI20N23149XF

Pipe which is cleaned off burrs and bent should be selected

The pipe end is held in the flaring unit. Select the appropriate size of flaring unit to suit the pipe.

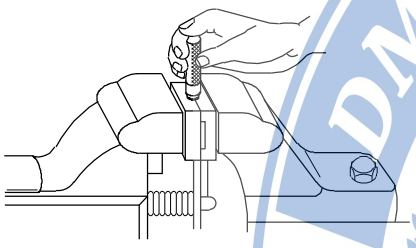
Sleeve and cap nut should be assembled before flaring (Fig 16).

Fig 16



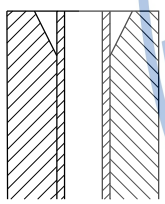
The flaring unit is held in a benchvice with the pipe (Fig 17).

Fig 17



Correct lenth of pipe should be projecting for flaring pipe edges should be in line with surface (Fig 18).

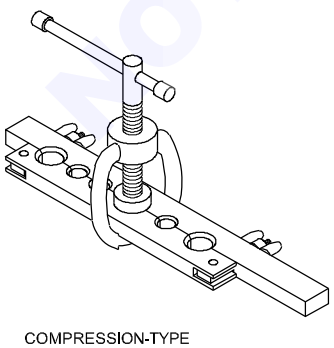
Fig 18



Using the flaring punch, flare the pipe end.

Flaring can also be done by using a compression type flaring tool (Fig 19).

Fig 19

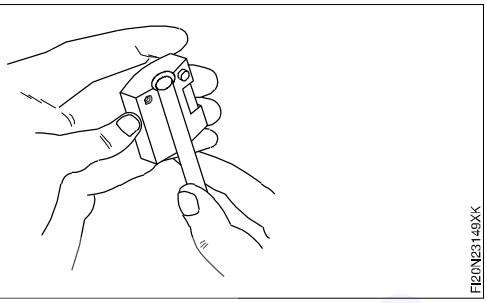


Installing a flare fitting

Flared tube is cleaned and the sleeve and cap nut are postioned on the flare.

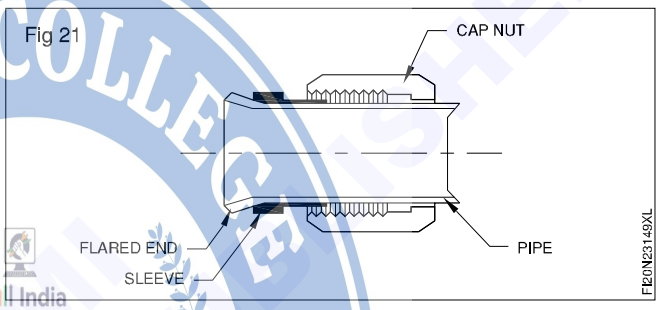
Check the flare angle is suitable to the sleeve angle (Fig 20).

Fig 20



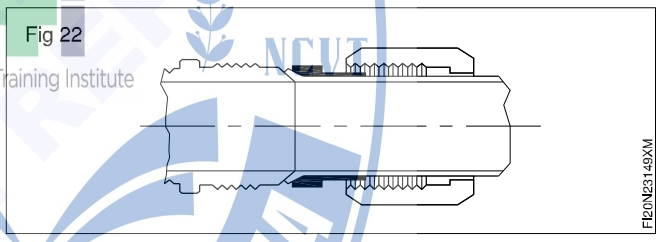
Place the flare on the connector end. Confirm the angle is same (Fig 21).

Fig 21



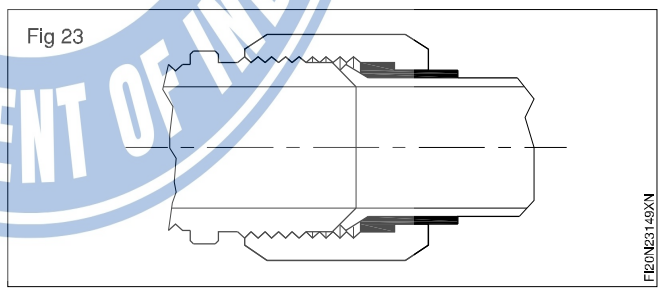
Screw the cap nut on the connector thread by hand (Fig 22).

Fig 22



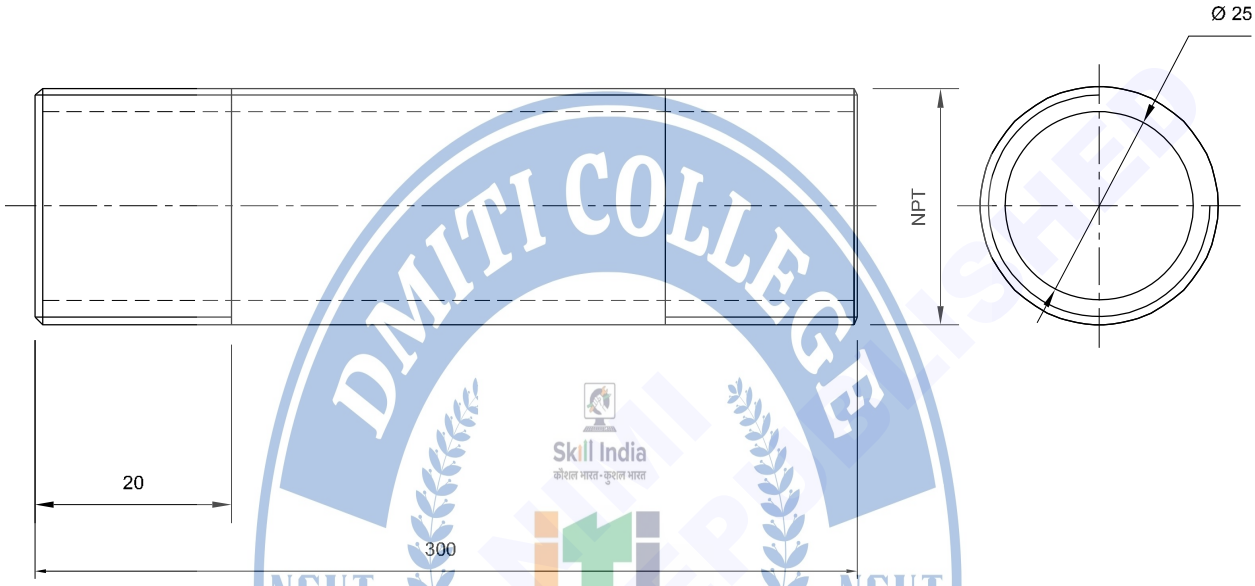
Use a suitable spanner and tighten the cap nut until the pipe does not rotate in the joint (Fig 23).

Fig 23



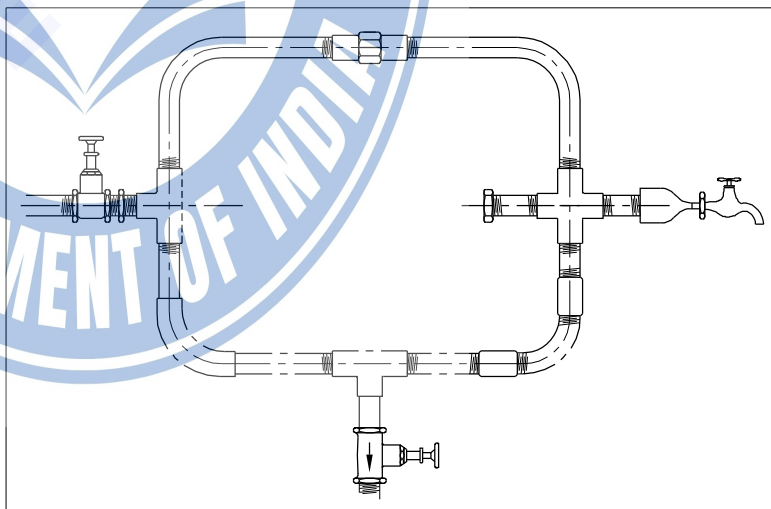
Cutting and threading on pipe

Objectives : At the end of this exercise you shall be able to
- **mark and cut pipe to length using pipe cutter**
- **mark and cut pipe to length using hacksaw.**



Job sequence

- Hold the G.I pipe in pipe vice tightly.
- Mark the required length as per drawing.
- Fix the pipe in pipe vice and tighten it to prevent it from rotating.
- Fix the pipe cutter on the G.I pipe.
- Cut G.I pipe for the required length using pipe cutter.
- Remove burrs using pipe reamer.
- Check that the pipe ends with try square for squareness.



1	Ø25 - 300L		G.I	-	-	2.3.150
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE : NTS	CUTTING & THREADING ON PIPE				DEVIATIONS	TIME : 3 Hrs
					CODE NO. FI20N23150E1	

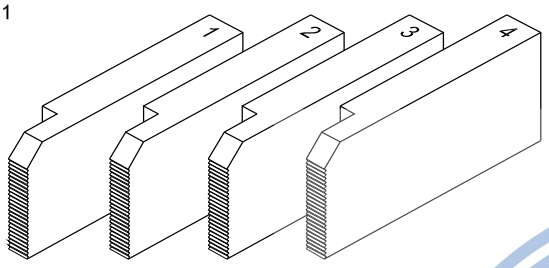
Skill sequence

Threading G.I.pipes using die stocks

Objective : This shall help you to
- **cut threads on G.I.pipe using die stock.**

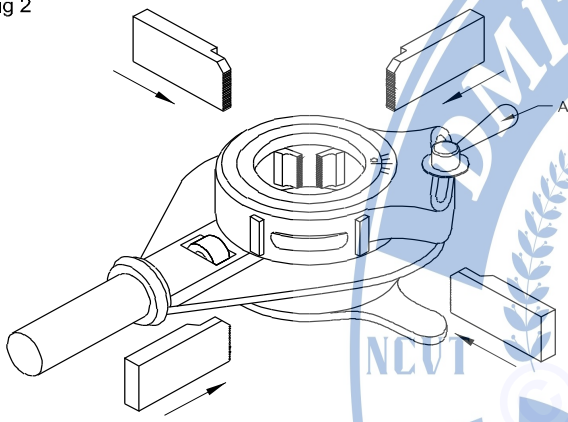
Select a set of dies, and ratchet-type die stock. (Fig 1& 2).

Fig 1



FI20N23150H1

Fig 2



FI20N23150H2

Open the adjustment lever. (A)

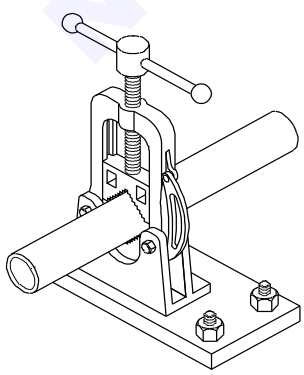
Coincide the zero setting mark '0' die stock and then insert the four dies according to the number on the dies and die stock respectively.

Ensure that the dies sit in the correct position.

Be sure that the number on the top edge of the die corresponds with the number of the slot into which it is to be placed.

Fix the pipe in a pipe vice and tighten to prevent it from rotating. (Fig 3)

Fig 3



FI20N23150H3

Ensure that the projection of the pipe is within 150-250 mm from the vice.

Open the self-centering pipe guide and slide the stock over the end of the pipe.

Adjust the pipe guide for correct sliding, fit and lock into position (Fig 4)

Apply a cutting lubricant to the part which is to be threaded.

Use lard oil, or mineral-lard oil when threading G.I.pipes.

Apply a little pressure to the stock and keep the handle at right angle to the pipe axis.

When the dies bite into the pipe, stop pushing and continue the rotation by moving the handle up and down.

Apply the lubricant to the pipe after the first thread has been cut.

Keep rotating the handles clockwise and check the length of the pipe thread.

Ensure that the length of the thread is sufficient to fit half way into the socket or coupling.

If the die stock and the die stick, turn the stock anticlockwise to break the chips.

Reverse the ratchet knob, ease the handle and turn the stock anticlockwise till the stock and dies come out of the pipe.

Clean the thread with a wire brush.

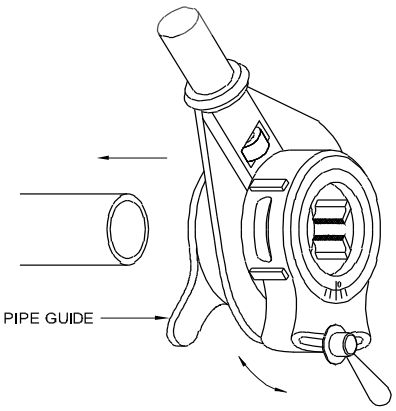
Form thread until the pipe extends about one or two threads beyond the end of the stock.

Remove the stock and dies by operating the quick-release lever and clean off the thread with a wire brush.

Check the formation of thread with a standard fitting.

Repeat the operation if the thread is too tight, by adjusting the dies.

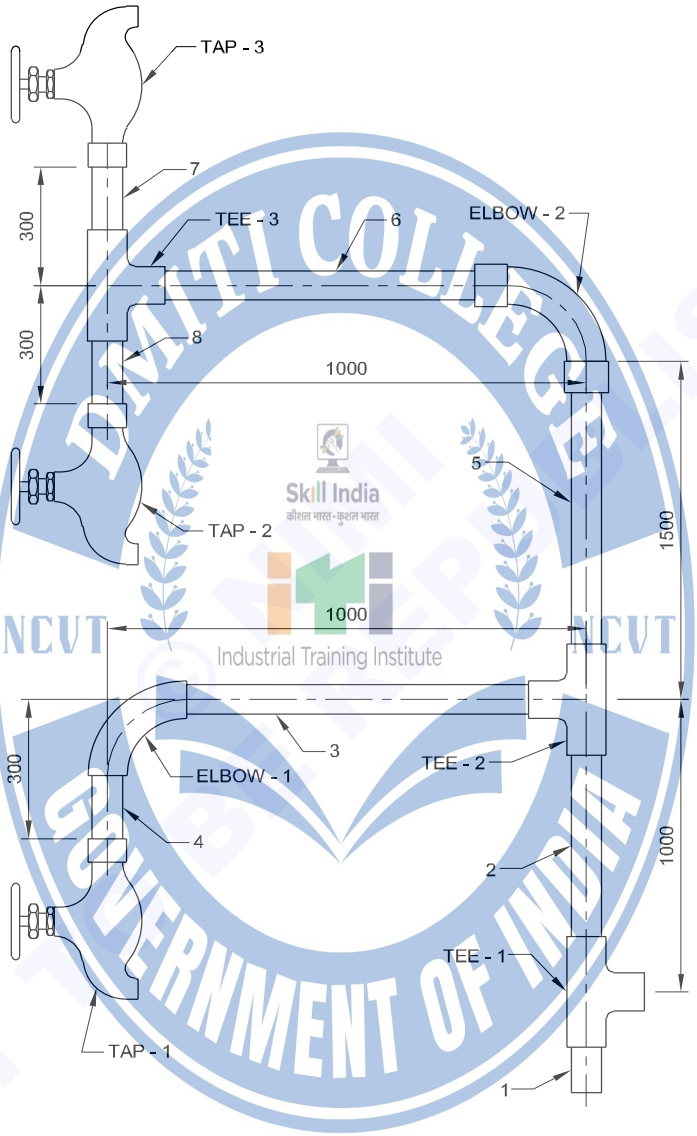
Fig 4



FI20N23150H4

Fitting of pipes as per sketch observing conditions used for pipe work

Objective: At the end of this exercise you shall be able to
- **fix the GI Pipes with fittings as per drawing.**



5	COUPLING(THD) - 1/2"		GI	–	5	
3	TEE - 1/2"		GI	–	TAP 1,2,3	
2	ELBOW - 1/2"		GI	–	BEND - 1 BEND - 2	
3	BIBCOCK - 1/2"		BRASS	–	TAP 1,2,3	
1	Ø 25 x 4.5 x 6000		GI	–	1 to 8	2.3.151
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE: NTS	**FITTING OF PIPES AS PER SKETCH OBSERVING CONDITIONS USED FOR PIPE WORK**	DEVIATIONS	TIME : 10 Hrs
		CODE NO. FI20N23151E1	

Job sequence

- Calculate the length of pipe required based on drawing.
- Cut the pipes as per the calculated length using pipe cutter/ hacksaw.
- Cut thread at the end of all the pipes using die stock.
- Fit tee 1 to the pipe 1 using pipe wrench.
- Fit the pipe 2 to tee 1 using pipe wrench after adopting the procedure.
- Fit tee 2 to pipe 2 using pipe wrench after adopting the procedure.
- Fit pipe 3 to tee 2 using pipe wrench after adopting the procedure.
- Fit elbow to pipe 3 using pipe wrench after adopting the procedure.
- Fit pipe 4 to elbow using pipe wrench after adopting the procedure.
- Fit a socket to pipe 4 using pipe wrench after adopting the procedure.
- Fit bibcock to socket using pipe wrench after adopting the procedure.
- Fit pipe 5 to tee 2 using pipe wrench after adopting the procedure.
- Fit socket to pipe 5 using pipe wrench after adopting the procedure.
- Fit bend to socket using pipe wrench after adopting the procedure.
- Fit socket to bend using pipe wrench after adopting the procedure.
- Fit pipe 6 to socket using pipe wrench after adopting the procedure.
- Fit tee 3 to pipe 6 using pipe wrench after adopting the procedure.
- Fit pipe 7and 8 to tee - 3 using pipe wrench after adopting the procedure.
- Fit socket to pipe 7 and 8 using pipe wrench after adopting the procedure.
- Fit bibcock to sockets using pipe wrench after adopting the procedure.
- Remove any excess hemp, string or sealing tape after completing the joints, using hacksaw blade or a blow lamp.
- Assemble pipe with standard fittings.

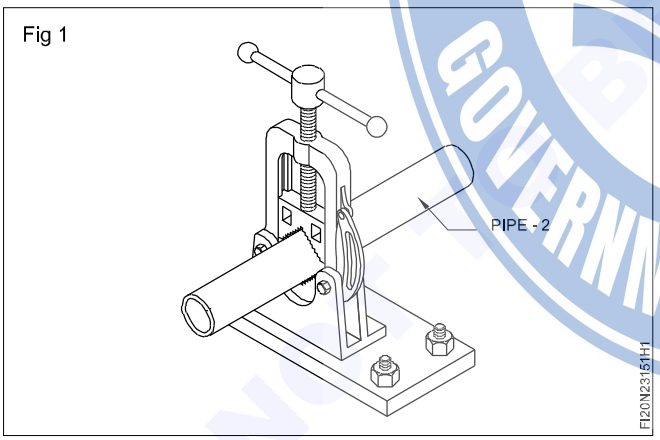
Skill Sequence

Pipe Fitting Assembly

Objective: This shall help you to
- **assemble pipe and pipe fittings.**

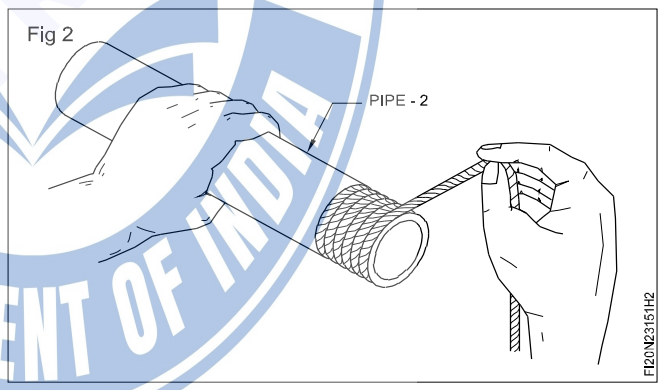
Hold the pipe No. 2 in a pipe vice (Fig 1).

Fig 1



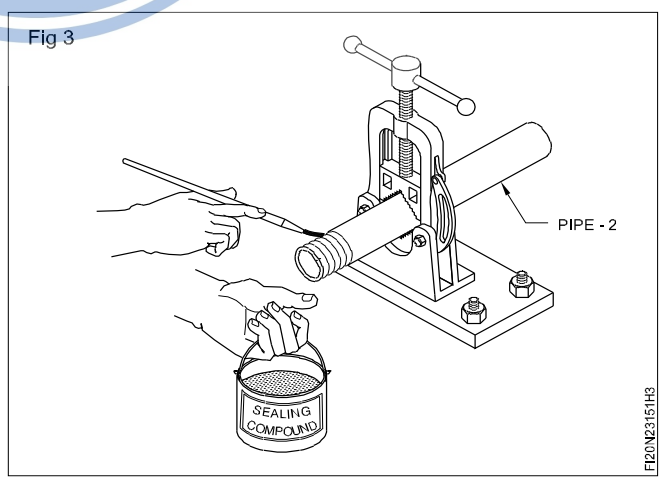
Wind the hemp packing/cotton thread material on the external threads of the pipe (Fig 2).

Fig 2



Apply sealing compound over the pipe threads (Fig 3).

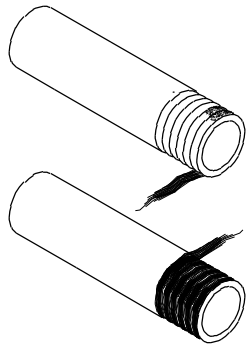
Fig 3



Fit Tee- 2 to pipe No. 2 and tighten it using a pipe wrench.

Wind the hemp packing to external threads of all the pipes and standard fittings and apply sealing compound over the threads before joining with the other one (Fig 4).

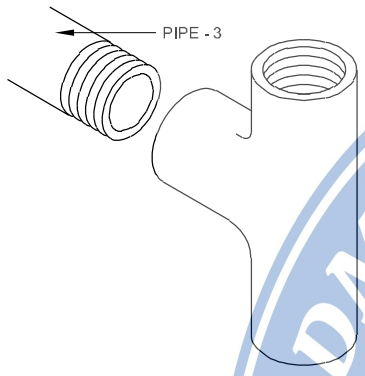
Fig 4



FI20N23151H4

Fit pipe No. 3 with Tee-2 (Fig 5).

Fig 5

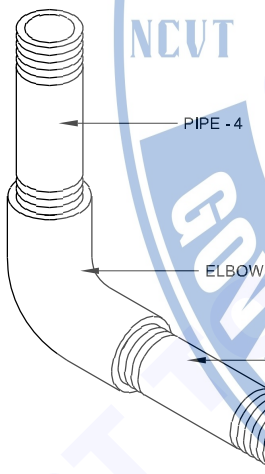


FI20N23151H5

Fit Elbow - 1 to Pipe No -3 (Fig 6).

Fit Elbow - 1 to Pipe No -4 (Fig 6).

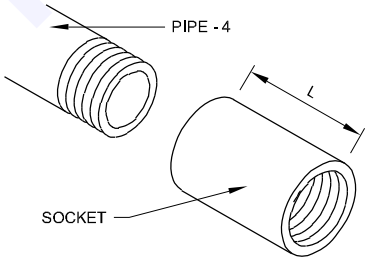
Fig 6



FI20N23151H6

Fit a socket to Pipe No - 4 (Fig 7).

Fig 7

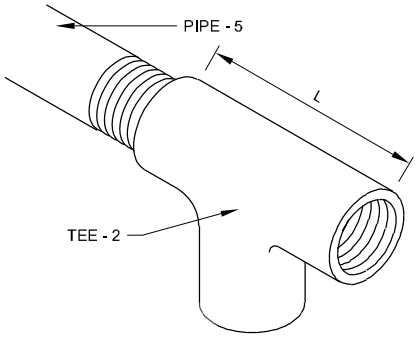


FI20N23151H7

Fit bib cock to socket.

Fit Pipe No - 5 to Tee - 2 (Fig 8).

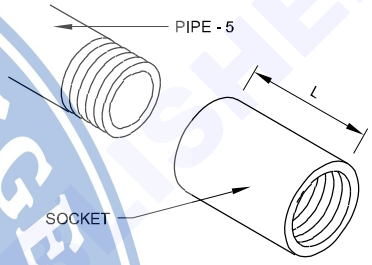
Fig 8



FI20N23151H8

Fit Pipe No - 5 to socket (Fig 9).

Fig 9



FI20N23151H9

Fit socket to Elbow - 2 on both ends (Fig 10).

Fit socket to Pipe No - 6 (Fig 10)

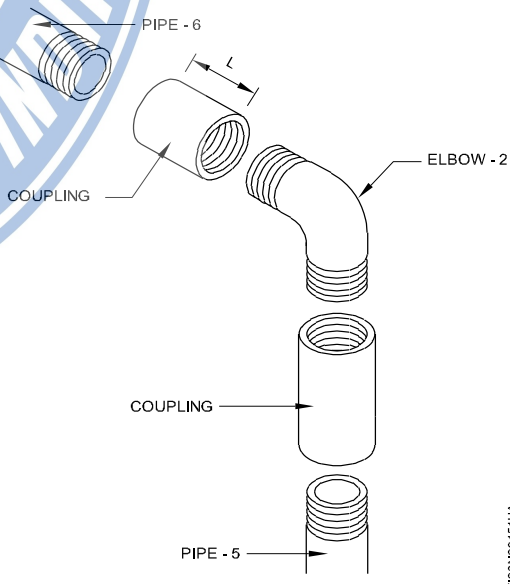
Fit Tee - 3 to Pipe No - 6 , 7, 8 (Fig 11).

Fit socket to Pipe No - 7 (Fig 12).

Fit socket to Pipe No - 8 (Fig 13)

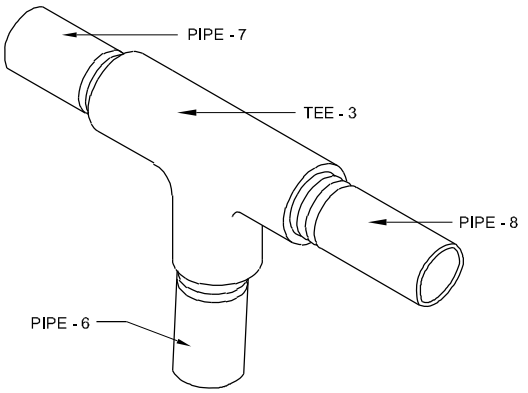
Assembling Elbow with pipe (Fig 14).

Fig 10



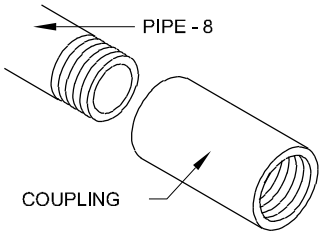
FI20N23151HA

Fig 11



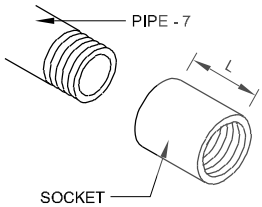
FI20N23151HB

Fig 13



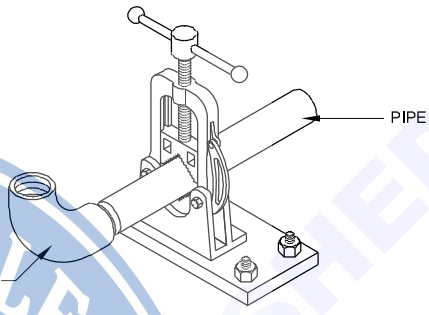
FI20N23151HD

Fig 12



FI20N23151HC

Fig 14

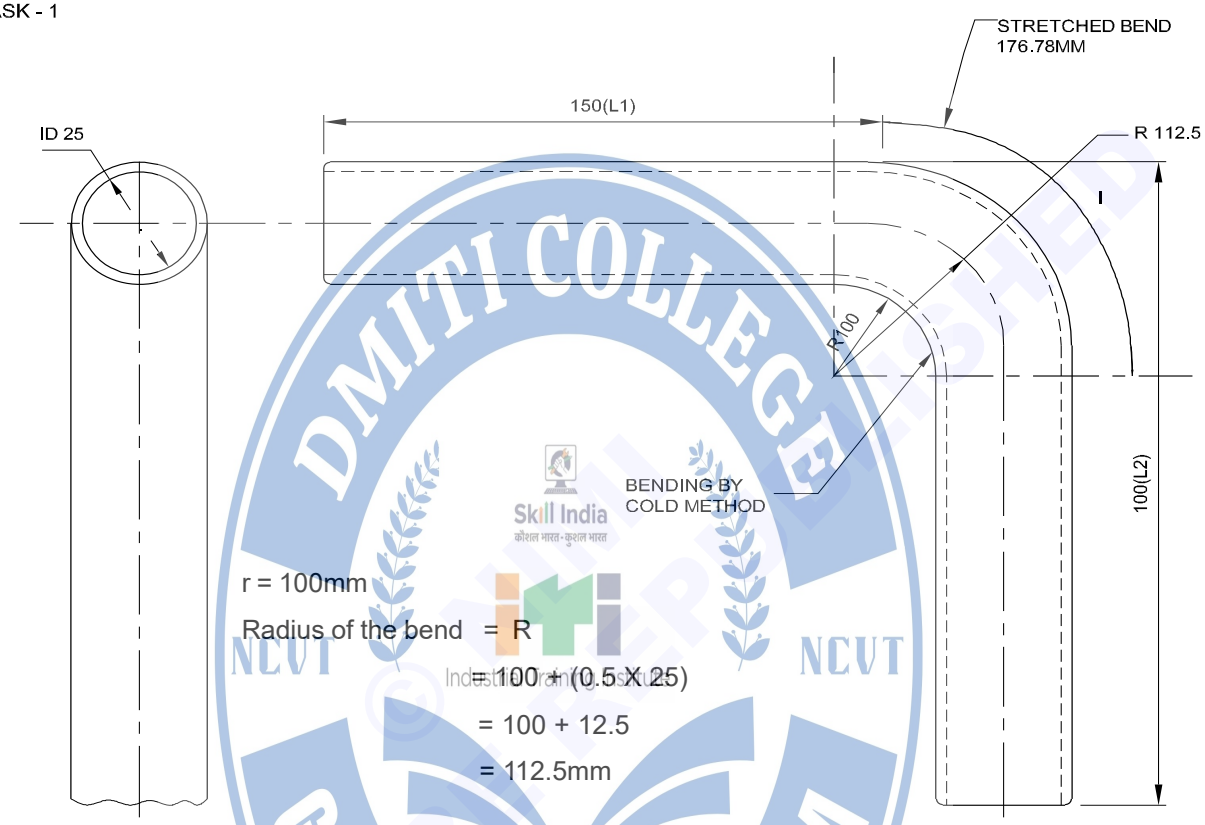


FI20N23151HE

Bending of pipes - cold and hot

Objective: At the end of this exercise you shall be able to
- **bend G.I. pipe by cold method as per template on a pipe bending machine.**

TASK - 1



r = 100mm

Radius of the bend = R

= 100 + (0.5 X 25)

= 100 + 12.5

= 112.5mm

Stretch of the bend = l

$$= \frac{90}{360} \times 2 \times \frac{22}{7} \times 112.5$$

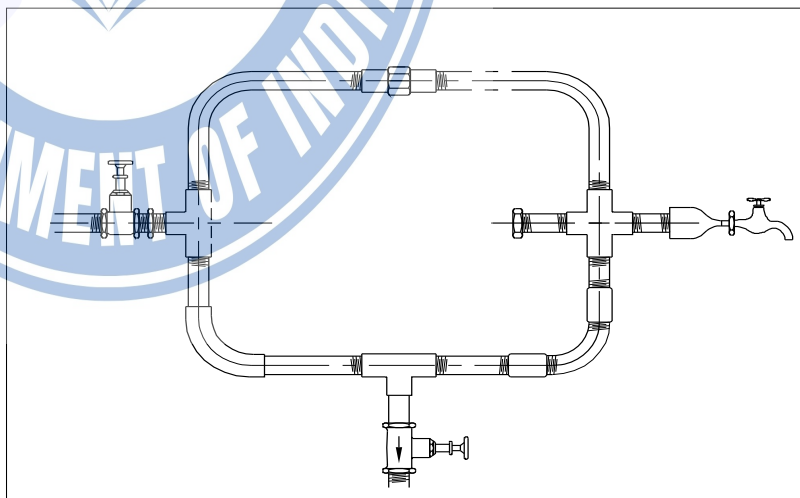
$$= \frac{11 \times 112.5}{7}$$

$$= 176.78mm$$

∴ L = (length of pipe) = L1 + L2 + l

= 150 + 100 +176.78

= 426.78 mm

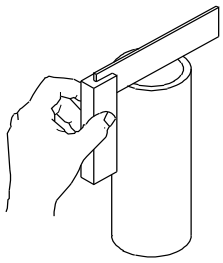


1	Ø 25 - 430 L		G.I	-	-	2.3.152
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE: NTS	**BENDING OF PIPES - COLD AND HOT (PIPE BENDING BY COLD METHOD)**				DEVIATIONS	TIME : 6 Hrs
					CODE NO. FI20N23152E1	

Job sequence

File the pipe ends and check up its squareness. (Fig 1)

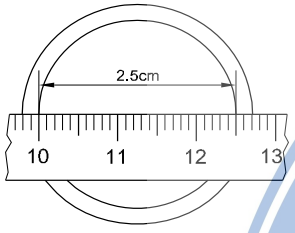
Fig 1



FI20N23152H1

Check the inside dia. of the pipe by using steel rule. (Fig 2)

Fig 2



FI20N23152H2

Please change the reading from inside diameter from 10cm. Measure the length of the pipe as per drawing

r=radius of bend (i.e) 150mm

Ø=angle of bend

l=length of curved portion

then

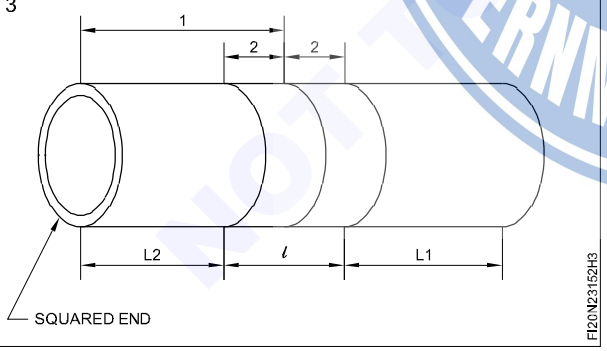
$$l = \frac{\pi \times D \times Ø}{360}$$

L = Total length

= L1 + l + L2

Mark off the beginning and the end of the bend from the centre line. (Fig 3)

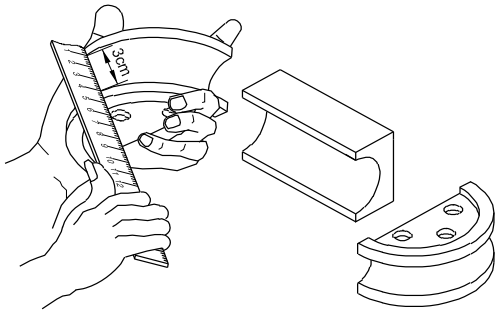
Fig 3



FI20N23152H3

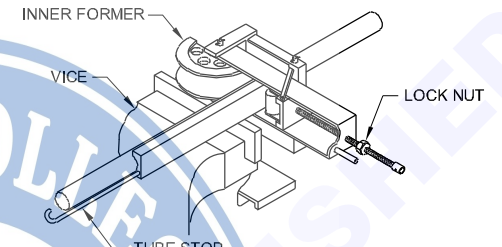
Select the standard former to suit the size of the pipe. (Fig 4)

Fig 4



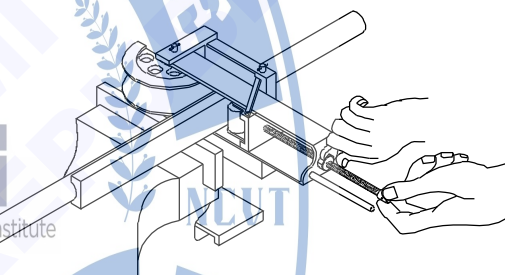
FI20N23152H4

Fig 5



FI20N23152H5

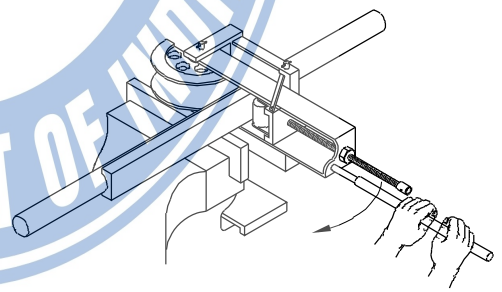
Fig 6



FI20N23152H6

Bend the pipe by pulling the bending arm towards your body. (Fig 7)

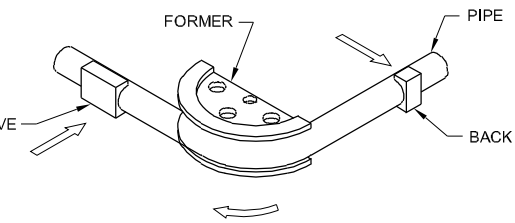
Fig 7



FI20N23152H7

The sleeve bends the pipe round the former as the bending arm is pulled. The back stop holds the tails end of the pipe in position. (Fig 8)

Fig 8



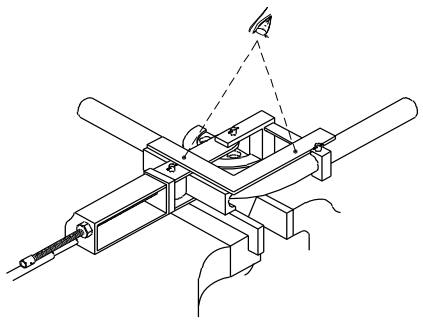
FI20N23152H8

Fix the bending machine in a benchvice and ensure it is tightened properly. Locate the tube stop bar at the required position. (Fig 5)

Set the roller on the bending arm by adjusting the screw and lock nut. (Fig 6)

Check the bend for squareness use a set square as shown. (Fig 9)

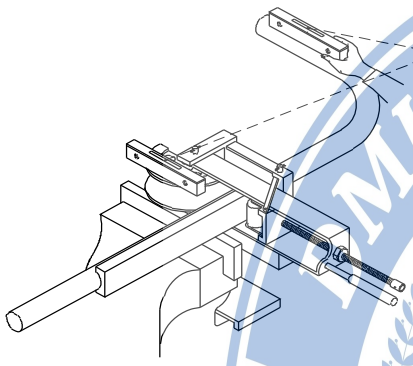
Fig 9



FI20N23152H9

Check level of former and first leg (90° bend) with spirit level by placing spirit levels as shown in Fig 10.

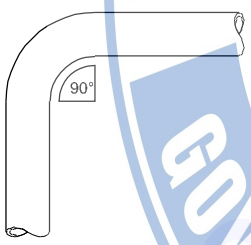
Fig 10



FI20N23152HA

Check the angle of bend and radius using standard template. (Fig 11)

Fig 11

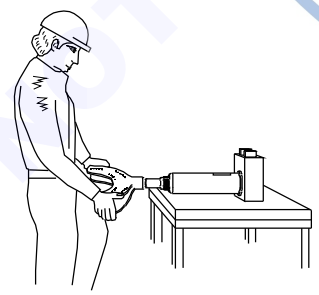


FI20N23152HB

Bending 120° by Hydraulic bending machine

Fit the pipe former on to the cylinder arm. (Fig 12)

Fig 12

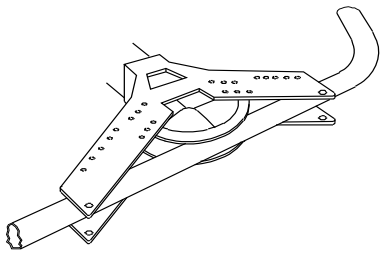


FI20N23152HC

Place the pipe between the forming head plates and against the former. (Fig 13)

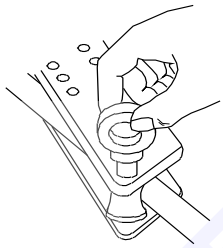
Support the pipe and fit dollies (or rollers) between the upper and lower plates of the forming head. Locate them in position by inserting pins through the plates and the dollies. (Fig 14)

Fig 13



FI20N23152HD

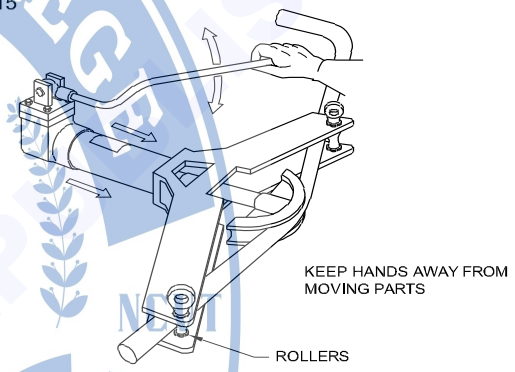
Fig 14



FI20N23152HE

Close the pressure release valve on the pump body then start pumping to push the former against the pipe. (Fig 15)

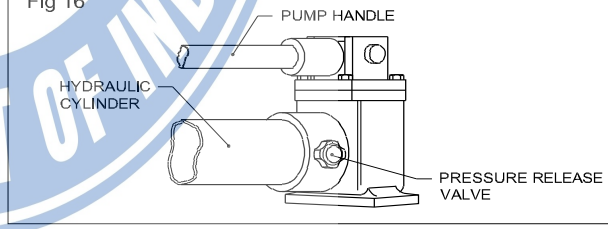
Fig 15



FI20N23152HF

Turn the pressure release valve anti-clockwise to release the pressure in the hydraulic cylinder. When the arm has moved back about 6 mm to 10 mm close the pressure release valve to hold the ram steady. (Fig 16)

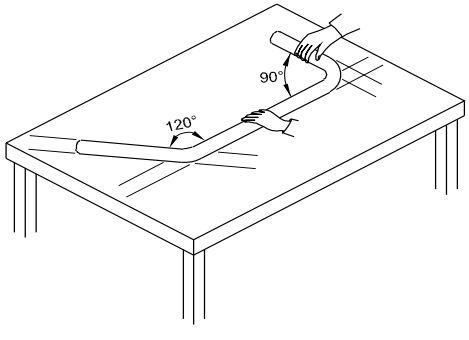
Fig 16



FI20N23152HG

Check both bends 90° and 120° by placing pipe on the layout. (Fig 17)

Fig 17

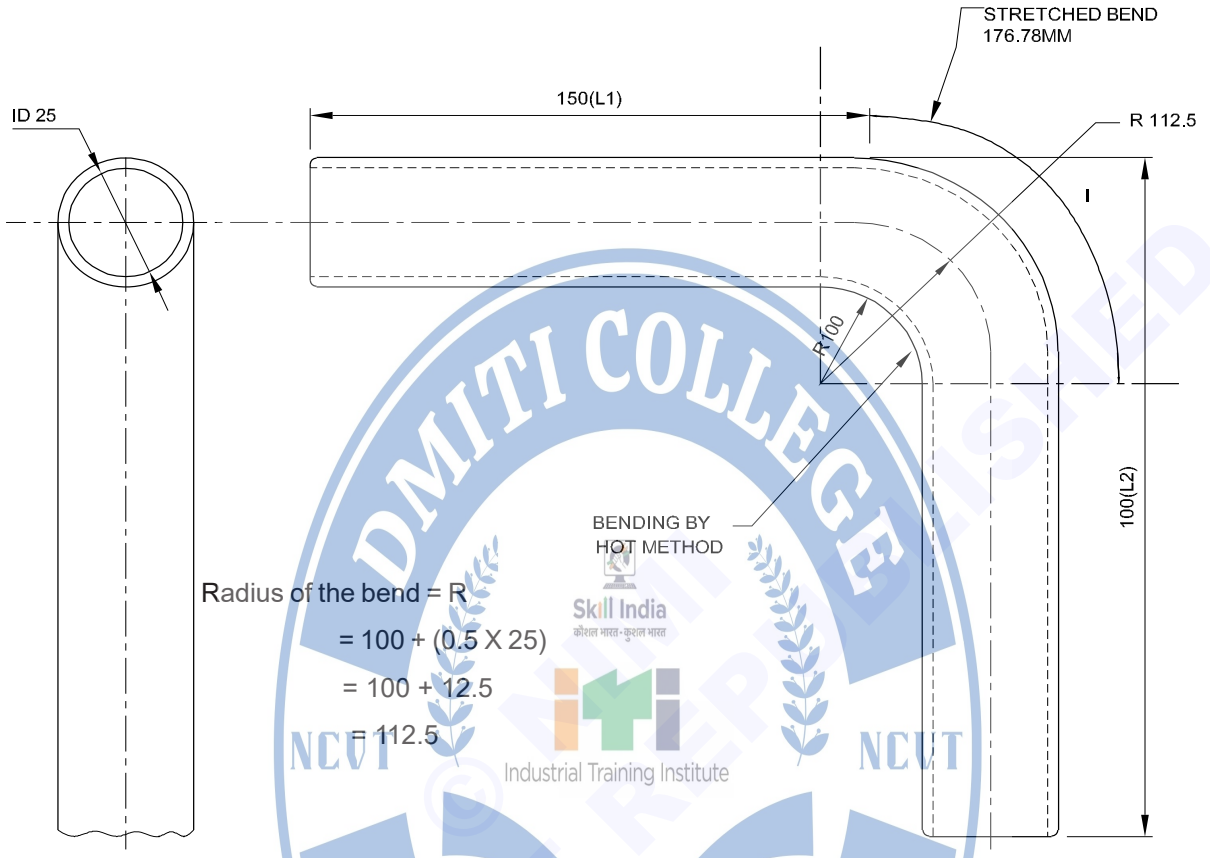


FI20N23152HH

Pipe bending by hot method

Objective: At the end of this exercise you shall be able to
- **bend G.I. pipe by heating and match with template.**

TASK - 2



Radius of the bend = R

= 100 + (0.5 X 25)

= 100 + 12.5

= 112.5

Stretch of the bend = I

$$= \frac{90}{360} \times 2 \times \frac{22}{7} \times 112.5$$

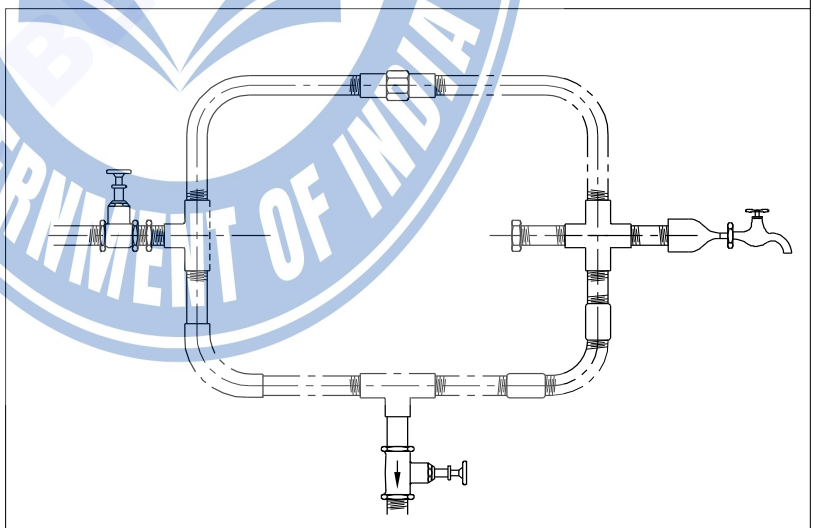
$$= \frac{11 \times 112.5}{7}$$

$$= 176.78mm$$

L (length of pipe) = L1+L2+I

= 150 +100+176.78

= 426.78mm



1	Ø 25 - 430 L		G.I	-	-	2.3.152
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE: NTS		**PIPE BENDING (BY HOT METHOD)**			DEVIATIONS	TIME : Hrs
					CODE NO. FI20N23152E2	

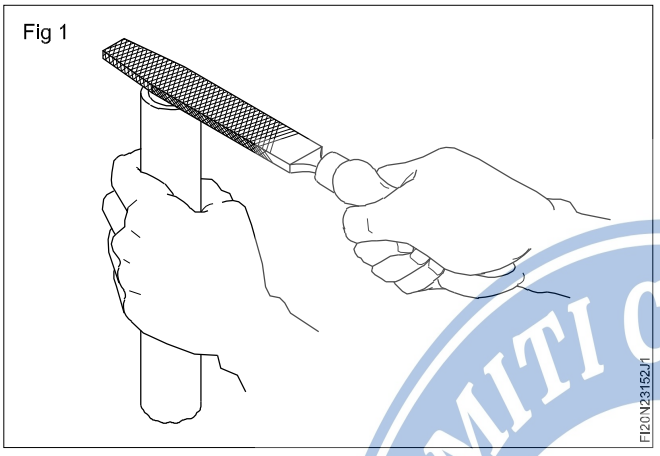
Job Sequence

Bending G.I. pipes using sand and pegs

Objective : This shall help you to
- **bend G.I. pipe by hot method.**

File the pipe ends square. (Fig 1)

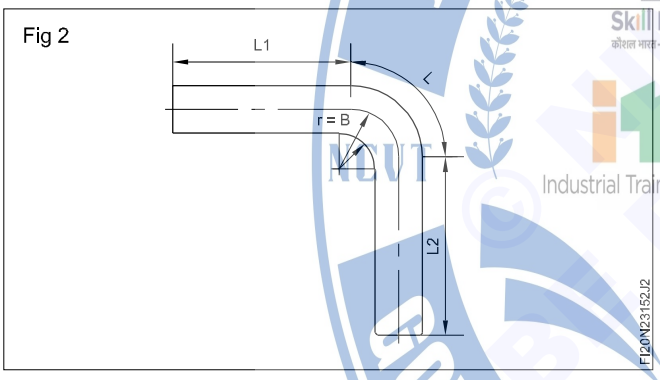
Fig 1



Remove burrs.

Calculate the length of pipe.(Fig 2)

Fig 2



If D = diameter of bend

ϕ = angle of bend

l = length of curved portion

then, $l = \frac{\pi \times D \times \phi}{360}$

If OA = inner radius of bend (R)

AB = radius of pipe (r)

OB = radius of bend (R+r)

then, l = (R+r) x Q x 0.01745.

Total length of pipe = $L_1 + L_2 + l$.

Measure and mark off the:

- centre of the bend (Fig 3)
- beginning and end of the bend from the centre line.

Measure the inside diameter of the pipe and select two suitable wooden pegs for the pipe. (Fig 4)

Fig 3

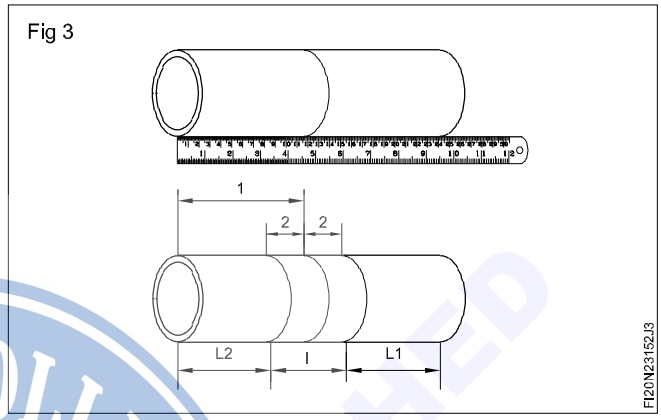
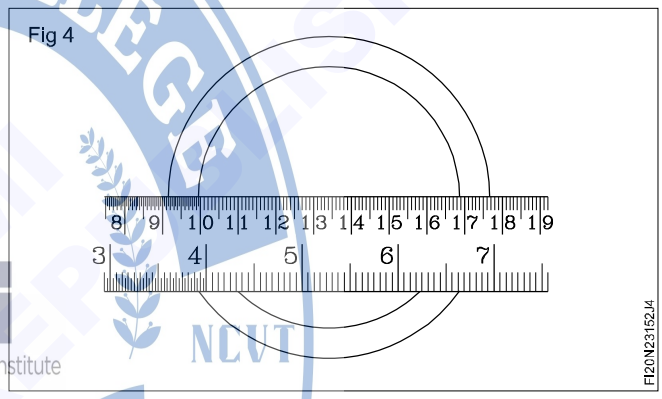
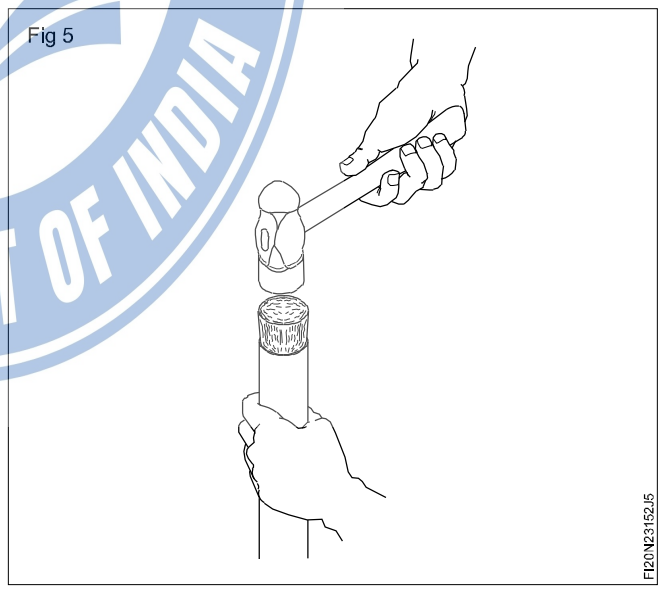


Fig 4



Plug one end of the pipe with a wooden peg.(Fig 5)

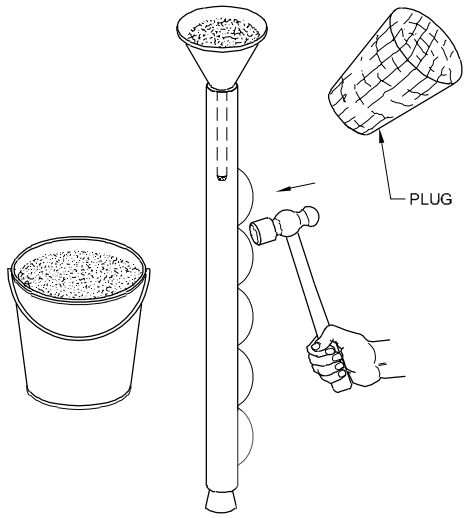
Fig 5



Fill the pipe with clean, dry and fine sand [Compress the sand by tapping the pipe up and down with a soft hammer.] (Fig 6) and plug the end.

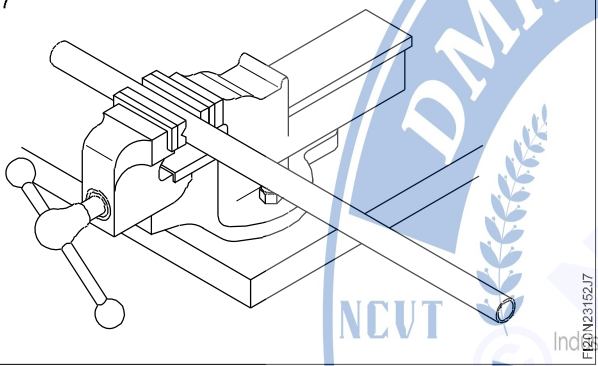
Ensure that the entire pipe is filled with sand.

Fig 6



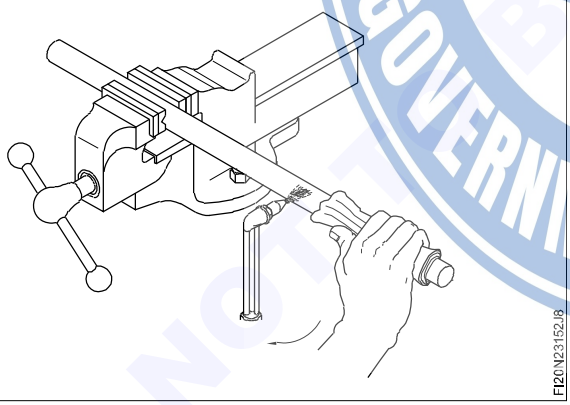
Clamp one end of the pipe in a vice and protect the clamped portion of the pipe with lead or copper shims. (Fig 7)

Fig 7



Heat the area to be bent with oxy-acetylene torch evenly until it glows dull red. (Fig 8)

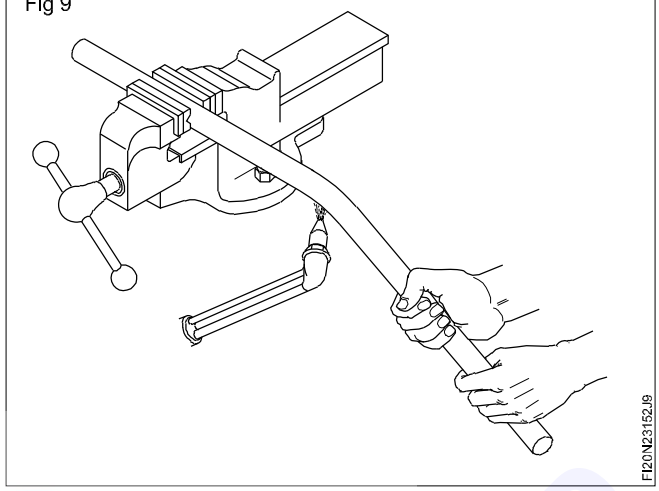
Fig 8



The bend area should not be overheated.

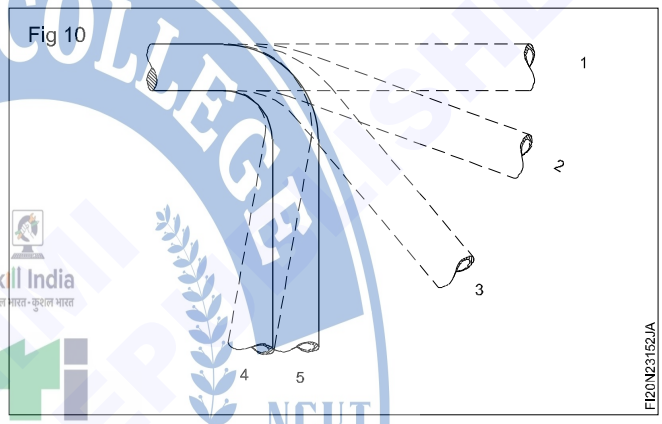
Pull down the pipe gently in the direction of the bend. (Fig 9)

Fig 9



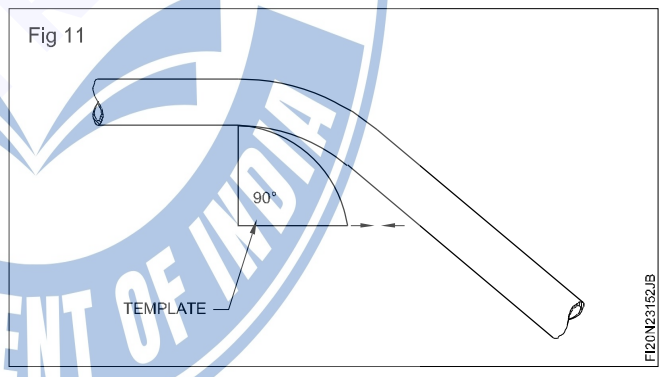
Take short pulls until the correct bend angle is reached. (Fig 10-1,2,3)

Fig 10



Check the bend radius with a template. (Fig 11)

Fig 11



Apply heat throughout the whole operation and overbend slightly and straighten out the final bend. (Fig 10-4,5)

Remove one end of the plug.

Ensure that the pipe is cooled before removing the plug.

Remove the sand by tapping the pipe gently with a hammer.

Calculate the length of material for bending

Objective : This shall help you to
- **calculate the required length of pipe for bending.**

While bending a rod, sheet or pipe, due to the tensile force in the outer part of the material at the bending point, the material is stretched. (Fig 1 and 2) Due to the force of pressure in the inner part of the material at the bending point, the material is compressed.

Fig 1

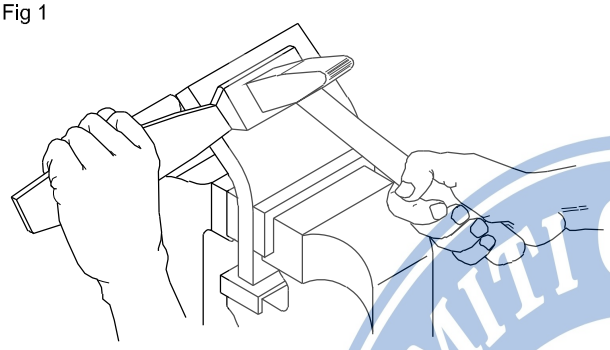
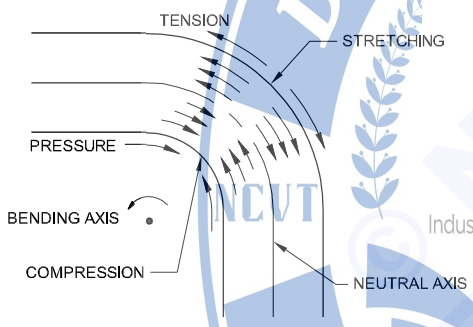


Fig 2



The layer in the middle of the material is not subjected to either tension or compression.

This is called the neutral axis. (Fig 2)

For calculating the length of material for bending, the material length at the neutral axis is taken into account.

The length of the blank/ rod/pipe is the stretched length before bending. The stretched length is determined along the neutral axis. For calculating the stretched/ elongated length of a rod/sheet/pipe while bending (Fig 3), first add all straight portions together.

x + y + z + y + x = 2x + 2y + z

Then add the bent space distances together. For calculating this:- take the radius of the bent up to the neutral axis and also take the angle of the bend into consideration. (Fig 4).

Fig 3

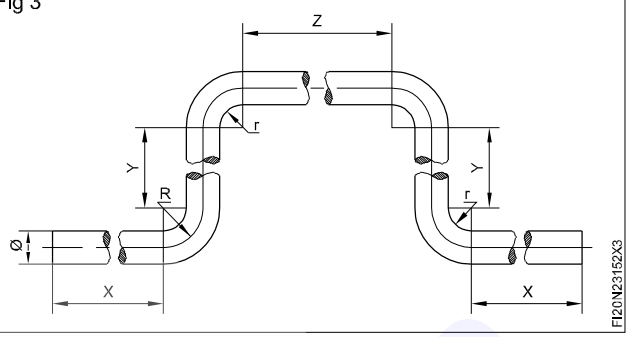
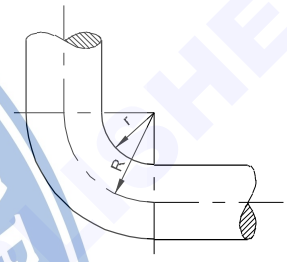


Fig 4



Radius of the bend up to neutral axis

= inner radius + 0.5 x thickness of sheet OR diameter of rod or pipe. Angle of the bend with respect to Figs 3 & 4 is 90.

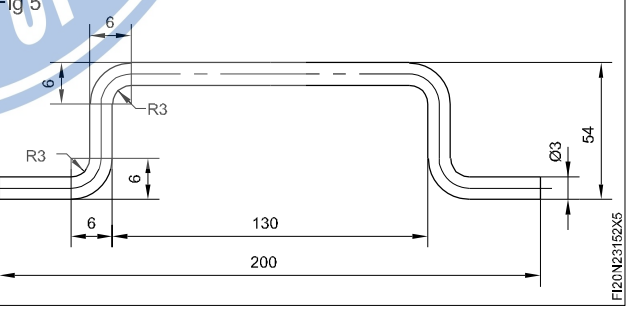
Length of the curved space

$$= \frac{\text{Angle of curve} \times 2\pi R}{360}$$

where 'R' is the radius of the curve at the neutral axis.

Calculation of stretching length (Fig 5)

Fig 5



Straight spaces length

$$x = \frac{200 - (130 + 6 + 6)}{2} = 29\text{mm}$$

$$y = 54 - (6 + 6) = 42\text{mm}$$

$$z = 130 - (3 + 3) = 124\text{mm}$$

$$2x + 2y + z = 58 + 84 + 124 = 266\text{mm}$$

There are four bends all having a 90° angle.

R (Radius up to neutral axis)= 3+1.5 = 4.5 mm

$$\text{Stretch length of one bend} = \frac{90}{360} \text{x} 2\text{x} \frac{22}{7} \text{x} 4.5$$

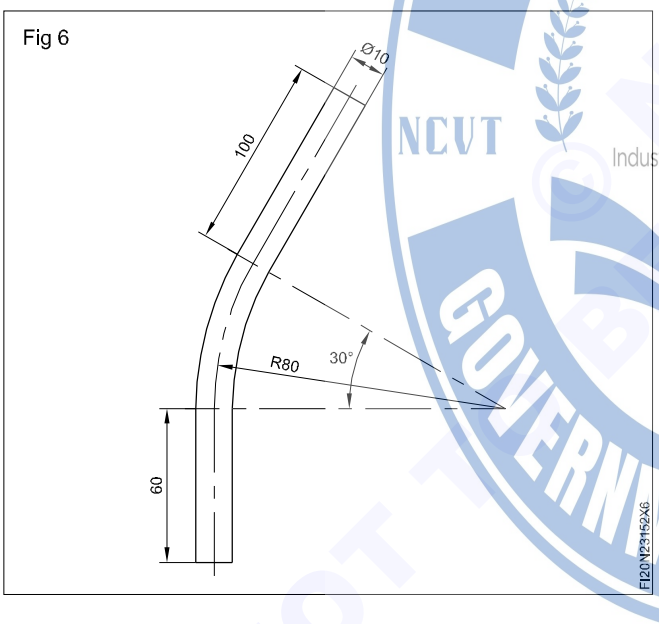
$$\text{For all the four bends} = 4\text{x} \frac{90}{360} \text{x} 2\text{x} \frac{22}{7} \text{x} 4.5 = 28.28\text{mm}$$

$$\text{Total stretched length} = 266 + 28.28$$

= 294.28 or = 295 mm

In the above calculation the angle of the bend is taken as 90°. For calculating the curved length for any bending angles the following formula can be used.(Fig 6).

Fig 6



$$\text{Length of curve} = \frac{\text{angle of curve}}{360°}$$

Where R is the radius of the curve at the neutral axis.

$$\text{Length of curve} = \frac{30° \text{ x } 2\pi \text{ x } 80}{360°}$$

= 41.88 mm

Total length of material of θ 10 mm

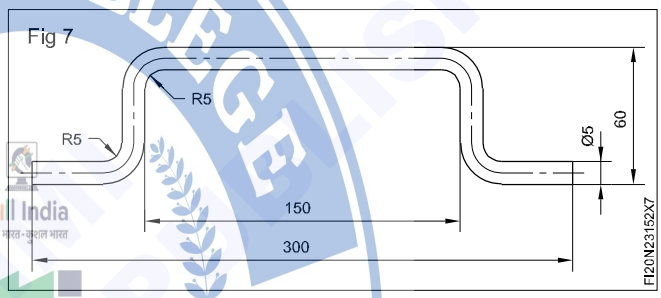
= 60 + 41.88 + 100 = 201.88 mm

Assignment

Calculate the total length of the material required for bending the round rod as given in the drawing below.

Answer -

Fig 7



Dismantling & assembling - globe valves, sluice valves, stop cocks, seat valves and non-return valve

Objectives: At the end of this exercise you shall be able to
- **dismantle, service and assemble a globe valve**
- **dismantle, service and reassemble a sluice valve (gate valve)**
- **dismantle, service and assemble a stop cock**
- **dismantle, service and assemble a seat valve**
- **dismantle, service and assemble a non-return valve.**

Fig 1

TASK 1

GLOBE VALVE

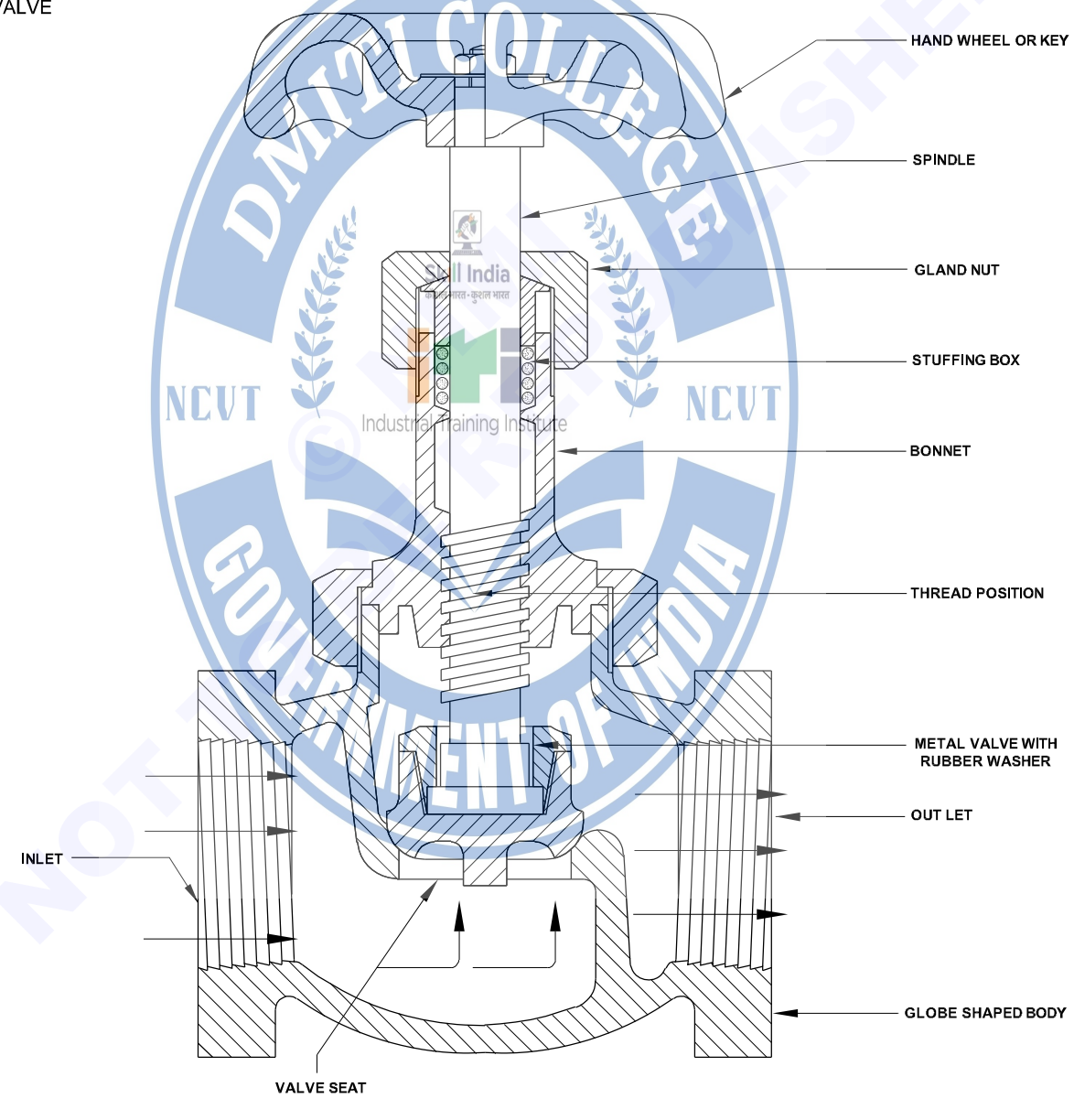
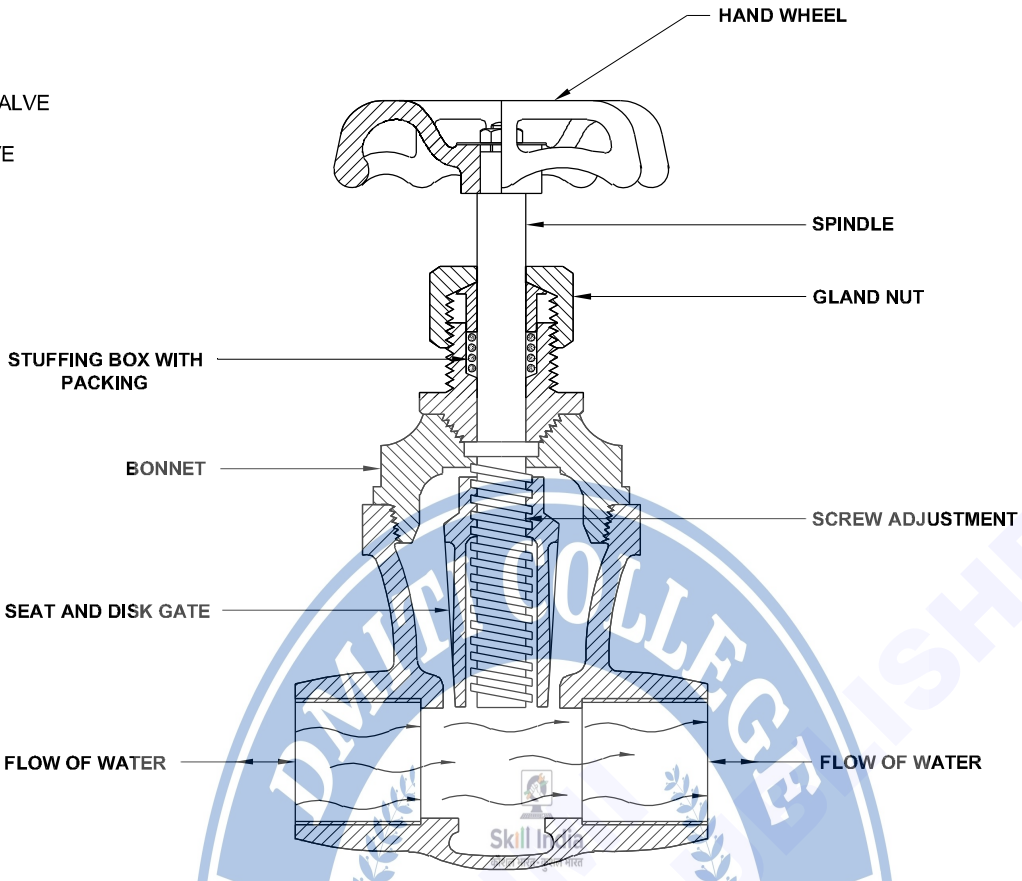


Fig 2

TASK 2
SLUICE VALVE
(or)
GATE VALVE



FI20N23153H2

Fig 3

TASK 3
STOP COCK

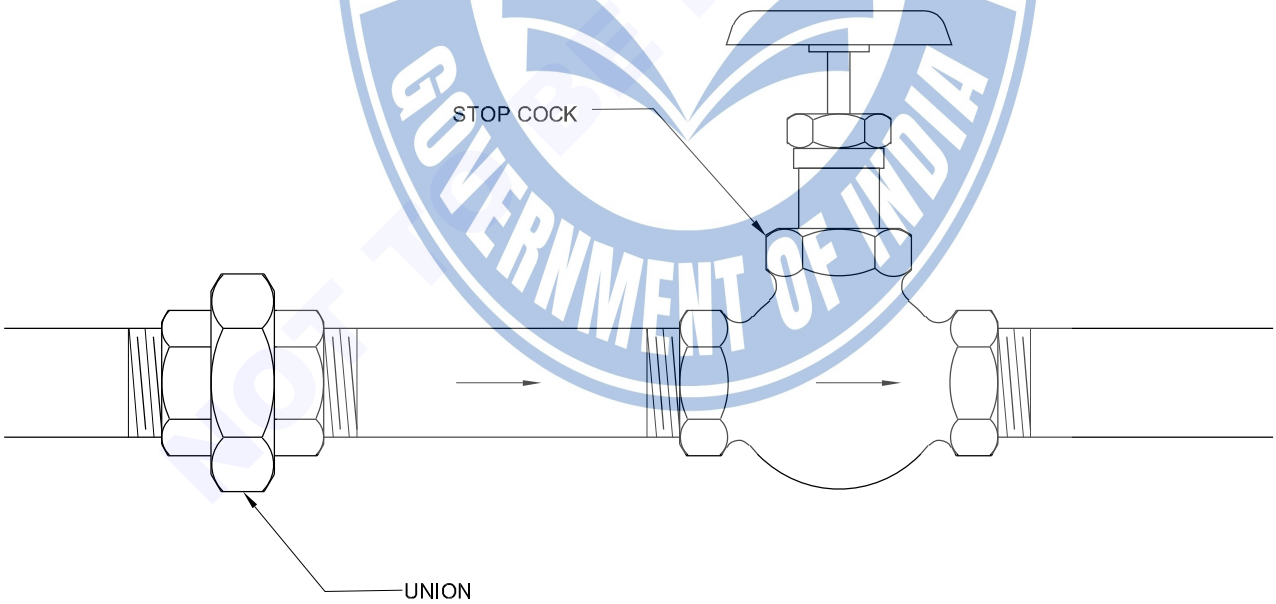


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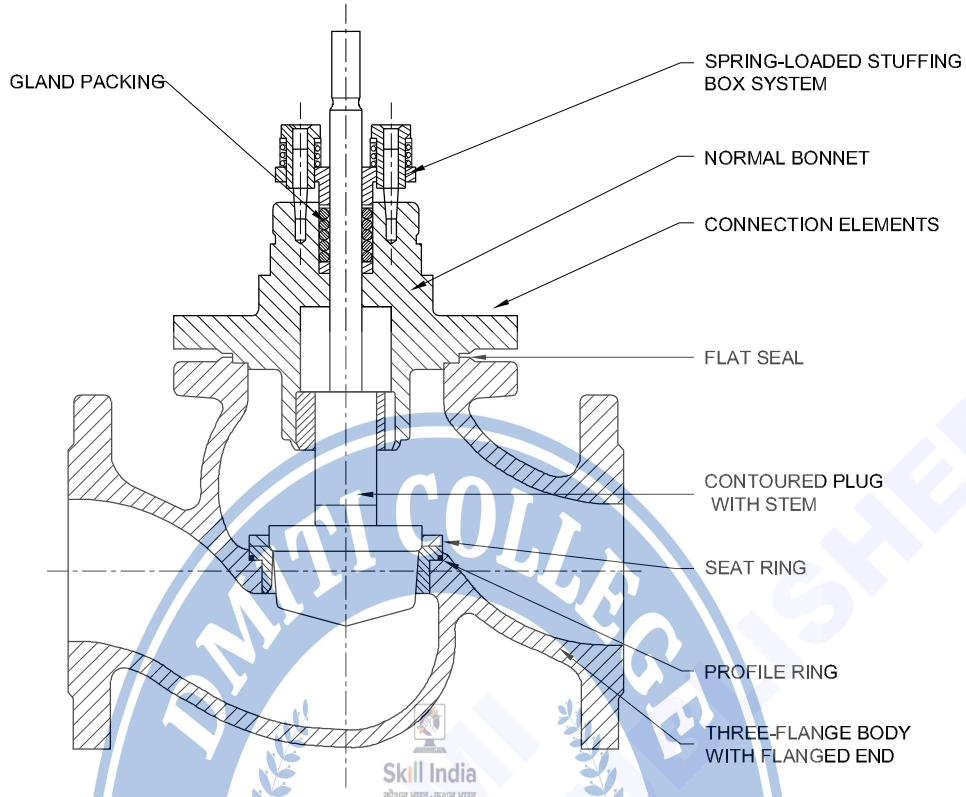
Fig 4

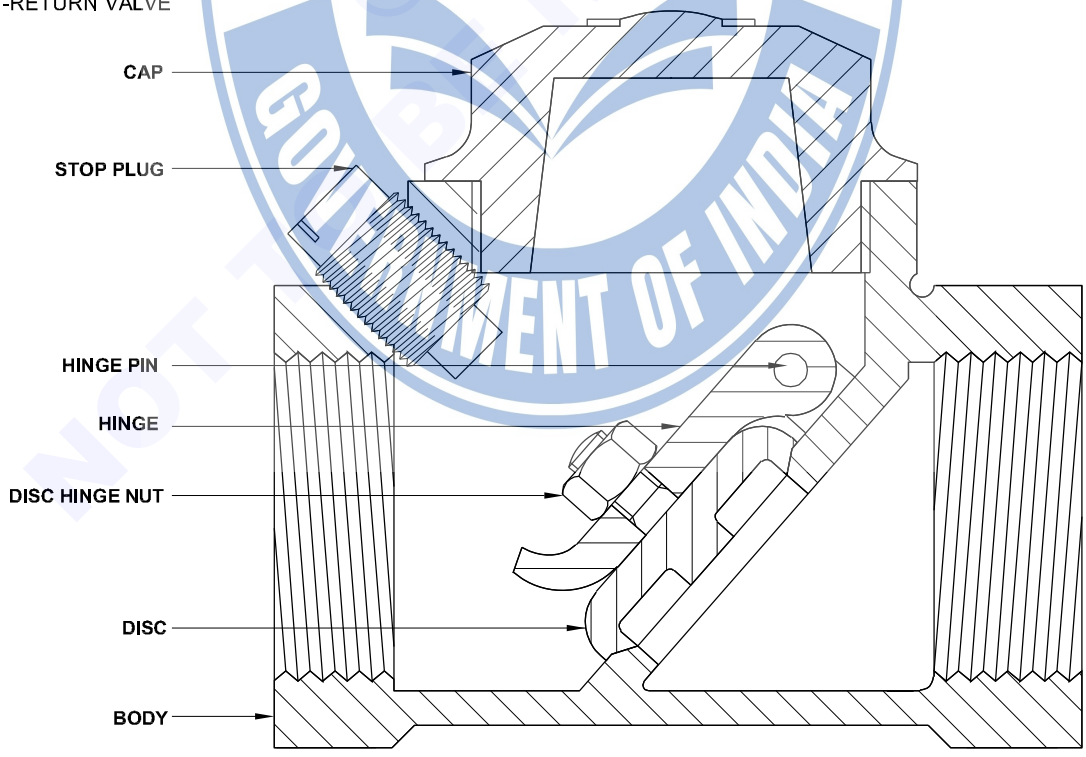
TASK 4
SEAT VALVE



FI20N23153H4

Fig 5

TASK 5
NON-RETURN VALVE



FI20N23153H5

Requirements

Tools/Instruments

- Spanner
- Screw driver
- File
- Hacksaw
- Hammer
- Pipe wrench
- Die set
- Screw spanner
- Pliers
- Spanner set
- Adjustable spanner
- Water pump pliers

Equipement/Machines

- Pipe vice
- Bench vice
- Oil can

Materials

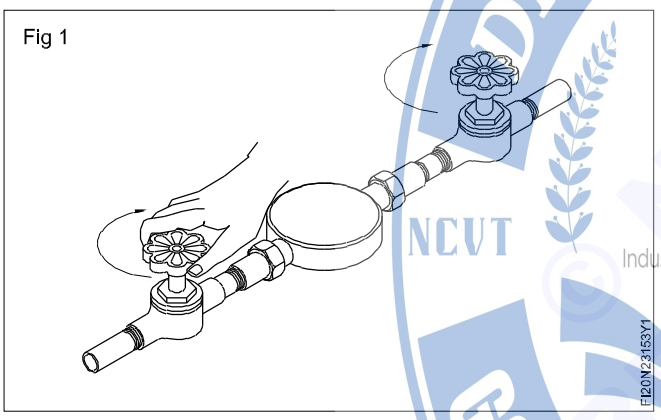
- Stop cock
- Union
- Thread seal material
- Gate valve
- Asbestos rope
- Rubber sheet
- Leather sheet
- Emery sheet
- Oil
- Grease

Job Sequence

TASK 1 : **Globe valve**

Shut off the water by closing the main gate valve.(Fig 1)

Fig 1

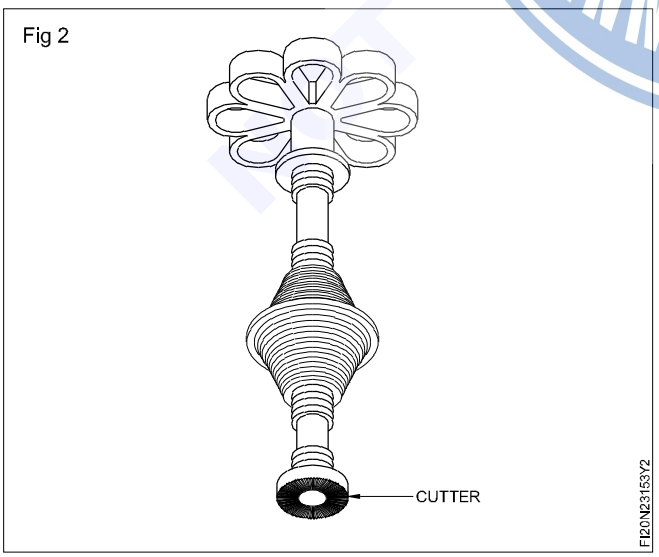


Drain the system and release the water pressure of the system.

Unscrew the bonnet and lift off the bonnet from the body.

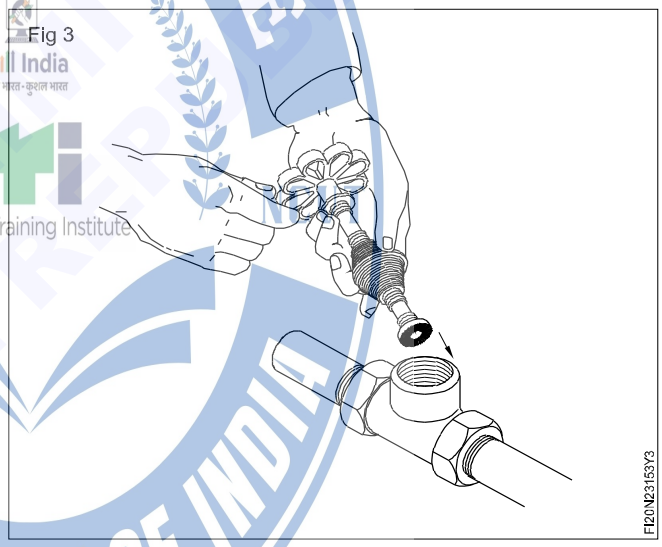
Select the correct size cutter and assemble it to the reseating tool. (Fig 2)

Fig 2



Insert the reseating tool into the body of the stopcock. (Fig 3)

Fig 3



Hold the handle on the top of the tool steadily and turn the feed screw clockwise until the cutter just touches the bottom seat. (Figs 4 & 5)

Face the bottom seat with the cutter by rotating the handle by gripping the feed screw. (Fig 6)

Ensure a minimum amount of metal is removed by adjusting the feed screw.

Loosen the feed screw and the adopter and remove the reseating tool from the body. (Fig 7)

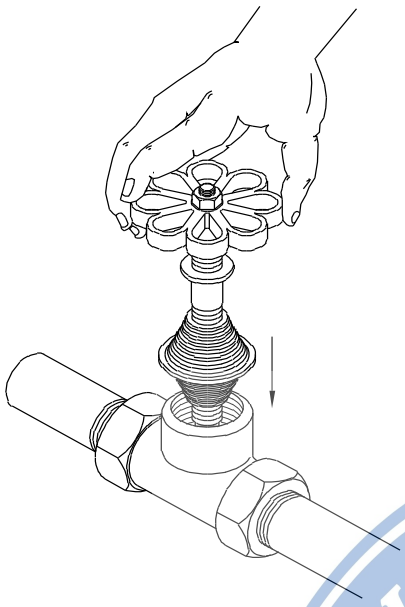
Inspect the valve seat using the beam of a flash light. (Fig 8)

Clean the seat and ensure that it is free from burrs, chips etc.

Replace the packing material into the gland box.

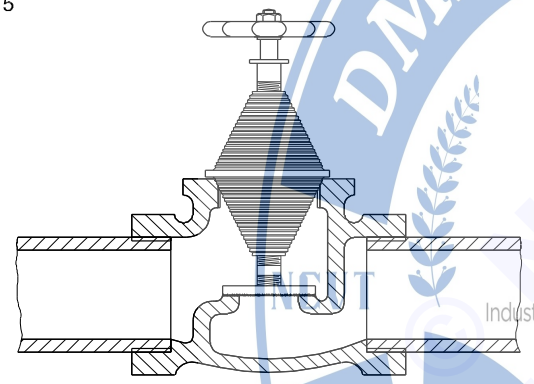
Tighten the bonnet. (Fig 9)

Fig 4



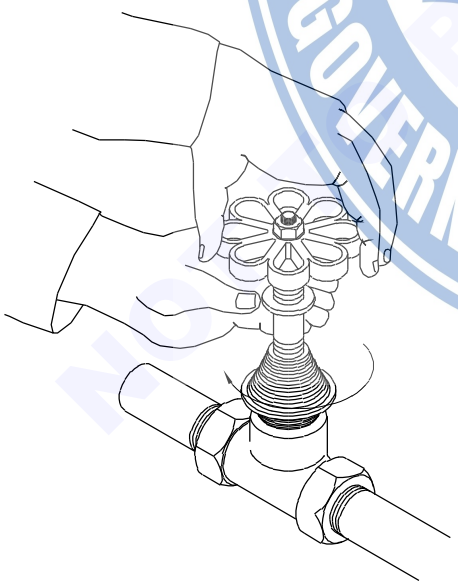
FI20N23153Y4

Fig 5



FI20N23153Y5

Fig 6

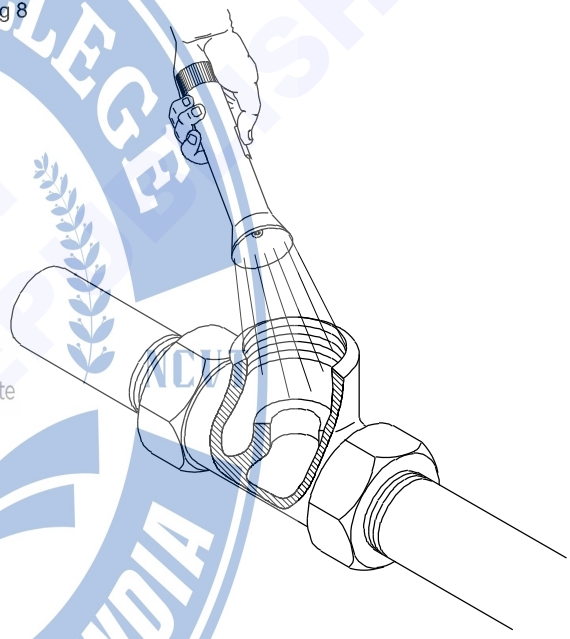


FI20N23153Y6

Fig 7

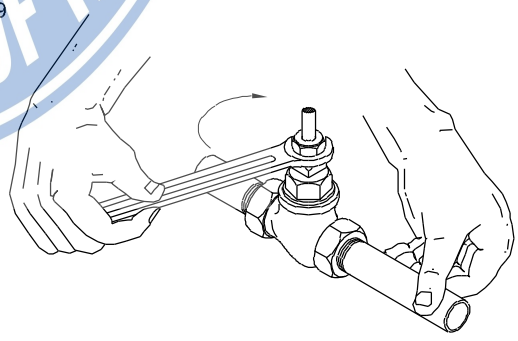
FI20N23153Y7

Fig 8



FI20N23153Y8

Fig 9



FI20N23153Y9

Avoid overtightening as this would cause damage to the thread of the body.

Close all the drain taps and open the main gate valve and check the globe valve for leakage.

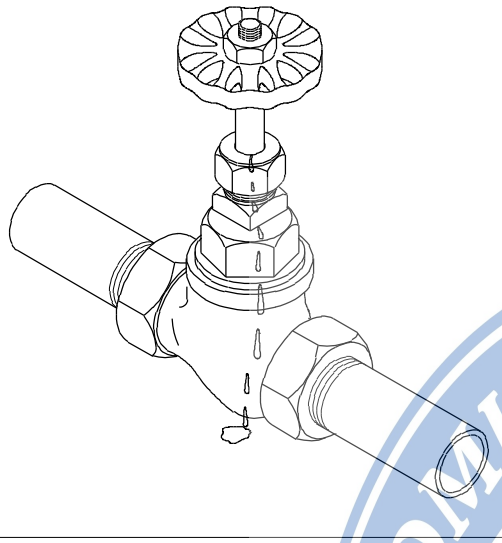
— — — — — —

TASK 2 : **Sluice/gate value**

Close the gate-valve by turning the hand wheel clockwise. (Fig 1)

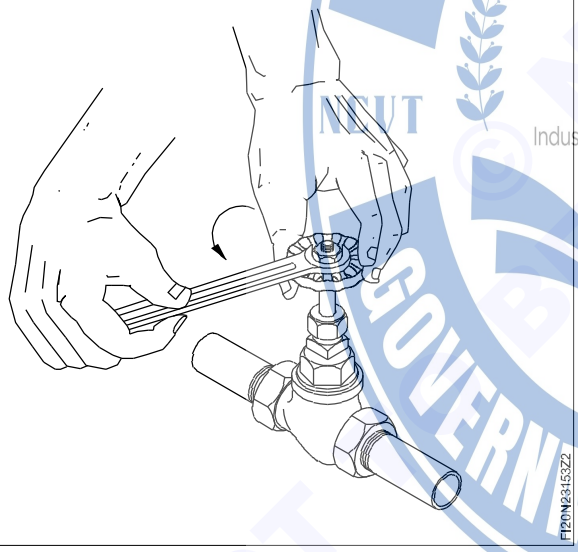
This will stop the water in the valve to be repaired.

Fig 1



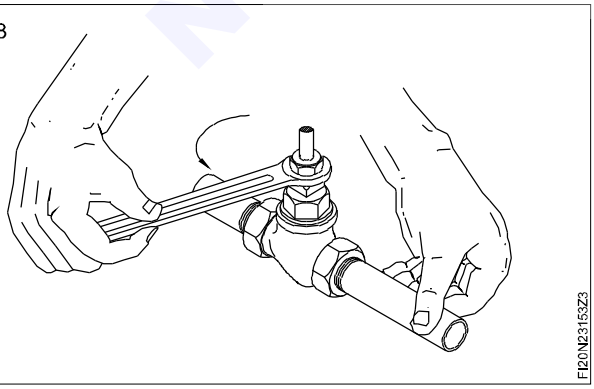
Remove the nut with a spanner and lift off the wheel. (Fig 2)

Fig 2



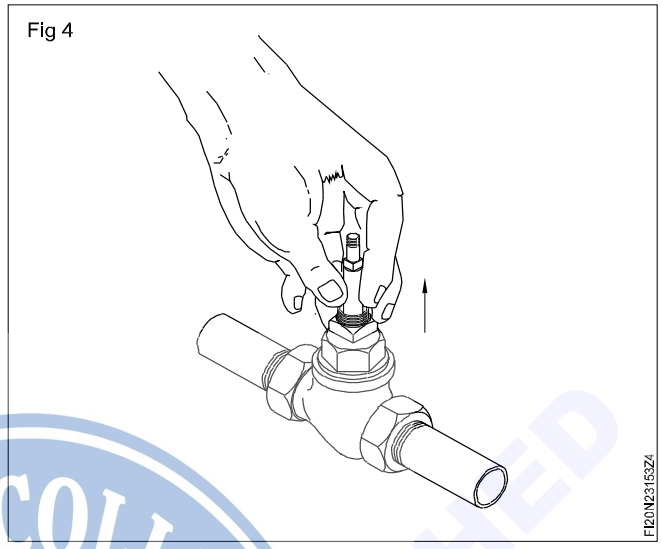
Remove the gland nut from the bonnet by turning it in the anticlockwise direction. (Fig 3)

Fig 3



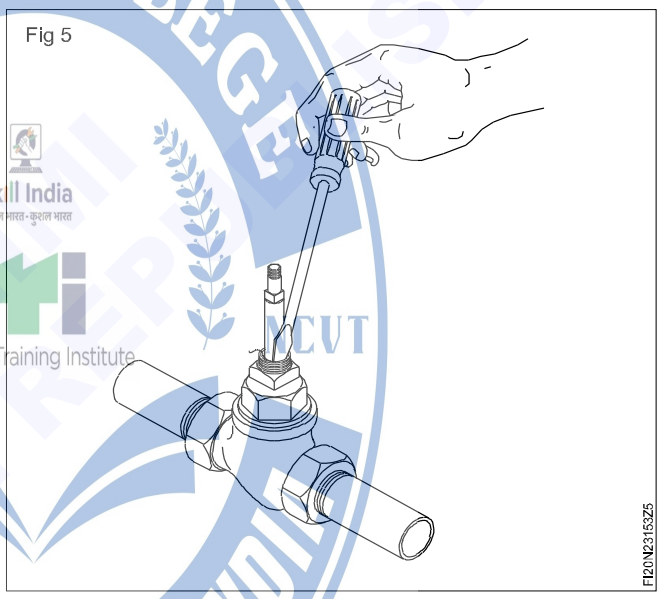
Remove the stuffing gland. (Fig 4)

Fig 4



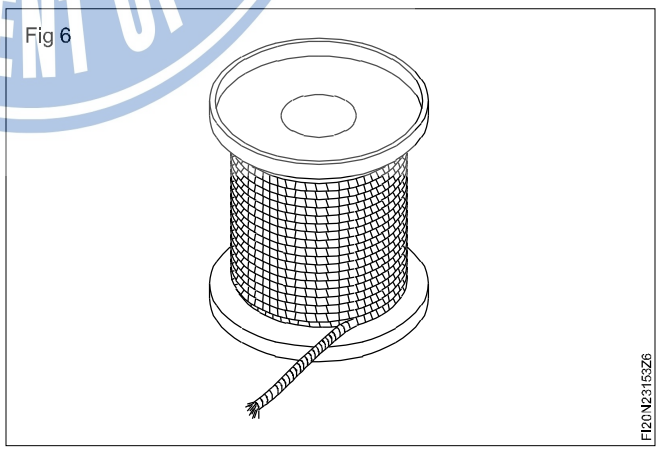
Clean out the old packing in the stuffing box. (Fig 5)

Fig 5



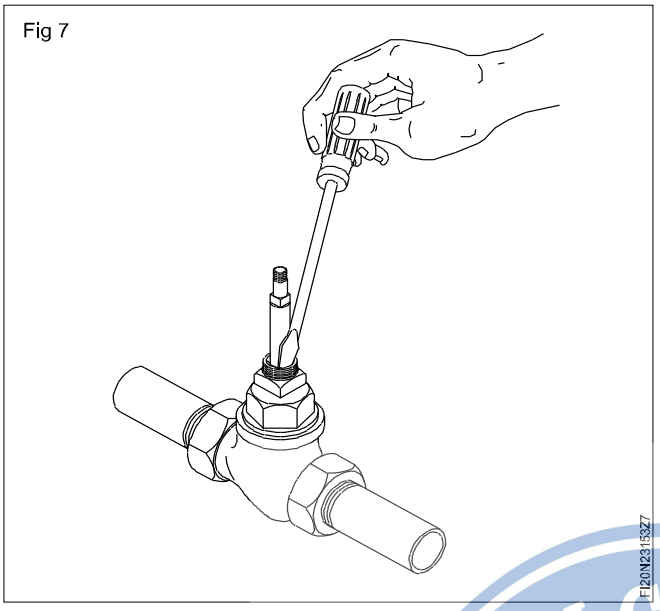
Cut a strand of asbestos rope to make a new packing. (Smear it with water pump grease or graphite paste) (Fig 6)

Fig 6



Coil the new packing round the shaft and push it down with a screw driver. (Fig 7)

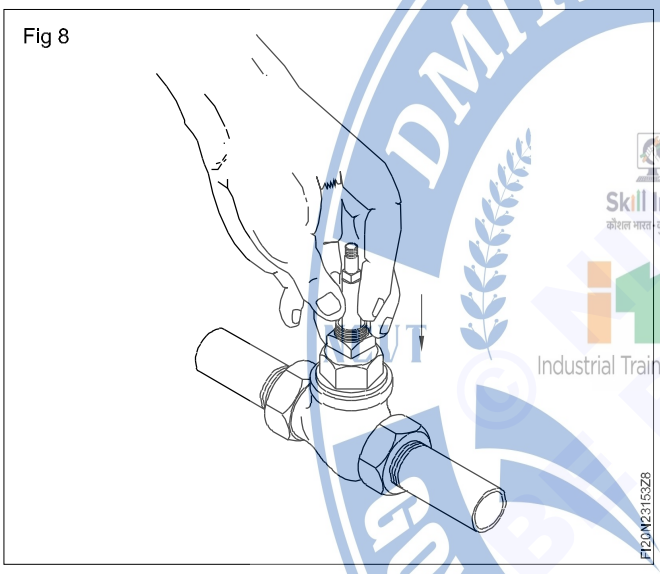
Fig 7



FI20N231532Z

Push in the stuffing gland and check that it fits tightly in the stuffing box. (Fig 8)

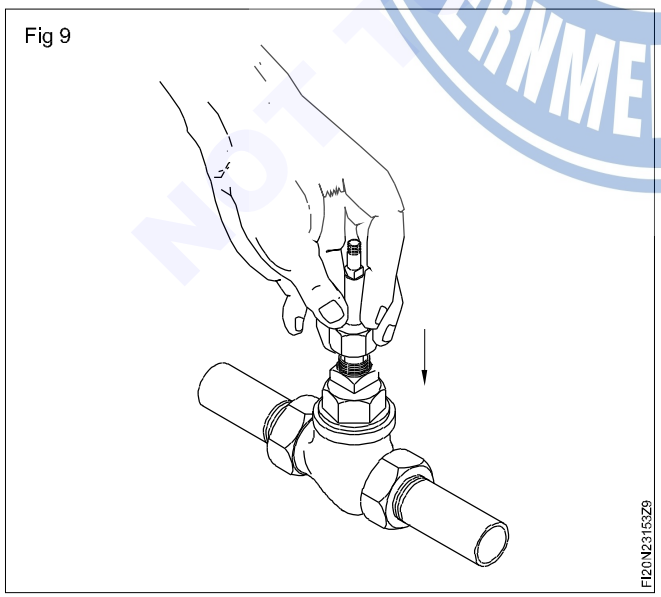
Fig 8



FI20N2315328

Reassemble and leave the gland nut hand tight. (Fig 9)

Fig 9



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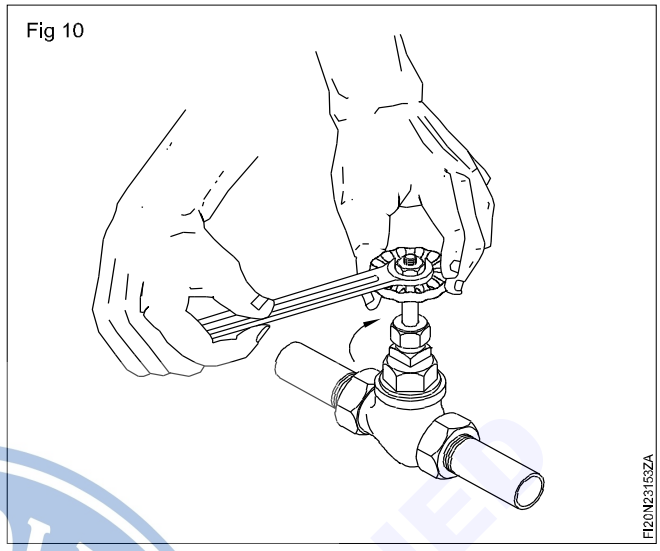
Assemble the hand wheel and tighten the hand wheelnut. (Fig 10)

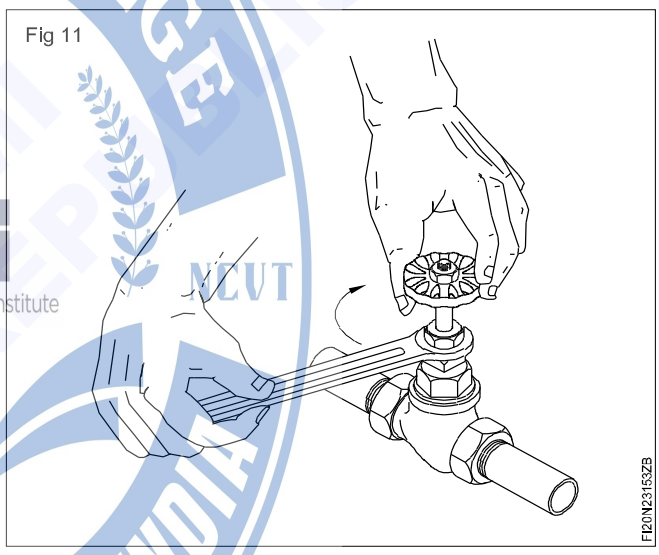
Fig 10



FI20N231532A

Open the gate valve and tighten the gland nut until the packing is compressed sufficiently to stop the water escaping from the gland nut. (Fig 11)

Fig 11



FI20N231532B

TASK 3 : **Stop cock**

1 Clean the pipe joints free from rust and dirt.

2 Loosen the union and separate the pipe joint.

3 Loosen and remove the pipe nipple from stop cock.

4 Loosen and remove the stop cock from the pipe joint.

5 Dismantle the stop cock parts one by one systematically.

6 Clean all the parts properly.

7 Check the parts of thread, if worn out replace with correct one. If it is in good condition clean it properly and use it.

8 Check the washer, whether it is damaged or in good condition. If damaged, change the washer.

9 Reassemble the parts to ensure in good condition.

10 While assembling the dismantled parts last one should fit first and vice versa sequence.

11 If the stop cock is in damaged condition, change it with new stop cock.

12 Fit the stop cock to one end in lengthy pipe in the dismantled place pipe joint properly.

13 Fit the pipe nipple to other end of stop cock properly.

14 Next fit the union with pipe nipple properly.

15 Apply pressure and test the pipe joints and stop cock. Check for leakage, if any to ensure proper working.

- **The arrow, embossed on stop cock is to be in the direction of flow of water**
- **Check the direction of arrow before fitting stop cock.**
- **Don't over tighten stop cock, and other pipe fittings.**
- **Use proper tools for dismantling and assembling pipe fittings.**

— — — — — —

TASK 4 : **Seat Valve**

1 Close the seat valve by turning the hand wheel clock wise.

2 Remove the nut with a spanner and lift the wheel.

3 Remove the gland nut from the bonnet by turning it in the anticlock wise direction.

4 Remove the stuffing gland.

5 Clean out the old packing in the stuffing box.

6 Cut a standard asbestos rope to make a new packing.

7 Assemble and spindle gate to the bonnet.

8 Assemble the hand wheel and tighten the hand wheel nut.

9 Open the seat valve and tighten the gland nut until the packing is compressed sufficiently to stop the water escaping from the gland nut.

Removal of spindle set and gate part

1 Hold the spanner at bonnet neck.

2 Loosen the bonnet two or three turn, again loosen the bonnet 2 or 3 turn.

Note

- **Dont over tight the gland nut.**
- **Filling the gasket should not be too much.**
- **Clean the disk gate with emery sheet.**

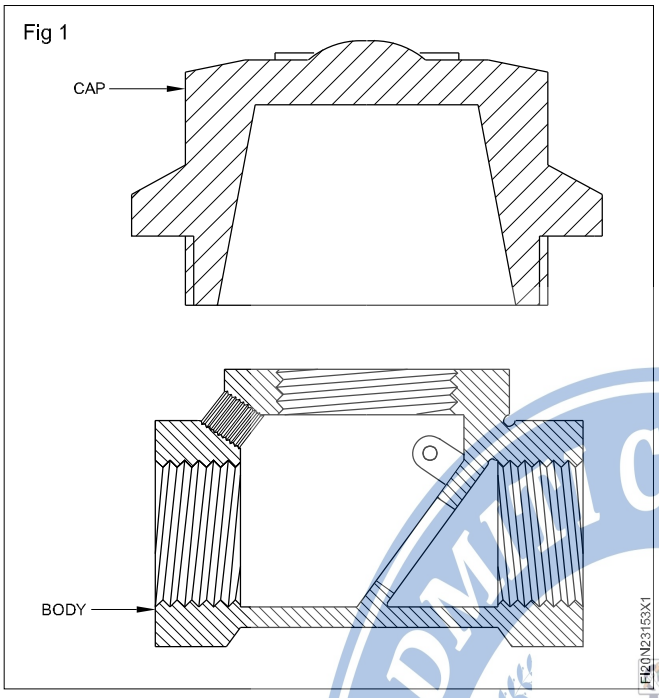
— — — — — —

TASK 5 : **Non return value**

1 Shut off the water by closing the main valve.

2 Remove the cap from the valve body. (Fig 1)

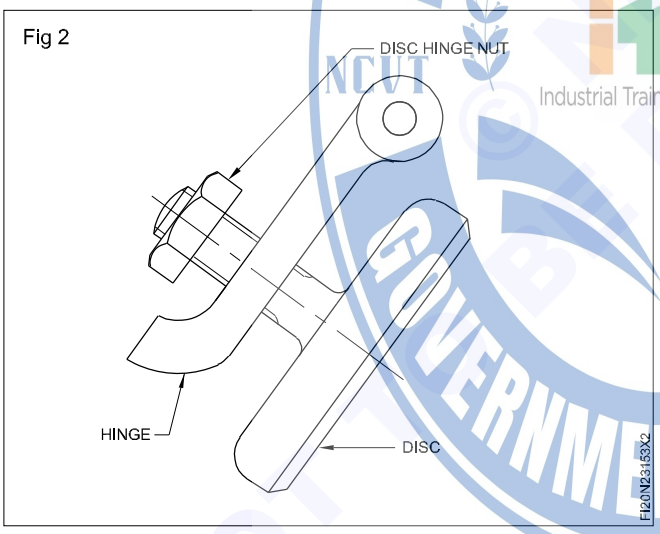
Fig 1



3 Remove the hinge pin and take out the disc.

4 Separate the disc from the hinge. (Fig 2)

Fig 2



5 Clean the seating area and the other parts of the disc.

6 Assemble the disc and hinge plate with the pin.

7 Check the function of the hinge unit.

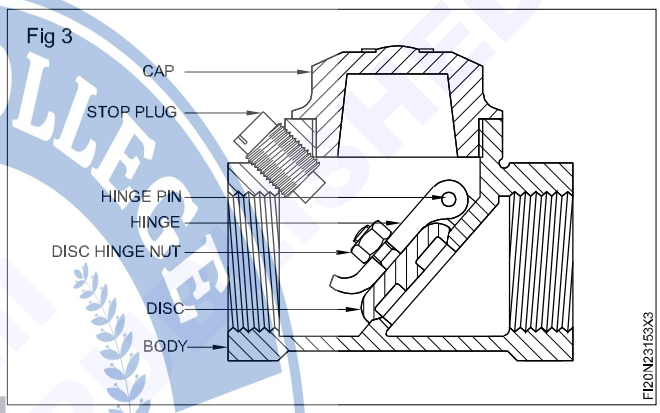
8 Replace the sealing material and assemble the cap to the body. (Fig 3)

9 Open the main gate valve and check for leakage.

Note

- **Dont over tight the hinge pin.**
- **Clean the seating area thoroughly.**
- **Replace the seating material carefully.**

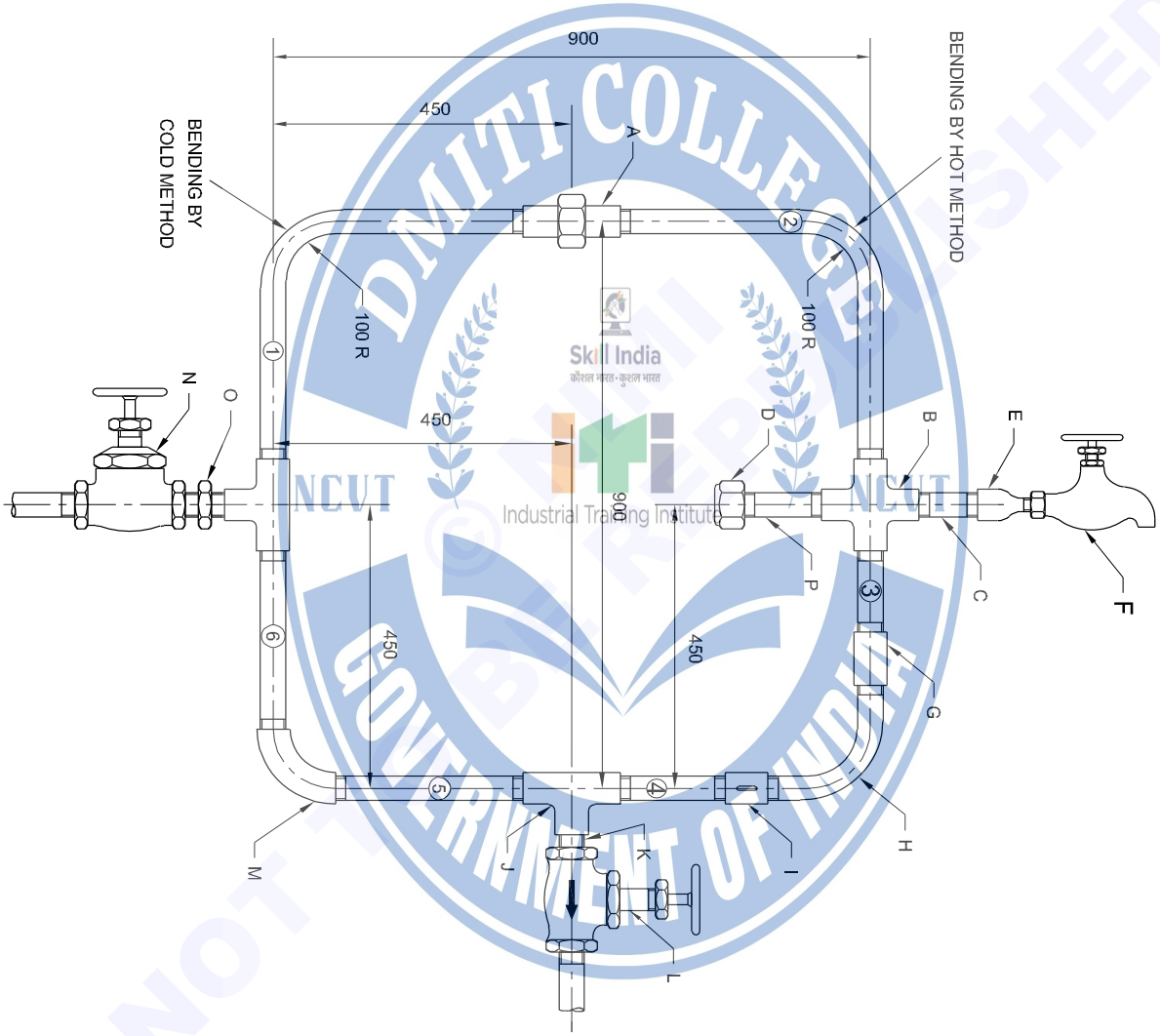
Fig 3



Fit & assemble pipes, valves and test for leakage & functionality of valves

Objectives: At the end of this exercise you shall be able to
- **fit the elbow with G.I. pipe**
- **fit the union with G.I. pipe**
- **fit valves with G.I. pipe**
- **assemble pipe with standard fittings.**

TASK - 1



-	-	-	-	-	-	2.3.154
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE:NTS	**FIT & ASSEMBLE PIPES , VALVES AND TEST FOR LEAKAGE & FUNCTIONALITY OF VALVES**				TOLERANCE	TIME : 18 Hrs
					CODE NO. FI20N23154E1	

Job Sequence

TASK 1 : **Assembling of pipes and valves**

1 Join pipe No. 2 with the 4-way cross. (B)

2 Fit pipe No. 3 with the 'cross'.

3 Join plain coupling (G) to the other end of the pipe No. 3.

4 Assemble G.I. bend (H) to the plain coupling.

5 Fit the ribbed coupling (I) to the other end of the bend.

6 Join pipe No. 4 to the ribbed coupling.

7 Fit 'T' (J) with pipe No. 4.

8 Join pipe No. 5 to the opposite end of 'T'.

9 Assemble elbow (M) with pipe No. 5.

10 Fit pipe No. 6 with the other end of the elbow.

11 Join 'T' with pipe No. 6.

12 Fit pipe No. 1 with the opposite end of 'T'.

13 Join pipe Nos. 1 & 2 with union. (A)

14 Fit 150mm barrel nipple (P) to the left side of the 'cross' and put cap (A) for it.

15 Put another 100mm barrel nipple (C) to the right side of the cross.

16 Join the reducer (E) to the barrel nipple.

17 Assemble the bib-cock (F) to the other end of the reducer.

18 Fit 100mm barrel nipple (K) to bottom 'T'.

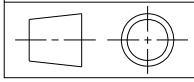
19 Assemble the globe valve (L) to the nipple.

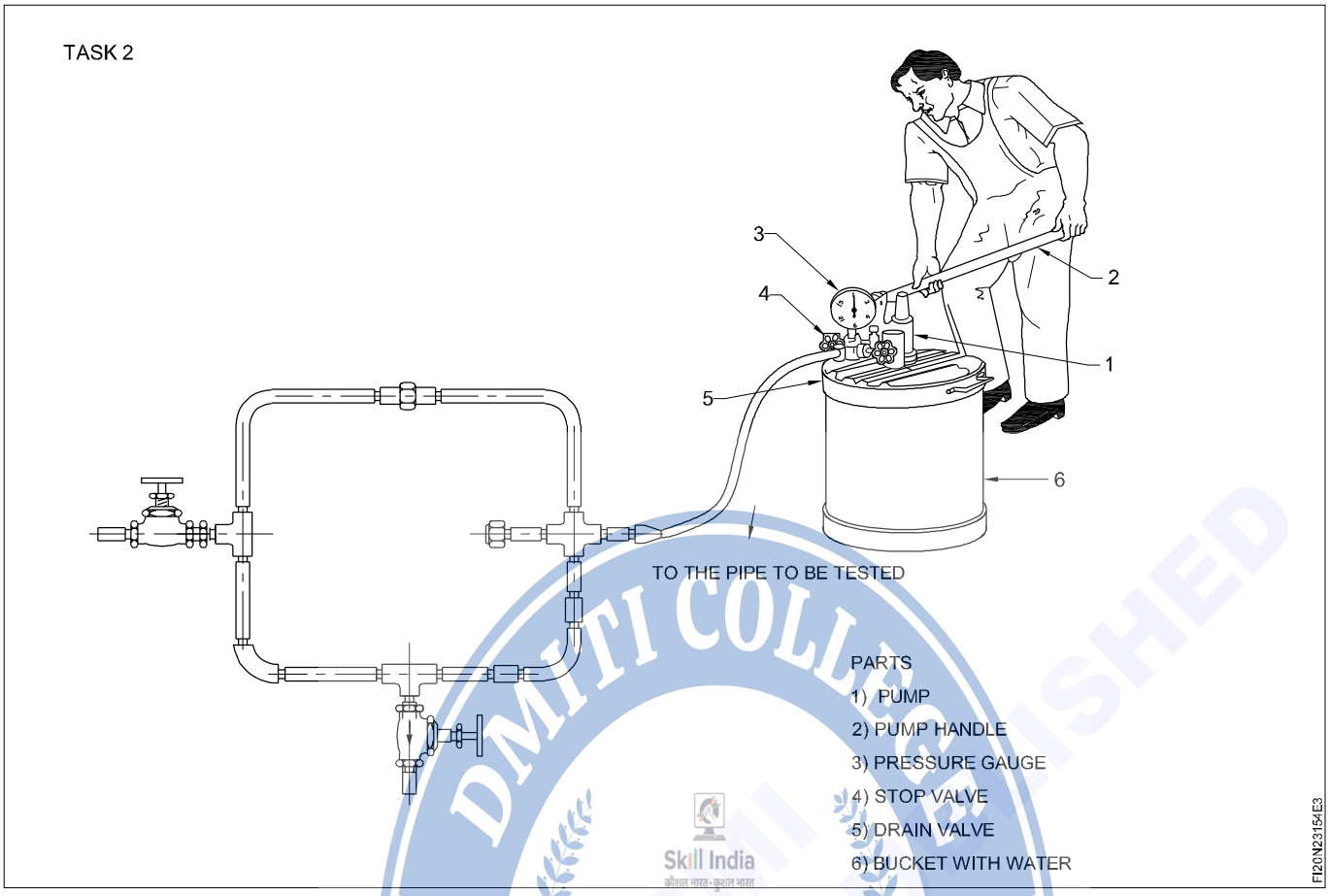
20 Put the hexagonal nipple (0) to the left side 'T'.

21 Assemble the gate-valve to the nipple.

22 Test the joints for leakage.

1	25 x 150 mm	BRASS NIPPLE	G.I.	P	P	
1	25 x 25 mm	HEXAGONAL NIPPLE	G.I.	O	O	
1	25 mm	GATE VALVE	COPPER ALLOY	N	N	
1	25 mm	ELBOW	G.I.	M	M	
1	25 mm	GLOBE VALVE	COPPER ALLOY	L	L	
1	25 x 100 mm	BARREL NIPPLE	G.I.	K	K	
2	25 mm	TEE	G.I.	J	J	
1	25 mm	RIBBED COUPLING	G.I.	I	I	
1	25 mm	BEND 90°	G.I.	H	H	
1	25 mm	PLAIN COUPLING	G.I.	G	G	
1	1/2 INCH	BIB COCK	BRASS	F	F	
1	25 x 15 mm	REDUCER	G.I.	E	E	
1	25 mm	CAP	G.I.	D	D	
1	25 x 100 mm	BARREL NIPPLE	G.I.	C	C	
1	25 mm	CROSS	G.I.	B	B	
1	25 mm	UNION (WITH WASHER)	G.I.	A	A	
1	Ø25 x 4.05 - 405	PIPE (CLASS B)	G.I.	6	6	
1	Ø25 x 4.05 - 410	PIPE (CLASS B)	G.I.	5	5	
1	Ø25 x 4.05 - 290	PIPE (CLASS B)	G.I.	4	4	
1	Ø25 x 4.05 - 300	PIPE (CLASS B)	G.I.	3	3	
2	Ø25 x 4.5 - 820	PIPE (CLASS B)	G.I.	1 & 2	1 & 2	06
NO.OFF	STOCK SIZE	DESCRIPTION	MATERIAL	DRG. NO. (ASSY)	PART NO.	EX. NO.

SCALE : NTS	**ASSEMBLY OF G.I. PIPES,VALVES AND STANDARD PIPE FITTINGS**	DEVIATIONS	TIME
		CODE NO. FI20N23154E2	



TASK 2 : **Test for leakage and functionality of valves**

1 Prepare the pressure testing machine.

2 Fill up water in pressure testing machine.

3 Connect the pressure testing machine tube with pipe fittings assembly to be tested.

4 Before connecting hose pipe with pipe fittings, plug all the openings in the section of test line with pipe nipples socket and plug.

5 Apply the pressure to test the pipe line completely without any air.

6 Pump the water into the pipeline.

7 Trace the pipe lines to find leakages.

8 Tight the pipe fittings properly, if leakage is there.

9 Apply pressure again and again test the pipe fittings assembly for proper functioning.

10 Remove hose pipe from pressure testing machine if leakages are not there.

11 Connect the pipe fittings with the existing pipe line.

- **While fixing the pipe fittings with pipe lines use proper materials to avoid leakages.**
- **Don't over tighten the pipe fittings while fitting with pipes.**

Skill Sequence

Assemble G.I pipes with standard fittings

Objective: This shall help you to
- **assemble pipe and pipe fittings.**

1 Hold the pipe No.2 in a pipe vice. (Fig 1)

2 Wind the hemp packing/cotton thread material on the external threads of the pipe. (Fig 2)

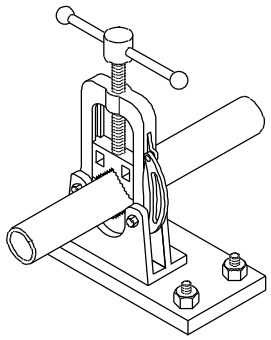
3 Apply sealing compound over the pipe threads. (Fig 3)

4 Fit the 4-way cross to pipe No.2 and tighten it using a pipe wrench.

Wind the hemp packing to external threads of all the pipes and standard fittings and apply sealing compound over the threads before joining with the other one (Fig 4).

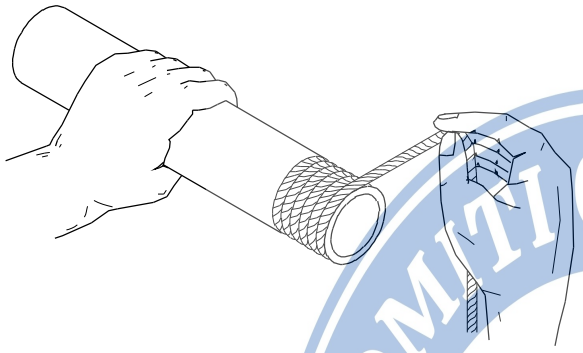
5 Fit pipe No.3 with the cross. (Fig 5)

Fig 1



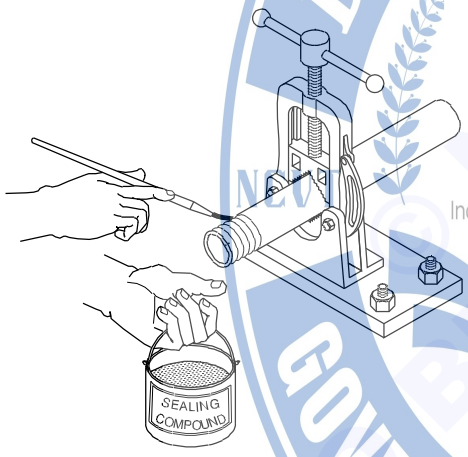
FI20N23154H1

Fig 2



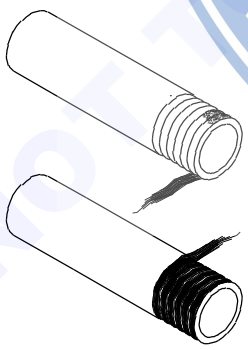
FI20N23154H2

Fig 3



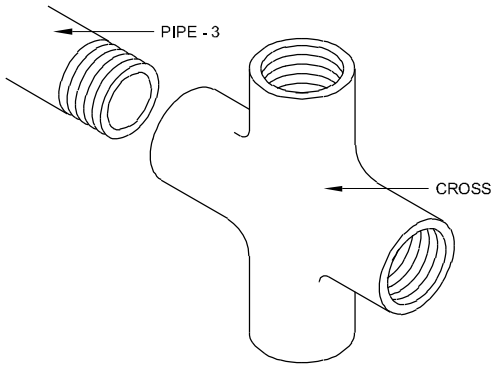
FI20N23154H3

Fig 4



FI20N23154H4

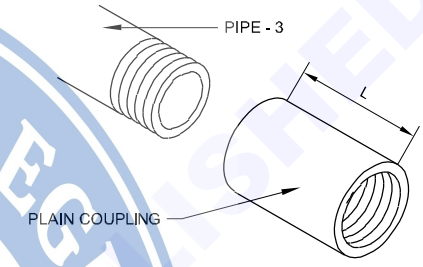
Fig 5



FI20N23154H5

6 Join the plain coupling to the other end of the pipe No.3. (Fig 6)

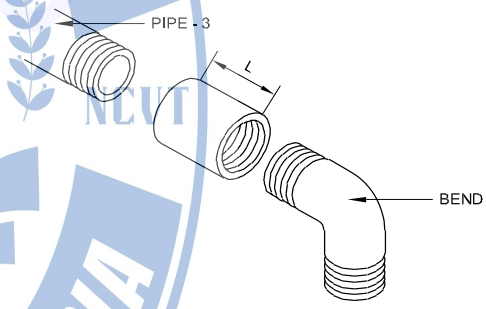
Fig 6



FI20N23154H6

7 Fit the G.I. bend to the plain coupling.(Fig 7)

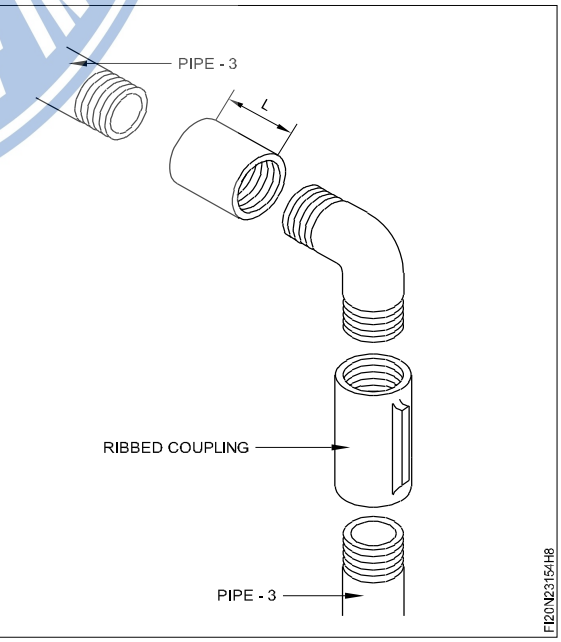
Fig 7



FI20N23154H7

8 Assemble the ribbed coupling to the other end of the G.I.bend. (Fig 8)

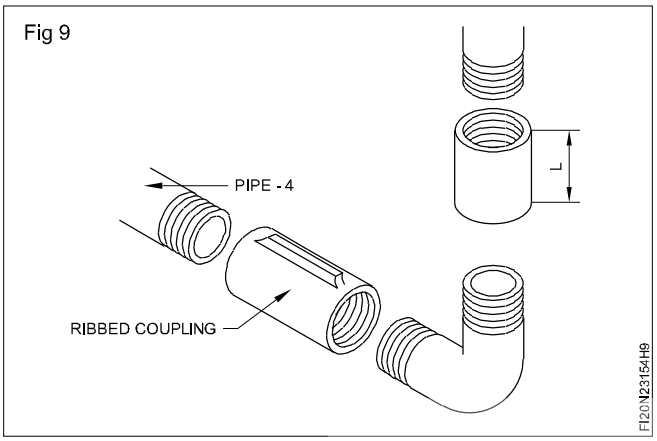
Fig 8



FI20N23154H8

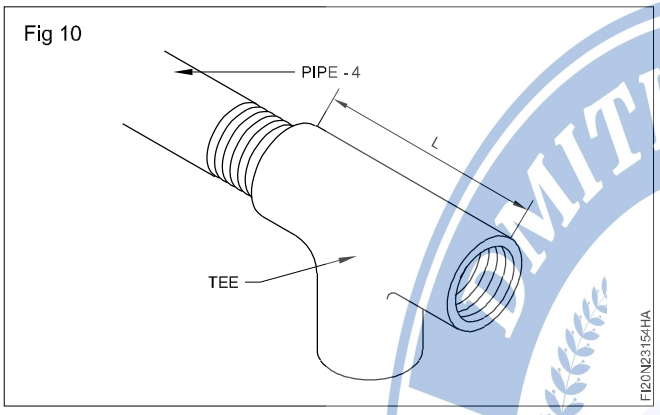
9 Connect pipe No.4 to the nibbed coupling. (Fig 9)

Fig 9



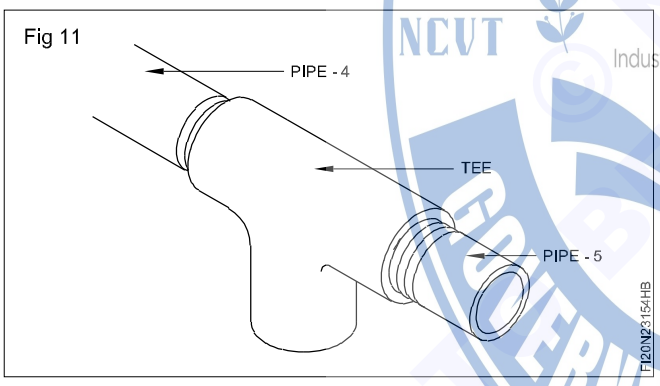
10 Fit 'T' with pipe No.4. (Fig 10)

Fig 10



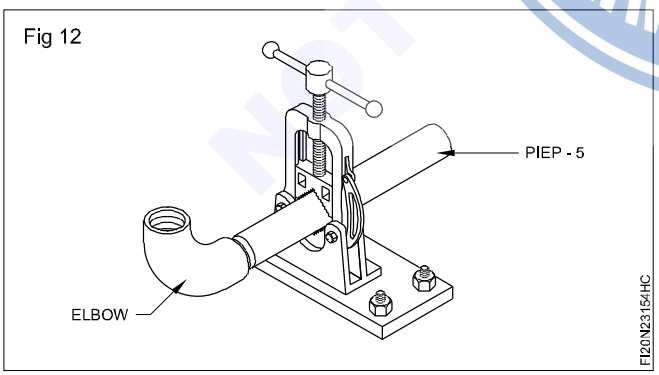
11 Connect pipe No.5 to the opposite end of 'T'. (Fig 11)

Fig 11



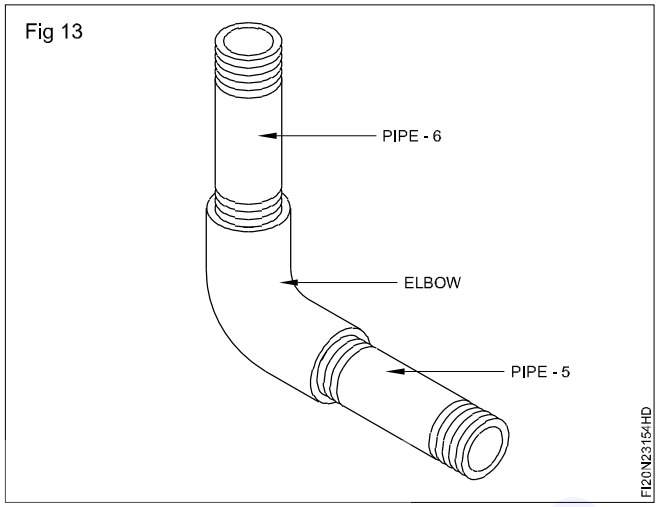
12 Assemble the elbow with pipe No.5. (Fig 12)

Fig 12



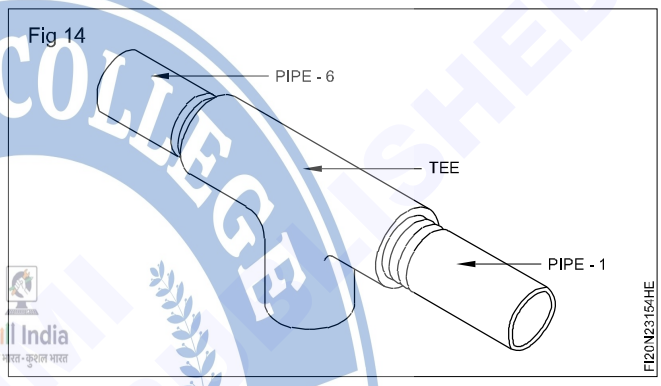
13 Fit pipe No.6 with the other end of the elbow. (Fig 13)

Fig 13



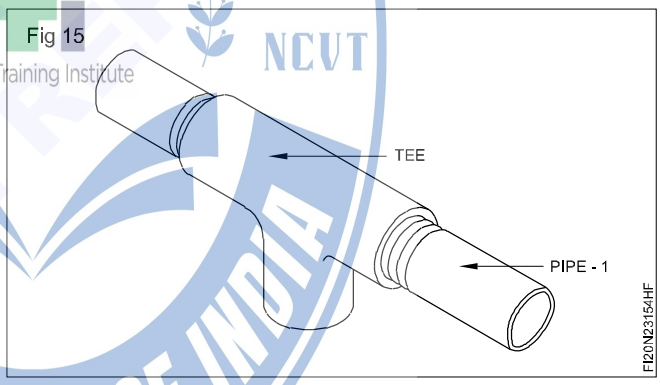
14 Connect 'T' with pipe No.6. (Fig 14)

Fig 14



15 Fit pipe No.1 with the opposite end of 'T'. (Fig 15)

Fig 15



16 Fit the rubber washer into the union.

17 Set pipe Nos. 1 & 2 with the union.

18 Hold one side of the union in one pipe wrench and the ring of the union in the other. (Fig 16)

19 Turn the two pipe wrenches gently in opposite directions and assemble.

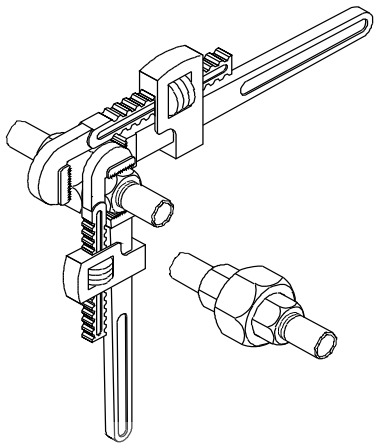
Use grease or vaseline on the union joint for easy dis-connection.

20 Fit a 150 mm barrel nipple to the left side of the cross and put a cap for it. (Fig 17)

21 Join another 150 mm barrel nipple to the right side of the cross. (Fig 18)

22 Connect the reducer to the barrel nipple. (Fig 19)

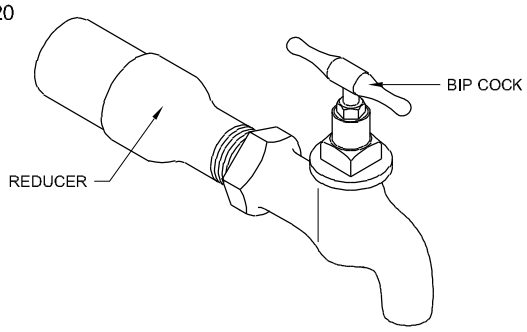
Fig 16



FI20N23154HG

23 Assemble a bib-cock to the other end of the reducer. (Fig 20)

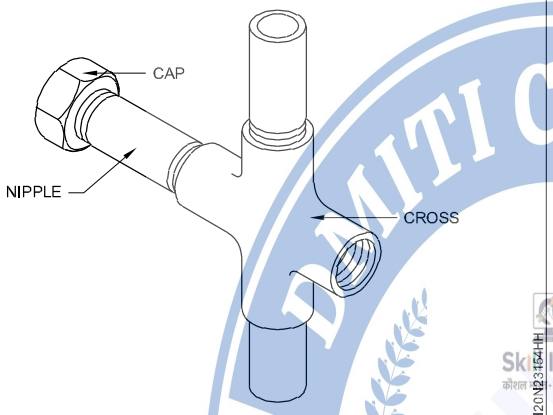
Fig 20



FI20N23154HK

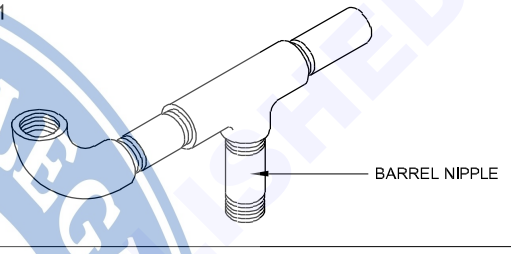
24 Fit a 100 mm barrel nipple to the bottom side of 'T'. (Fig 21)

Fig 17



FI20N23154HH

Fig 21

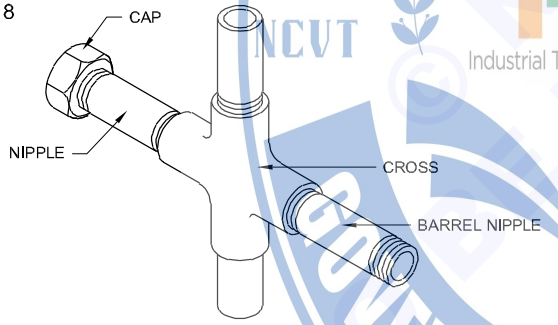


FI20N23154HL

25 Assemble the gate-valve to the 100 mm barrel nipple. (Fig 22)

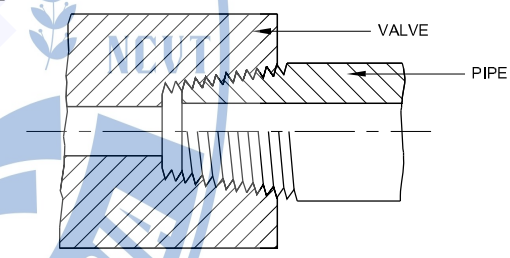
26 Allow a clearance between the valve and pipe. (Fig 22)

Fig 18



FI20N23154HJ

Fig 22



FI20N23154HM

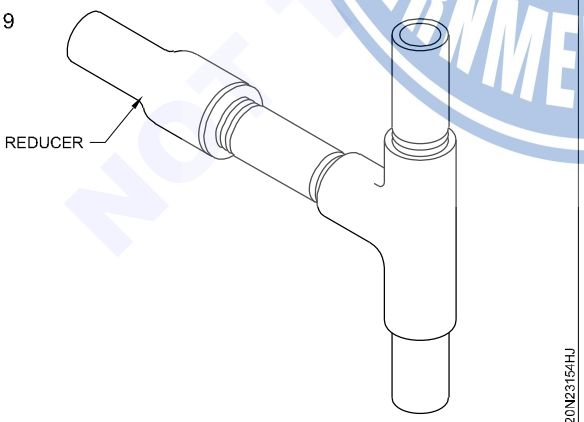
27 Join a hexagonal nipple to the left side 'T'.

28 Assemble a globe valve to the hexagaonal nipple.

29 Check the joint for leakage.

Do not overtighten the fittings as this may cause the threads to the split.

Fig 19

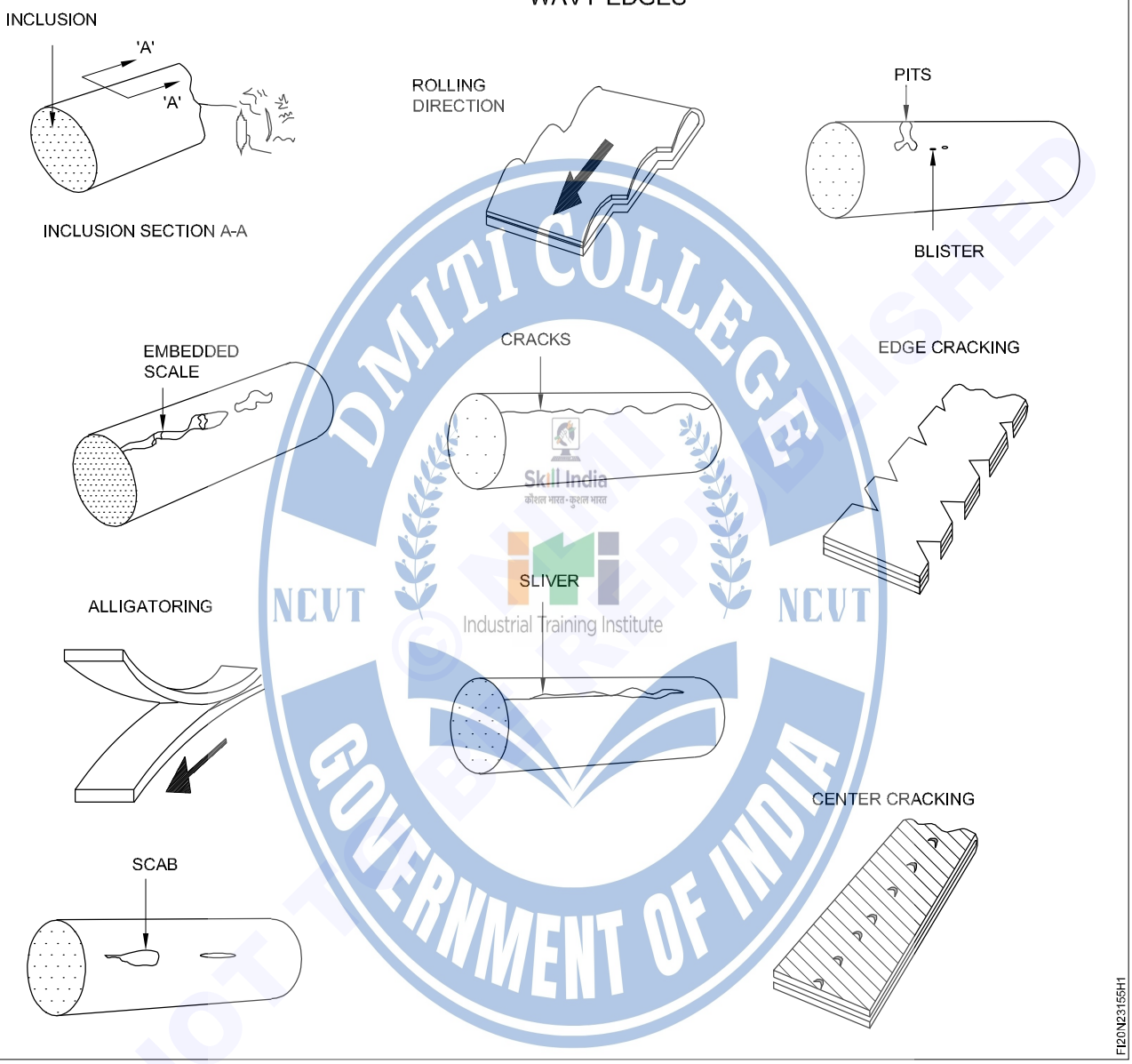


FI20N23154HJ

Visual inspection for visual defects e.g. dents, surface finish

Objective: At the end of this exercise you shall be able to
- **visual identification of defects on various metal sections.**

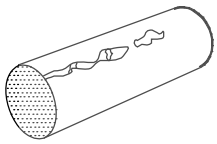
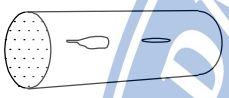
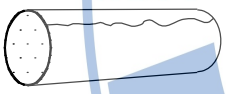
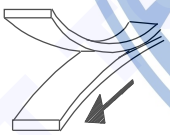
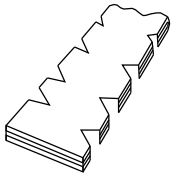
Fig 1

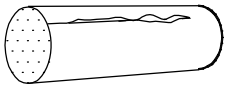
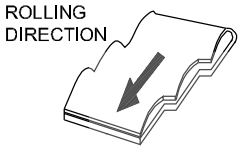
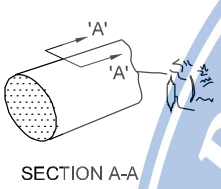
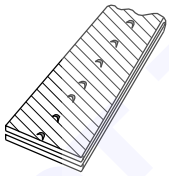


Job sequence

Instructor shall explain various defects on metal surfaces and demonstrate the same with the available surface finish damaged raw material, dent pipes and sheet metal etc.

- Ask the trainees to identify the defects and record it in table.

Sl.No.	Defects	Nature of defect
1		
2		
3		
4		
5		

Sl.No.	Visuals	Nature of defect
6		
7		
8		
9		
10		

- Get it checked by your Instructor.

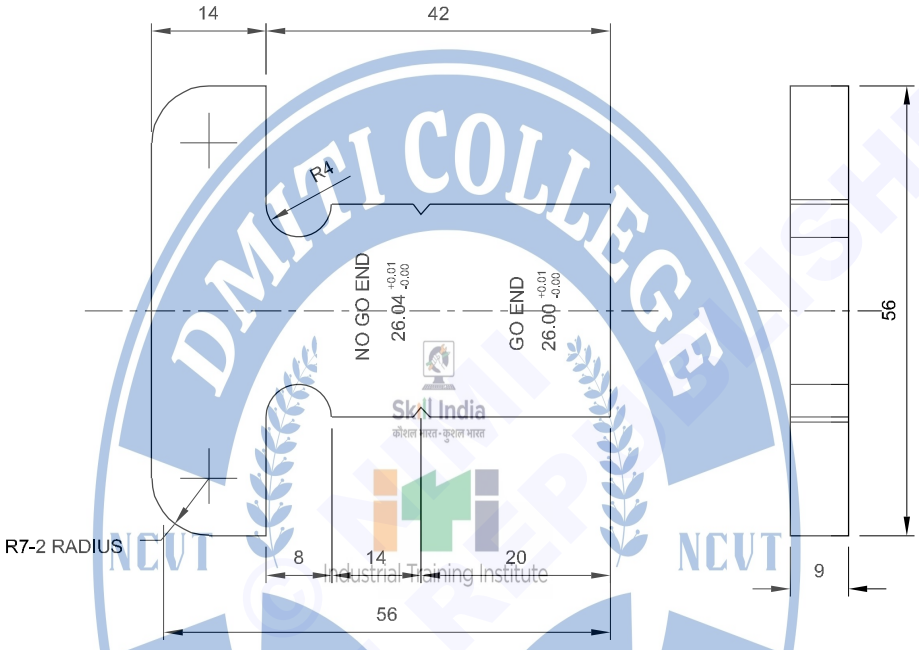
Measuring,checking and recording in control chart

Objective: At the end of this exercise you shall be able to
- **measure the dimensions and prepare the chart.**

Instructor has to prepare 20 components as per drawing and keep it ready.

Ask the 20 trainees to check and measure all the 20 components hole size and plot the same reading on the control chart.

PART A



NOTE:

$26.00^{+0.021}_{+0.000}$

Job sequence

- Each trainees measure the dimension 26.00mm $^{+0.010}_{-0.000}$ of gap gauge 'Go' end and note down the value against his Roll number in Table 1
- Based on the data available in Table . Ask the trainees to record it on the chart (Fig 2)
- Draw the curve according the mark in the chart.
- Submit the chart to the instructor for checking.

-	-	-		-	-	2.3.156
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE: 1:1	MEASURING, CHECKING AND RECORDING IN CONTROL CHART				TOLERANCE	TIME : 2 Hrs
					CODE NO. FI20N23156E1	

Table 1

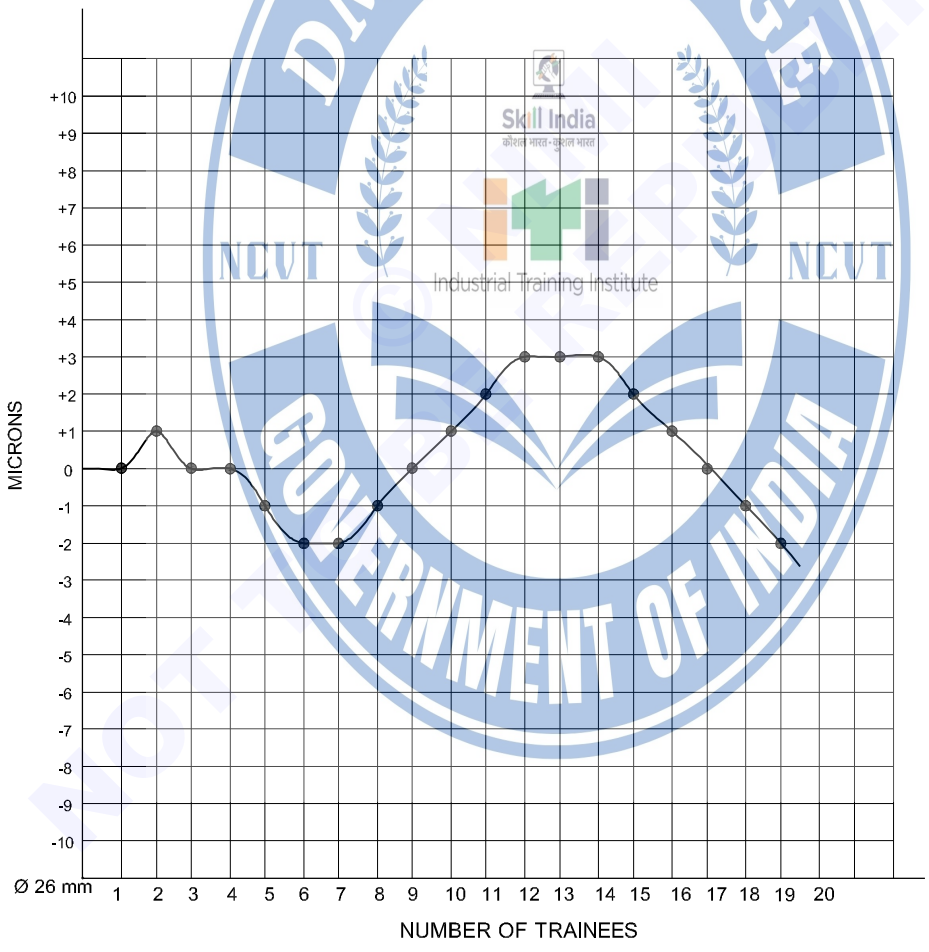
Enter each trainees component dimension 26.00 $^{+0.010}_{-0.000}$

Sl.No.	Trainee Roll No.	Reading in mm
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Sl.No.	Trainee Roll No.	Reading in mm
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Example of Control chart (Fig 1)

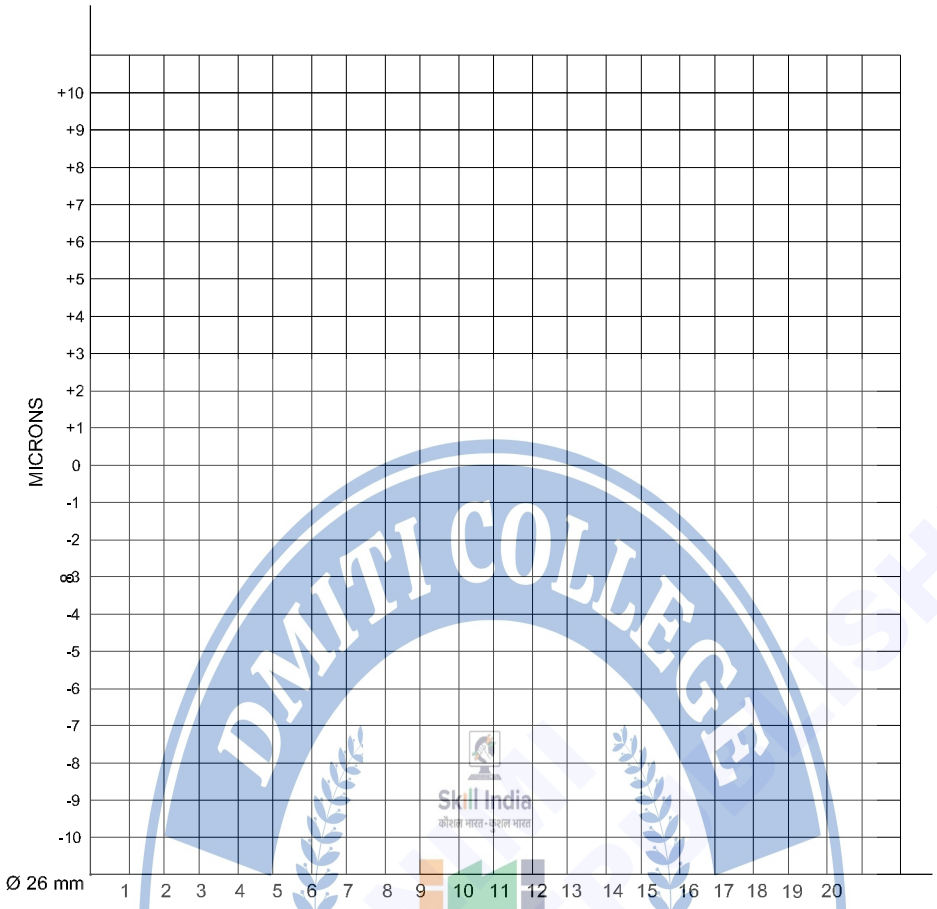
Fig 1



The control chart is a graph used to study how a process changes over time. Data are plottd in time order. A control chart always has a centre line for the average, an upper line for the upper control limit and a lower line for the lower control limit. These lines are determined from historical data.

Chart - 2

Fig 2



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