Edge preparations and GTAW parameters for different type of metals

Objective: At the end of this lesson you shall be able to
- **state the welding method of MS pipe using TIG welding process.**

GTAW/TIG welding is generally recommended for pipe to pipe or tube to tube joints. TIG welding with inert gas shielding produces the joints without any defect like gas porosity, oxide slag inclusions and hence the joints are of superior quality.

For MS/Carbon steel pipes and tubes, when welding is done with TIG process, the weld metal is free from hydrogen entrapment which usually occurs in normal oxy acetylene gas welding or manual metal arc welding processes. The hydrogen gas dissolved in the weld causes embrittlement during service. Hence TIG welding for MS pipes is always preferred for all pipe lines viz., gas pipe lines/liquid lines in all petroleum and power plant to convey high temperature and high pressure fluids (liquids & gases,steam etc.).

There are various pipe jointings like straight butt welds, fillet tee joints and pipe elbow joints to suit the piping layout of any process plant say petroleum or power generating plant.

Therefore it is mandatory to take utmost care in development of members of pipe joints so that the geometry will provide appropriate clearances for the joint fit up and the TIG welds so produced will be free from any defect and will offer highest joint efficiency as per the design standards.

Various configuration of the joints are well shown in practical Exercise book.

Low alloy steel (DCSP)

Metal Gauge	Joint Type	Tungsten size	Filler Rod Size	Cup Size	Shield Gas Flow			Welding Amperes	Travel Speed
					Type	CFH (L/Min)	PSI		
1.6 mm	Butt Fillet	1.6 mm	1.6 mm	4, 5, 6	Argon	15 (7)	20	95-135	400 mm
3.2 mm	Butt Fillet	1.6 mm 2.4 mm	2.4 mm	4, 5, 6	Argon	15 (7)	20	145-205	300 mm
4.8 mm	Butt Fillet	2.4 mm	3.2 mm	7, 8	Argon	16 (6.5)	20	210-260	250 mm
6.4 mm	Butt Fillet(2)	3.2 mm	4.0 mm	8, 10	Argon	18 (8.5)	20	240-300	250 mm

Welding low alloy steel

Mild and low carbon steels with less than 0.30% carbon and less than 25 mm thick, generally do not require preheat. Low alloy steels such as the chromium-molybdenum steels will have hard heat affected zones after welding, if the preheat temperature is too low. This is caused by rapid cooling of the base material and the formation of martensitic grain structures. A 90^0 to 200^0C preheat temperature will slow the cooling rate and prevent the martensitic structure.

Typical manual GTA (TIG) welding parameters

Aluminium (ACHF)

Metal Thickness	Joint Type	Tungsten size	Filler Rod Size	Cup Size	Shield Gas Flow			Welding Amperes	Travel Speed mm/min
					Type	CFH (L/Min)	PSI		
1.6 mm	Butt Fillet	1.6 mm	1.6 mm	4, 5, 6	Argon	15 (7)	20	60-80 70-90	300 250
3.2 mm	Butt Fillet	2.4 mm	2.4 mm 3.2 mm	6, 8	Argon	17 (8)	20	125-145 140-160	300 250
4.8 mm	Butt Fillet	3.2 mm	3.2 mm	6, 8	Argon/ Helium	21 (10)	20	190-220 210-240	250 230
6.4 mm	Butt Fillet	4.8 mm	3.2 mm	8, 10	Argon/ Helium	25 (12)	20	260-300 280-320	250 200

CFH - Cubic Feet per hour ACHF - Alternative current with high frequency L/Min - Litre per minute

Welding aluminium

The use of TIG welding for aluminium has many advantages for both manual and automatic processes. Filler metal can be either wire or rod and should be compatible with the base alloy.

Filler metal must be dry, free of oxides, grease, or other foreign matter.

Magnesium (ACHF)

Metal Gauge	Joint Type	Tungsten size	Filler Rod Size	Cup Size	Shield Gas Flow			Welding Amperes	Travel Speed mm/min
					Type	CFH (L/Min)	PSI		
1.6 mm	Butt Fillet	1.6 mm	2.4 mm 3.2 mm	5, 6	Argon	13 (5)	15	60 60	500
3.2 mm	Butt Fillet	2.4 mm	3.2 mm 4.0 mm	7, 8	Argon	19 (9)	15	115 115	450
6.4 mm	Butt Butt(2)	4.8mm	4.0 mm	8	Argon	25 (12)	15	100-130 110-135	550 500
12.8 mm	Butt(2)	6.4 mm	4.8 mm	10	Argon	35 (17)	15	260	250

Welding magnesium

Magnesium alloys are in three groups, they are (1) aluminium-zinc-magnesium, (2) aluminium-magnesium, and (3) maganese-magnesium. Since magnesium absorbs a number of harmful ingredients and oxidize rapidly when subjected to welding heat, TIG welding in an inert gas atmosphere is distinctly advantageous, the welding of magnesium is similar, in many respects, to the welding of aluminium. Magnesium was one of the first metals to be welded commercially by TIG. Magnesium requires a positive pressure of argon as a backup on the root side of the weld.

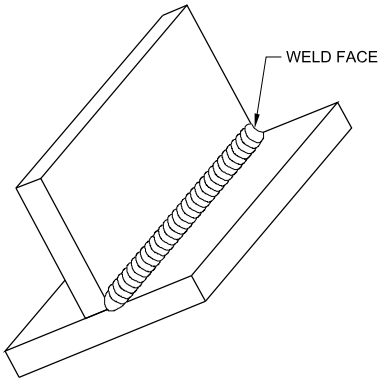
Types of welding joints

There are five basic joint designs mentioned below.

1 Butt joint
2 Lap joint
3 corner joint
4 T joint (Fillet joint)
5 Edge joint

The Fig. 1 below shows, filler T joint welded in flat position, When the weld axis and weld face are horizontal.

Fig 1



T - JOINT WELDED IN FLAT POSITION

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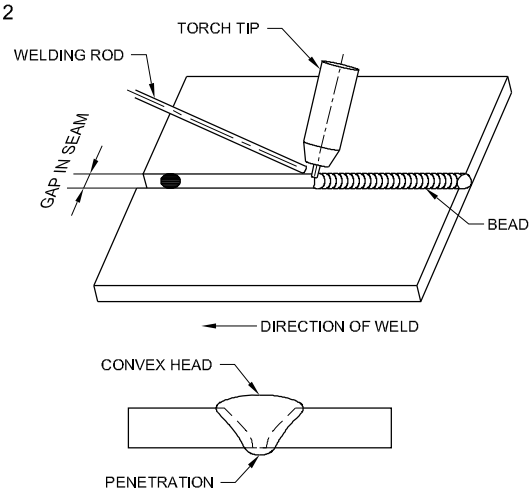
Square butt joint on aluminium: The Fig. 2 shows the recommended torch and welding filler rod positions for welding a butt joint in flat position.

Fig 2

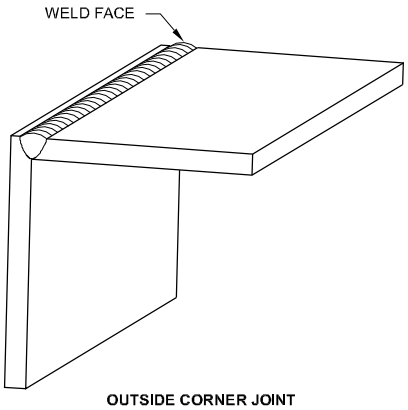


RECOMMENDED TORCH AND WELDING POSITIONS FOR WELDING A BUTT JOINT IN THE FLAT POSITION

WLN2392112

Outside corner joint on aluminium: Fig.3 on the next page shows a typical corner joint welded from outside.

Fig 3



OUTSIDE CORNER JOINT

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Fig.4 shows the setup for fillet tee joint on stainless steel sheets, welded by (TIG) GTAW process. Satisfactory weld, should be free from undercut at the toes and of equal leg lengths.

Fig 4

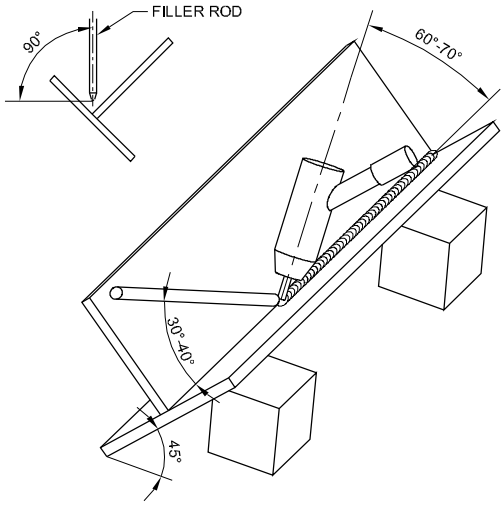

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Fig. 5 shows the corner joint welded by TIG process. It also gives the set up for making the outside corner joint in flate position.

Fig 5

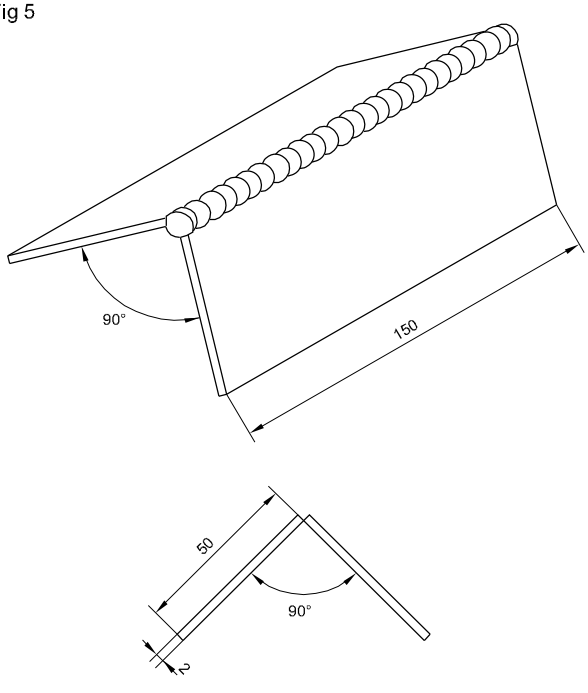

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Fig. 6a,b& c elaborates the recommended steps by GTAW process using filler rod.

In this method, the two pieces of metal do not overlap. While welding the outside corner joint, watch the outside edges of the metal. When the puddle touches the outside edges of the metal, the welding rod should be placed in the puddle. Enough filler metal should be melted into the puddle to form a convexed bead. The torch is moved forward and the welding rod is again placed in the puddle when the puddle touches the outside edges of the joint. This operation is repeated until the joint is completely welded. The keyhole welding technique may be used on this joint. Fig.7 shows a macrograph of a completed outside corner joint made with proper and improper assembly of a corner joint.

Fig 6

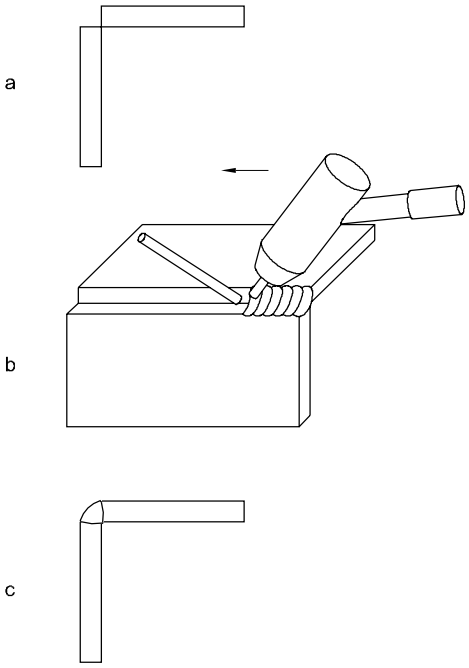

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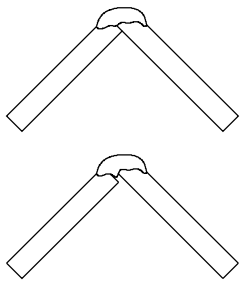
Fig 7



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Welding stainless steel

In TIG welding of stainless steel, welding rods having the AWS-ASTM prefixes of E or ER can be used as filler rods. However, only bare uncoated rods should be used. Stainless steel can be welded using ACHF, however, recommendations for DCSP must be increased 25%. Light gauge metals less than 1.6 mm thick should always be welded with DCSP using argon gas. Follow the normal precautions for welding stainless such as: Clean surfaces; dry electrodes; use only stainless steel tools and brushes, carefully remove soap from welds after pressure testing; keep stainless from coming in contact with other metals.

Stainless steel (DCSP) Welding parameters

Metal Gauge	Joint Type	Tungsten size	Filler Rod Size	Cup Size	Shield Gas Flow			Welding Amperes	Travel Speed mm/min
					Type	CFH (L/Min)	PSI		
1.6 mm	Butt Fillet	1.6 mm	1.6 mm	4, 5, 6	Argon	11 (5.5)	20	80-100 90-100	300 250
3.2 mm	Butt Fillet	1.6 mm	2.4 mm	4, 5, 6	Argon	11 (5.5)	20	120-140 130-150	300 250
4.8 mm	Butt Fillet	2.4 mm 2.4 mm 3.2 mm	3.2 mm	5, 6, 7	Argon	13 (6)	20	200-250 225-275	300 250
6.4 mm	Butt Fillet	3.2 mm	4.8 mm	8, 10	Argon	13 (6)	20	275-350 300-375	250 200

Pulsed TIG welding and description of pulse parameters

In this type of power source, the supply current is not constant and it is being fluctuated from low level to high level. This causes low heat input to the metal and hence distortion effect will be less.

Pulsed TIG has the advantages of

1 better penetration with less heat

2 less distortion

3 better control when welding out of position

4 Easy to use on thin materials

The down side is - more set-up cost and more operator training.

Pulsed TIG consists of

Peak current - This is set up higher than for non-pulsed TIG.

Background current - This is set lower than peak current and is the bottom current the pulse will drop to, but must be enough to keep the arc alive.

Pulses per second - This is the number of times per second that weld current reaches peak current.

% on time - This is the pulse peak duration as a percentage of the total time, which controls how long the peak current is on for before dropping to the background current.

The pulse and base current periods are also controllable.

When welding is done with pulsing welding mode the weld is in principle a row of spot welds overlapping to a lerger or smaller extent depending on the welding speed. (Fig.8)

Many double-current machines are equipped with a control function which makes it possible to modify the curve of the alternating current in balance between thew positive and the negative semi-periods.

Fig 8