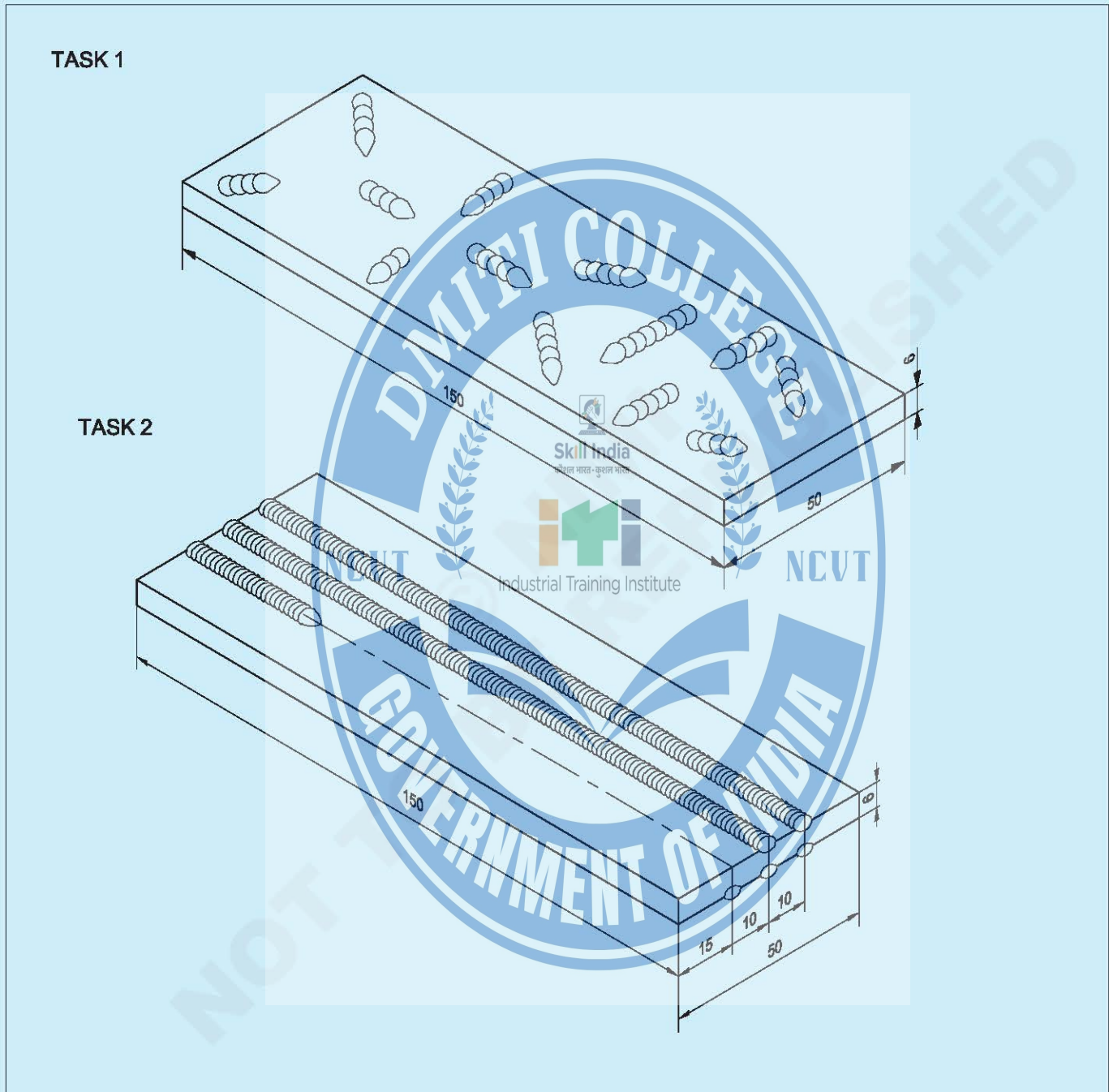


Striking and maintaining arc, laying straight - line bead

- Objectives:** At the end of this exercise you shall be able to
- strike and maintain the arc by scratching and tapping method
 - deposit uniform straight weld beads and inspect for faults.



1	50 ISF 6-150	-	Fe310-O	-	-	-
1	50 ISF 6-150	-	Fe310-W	-	-	1.4.56
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	STRIKING AND MAINTAINING ARC LAYING STRAIGHT LINE BEADS BY ARC WELDING				DEVIATIONS : ± 0.5mm	TIME :
					CODE NO. F120N1456E1	

Job Sequence

TASK 1 : Striking and maintaining arc

- Check the size of the raw material.
- Mark and file to size.
- Clean the metal surface with a steel wire brush and wipe off the oil and grease if any.

Dirt or rust makes poor connections.

- Wear safety apparel (Protective clothing)
- Connect the welding cables with the machine and the job.

Check the cables for damage and loose connections. Check whether the earth-clamp is properly attached.

- Fix a \varnothing 4mm M.S. electrode in the holder.

Ensure the electrode is firmly held in the holder from the bare end.

- Set the welding current (amperage) 140-150 amps.

If the welding machine is a D.C. one, connect the electrode to the negative.

- Start the welding machine.
- Strike and maintain the arc by the scratching method.

Use a welding screen fitted with proper coloured glasses while arc-welding.

- Hold a correct arc for a short distance and break by quickly withdrawing the electrode up.

The correct arc burning will give steady, sharp, crackling sound.

Repeat this exercise until the arc can be struck every time without the electrode freezing.

If the electrode freezes (sticks) to the plate, it should be freed immediately by a quick twist of the wrist motion to avoid overheating or spooling.

TASK 2 : Laying straight line beads by arc welding

- Check the size of the raw material.
- Mark and file to size.
- Mark the bead position as per drawing.
- Set the work piece on the welding Table in a flat position
- Set the arc-welding plant and connect the welding cables.
- Select and fix M.S. Electrode \varnothing 4mm in the holder.

Ensure that the electrode-holder JAWS are clean.

- Set a welding current 140-150 amps on a AC or DC machine.

If the power source is D.C. connect the electrode with the negative straight polarity.

- Wear the complete safety apparel and check the filter lens of the welding screen.
- Strike the arc on a scrap piece for trial and observe the current setting.

Ensure that the burning of the electrode is normal.

- Strike the arc on the job-piece at one edge and maintain a uniform normal short arc.
- Move the electrode in a straight line and complete the bead at the other edge of the plate.
- During welding maintain a correct angle of the electrode at 70° - 80° .
- Arc length producing a steady sharp crackling sound.
- Travel speed approx. at the rate of 150mm per minute.
- Remove the slag from the weld bead and inspect for:
 - Uniform width and height - slag inclusion.
 - Normal depth of fusion.
 - Straightness.
- Repeat the exercise till you achieve good results.

Skill Sequence

Setting of arc welding machine for welding

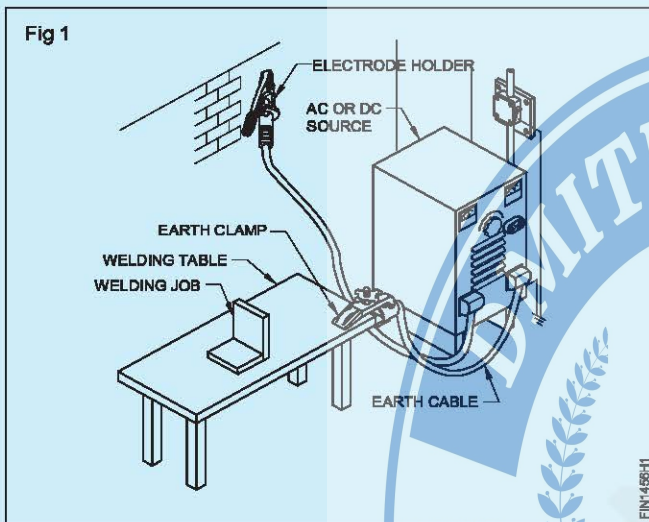
Objectives: This shall help you to

- set the arc-welding plant
- set the current according to the size of electrode
- strike and maintain the arc by the scratching and tapping method.

Striking an arc is a basic operation in arc welding. It will occur every time the welding is to be started.

It is an essential basic skill to learn in arc welding.

Setting of arc-welding plant (Fig 1)



Check the working of power source for the welding machine.

Remember electricity is a good servant but a bad master.

Call an electrician for solving any electrical problems.

Connect the welding cables with the welding machines.

Ensure that the cable connections are clean, dry, tight and are attached to the proper terminals of the machine.

Attach tightly the earth cable with the welding table at the proper place.

Keep the electrode-holder at a safe place.

If the machine is on DC power, connect the cables in correct POLARITY.

Setting a welding current

Set the welding current as per the diameter of the electrode to be used. (Table 1)

Select the electrode as per the thickness of the metal to be welded or as recommended. (Table 1)

Use alternative electrodes of nearest size in the case of non availability of the exact size of electrodes.

The electrodes diameter should not be more than the thickness of the metal to be welded.

Striking and maintaining an arc

Scratching method (Fig 2)

Hold the electrode about 25mm above the job-piece at one end, perpendicular to the surface.

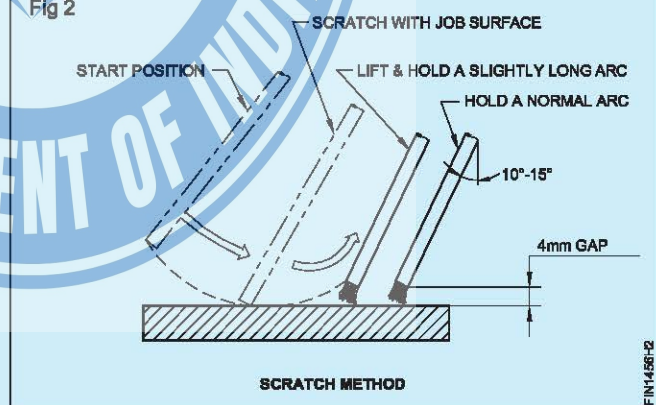
Bring the welding screen in front of your eyes.

Ensure safety apparel is worn.

Table 1

Plate Thickness in mm (approx.)	Electrode Size mm	Current Range (amperes)
1.6	1.6	40-60
2.5	2.5	50-80
4.0	3.2	90-130
6.0	4.0	120-170
8.0	5.0	180-270
25.0	6.0	300-400

Fig 2



Strike the arc by dragging the electrode quickly and softly across the welding job, using wrist movement only.

Withdraw the electrode approximately 6mm from the surface for a few seconds, and then lower it to (approx) 4mm distance.

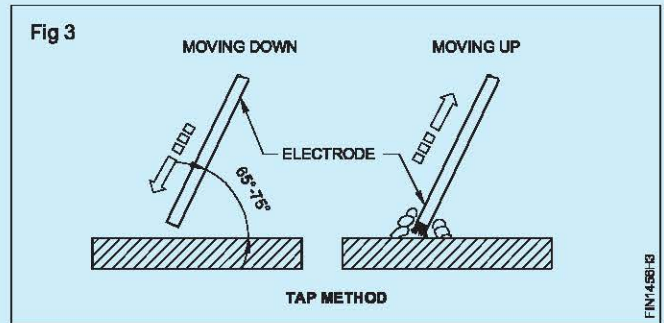
If the arc has been properly struck, a burst of light with a steady sharp crackling sound will be produced.

Tapping method (Fig 3)

Strike the arc by moving the electrode down to touch the job surface lightly.

Move the electrode slowly up, approximately 6mm for a few seconds, and then lower it to approx. 4mm from the surface.

The tapping method is generally recommended as it does not produce pit marks on the job surface.



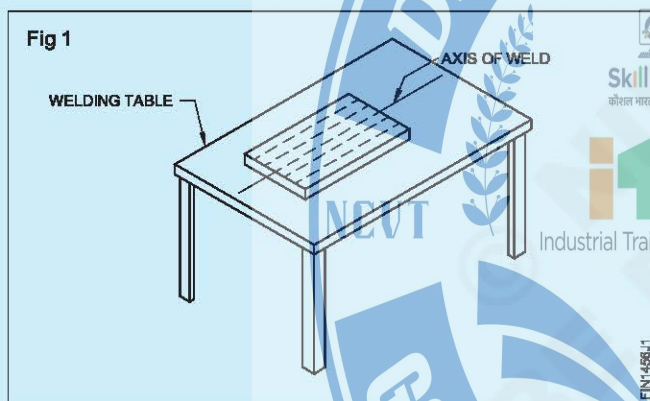
Straight line beading by arc (Flat position)

Objectives : This shall help you to

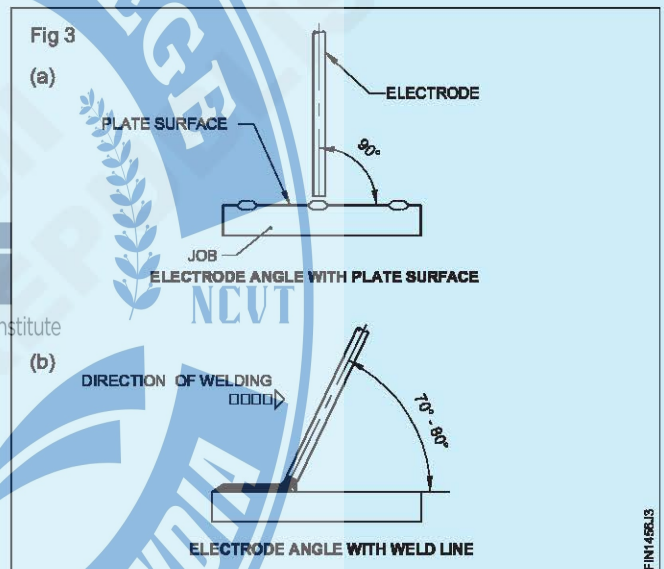
- deposit straight beads in a flat position
- clean the weldment and inspect for faults.

Job setting

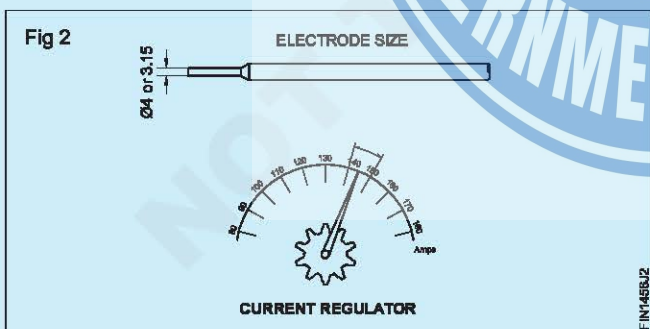
Set the job in a flat position on the welding table. (Fig 1)



Ensure there is a good electrical contact between the job and the welding table.



Current setting (Fig 2)



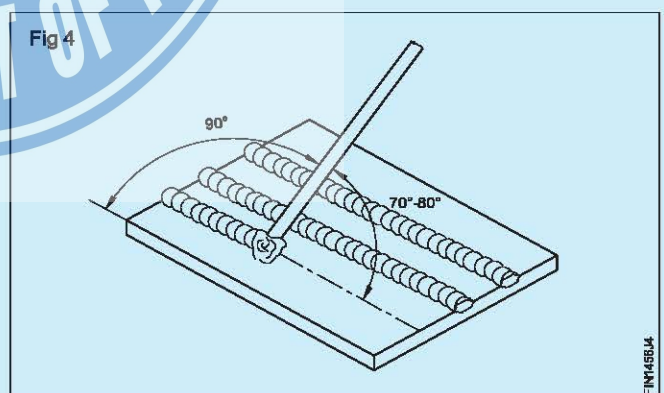
Set the current on the welding machine, 140-150 amps for Ø4mm M.S. Electrode.

Always follow the current range chart for the electrodes in use.

Electrode position (Fig.3a&b)

Hold the electrode at an angle of 70° - 80° with the weld line and 90° with the adjoining plate surface.

Depositing straight beads (Fig 4)



Deposit straight beads by following the punched line and maintaining arc

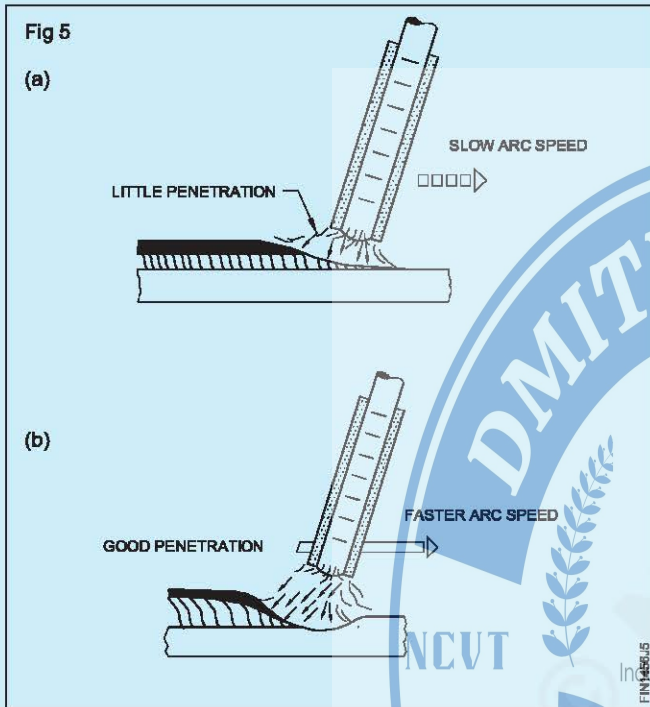
- Correct arc length
- Correct travel speed
- Correct angle of electrode.

Ensure that the welding screen lens is clean so that you can see the arc and the weld line.

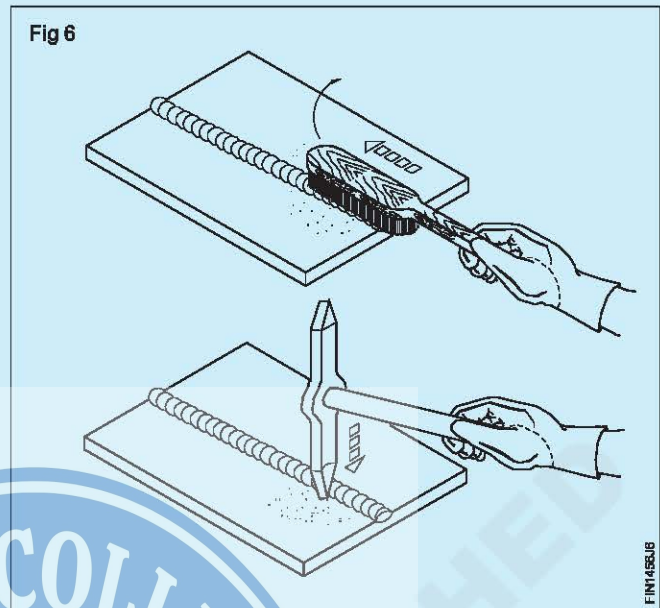
Replace the plain glass, if spattered.

LISTEN to the arc. It produces a steady sharp crackling SOUND.

Adjust the travel speed by watching the electrode melting and flowing through the molten pool to form a deposited metal. (Fig 5a & b)



Weldment Inspection (Fig 6)



Remove the slag from the weldment using a chipping hammer and a wire brush.

Use goggles during slag removal.

Inspect the deposited beads and note any variations

Skills in the:

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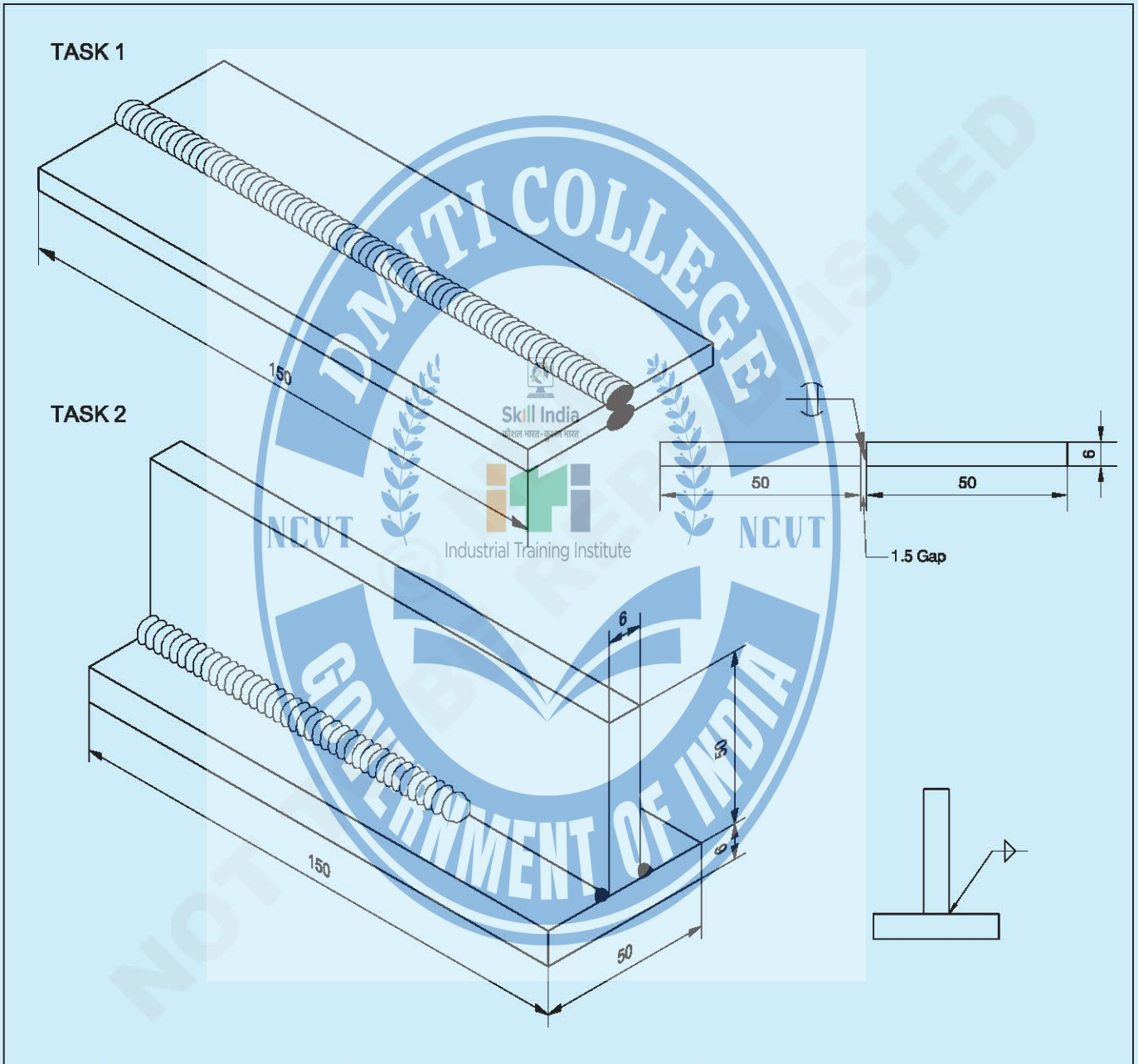
- Width and height
- Depth of fusion
- Length of run, (Straightness)

NCVT Industrial Training Institute

Making butt joint and 'T' joint using gas and ARC welding process

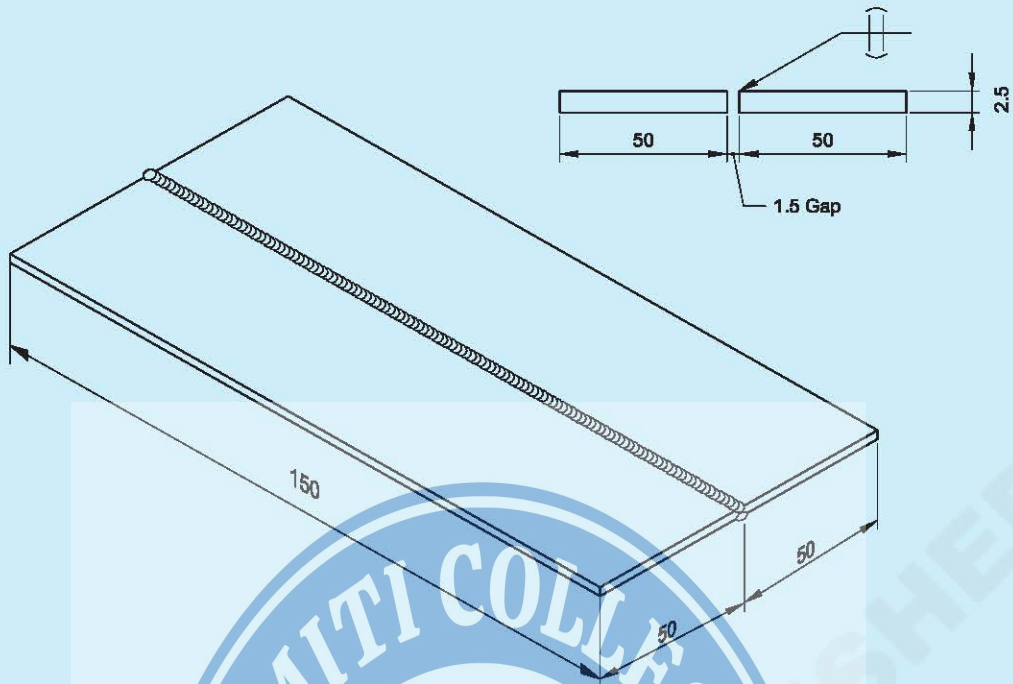
Objectives: At the end of this exercise you shall be able to

- set and weld the workpiece to form a square butt and 'T' fillet joints in correct alignment in arc
- weld a 'T' fillet and square butt joint using recommended electrode, filler rod and nozzle size
- remove distortion from the joint
- clean the weldment and inspect for the surface defects.

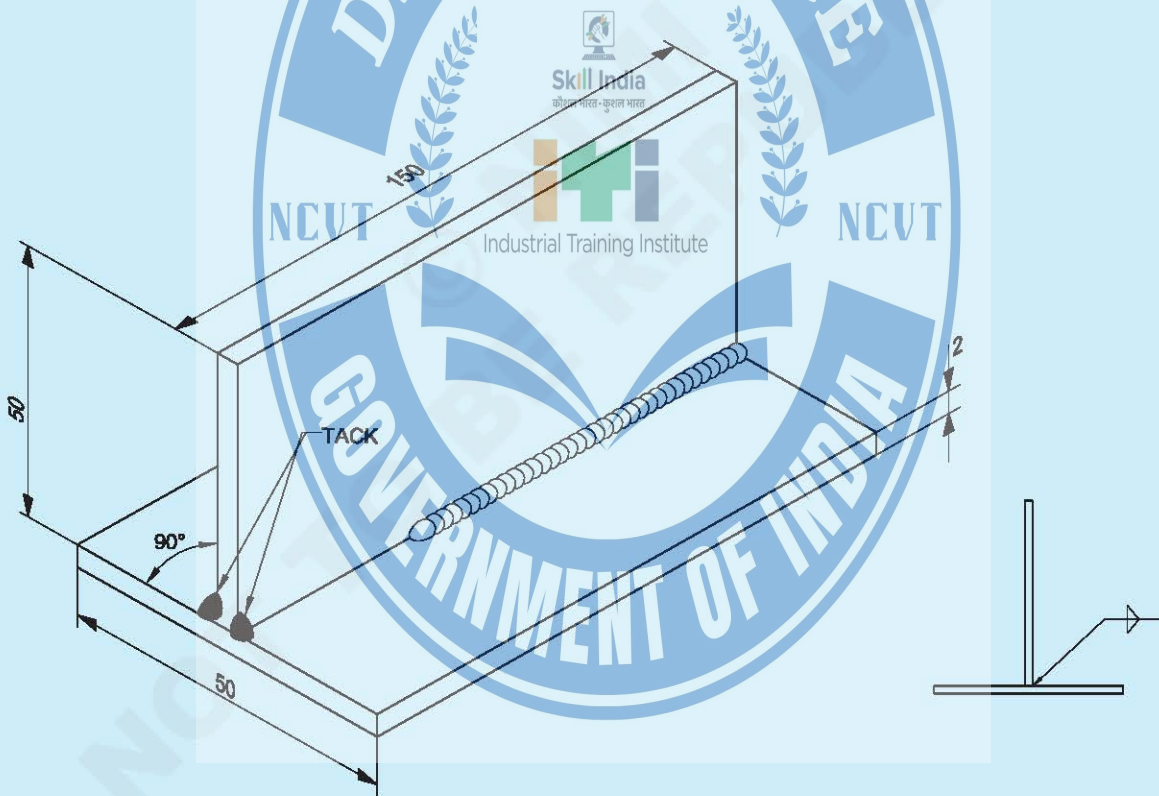


2	50 ISF 6 -150	-	Fe310 - W	-	TASK 2	-
2	50 ISF 6 -150	-	Fe310-W	-	TASK 1	1.4.57
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE : NTS					DEVIATIONS : ±0.5mm	
<p align="center">SQUARE BUTT AND 'T' FILLET JOINT IN FLAT POSITION BY ARC WELDING</p>					TIME :	
					CODE NO. FI20N1457E1	

TASK 3



TASK 4



2	ISSH 150 x 50 x 2		Fe310 - W		TASK 4	-
2	ISSH 150 x 50 x 2.5	-	Fe310 - W	-	TASK 3	1.4.57
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE : NTS	SQUARE BUTT AND FILLET WELD 'T' JOINT IN FLAT POSITION BY GAS WELDING				DEVIATIONS: ±0.5mm	TIME :
					CODE NO. FI20N1457E1	

Job Sequence

TASK 1 : Square butt joint in flat position by arc welding

- Check the size of the raw material.
- Mark and file to size for square.
- Set the pieces on the welding table for square butt joint with 1.5mm gap in alignment. (Refer to drawing)
- Select a $\varnothing 3.15$ mm M.S. electrode and set a 120 amps current.

Connect the electrode to negative, if the power source is D.C.

- Tack the pieces at both ends and also in the centre.

Ensure safety apparel is worn.

- Check the alignment of the tacked pieces, and reset, if necessary.
- Place the joint in a flat position on the welding table, well grounded. (Tacks side down)
- Select a $\varnothing 4.0$ mm M.S. electrode and set a 150-160 amps current.
- Deposit the first bead along the joint line with a:

- Correct arc length
- Correct electrode angle
- Correct welding speed.
- Chip the slag from the bead, brush and inspect.

Use tongs to hold the hot job, chipping hammer and wire brush for chipping and cleaning, goggles for the protection of the eyes.

- Clean the back side of the first bead thoroughly and grind tacks flush.
- Deposit the second bead on this side, using the same settings.
- Chip the slag from the bead, brush and inspect for faults.
- Practice this exercise until you can produce a sound butt weld.

While but joint welding 1/3rd of gap to be maintained according to the thickness of plate or flat section of metal.

TASK 2 : 'T' Fillet joint in flat position by arc welding

- Check the size of the raw material
- Mark and file to size
- Set and tack the job-pieces at both ends as 'T' fillet joint. (Refer to drawing).
- Ensure that a $\varnothing 3.15$ mm electrode and a 130 amps current are used. Safety apparel should be worn.
- Clean the tacks, check alignment and reset the job, if necessary.
- Place the joint on a welding table in a flat position. (Tack side down)
- Select a $\varnothing 4$ mm M.S. electrode and set a 150-160 amps current.
- Deposit the first bead along the joint line with a correct and uniform
 - Arc length
 - Travel speed
 - Electrode angle.

Clean the weldment and inspect for faults.

- Clean the other side of the joint and grind the tacks flush.
- Set the joint in a flat position (weld side down).
- Make a second weld along the joint line with the same setting and technique as used for the first bead.

Clean the weld and inspect for the following weld characteristics.

- Smooth and close ripple appearance. Uniform width and height equal leg lengths
- Good fusion at the toe of the weld without undercut and overlap
- Leg length of the fillet weld equal to the plate thickness
- Repeat the exercise until you can produce good welds.

Ensure the electrode angle is 45° with the corner and 70° to 80° with the welding line in the direction of travel.

TASK 3 : Square butt joint in flat position by gas welding

- Check the size of the raw material.
- Mark and file to size.
- Set the job pieces on a welding table to form a square butt joint (open) with a root gap 1.5 mm.
- Set a gas welding plant, attach nozzles No.5 and set a pressure of 0.15kg/cm² for both the gases.
- Select a C.C.M.S. filler rod \varnothing 1.5mm for tacking and \varnothing 3.00mm for welding.
- Wear safety apparel.
- Set the neutral flame.
- Tack the pieces at both the ends and also in the centre using a \varnothing 1.5mm filler rod. (Keep a shrinkage allowance of 2)

Tacks should be well fused and penetrated.

- Check the alignment and gap between the pieces, and reset, if necessary.

- Clean the tacks and reset the job on the welding table in a flat position.
- Start welding, using the leftward technique with the correct angle of the blowpipe and filler rods of \varnothing 3mm.
- Fuse the edges uniformly and add filler metal. (maintain a correct travel speed and motion of the blowpipe and filler rod, to produce a uniform weld bead)
- Stop at the left edge, fill the crater to complete the weld.
- Extinguish the flame, cool the nozzle and place the blowpipe at a safe place.

Clean the welded joint and visually inspect for

- a slight convex uniform width and height of bead.
- a slight penetrating bead on the reverse side of the ripples joint near the root.
- Repeat the exercise till you get good results.

Task 4 : Fillet weld 'T' joint in flat position by gas welding

- Prepare job pieces as per drawing.
- Clean the surface and edges of the sheets to be welded.
- Set the sheets in the form of a 'Tee' joint on the gas welding table.
- Wear safety apparels and gas welding goggles.
- Set the gas welding plant, fix nozzle No.5 and set pressure at 0.15 kgf/cm² for both the gases.
- Set the neutral flame, tack at both ends of the joint and also in the centre with a 1.6 mm C.C.M.S rod.
- Check the alignment of the joint with a try square and clean the tacked portion.
- Keep the job on the welding table in a flat position.
- Start welding with the leftward technique and melt the right hand end of the joint.

- Fuse the area to be welded (i.e. equally the part of the horizontal sheet and the vertical sheet) and apply the filler rod in the molten pool to form a fillet weld at the joint.
- Maintain correct travel speed, manipulate the blowpipe and filler rod to produce a uniform weld bead.
- Stop the weld at the left hand end of the joint after filling up the crater at the end of the weld.
- Extinguish the flame, cool the nozzle and place the blowpipe at its place.
- Clean the weldment and inspect for defects in the fillet weld.

Visual inspection

- Slight convexity, uniform width, uniform ripples indicate a good weld bead. A weld without undercut, overlap, porosity, etc. will ensure a good quality weld.
- Weld on the other side of the joint for more practice

Skill Sequence

Square butt joint by arc in flat position (TASK 1)

Objectives : This shall help you to

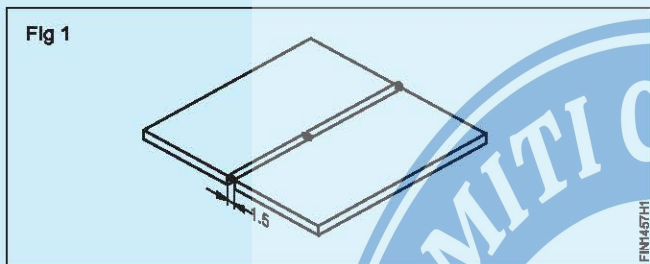
- weld a square butt joint in a flat position
- inspect the completed butt weld.

This type of joint is used very extensively in industry. If welded from both the sides (6 mm plate thickness), a sound weld can be obtained.

Setting and tacking

Set the pieces as butt joints with a 3 mm gap in a welding.

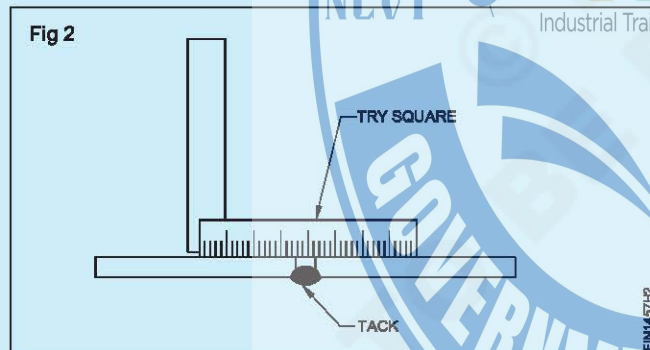
Tack at both the ends and one in the centre. (Fig 1)



Use a \varnothing 3.15mm M.S electrode. Set the current 120-130 amps and length of the tack 15 mm.

Ensure the tacks are fused.

Check the alignment after tacking, and reset, if necessary (Fig 2).



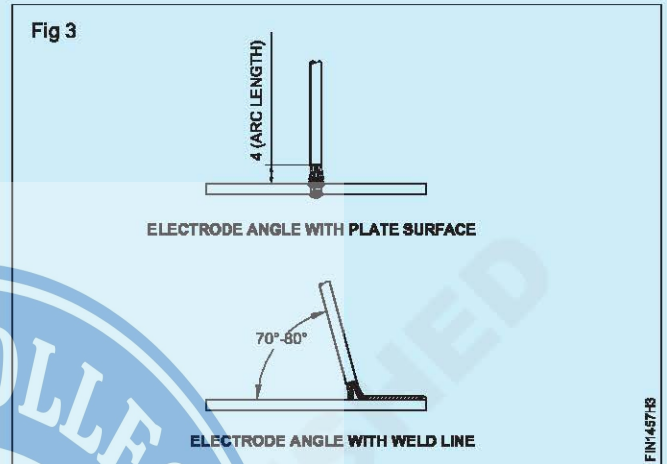
Check the tack-welds thoroughly.

Welding butt joint

Place the joint in a flat position.

Deposit the first bead, using a \varnothing 4mm M.S. electrode and 150-160 amps current with a correct:

- Electrode angle
- Travel speed, and
- Arc length. (Fig 3)

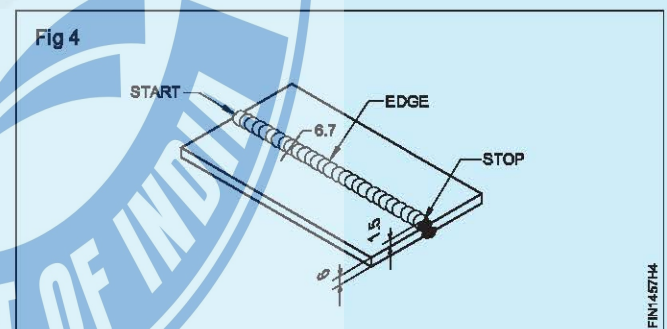


Move the electrode forward and backward along the line of the weld to

- Pre-heat the metal ahead of the weld
- Minimize the tendency to burn through
- Force the slag back over the top of the weld and control slag inclusion.

Inspection of the weld

Remove the slag from the weld and inspect for the following weld characteristics. (Fig 4)



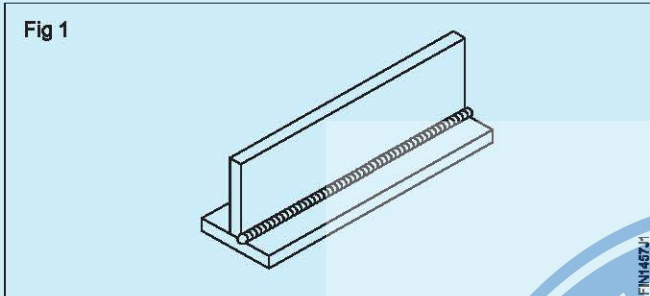
- Width and height of bead should be uniform.
- Appearance should be smooth with close ripples.
- The face of the weld should be slightly convex.
- Edge of the welds should have good fusion, no overlap and undercut.
- The starting and stopping points should be free of depressions and high spots.
- The root of the weld and plate surface should have good fusion and penetration.
- The surface of the plate should be free of spatters.

'T' fillet joint by arc in flat position

Objectives : This shall help you to

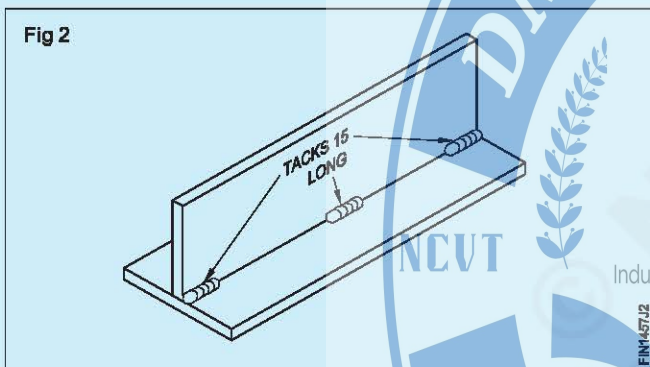
- weld 'T' fillet joint by arc in flat position free of distortion and weld defects
- inspect the fillet for weld characteristics.

The weld deposited on a 'T' or lap joint is called a fillet weld. Often the 'T' joint is called a fillet joint. (Fig 1) This joint is mostly used in industrial fabrication work.



Setting and tacking (Fig 2)

Set the pieces in alignment, forming a 90° 'T'. Tack the pieces at both ends.

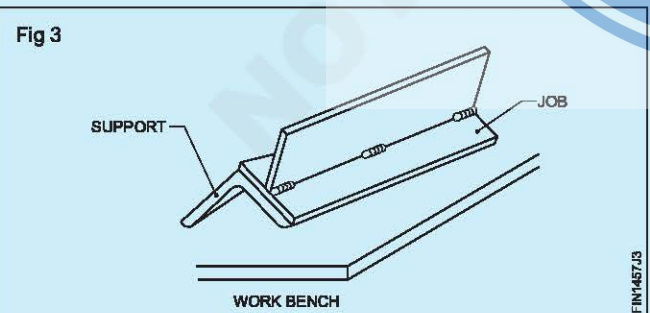


Use $\varnothing 3.15\text{mm}$ M.S. electrodes.
Set current at 150-160 amps.

Ensure the tacks are well fused having a 15 mm length

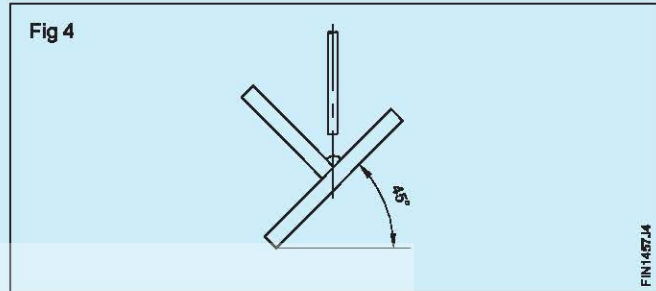
Check the alignment after tacking.

Welding a fillet joint



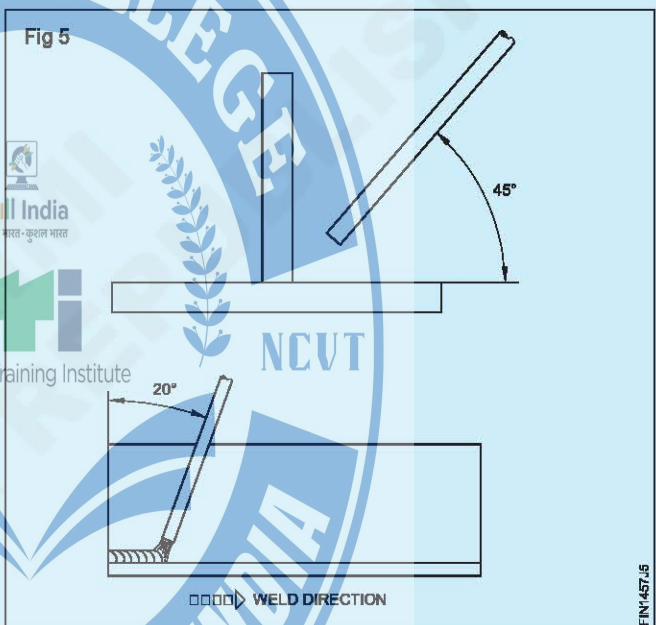
Place the joint for flat position welding. (Fig 3)

Hold the electrode, pointing at the corner of the joint at an angle of 45° to the plate surface. (Fig 4)



Incline the electrode 10°- 20° in the direction of travel. (Fig 5)

Proceed to weld along the joint with a uniform travel speed. (Fig 5)



Watch the molten pool and frozen bead carefully for excessive build up or undercut (faults).

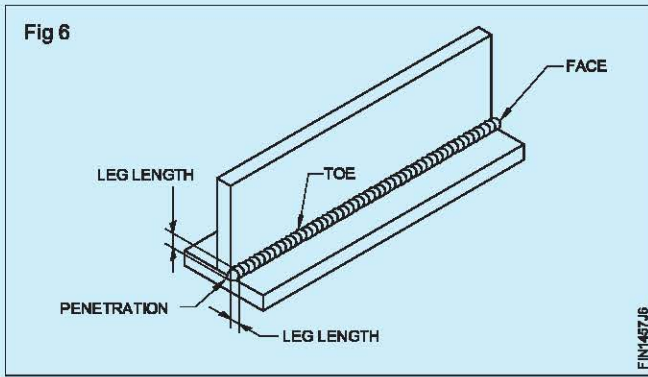
Increase the speed or change the angle of the electrode to correct the above faults, if they appear.

Inspect the weld

Clean the weld thoroughly.

Inspect the fillet for correct shape and size.

No undercut and overlap at the toe of the weld. (Fig 6)



Leg lengths of the fillet almost equal to the plate.
Penetration of the weld complete to the root.
Face of the weld slightly convex.

Setting up OXY-Acetylene plant

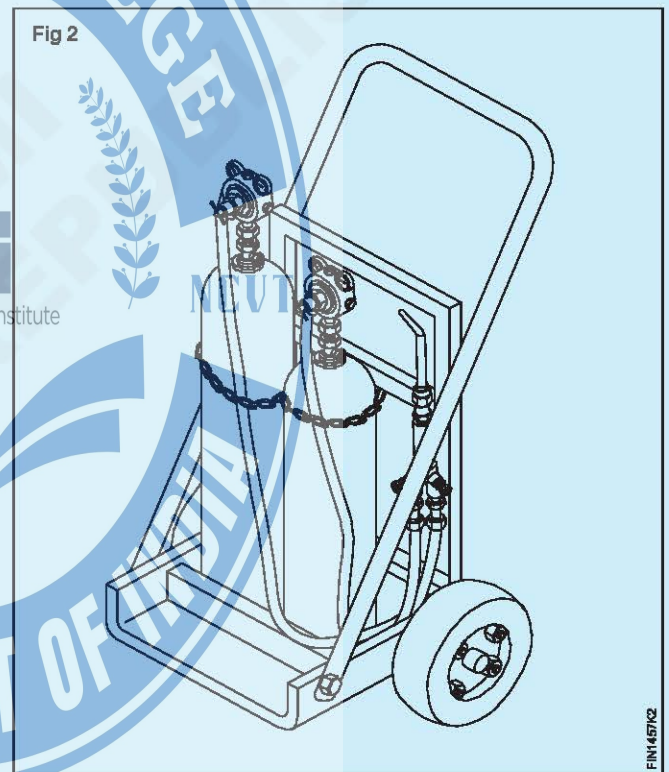
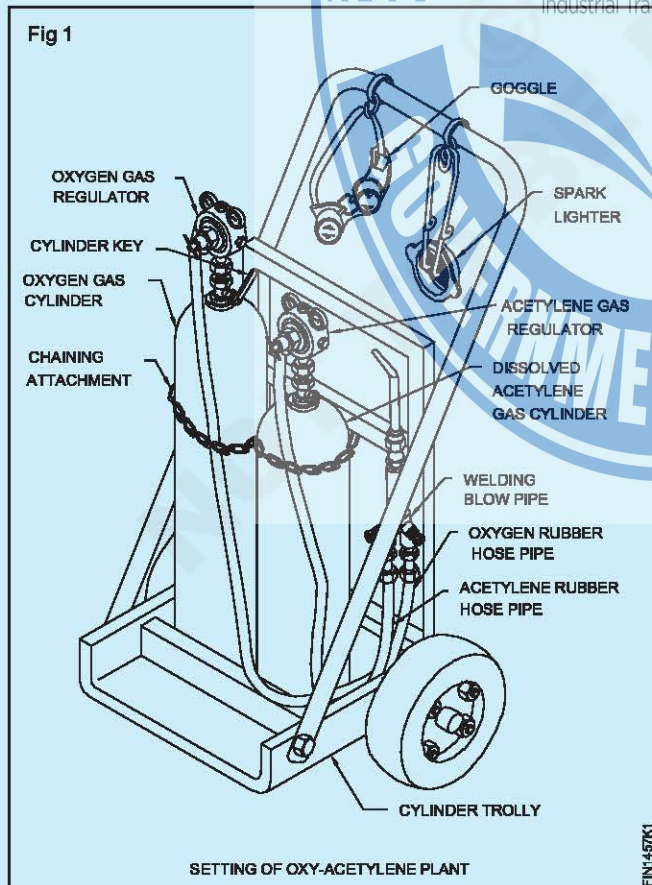
Objective : This shall help you to
• set up the oxy-acetylene plant.

Move oxygen and acetylene cylinders with the caps from the store to the gas welding area. An oxygen cylinder is identified by the black colour painted on it. An acetylene cylinder is identified by the maroon colour painted on it. Also the oxygen cylinder will be taller than an acetylene cylinder and the diameter of oxygen cylinder will be less than the diameter of an acetylene cylinder.

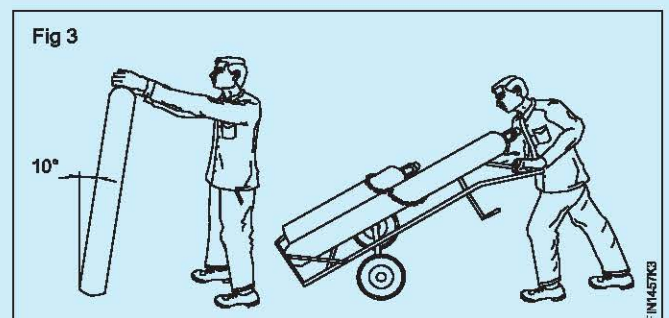
Ensure cylinders are kept separately from the empty cylinders.

Position the gas cylinders in a trolley and secure them with a chain.

Always keep the cylinders upright/vertically in the cylinder stand/on the floor (Fig 2)

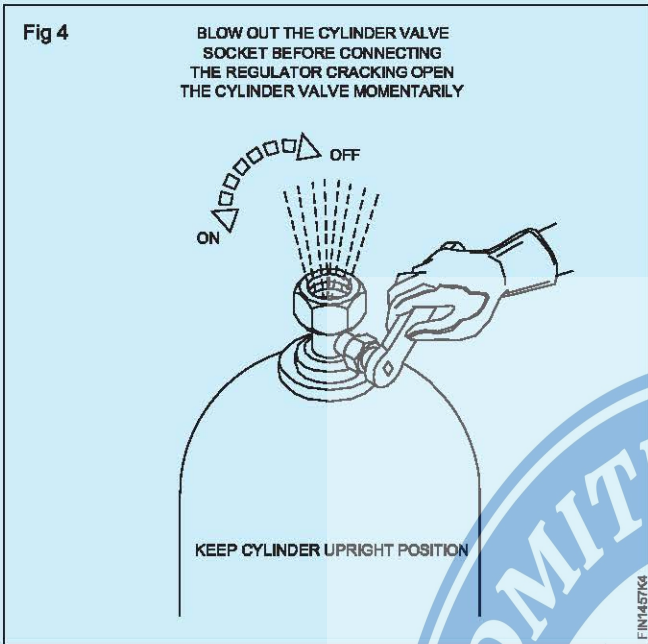


While moving, the gas cylinders should be kept slightly inclined to the vertical position and the protector cap used to avoid damage to the cylinder valves. (Fig 3)



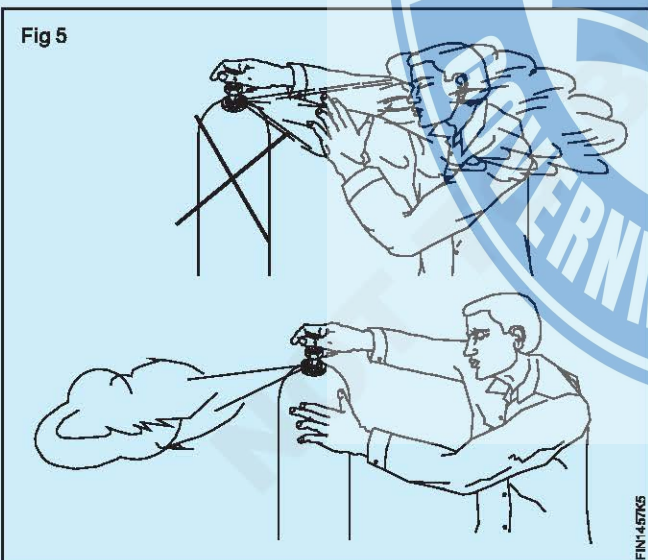
Do not roll the cylinders horizontally on the ground.

Remove the cylinder caps. Crack the gas cylinder valves by quickly opening and closing them using the cylinder key. Fig 4



Dirt dust particles from the cylinder valve sockets are cleaned by cracking the cylinder valve. This will avoid leakage of gas due to improper seating of the cylinder valve and also to prevent the dust particles from entering into the regulators which may cause damage to the regulators.

Always stand opposite to the valve outlet while cracking the cylinders. (Fig 5)



Ensure that your hands are free from grease or oil.

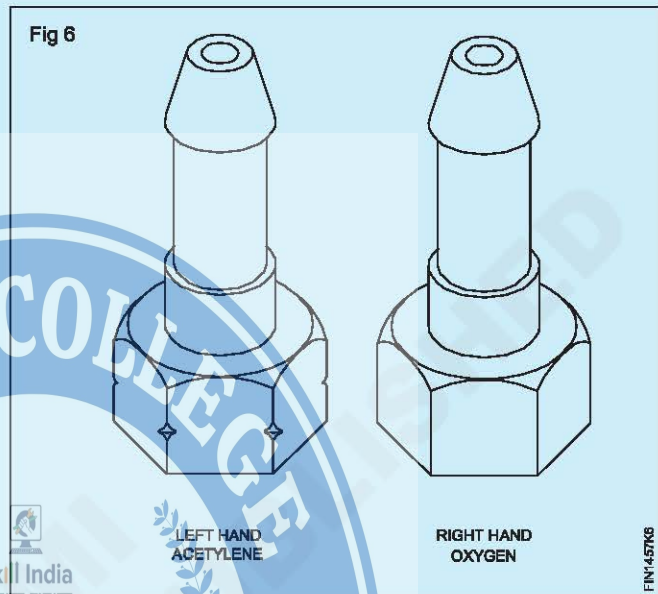
Connect the oxygen regulator to the oxygen gas cylinder (right hand threads).

Connect the acetylene regulator to the acetylene gas cylinder (left hand threads)

Ensure the pressure adjusting screws of both regulators are in a released condition.

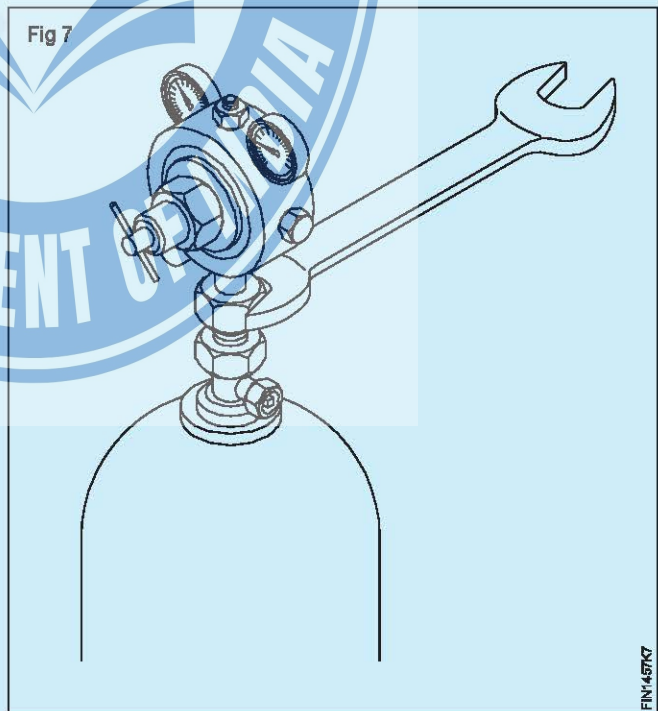
Be sure to connect the correct regulator on cylinders, Acetylene connections have left hand thread and oxygen has right hand thread.

The acetylene regulator connecting nut will have a groove cut on it (Fig 6) and the pressure gauge dial will be of maroon colour.

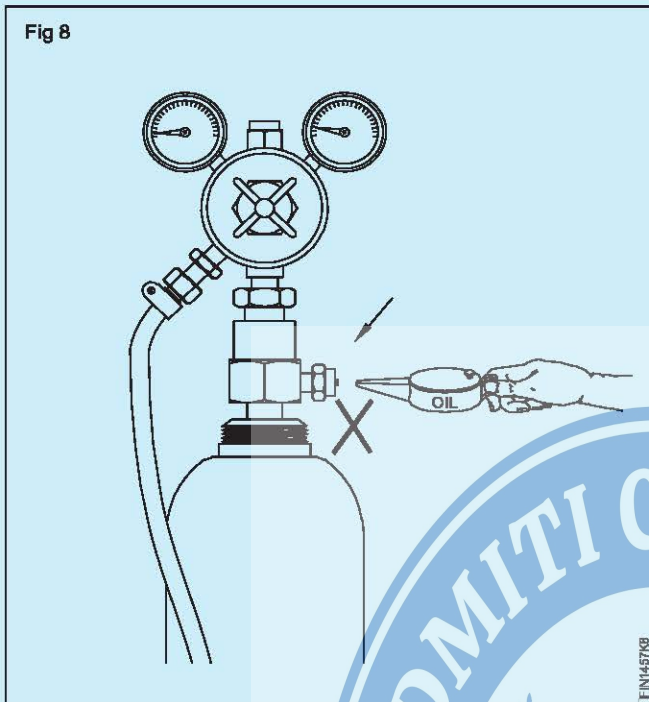


All threaded connections should be fixed initially by tightening by hands and then only a spanner should be used. This will help to avoid assembly with cross thread leading to damage to threads.

Always use the correct size spanner to prevent damage to the threads (Fig 7)



It is dangerous to apply lubrications in the threaded assemblies of gas welding equipment as it can cause fire (Fig 8)



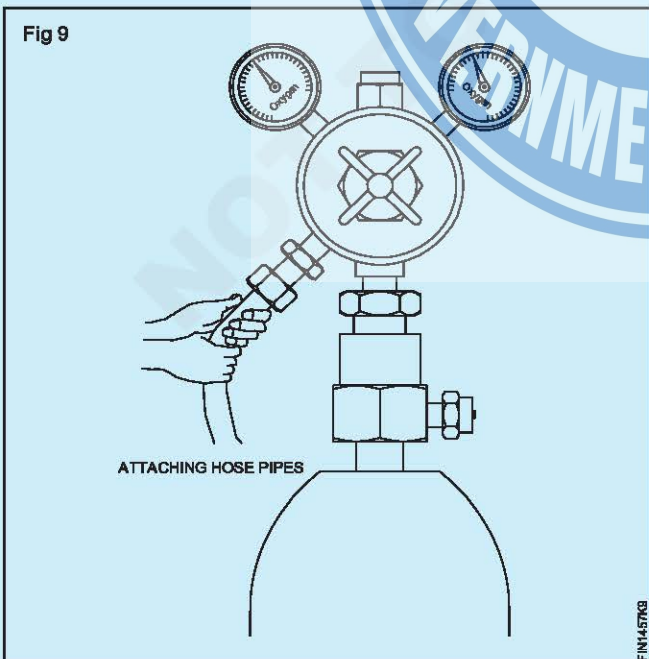
while tightening avoid undue force. The connections should be just tight.

connect the hose connector at the regulator end and the hose-protectors at the blowpipe end.

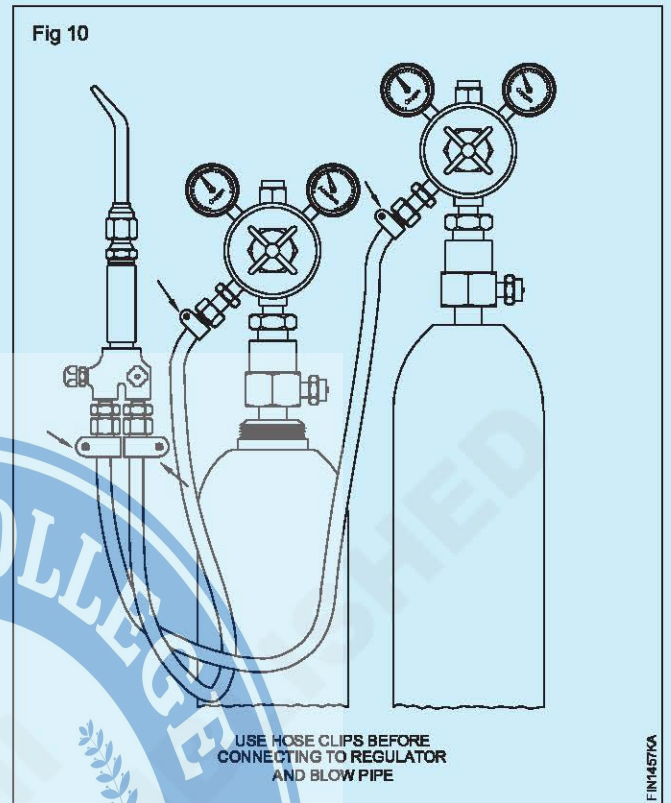
(use black hose for oxygen line and maroon hose for acetylene line.)

Acetylene connections have left hand threads with a cut on the corners of the nut while oxygen connections have right hand thread without a cut.

Attach one end of the black hose-pipe to the oxygen regulator outlet and the maroon coloured hose-pipe to the acetylene regulator outlet (Fig 9)

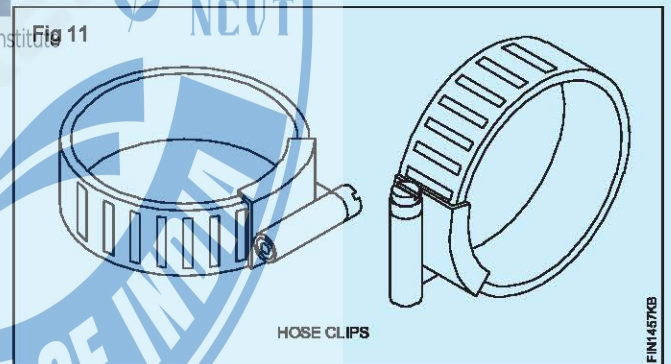


Secure the joints using hose-clips to ensure good grip and to avoid gas leakage (Fig 10)



Use a screwdriver to tighten the hose-clips.

Always use the correct size hose-clips (Fig 11)



Turn on the pressure adjusting screw of the regulator to which the oxygen hose pipe is connected (Fig 12)

Exert sufficient pressure to blow out dust or dirt particles if any are tapped inside the hose-pipe and then release the pressure adjusting screw.

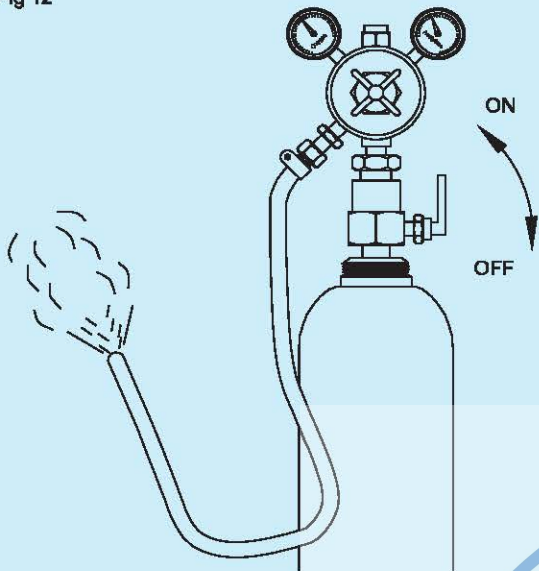
Repeat the same for the acetylene hose also.

Attaching blowpipe

The other end of the hose-pipe is to be attached to the blowpipe inlets. (Fig 13)

Fix the hose-protectors at the blowpipe ends. The hose-protectors with a groove at the corners are fixed on the acetylene hose-pipe and connected to the acetylene inlet of the blowpipe. The hose-protectors without cutting marks are fixed on the oxygen hose-pipe and connected to the oxygen inlet of the blowpipe. (Fig 14)

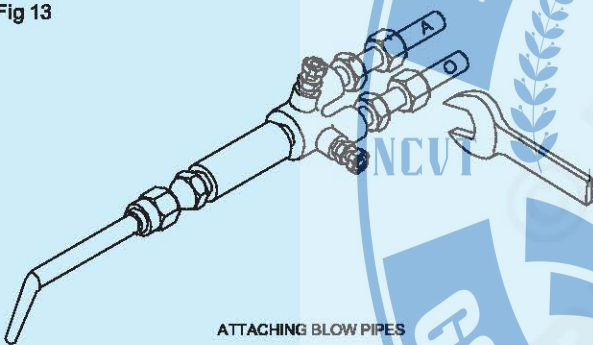
Fig 12



ATTACH NEW HOSES TO REGULATORS AND TO DISPEL DUST ETC., QUICKLY PASS PRESSURISED GAS TO ATMOSPHERE MOMENTARILY.
NOTE: THIS SHOULD BE DONE BEFORE FITTING HOSE PROTECTORS

FIN1457KC

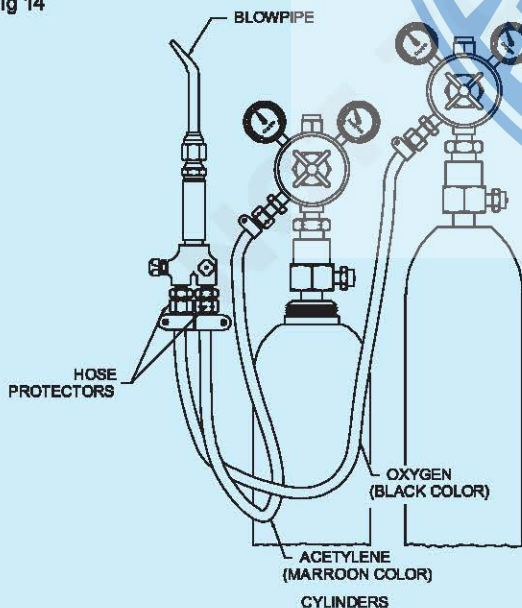
Fig 13



ATTACHING BLOW PIPES

FIN1457KD

Fig 14



FIN1457KE

The hose-protectors protect against the return flow of gas from the blowpipe to the rubber hoses. They act as non-return valves.

Adjusting the gas pressure

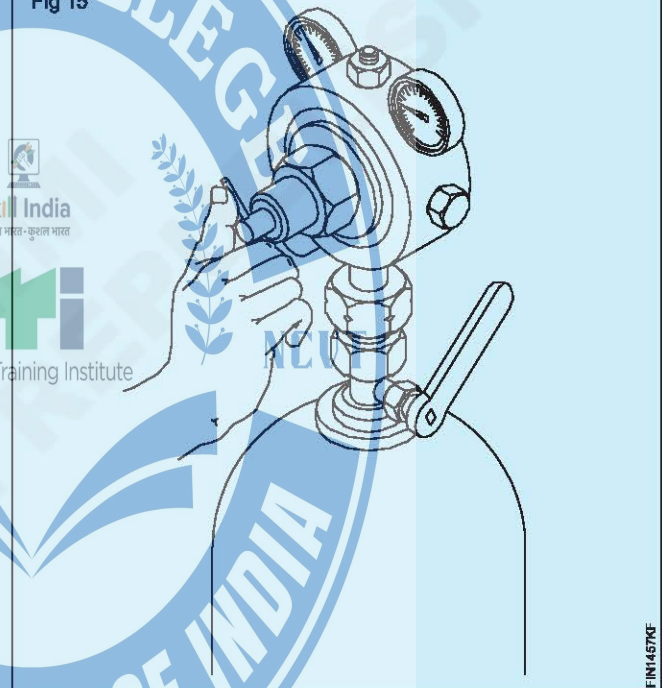
The gas pressure for both oxygen and acetylene has to be adjusted at regulators according to the size of the nozzle.

The size of the nozzle is selected according to the job material and thickness.

For adjusting the gas pressure, open the valves of both the cylinders slowly by one turn and set the pressure on both regulators as 0.15 kg/cm² for small size nozzles, by tightening the pressure adjusting screws. (Fig 15) Ensure the blow pipe control valves are kept open while setting the gas pressure.

The pressure can be read on the working pressure gauge of gas regulators

Fig 15



FIN1457KE

Testing for leakage

All connections must be tested for leakage.

Apply soap water solution for acetylene connections and fresh water for oxygen connections (Fig 16).

Use of soap water on oxygen connections may lead to fire hazards.

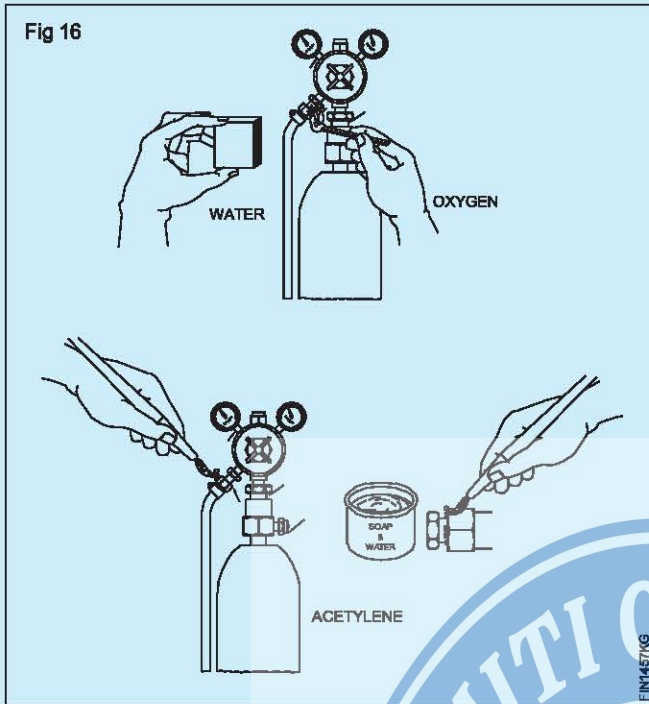
Never use matches or flame light during leakage test.

Lighting the flame

Attach the recommended size of nozzle to the neck of the welding blowpipe i.e nozzle No.3.

Open the gas cylinders and adjust the recommended gas pressures on the regulators.

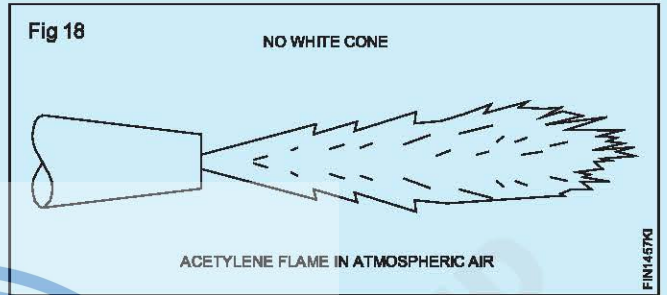
The pressure of oxygen and acetylene is 0.15 kg/cm² for nozzle no.3



Avoid using any other source of fire other than the spark lighter.

Point the blowpipe in a safe direction in the open space, away from you and others.

Increase the acetylene till the black smoke disappears. (Fig 18)

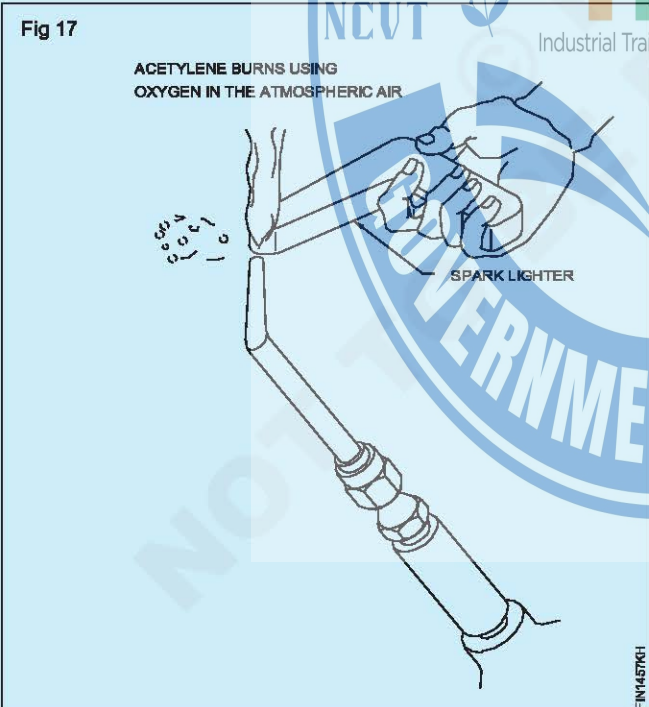
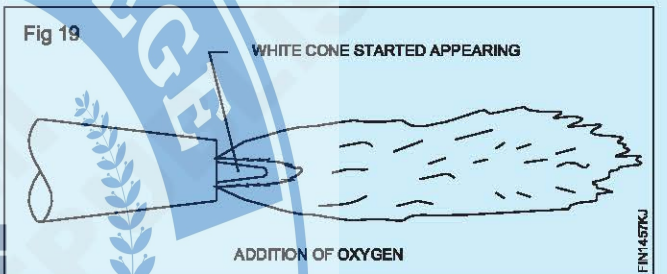


Observe the flame and add oxygen by opening the oxygen control valve of the blowpipe. Now a bright white cone starts appearing at the tip of the nozzle (Fig 19)

Open cylinder valves very slowly.

while setting pressure on the regulator, keep the blowpipe control valve open for accurate setting.

Open the acetylene control valve 1/4 turn on the blowpipe and ignite with a spark lighter. (Fig 17) Acetylene burns using the oxygen in the atmospheric air with a black smoke.



Square butt joint in flat position by gas

Objectives : This shall help you to

- set and tack the workpieces in alignment for a square butt joint
- produce a uniform and well penetrated bead on an open square butt joint in a flat position
- visually inspect the completed joint.

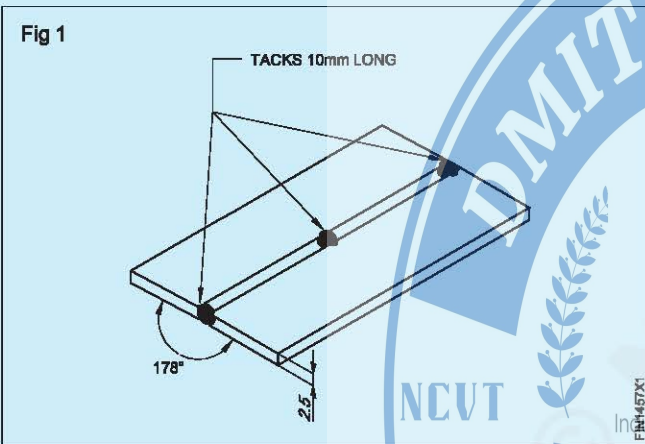
The requirements of a good welded joints are:

The joint must be in correct alignment (distortion free)

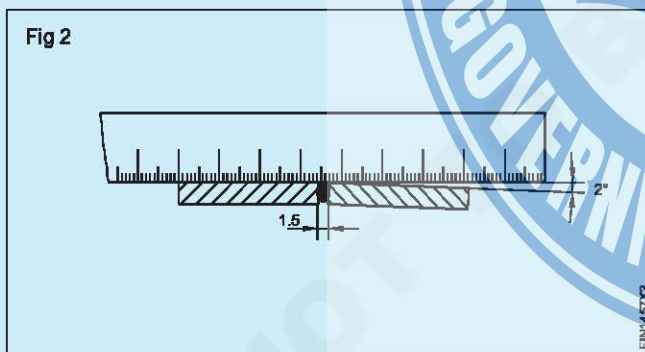
The weld must be well fused, well penetrated, uniform in width and height, of correct size and free from internal or external faults.

Setting and tacking

Set and tack the job-pieces in correct alignment with a proper gap and for distortion allowance. (Fig 1)



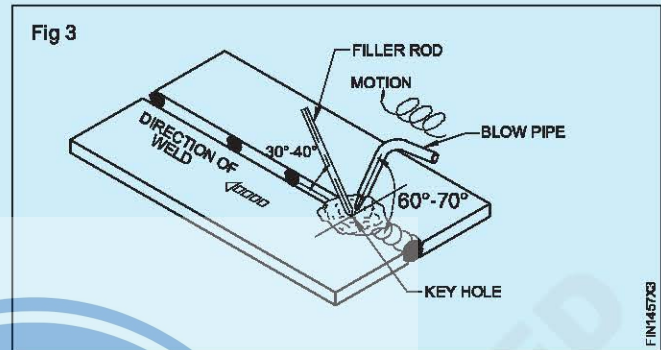
Check the alignment after tacking, and reset, if necessary. (Fig 2)



Welding

Produce a well-fused uniform bead with complete penetration using a leftward technique (Fig 3) by;

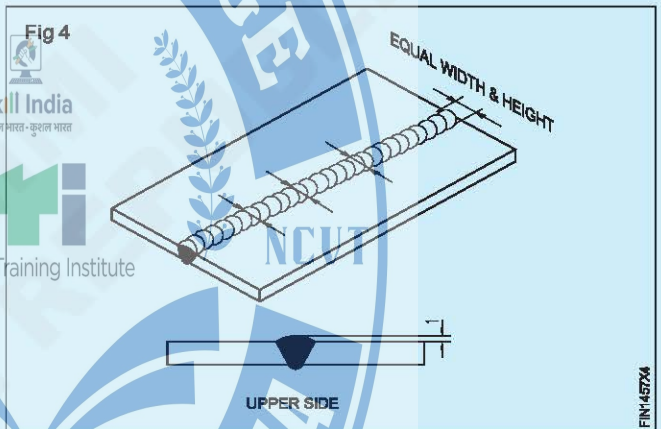
- Holding and manipulating the blowpipe and filler rod in the recommended angles.
- Maintain a uniform travel speed and feed.
- Forming a correct size keyhole.



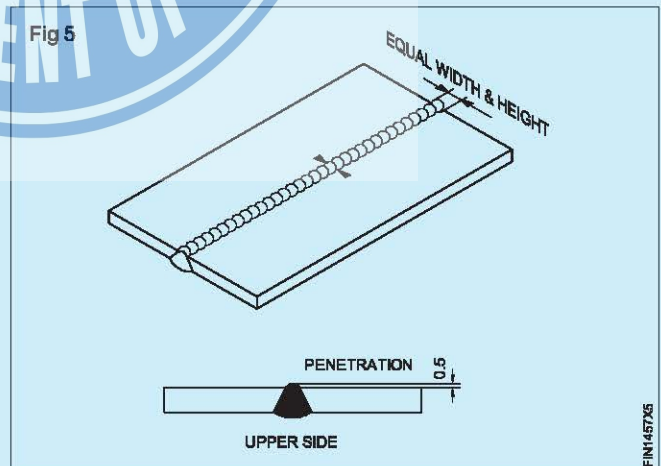
Finish the job.

Check alignment - remove distortion, if required, and inspect for:

Uniform width and height of weld bead in size. (Fig 4)



- Uniform ripples and fusion, complete penetration. (Fig 5)
- Absence of faults such as undercut, lack of fusion, unfilled crater etc.



Fillet weld 'T' joint in flat position by gas welding

Objectives: This shall help you to

- set and tack the workpiece in alignment for a fillet weld tee joint
- weld a tee fillet joint using recommended filler rod and nozzle size
- visually inspect the completed joint.

'T' fillet joints are used extensively in industry i.e., fabrication of underframes, vertical supporters for oil and water containers and other similar structural work.

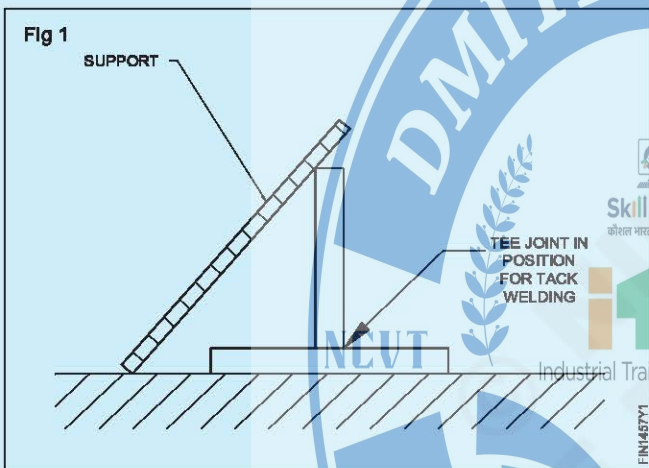
It is an economical joint with very little edge preparation but difficult to weld without defects (i.e. unequal leg length, undercut, etc.) unless the operator gets proper practice.

Root penetration must be obtained completely and undercut is to be avoided.

Setting and tacking the job pieces

Place the pieces on the welding table for Tee joint.

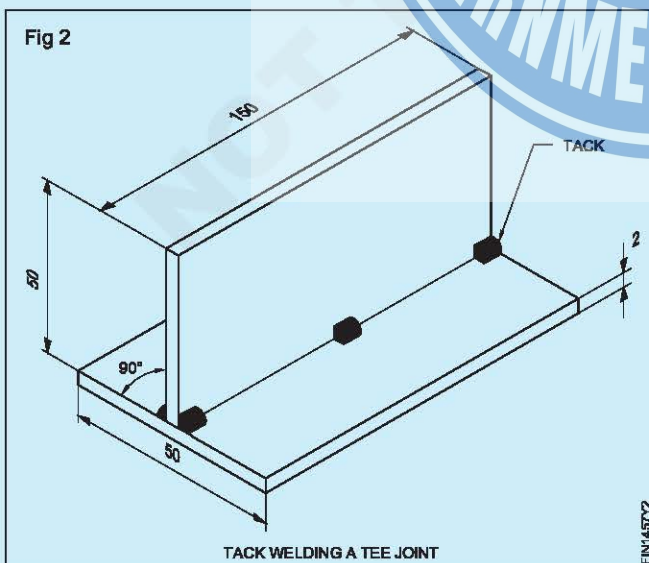
Hold the pieces in position using support. (Fig 1)



Ensure the vertical piece is perpendicular to the horizontal piece without gap of the joint.

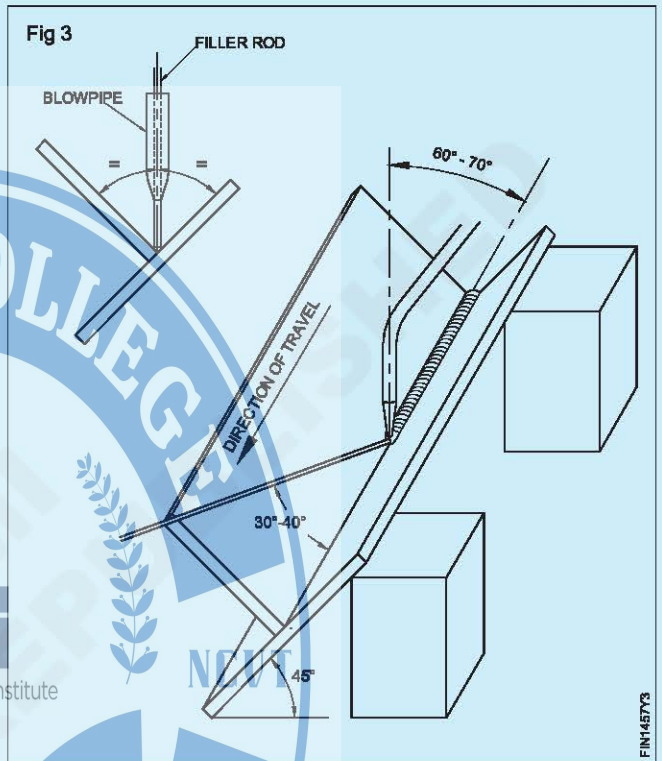
Check with a try square for perpendicularity.

Tack-weld the joint at both ends (Fig 2) on one side of the joint.



Welding of fillet 'T' joint in flat position (Fig.3)

Place the tacked joint in flat position by tilting and supporting it. (Fig.3)



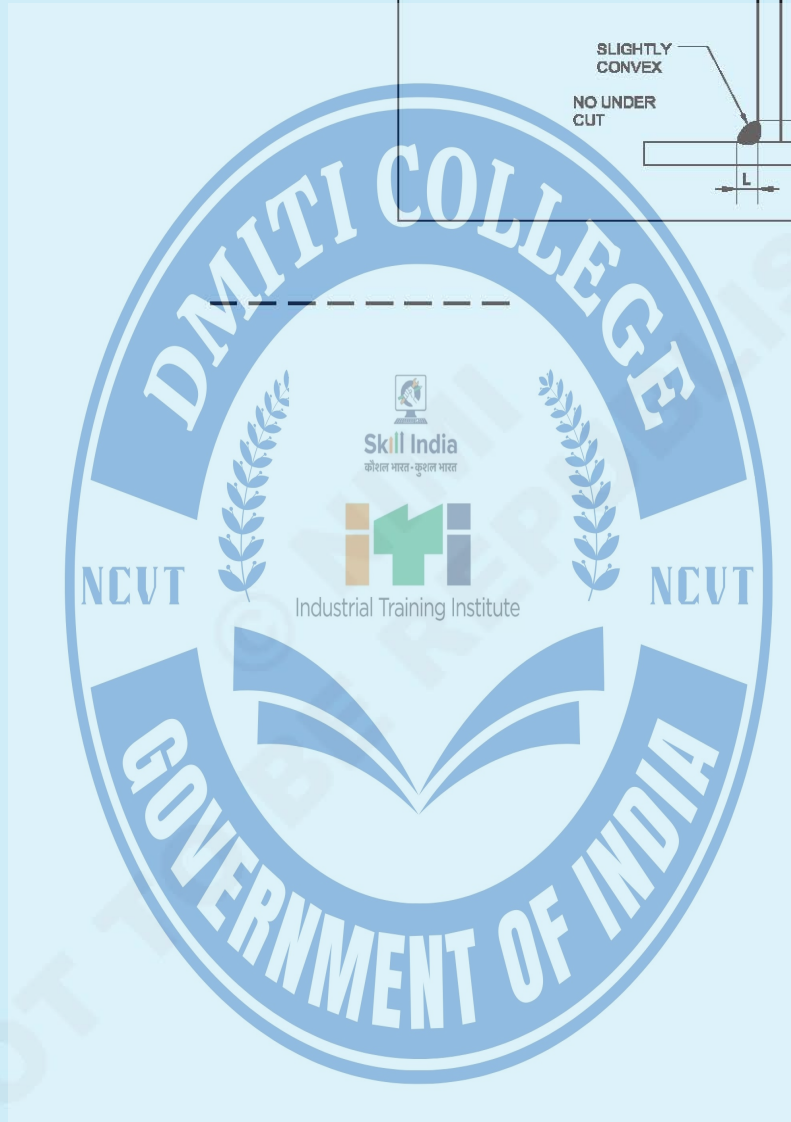
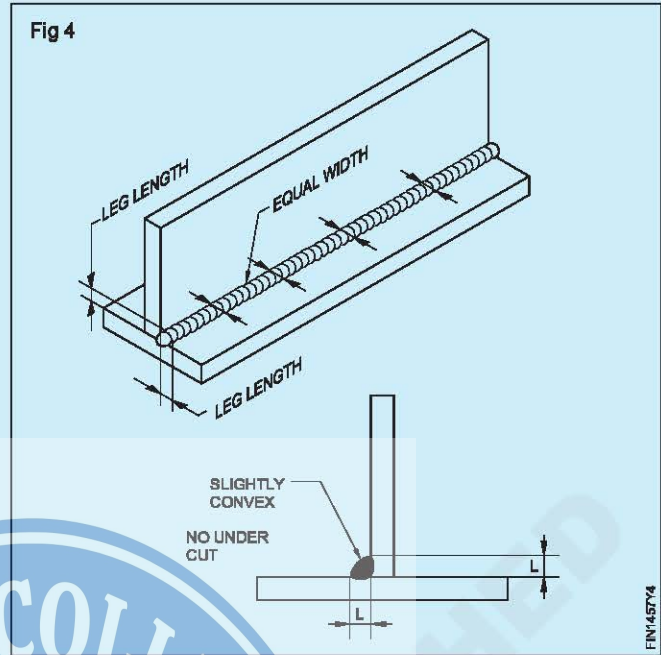
Start welding at the right hand end of the joint by fusing the tack-weld and the parent metal to form a molten pool. Keep the blowpipe in the leftward direction at an angle of 60° to 70° and the filler rod at an angle of 30° to 40° to the line of travel. The blow pipe and filler rod should be held at 45° between the 2 surfaces of the joint. This will ensure root penetration. Watch the molten metal closely to make sure that both pieces melt uniformly. Change the angle of the blow pipe if the pieces do not melt uniformly. When the molten pool is formed add the filler rod in the centre of molten pool. Give slight side-to-side movement to the flame (blowpipe) and a piston like motion to the filler rod.

Adjust the rate of travel of the blowpipe and the filler rod to secure even penetration at the root and into both sheets and to produce a fillet weld of equal leg length.

Visual inspection (Fig 4)

Clean the weldment and inspect for:

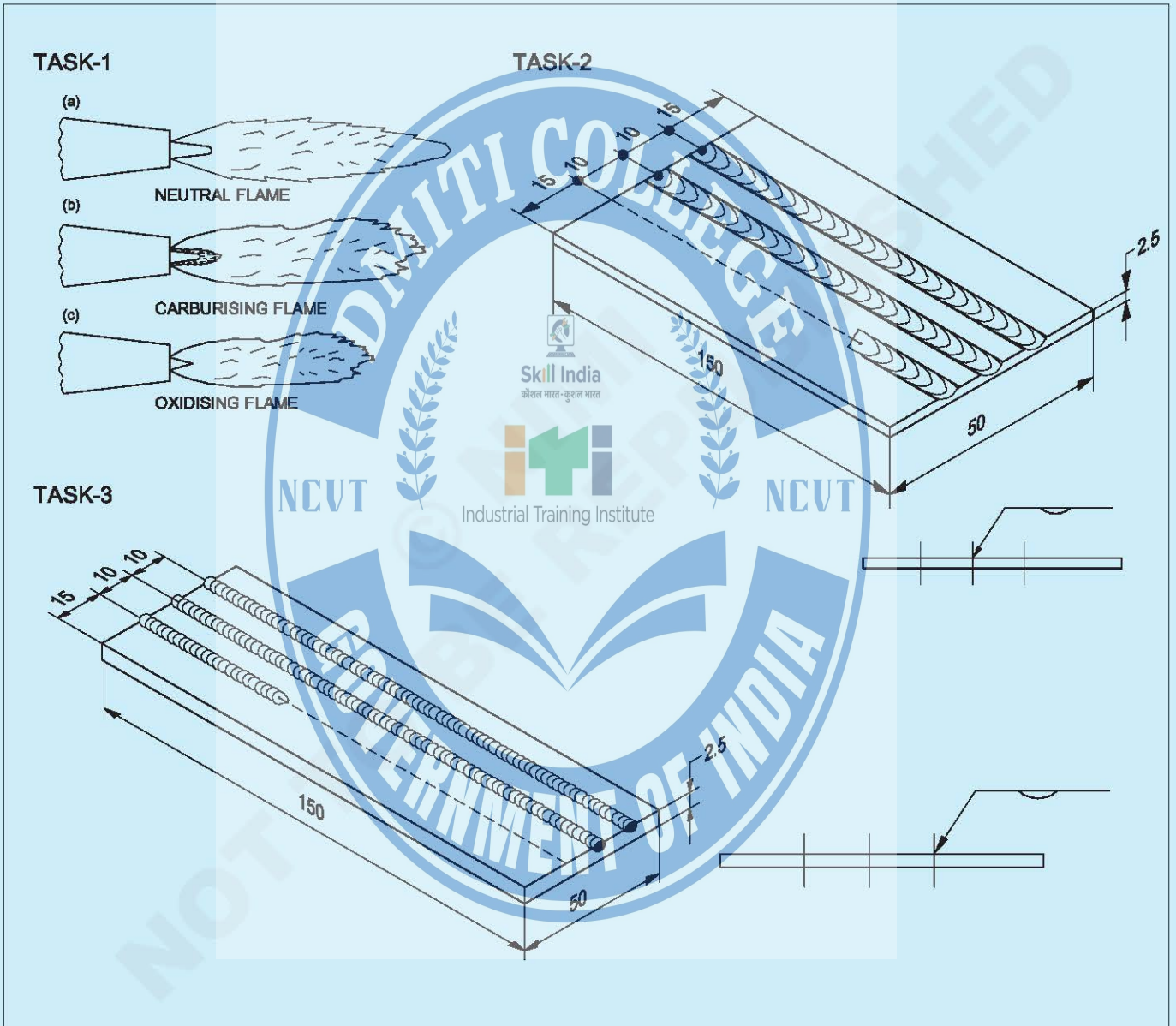
- Uniform weld size and shape of bead (reinforcement and contour slightly convex)
- Equal leg length, no undercut at the toes of the weld
- no porosity, overlap



Setting up of flames, fusion runs with and without filler rod and gas

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

- set gas pressure according to the nozzle size
- select and fit the correct size nozzle according to the job thickness
- set job for flat position, weld fusion run with and without filler rod using leftward technique
- ignite, adjust and extinguish oxy-acetylene flame
- shut the oxy acetylene plant for stopping work
- clean the weldment and visually inspect for weld defects.



1	ISSH 150 x 2.5-50	-	Fe310-W	-	TASK 3	-
1	ISST 150 x 50 x 2.5	-	Fe310-W	-	TASK 2	1.4.58
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE	TITLE: SETTING OF OXY-ACETYLENE FLAME (NEUTRAL, CARBURISING AND OXIDISING FLAMES)				DEVIATIONS	TIME:
					CODE NO. F120N1458E1	

Job Sequence

TASK 1 : Oxy - acetylene flame setting

- Wear safety apparel
- Open the gas cylinders and adjust the gas pressures on the regulators
- Open the control valve of the acetylene gas in the blowpipe
- Ignite the flame by using a spark lighter.

Avoid using any other source of fire

- Adjust the acetylene flow till the black smoke goes away
- Open the oxygen gas till a proper round inner cone is established without any sound in the flame. This is known as a neutral flame.

- Adjust the oxidizing flame by increasing the oxygen gas (with sharp inner cone and little hissing sound)
- Set the neutral flame again and adjust the carburizing flame by increasing the acetylene gas with the soft inner cone covered with an outer feather without any sound
- Repeat the setting of the flames till you manage to set the flame without any backfire or flash-back

Flame extinguishing and stopping work

- Extinguish the flame by closing the acetylene valve first and then the oxygen valve
- Dip the blowpipe nozzle in water to cool down by opening a little oxygen gas
- Close the cylinder valves and release all the pressure from the line

TASK 2 : Fusion runs without filler rod in flat position by gas

- Check the size of the raw material.
- Mark and file to size.
- Mark the bead position as per drawing.
- Clean the surface
- Set the job piece on the welding table with the left edge raised about 15mm.
- Select and attach nozzle size 5 with a blowpipe (Indian Oxygen make)
- Set the acetylene and oxygen pressure at 0.15kg/cm² on the regulators.
- Wear safety apparel and set the NEUTRAL flame.
- Hold the blowpipe in position with the job at the right edge with the nozzle angle 60° - 70° with the welding line (marked with punches) nozzles angle 90° with the adjoining surface distance of the flame cone 1.5mm to 3.0mm from the surface, pointing leftward.
- Start heating and fusing the surface with a slight circular motion of the blowpipe.

- Move the blowpipe in a leftward direction keeping a uniform speed as you get local fusion (small round pool of molten metal).

Avoid excessive concentration of heat. If the metal becomes too hot, lift the blowpipe momentarily away from the molten pool.

Keep the molten pool in correct size by adjusting the rate of travel and the circular motion of the blowpipe.

- Stop at the left edge and lift the blowpipe quickly.
- Extinguish the flame and cool the blowpipe in water.
- Clean the fused surface with a steel-wire brush and inspect the uniformity of fusion runs.

If the speed of travel and the blowpipe motion are correct, the FUSION RUNS will appear in uniform width and even ripples.

- Repeat the exercise till you achieve uniform FUSION.

TASK 3 : Fusion run with filler rod in flat position by gas

- Check the size of the raw material.
- Mark and file to size.
- Mark the bead position as per drawing.
- Set the workpiece on the welding table with the left edge raised about 15mm.
- Select the nozzles size 5 (IOL make-saffire type) and set the acetylene/oxygen pressure at 0-15 kg/cm².

- Select a mild steel copper coated (C.C.M.S) filler rod of Ø1.6mm.
- Wear safety apparel and set a neutral flame.
- Hold the blowpipe at an angle of 60° - 70° on a punched line of sheet and make a small molten pool at the right hand edge.

Keep a flame cone distance of 2.0 to 3.0mm from the job surface.

- Hold the filler rod in the left hand, pointing near the molten pool with an angle of 30°- 40° with the line of weld.
- Dip the end of the filler rod into the molten pool and add the filler metal on the job surface to form a weld bead.
- Move towards the left with a uniform speed along the punched line with a slight circular motion of the blowpipe and piston-like motion of the filler rod.

Add enough rod into the molten pool to build up the bead evenly in height and width.

Coordinate the rate of travel with the filler rod to control the size of the bead and the required penetration.

- Stop at the left edge, extinguish the flame and cool the nozzle.
- Clean the weld surface. Inspect for even ripples and uniform width/height of the weld bead.
- Repeat the exercise till you get good results.

Skill Sequence

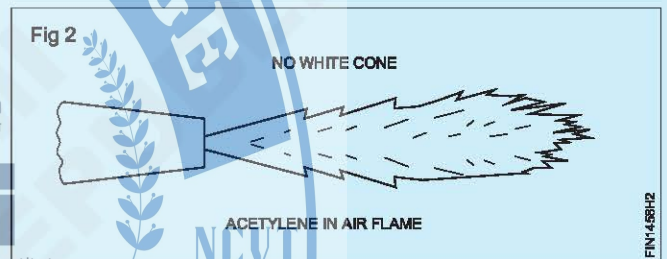
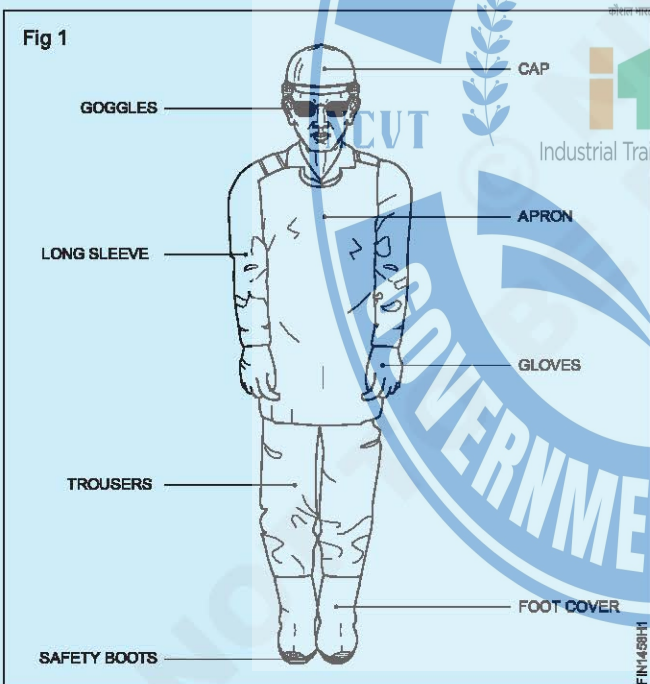
Ignite, setup and extinguish oxy-acetylene flame for gas welding (TASK 1)

Objectives: This shall help you to

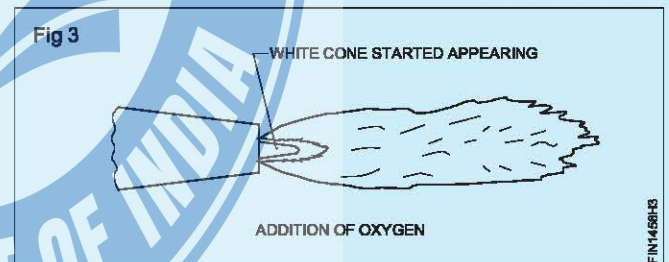
- ignite, set and extinguish an oxy-acetylene flame for gas welding correctly
- shut the oxy-acetylene plant for stopping work.

Flame lighting

The safety apron, gloves and goggles are worn as shown in (Fig 1).

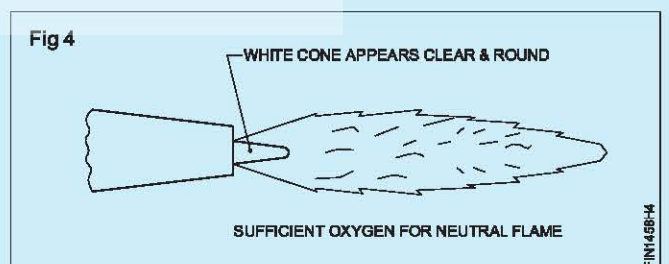


Observe the flame and add oxygen by opening the oxygen control valve of the blowpipe. (Fig 3)



Flame adjustment

To adjust the neutral flame, add sufficient oxygen to make the white cone clear and round. (Fig 4)



The gas mixture from the blowpipe consists of oxygen and acetylene in equal volumes.

To adjust the oxidising flame, add more oxygen.

Set the pressure of oxygen and acetylene at 0.2kgf/cm² for a small size nozzle. (No.3)

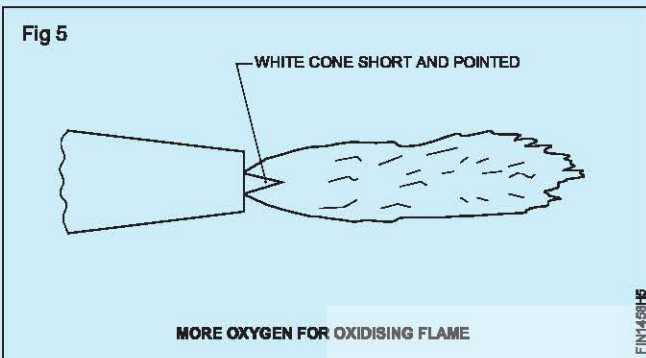
While setting the pressure on the regulator, keep the blowpipe control valve open for accurate setting.

Open the acetylene control valve ¼ turn of the blowpipe and ignite with the help of the spark-lighter. Adjust the acetylene flow till the black smoke goes away. (Fig 2)

Avoid back fire or flash-back of blow pipe.

The white cone will become short and sharp.

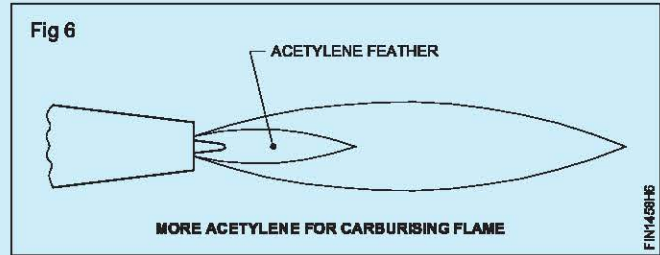
The flame will produce a hissing sound and will have a short length. (Fig 5)



To adjust a carburising flame, adjust the flame to neutral and then add acetylene.

The white cone will become long, surrounded by a feather-like portion.

The flame will burn quietly and have more length. (Fig 6)



Extinguishing the flame

To extinguish the flame, close the acetylene valve (blowpipe) first and then the oxygen valve.

Shutting off the plant

At the end of the work, shut off the plant as stated below.

Close the acetylene cylinder valve.

Open the blowpipe acetylene valve and release all pressure.

Release the acetylene regulator pressure adjusting screw.

Close the blowpipe acetylene valve.

Repeat the above four steps for shutting off oxygen also.

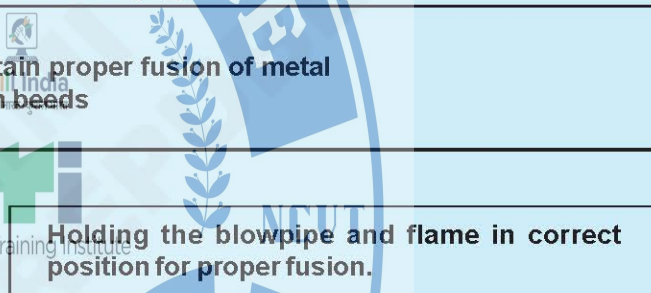
Fusion runs without filler rod in flat position by gas (TASK 2)

Objectives : This shall help you to

- hold the blowpipe and flame in correct position to obtain proper fusion of metal
- make fusion runs without filler rod to produce uniform beads.
- visually examine the quality of fusion beads.

Fusion runs

Homogeneous joints are produced in gas welding by melting and fusing the metal edges with the help of a gas flame.



Holding the blowpipe and flame in correct position for proper fusion.

Hold the blowpipe and flame in such a position that the axis of the joint is parallel to the operator's body (Fig 2)

The beginner in gas welding must practice the following steps correctly.

Fusing of a metal using a proper gas flame.

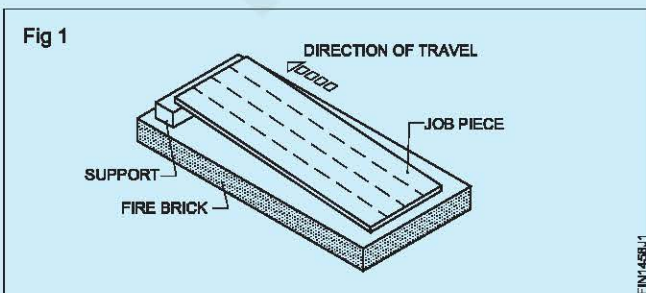
Holding the blowpipe in a correct position.

Fusion run in a straight line using the leftward technique.

Cleaning and setting the job-piece

Clean the job-piece surface with a steel-wire brush and emery paper.

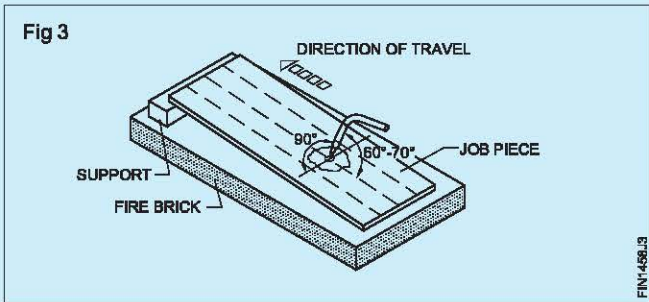
Set the job-piece on a fire-brick welding table, raising the left edge app. 15mm. (Fig 1)



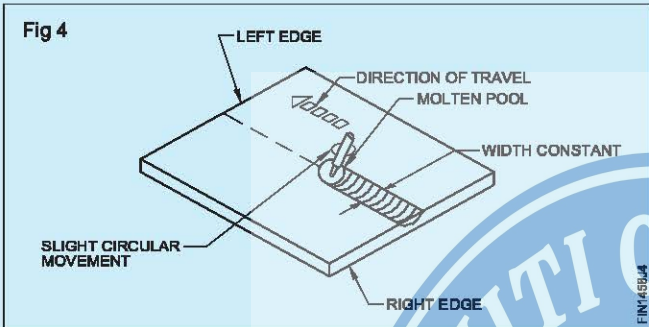
The angle of the nozzle with welding line 60° - 70° (Fig.3) the fuse metal forms a small puddle on the molten pool on the job surface at the right edge (Fig 3) give a slight circular motion to the blowpipe.

Making fusion run without a rod

Move the blow pipe in a leftward direction as you get local fusion.

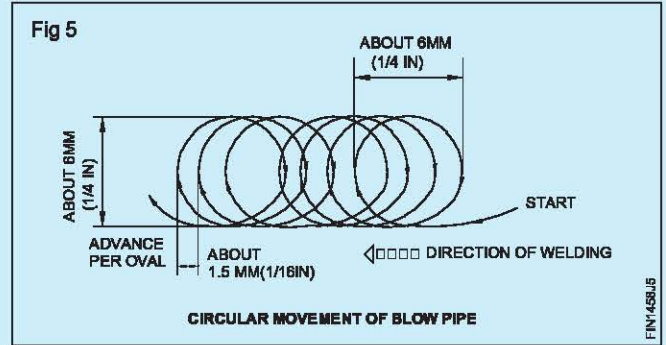


Keep the molten pool on the punch line. (Fig 4)



Maintain a constant speed of travel with a slight circular motion to the blowpipe. (Fig 5)

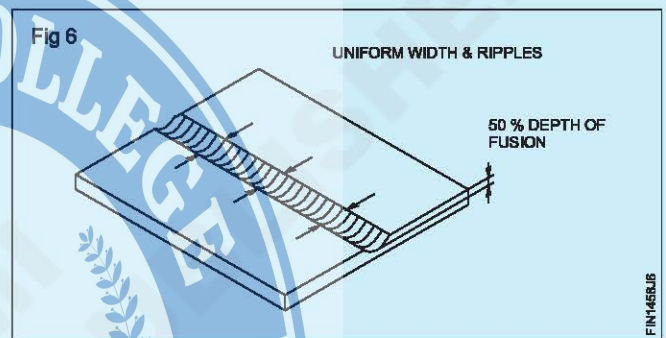
Maintain a constant 2-3mm of distance between the white cone of the flame and the sheet surface for a proper HEAT INPUT and avoidance of BACKFIRE.



Visual examination of fusion run

Clean the fusion run with a steel-wire brush at the end of the weld.

Inspect visually for uniform width, and ripples with the uniform depth of fusion in job thickness. (Fig 6)



Fusion runs with filler rod on steel plate in flat position by gas (TASK 3)

Objectives : This shall help you to

- make fusion runs with filler rod in a straight line using leftward technique
- clean and inspect the weldment for faults.

During gas welding, most of the joints require filler metal to obtain a proper, strong weld.

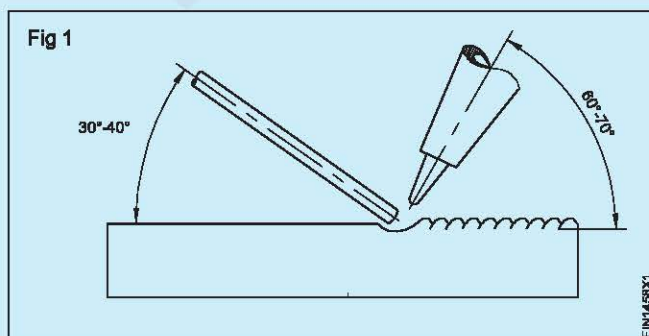
The feeding of the filler metal in the molten pool requires special skill, which is outlined here.

Correct position of the blowpipe and filler rod.

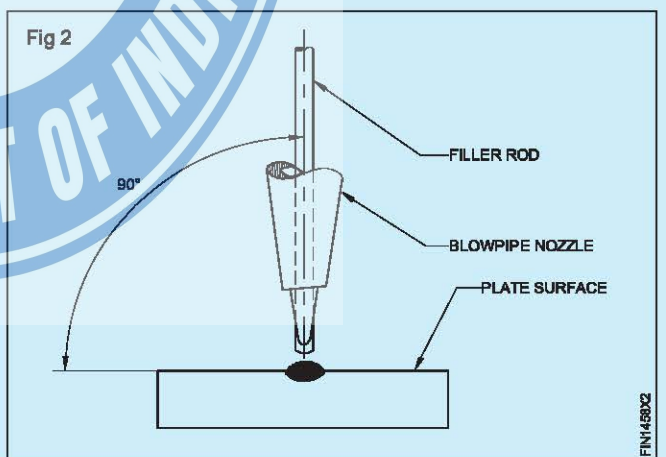
Hold the blowpipe and the filler rod in the correct position in respect of the job.

The blowpipe angle should be $60^\circ - 70^\circ$ with the weld line (towards right).

The filler rod angle should be $30^\circ - 40^\circ$ with the weld line (towards left). (Fig 1)



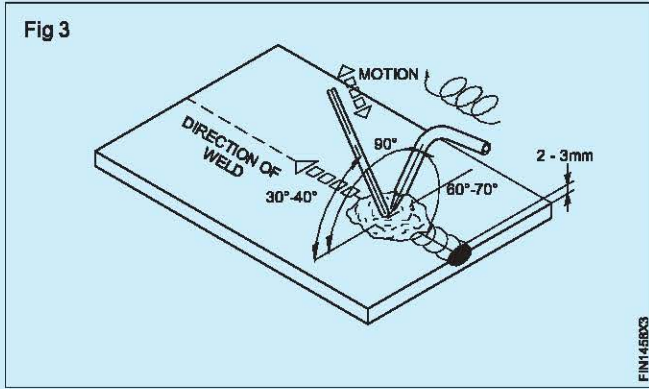
Keep the blowpipe and the filler rod at 90° to the plate surface. (Fig 2)



Surface fusion and filler rod addition

Fuse the metal surface and add the filler metal with proper motions; circular motion for the blowpipe, and piston-like motion for the filler rod. (Fig 3)

Maintain a flame cone distance from 2 to 3mm from the metal surface.



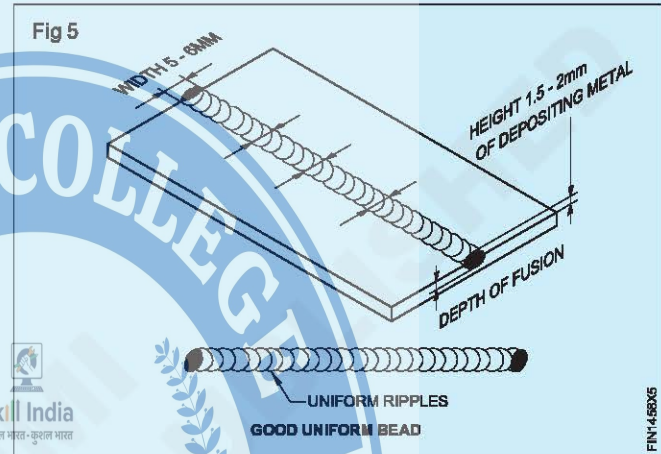
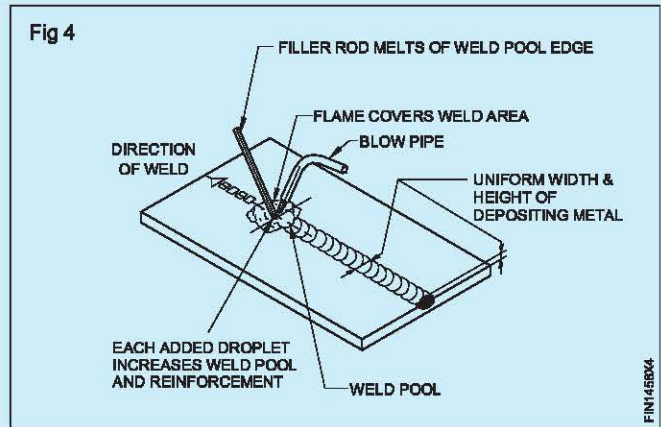
Direction of welding

Move the blow pipe in a leftward direction along a straight line to complete the weld. (Fig 4)

Maintain a constant 2-3mm of distance between the white cone of the flame and the sheet surface for a proper HEAT INPUT and avoidance of BACKFIRE.

Inspection of weld

Inspect the weld bead after cleaning properly with a wire brush, for a uniform width and height of the bead, uniform ripples, and proper depth of fusion. (Fig5)



Make butt weld and corner, fillet in arc welding

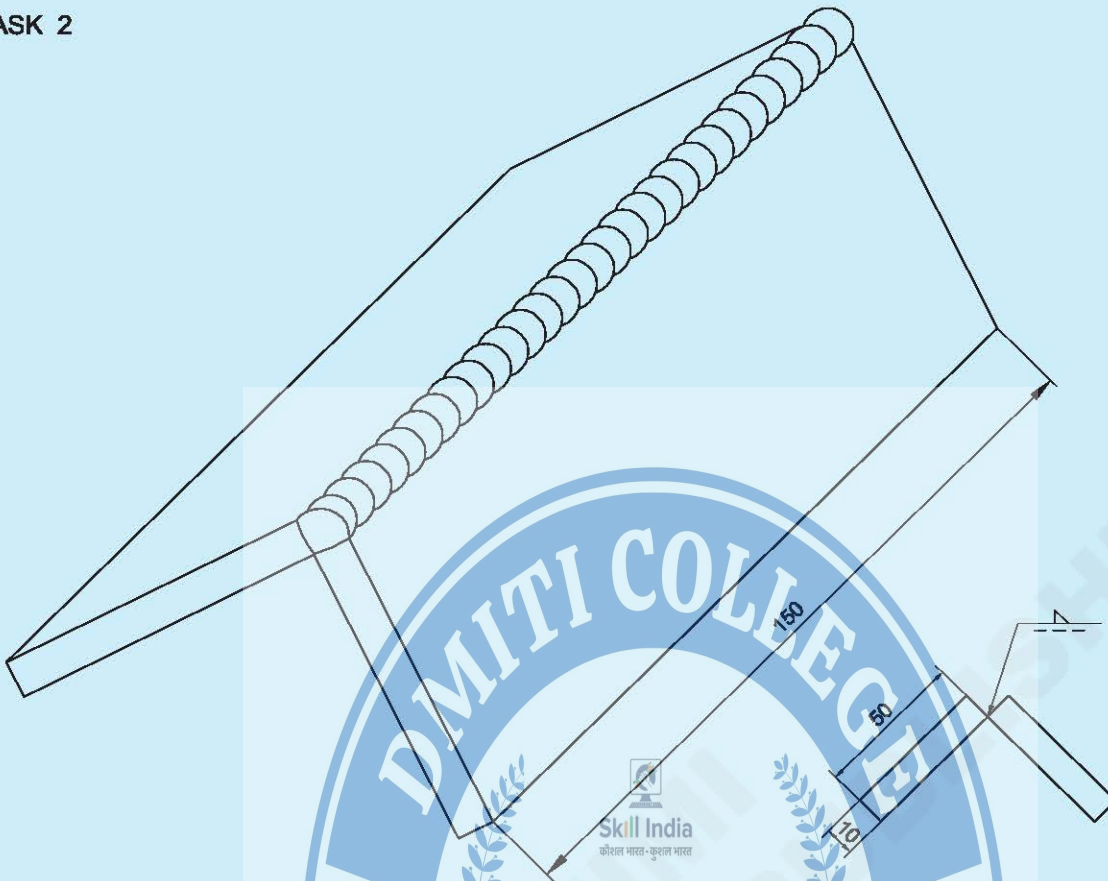
Objectives: At the end of this exercise you shall be able to

- bevel the plate edges by gas cutting for single vee butt joint
- grind the gas-cut bevel edges with proper root face for single Vee butt joint
- set the plates with a root gap of 2mm and proper distortion allowance for single Vee butt joint
- control arc blow
- deposit root run in single Vee butt joint to ensure complete penetration
- deposit intermediate and final covering runs in single Vee butt joint to obtain proper fusion and reinforcement
- clean and inspect the groove weld for surface defects and uniform root penetration.

TASK 1

2	50 ISF 12 - 150		Fe 310 - W		TASK 1	1.4.59
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	SINGLE 'V' BUTT JOINT IN FLAT POSITION BY ARC WELDING				TOLERANCE ±0.5mm	TIME
					CODE NO: F120N1459E1	

TASK 2

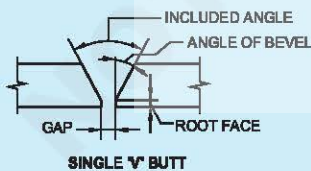


Job Sequence

TASK 1 : Single 'V' butt joint in flat position by arc welding

- Straight cut two 12mm thick plates by gas cutting as per drawing and grind them to size.
- Mark the bevel to 30° angle using bevel protractor in two plates.
- Punch witness marks
- Bevel the edges of each plate to 30° angle by gas cutting and file the root face as per drawing for edge preparation single 'V' Butt of joint. (Fig. 1)
- Clean the plates from dirt, water, oil grease, paint etc.
- Keep the plates inverted in the form of a butt joint with proper root gap.
- Maintain a distortion allowance of 1.5° on each side of the joint.
- Wear all protective clothings.
- Use a 3.15mm medium coated MS electrode and set 110 amperes current. In case of DC welding machine connect the electrode cable to the negative terminal of the machine.
- Tack weld on the back side of the plates at the ends. The length of tack should be 20mm.
- De-slag the tack weld and clean.

Fig 1



2	50 ISF 10 - 150		Fe 310		TASK 2	1.4.59
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	FILLET WELD IN OPEN CORNER JOINT IN FLAT POSITION BY ARC WELDING				TOLERANCE: ±0.5mm	TIME :
					CODE NO. FI20N1459E1	

- De-slag and clean the root run and inspect root penetration.
- Position the tack welded job on the table in flat position (the single V portion facing up)
- Deposit the root run and fill the crater as done for welding square butt joint.
- Take special care to maintain key hole to ensure proper melting of root face and root penetration.
- Deposit the second run/intermittent run using 4mm medium coated electrode and 150-160 ampere current, short arc and proper weaving of the electrode. Avoid excessive weaving and ensure normal travel speed.
- Fill the crater wherever necessary.
- De-slag.
- Deposit the third run/covering run using the same parameter and technique used for 2nd run. Ensure a proper reinforcement of 1 to 1.5mm and avoid undercut.
- Inspect for any surface weld defect.

TASK 2 : Fillet weld in open corner joint in flat position by arc welding

- Prepare job plates to size as per drawing.
- Clean the joining edges and surfaces of plates.
- Set the plates as an open corner joint with a root gap of 2.5 mm using an angle iron jig.
- Select correct polarity, if a DC generator is used.
- Tack the joint pieces at both ends using \varnothing 3.15 mm medium coated MS electrode and 100-110 amps current from inside of the joint.
- Ensure safety apparels are worn. Use a proper method to control distortion.
- Clean the tacks, check alignment and reset the joint, if required.
- Set the joint on the welding table in a flat position.
- Deposit root run in the joint by forming a keyhole and obtain complete penetration.
- De-slag and clean the root run and inspect root penetration.
- Grind and dress the face of the root run, if required.
- Set the welding current 160 amps for \varnothing 4mm medium coated M.S. electrode.
- Deposit an intermediate layer i.e. second run over the root run with slight weaving motion using \varnothing 4mm electrode.
- Clean the intermediate layer thoroughly and inspect for faults. Rectify the defects, if any.
- Deposit the final layer to the weld size using the same current setting, electrode and weaving motion as used for the second layer.
- Clean the final layer for inspection.
- Inspect the corner fillet weld:
 - to ensure uniform and correct reinforcement
 - to ensure that the weld face is free from porosity, slag inclusion, unfilled crater, overlap and edge of plate melted off/insufficient throat thickness.

Ensure the crown of penetration is not more than 1.6 mm in height.

Skill Sequence

Single 'Vee' butt joint in flat position by arc (TASK 1)

Objectives: This shall help you to

- single 'vee' butt joint in flat position by welding
- prepare the plate edges for single vee butt joint
- set the plates with a root gap of 2mm and proper distortion allowance for single 'vee' butt joint
- deposit root bead in intermediate and final covering runs in single 'vee' butt joint
- clean and inspect the weld for surface defects.

Preparation of the pieces (Fig 1)

Cut a 30° bevel on each pieces using oxy-acetylene cutting.

Grind the edges to remove oxide deposits on the bevel.

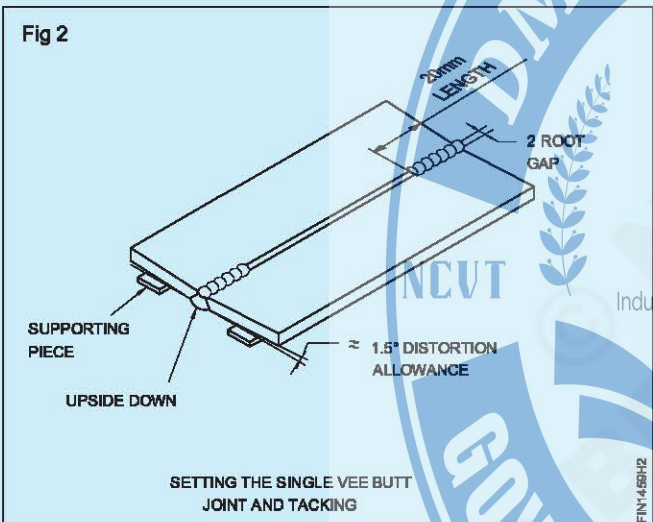
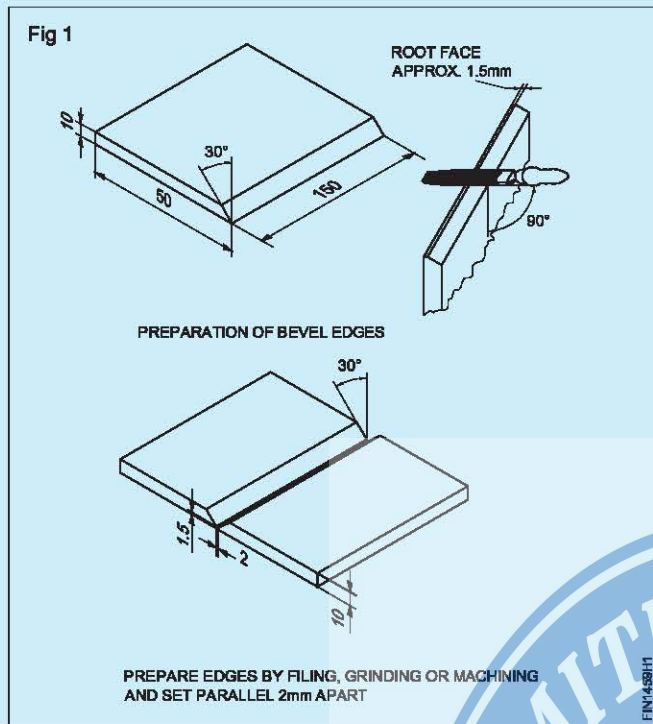
Prepare a uniform root faces of 1.5mm by filling on both the bevelled edges.

Setting the single Vee butt joint and tacking

Keep the bevel edges upside down with a root gap of 2mm, and 3° distortion allowance. (Fig 2) using suitable support i.e. 1.5° on each side of the joint.

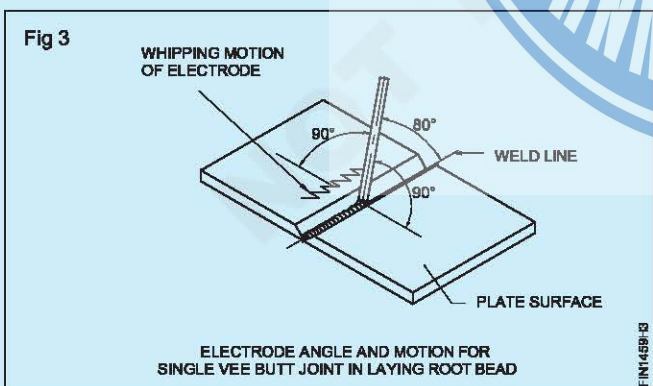
Tack-well on both ends. (20mm long)

Ensure safety apparels are worn.



Place the joint in flat position after tacking.

Deposition of root bead (Fig 3)



Deposit root bead using a $\varnothing 3.15$ M.S. electrode and 110 amps welding current.

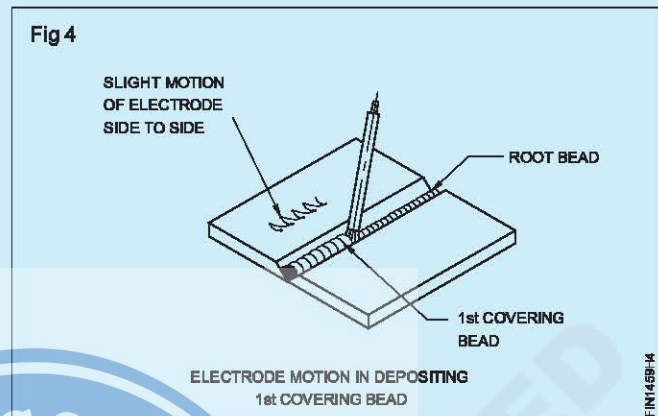
Proceed with a uniform normal speed holding a short arc.

Keep the electrode angle (as shown in Fig 3) at 80° to the line of weld.

Give a whipping motion to the electrode to maintain the size of the KEYHOLE for correct penetration.

Clean the root bead, and observe penetration.

Deposition of hot pass & capping beads (Fig 4)



Deposit the 1st covering bead using a 4.00mm dia medium coated M.S. electrode and 160 amps welding current.

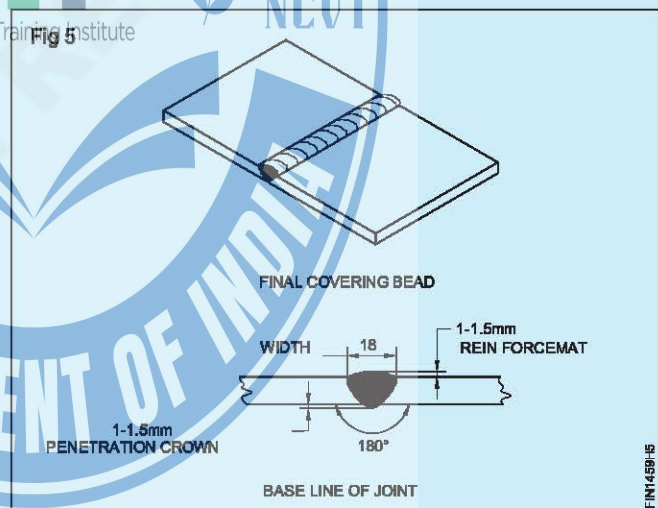
Proceed with a uniform speed, holding a normal short arc and a side-to-side weaving motion to the electrode.

Ensure the electrode angle is the same as it was for the root bead.

Clean the bead thoroughly and grind the humps in beads (if present).

Rectify possible defects, if any.

Deposition of final/caping bead (Fig 5)



Deposit the final covering bead using a $\varnothing 5.0$ mm M.S. electrode, 220amps welding current, and imparting a wider side-to-side weaving motion to the electrodes. Pause (stop) the electrode weaving at the toes of the weld so that undercut defect will get eliminated.

Cleaning and inspection

Clean the welded joint thoroughly from both sides.

Inspect the weld size, surface defects, root penetration and distortion.

Gas cutting of MS plates

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

- mark cutting lines on the plate by keeping proper cutting allowance
- set the job for straight, bevel, circle and profile cutting
- select the cutting nozzle number and the cutting oxygen pressure for different plate thickness
- adjust the preheating flame and preheat the metals
- cut straight line bevel, circle and profile by hand and machine
- clean the gas cut edges and inspect for defects.

1	100 ISF 10 - 150		Fe310 - W		TASK 2	-
1	150 ISF 10 - 200		Fe 310 - W		TASK 1	1.4.60
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	OXY-ACETYLENE HAND CUTTING STRAIGHT ,BEVEL CUT,CIRCLE AND PROFILE				TOLERANCE ±0.5mm	TIME :
					CODE NO : F120N1460E1	

Job Sequence

TASK 1 : Oxy - acetylene hand cutting straight and bevel cut

- Wear all safety clothing.
 - Set the gas welding plant with a cutting blowpipe, and cutting oxygen regulator.
 - Fit the correct cutting nozzle according to the thickness of the metal to be cut (for M.S. plate 10mm thickness use 1.2mm dia. orifice cutting nozzle)
 - Adjust both oxygen and acetylene gas pressure according to the cutting nozzle size. (Oxygen 1.6 kgf/sq.cm and acetylene 0.15 kgf/sq.cm)
- While adjusting the pressure keep the cutting blow pipe walls open**

- Check the size of the raw material
- Mark and file to size 200x150x10
- Clean the plate from dirt, oil, grease paint, water etc.
- Mark gas cutting lines as per drawing.
- Punch witness marks on cutting lines
- Set the job on cutting table.
- Set the neutral flame.
- Wear the gas welding goggles.
- Hold the blowpipe at an angle of 90° between the line of cut and the cutting nozzle axis is between the nozzle and the surface of the plate.
- Heat one end of the punched line up to cherry red hot condition.
- Keep the distance between the workpiece and the tip of the nozzle about 5mm.
- Place the preheat cone approximate 1.6mm above the plate.
- Move the flame in circle a little larger than the tip size. When metal is heated to Cherry red, move the tip to the edge of the plate.

- Operate the cutting oxygen lever immediately and move the torch slowly along cutting direction.
- Maintain correct torch speed and distance between the plate surface and the nozzle up to the end of the cut.
- If long plates are to be cut, to get a good straight gas cut surface, clamp a straight edged flat parallel to the line of cut and use a spade guide attached to the cutting torch. Move the torch uniformly along the clamped flat and pressing the spade guide against the flat.
- On completion of the cut release the cutting oxygen lever and shut off the flame.
- Clean the cut surface by wire brush after chipping off any slag sticking to the cut edge.

Making bevel cuts

- The best method for obtaining a good bevel with a minimum slag is to cut and bevel at the same time.
- Mark and punch straight lines 25mm apart.
- For cutting a bevel keep one or two flats on the plates to be bevelled and angle the cutting nozzle by resting the nozzle over the flats.
- Hold the torch in left hand, light it, tilt it to $30-35^\circ$ of the perpendicular.
- Preheat and start the cut holding the torch on both hands as done in straight line-cutting. Avoid kerf filling by increasing travel speed.
- On reaching the end, cutting should continue for another 6mm or more to get a complete cut.
- Shut off the torch at the end and dip it in water and chip off the slag.
- Repeat the exercise till a good and smooth cut is achieved.
- To bevel the edge of a long plate with a clean and good gas cut surface, use a bevelling attachment to the torch and tilt the nozzle of the torch to the required angle of bevel.

TASK 2 : Oxy - acetylene machine cutting

- Check the size of the raw material.
- Mark and file to size
- Mark the gas cutting lines a straight bevel, circle and profile as per drawing.
- Punch witness marks on the gas cutting marked line.
- Set the cutting machine and connect the oxygen and acetylene cylinders, regulators to the hoses of the machine and fix a suitable cutting nozzle.
- Fit the circular and profile template on the cutting machine table.
- Clean the surface of the metal plate to be cut.
- Select and fix the nozzle as per the thickness of the plate to be cut.
- Clean the track on which the cutting torch assembly unit is mounted and the circular and profile templates and make sure that there is no dirt on them.
- Check the starting lever and ensure that it is in neutral position.
- Set the required pressure of oxygen and acetylene according to the size of the nozzle.

- Set the required speed in the speed control dial according to the thickness of the metal to be cut.
- Adjust the nozzle to a height such that the inner cone of the preheating flame is 3 mm from the surface of the metal to be cut.
- Place the cutting machine at the starting point.
- Ignite and set the neutral flame.
- Allow for sufficient preheating, and then switch 'on' the jet of oxygen.
- Simultaneously switch 'on' the machine to move the cutting unit forward with the correct speed on the rails to make a straight line cut.
- Stop the machine and turn the switch to neutral position at the end of the cut.
- Set the cutting nozzle to 30° angle and cut the bevel similar to the straight line cut.
- Turn the job plate by 180° and cut the 60° bevel angle by setting the cutting nozzle to 60°.
- Arrest the linear movement of the cutting unit of the machine with the rails using a clamp and attach it to the pivot block used for cutting circle and profiles.
- Set the pivot block to get the required diameter and fix it on the machine table.
- Set the cutting nozzle perpendicular to the job plate and ignite it and set the preheating flame.
- When the plate becomes red hot, open the stream of cutting oxygen and cut the circle.
- For profile cutting, attach the template of the profile to the machine table and make the cutting head unit to follow the profile.
- After the cut is over stop all machine movements and remove the slag from all the gas cut surfaces.
- Use tongs while handling the gas cut job.
- Ensure that the molten slag during cutting, and solidified hot slag chipped after cutting, fall into a collecting trough kept below the table.
- Clean the cutting edges from slag and inspect the cut for gas cutting defects.

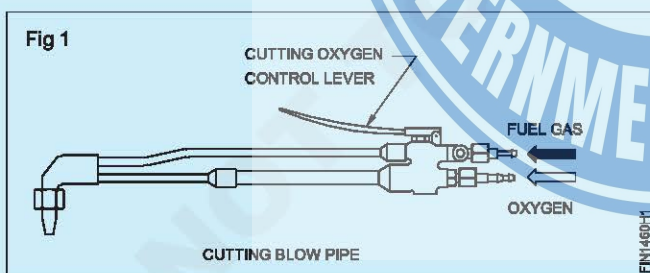
Skill Sequence

Oxy-acetylene hand cutting straight and bevel cut

Objectives: This shall help you to

- set the gas cutting plant
- set the job for cutting
- adjust the cutting flame for gas cutting.

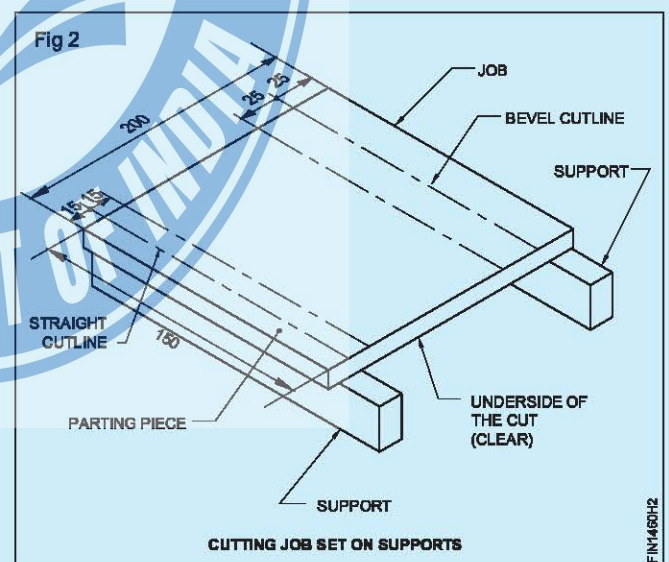
Setting the gas cutting plant: Set the oxy-acetylene gas cutting plant in the same way as was done for welding and connect the cutting blowpipe in the place of the welding blowpipe. (Fig 1) Also change the oxygen welding regulator with oxygen cutting regulator.



Setting the job for straight line cutting (Fig 2): Mark and punch 7 straight lines on the plate 15 mm apart for a straight line cut and 3 lines 25 mm apart for bevel cutting on other edge.

Set the job on the cutting table so that the parting piece is free to fall.

Ensure that the underside of the cutting line is clear and no combustible materials are lying nearby.



Adjusting cutting flame: Select the cutting nozzle and set the gas pressure as per the cutting job thickness. (Table 1)

The bevel thickness will be more for bevel cut, when compared with a square cut for same thickness.

TABLE 1
Data for cutting

Diameter of cutting oxygen orifice nozzle	Thickness of steel plate	Cutting oxygen pressure
(1) mm	(2) mm	(3) kgf/cm ²
0.8	3.6	1.0 - 1.4
1.2	6.19	1.4 - 2.1
1.6	19 - 100	2.1 - 4.2
2.0	100 - 150	4.2 - 4.6
2.4	150 - 200	4.6 - 4.9
2.8	200 - 250	4.9 - 5.5
3.2	250 - 300	5.5 - 5.6

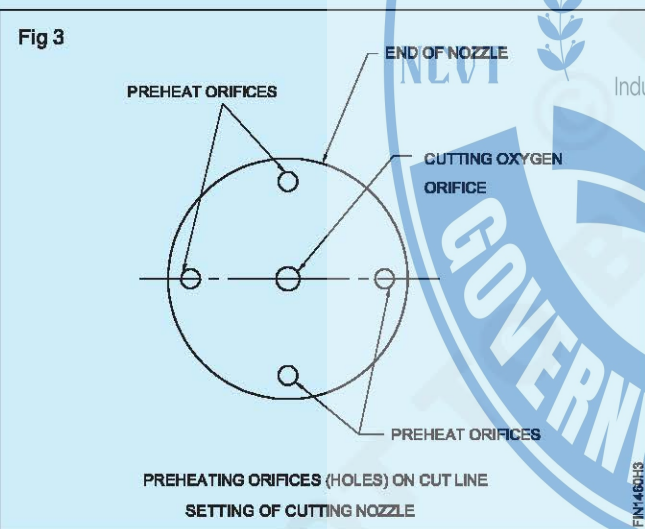
Acetylene pressure should be 0.15 kgf/cm² for all thickness of plates.

Select ϕ 1.2 mm (orifice) cutting nozzle for cutting a 10 mm thick plate.

Set 1.6 kgf/sq.cm pressure for the cutting oxygen and 0.15 kgf/sq.cm pressure for the acetylene gas.

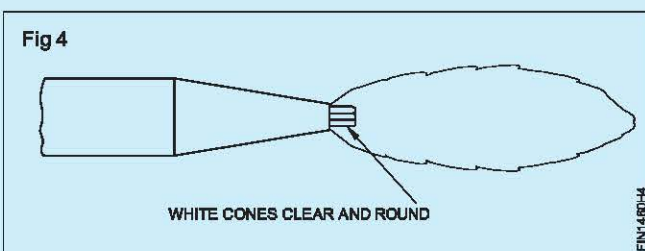
Ensure safety apparel is worn.

Fix the cutting nozzle into the cutting blowpipe correctly. (Fig 3)



Check for leakage in the blowpipe connections of oxygen and acetylene gas lines.

Adjust the neutral flame for preheating. (Fig 4)

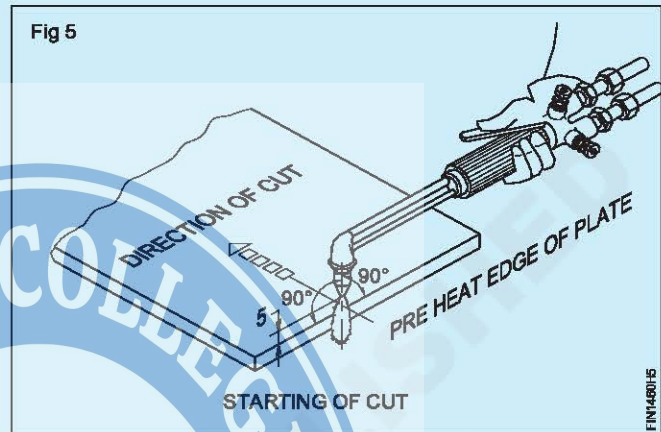


Ensure that the flame adjustment is not disturbed while operating the cutting oxygen lever.

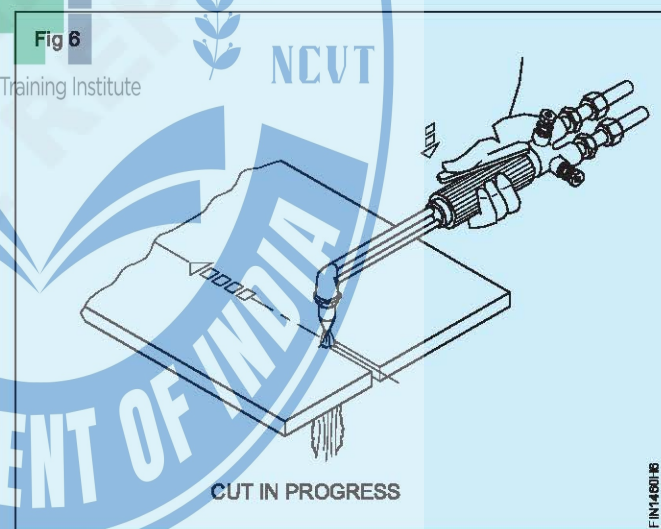
Straight line cutting: Keep the hand cutting blowpipe at 90° angle with the plate surface and start cutting a straight line. (Fig 5)

Preheat the starting point to red heat before pressing the cutting oxygen lever. (Fig 5)

Keep the distance between the workpiece and the nozzle about 5 mm to avoid backfire. (Fig 5)



Release the cutting oxygen by pressing the cutting oxygen control lever and start the cutting action and move the blowpipe along the punched line with uniform speed. (Fig 6)



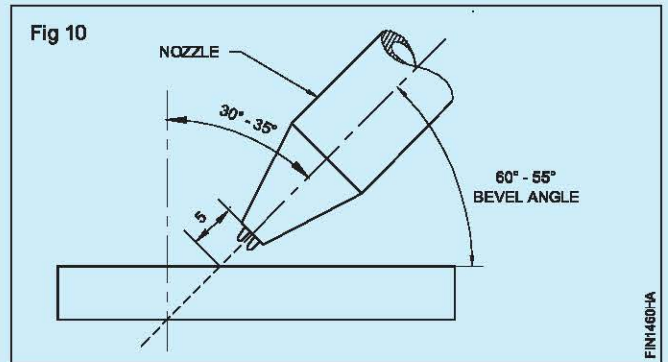
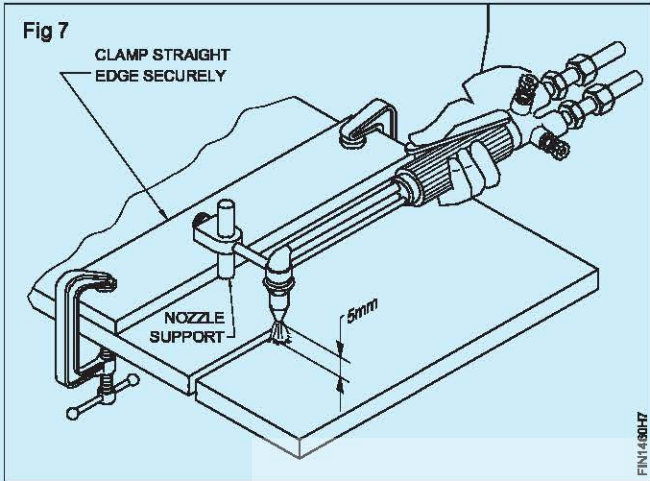
Ensure straight travel without any side-to-side movement. The nozzle angle is 90° with the plate surface till the completion of cut.

Open the cutting oxygen valve fully.

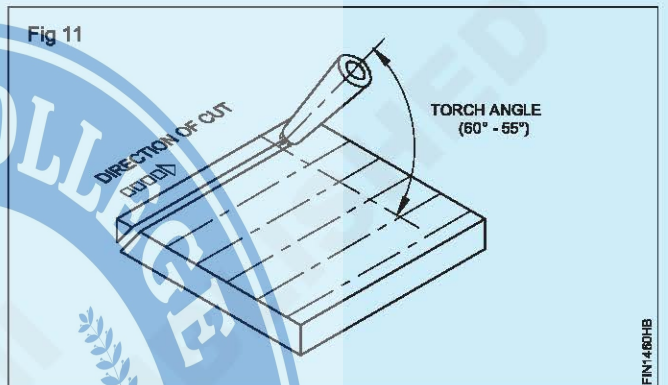
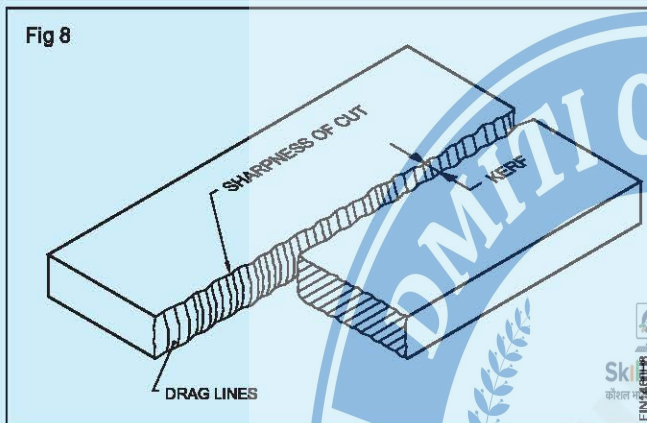
If possible fix a straight edge or template to the plate and fix a support to the cutting nozzle so as to ensure constant distance between the tip of the nozzle and the plate surface and maintain a uniform straight cut. (Fig 7)

Inspect the cutting for

- uniform and smooth cut or drag line
- straightness, sharpness.
- width of the cut (Kerf) Fig 8



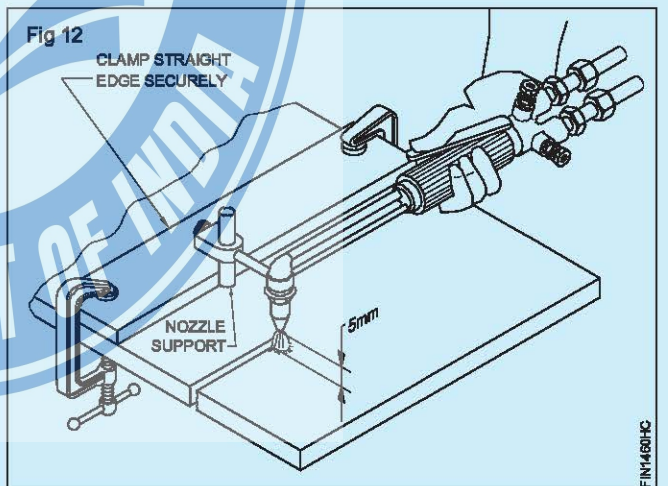
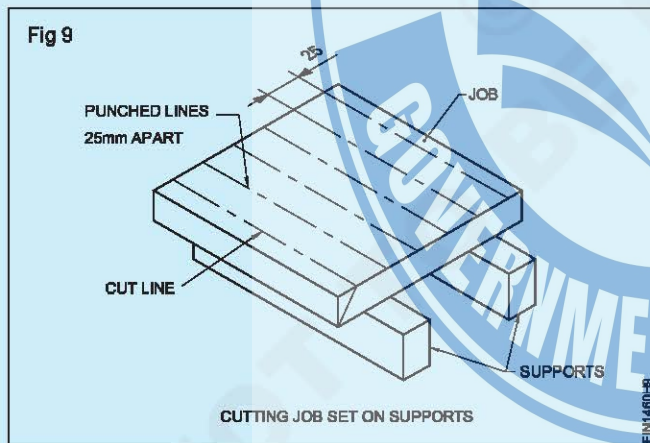
Release extra oxygen by pressing the cutting oxygen lever, observe the cutting action and start moving along the punched line with uniform speed. (Fig 11)



Keep less cutting speed than you would use for a straight cut for the same thickness.

Bevel cutting: Set the job as shown in Fig 9. Hold the cutting blowpipe (nozzle) at (required) 60 - 55° angle so that the bevel angle on the plate will be 30 - 35°. (Fig 10)

Fix one or more straight bar to the cutting job to ensure the cut is along the straight line and also able to maintain the correct angle. (Fig 12)



There should not be any obstruction at the underside of the cutline and the parting piece from the job should be free to fall.

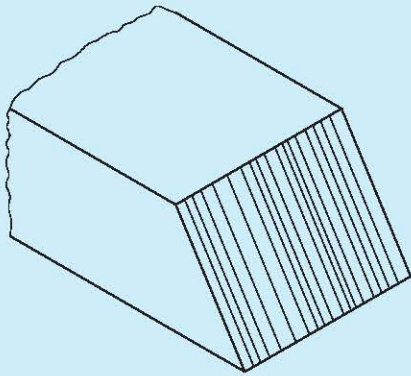
Preheat the starting point to cherry red colour.

Keep the distance between the workpiece and the nozzle about 5mm to avoid backfire. (Fig 10)

Inspection of bevel cut: Clean the slag if sticking to the cut surface by a chipping hammer and wire brush and inspect for any gas cutting defects.

GOOD QUALITY is shown by excellent top edge and extremely smooth cut face. The cut part is dimensionally accurate. (Fig 13)

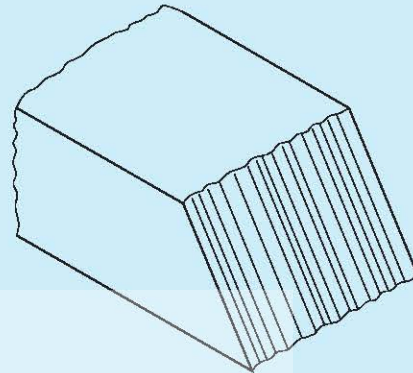
Fig 13



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POOR QUALITY results in gouging which is a most common fault. This is caused either by excess speed or too low a preheat flame. (Fig 14)

Fig 14



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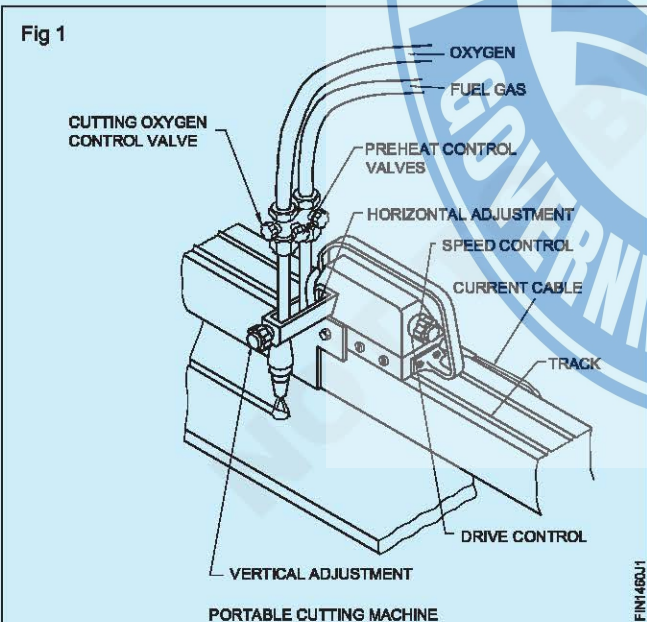
Oxy-acetylene machine cutting (straight, bevel, circle and profile) (TASK 2)

Objectives: This shall help you to

- assembly of the portable cutting machine
- set the gas pressure to the size of nozzle
- cut the profiles by portable cutting machine.

The assembly of the machine, the use of templates or systems of reproduction, the position of the work, the speed range and cutting nozzles vary according to the type of the machines.

Assemble the accessories like cutting head for straight and bevel cutting with the cutting machine. (Fig.1)



FIN14601

Select the 1.2mm size of the cutting nozzle for 10mm thick plate.

Set the correct gas pressure of 0.15kgf/cm² for acetylene and 1.4 to 2 kgf/cm² for oxygen for 1.2mm size nozzle.

Set the machine to run freely as per the regulated speed i.e 50cm/min for 10mm thick plate.

Ignite the flame and adjust the neutral flame.

Set the nozzle tip to a correct distance from the surface of the plate to be cut i.e. about 7 to 8mm.

Start the machine and run to the required distance to cut the metal.

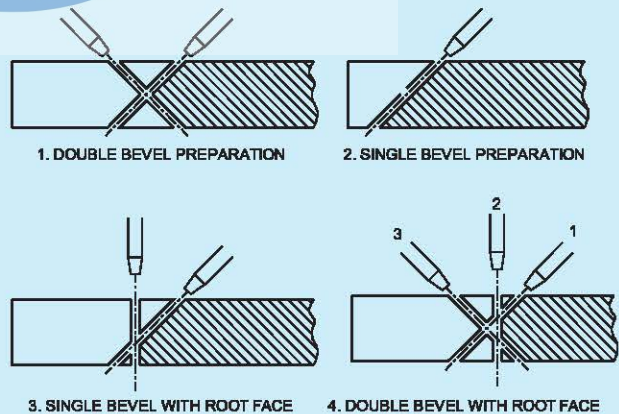
Switch 'off' the machine and extinguish the flame at the end of the cut.

Remove the plate, clean the iron oxide slag and inspect the cut surface.

For cutting a bevel edge tilt the cutting torch nozzle to the required angle and follow the same skill sequence followed for straight line cutting. (Fig.2)

Fig 2

PLATE EDGE PREPARATIONS PRODUCED BY ARRANGEMENT OF CUTTING HEADS SHOWN



FIN14601J

Start the machine and run to the required distance to cut the metal.

Switch 'off' the machine and extinguish the flame at the end of the cut.

Remove the plate, clean the iron oxide slag and inspect the cut surface.

For cutting a bevel edge tilt the cutting torch nozzle to the required angle and follow the same skill sequence followed for straight line cutting. Fig 2.

For cutting a circle, attach cutting torch nozzle to the pivot block (Fig.3) and follow the same method used to cut straight line and bevel. It is important to pierce a small hole inside the circumference of the circle to be cut and then move the torch to the nearest point on the circumference. Then use the pivot block to move the flame along the circumference of the circle.

To cut a profile the same sequence used for circle cutting is followed except that a template similar to the profile to be cut is mounted on the table and a tracer attached to the cutting head will follow the template profile. The torch flame will cut the profile on the job.

