# MUREX

# TIG Tungsten Inert Gas Welding

## Features

**Applied mainly on thin sections -**
- The low heat input and slow deposition rates of the basic TIG process generally restrict its suitability to materials less than 6mm thick.

**Clean high quality welds**
- The TIG process uses an inert atmosphere with-out flux. This reduces the possibility of weld defects.

**Access and manoeuvreability**
- TIG torches are compact and can be used where access is difficult. Slow travel speeds assist in welding complex joint profiles (e.g. tube-to-tube welds).

**Good control of filler addition**
- Since the filler rod can be added, independently, the amount of filler can be carefully controlled to bridge a gap or to produce a good weld shape.

**Low current operation**
- Low currents (down to 5 amps) can be used to weld very thin materials (foils etc).

**Usable for a wide range of metals**
- Even chemically reactive metals such as titanium, can be successfully welded with TIG.

**No flux required**
- Especially beneficial on aluminium and magnesium (where corrosive flux residue is formed if gas welding or brazing is used).

**Automation**
- The process is readily 'automated' and is one of the first processes to use 'close loop control'. This type of control ensures that variations in joint conditions are kept within close tolerances.

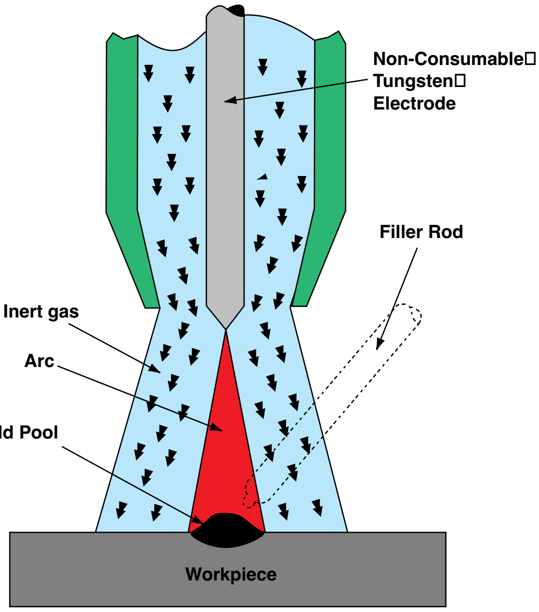
**Simple process - Flexible application**
- Although the basic process is simple it is suitable for uncomplicated, high production welds and high precision complex fabrications.

**Take full advantage of the TIG process by:**

1. Choosing the correct equipment gas, electrode and filler material.
2. Ensuring adequate joint preparation and cleanliness.
3. Providing adequate process training.
4. Providing adequate equipment service and maintenance procedures (Murex service centres are available for advice and assistance).
5. Provision of an adequate working environment (e.g. fume extraction, Safety equipment).

## Typical Applications

- Aluminium fabrications
- Window frames
- Truck bodies
- Road Tanker shells
- Boat hulls
- Aircraft engine and airframe fabrication
- Stainless steel fabrications
- Food processing plant
- Chemical tanks and storage vessels
- Nuclear power plant fabrication




**WARNING: Adequate safety precautions must be taken to offset the effect of heat, glare and fumes SEE 'ACCESSORIES'**

## Process Description

In the TIG process the heat generated by an arc, formed between the end of a tungsten (non-consumable) electrode and the workpiece, is used to fuse the joint area.

The joint may be formed by either melting the butting edges together without adding filler rod (autogenous weld), or by feeding the filler rod into the molten pool.

The inert gas, which shrouds the weld, prevents oxidisation of the weld, assists in cleaning and determines the heating characteristics of the arc.

## Equipment

The equipment required for TIG welding comprises a power source, welding torch gas supply and various accessories. The power sources normally have constant current or 'drooping' characteristics. This ensures minimum variation of welding current with changes in arc length.

To avoid touching the electrode down on the workpiece and to assist in arc striking, a high frequency (HF) source is connected between electrode and workpiece. This high frequency is switched off once the arc is established.

The torches used can be air or water-cooled. Gas lenses are available to stabilise the gas flow and improve its shielding efficiency.

## Filler Rods and Electrodes

Filler rods are available in cut lengths usually in diameters from 1.6mm to 3.2mm.

The composition of the filler rod used is generally chosen to suit the parent plate, although alloying additions are sometimes used to control the weld properties (e.g.) Ti, Si or Al to deoxidise carbon steel, or additions to correct the ratio of Mg, Si or Cu to prevent hot cracking in aluminium.

Thoriated tungsten electrodes are used for d.c. welding whilst zirconiated electrodes are used for a.c. welding. Ceriated tungstens may be used for both a.c. and d.c. welding.

## Shielding Gases

Argon gas is easily ionised whilst helium gives a greater heat input to the weld.

Argon/hydrogen mixtures are used to increase heat input and chemically reduce metal oxides, producing cleaner welds. These mixtures however are unsuitable for hydrogen sensitive materials such as low alloy steels or undeoxidised copper.

1 to 5% hydrogen gives very good results on austenitic (18/8) stainless steel or cupro-nickel alloys.

Argon/helium mixtures may be used on aluminium and its alloys (Hydrogen causes gross porosity in these metals).

## Accessories

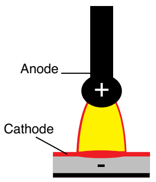
To provide a safe and comfortable working environment whilst TIG welding and to make the welding jobs easier, a wide range of Accessories are available:

- Helmets & Lenses
- Clothing & Gloves
- Wire brushes
- Work return clamps
- Respiratory protection
- Safety spectacles, Goggles & Lenses
- Tungsten Grinders
- Cables, connectors and Lugs
- General Eye & Face
- Welding screens and curtains
- Metal markers
- Chipping hammers
- Chemical Sundries

## Modes of Operation

Electrode +VE | Electrode -VE | A.C. | Pulsing

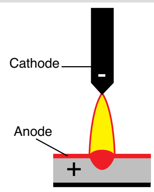
### Electrode positive




The heat input to the electrode is high, therefore larger diameter electrodes are required. The heat input to the work is relatively low, giving shallow penetration of the workpiece, making the process impractical for almost all applications.

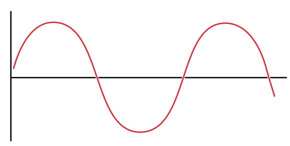
Cathodic (workpiece) cleaning takes place, which makes it possible to use the process for aluminium although a.c. is normally used for aluminium and its alloys.

### Electrode negative



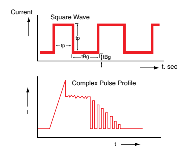

In this mode the electrode remains relatively cool and the heat input to the workpiece is high. This makes the process ideal for most applications, typically in the welding of mild steel, stainless steel, copper, nickel, alloy steels, nickel alloys and titanium.

### A.C.



During the a.c. cycle the electrode changes between positive and negative producing the combined effect of clean workpiece (electrode positive) and good heat input (negative electrode). This mode is normally used for aluminium and its alloys.

### Pulsed TIG




Pulsed TIG is normally used with d.c. electrode negative A low level 'background current' provides a pilot arc. Onto this background current pulses of high current are super-imposed, usually at a rate of 1-10 pulses per second.

The background current maintains the arc during pulse off conditions.

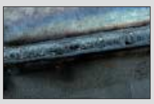
This mode of operation produces:

a. Reduced distortion.
b. Reduced heat build up.
c. Improved tolerance to joint fit up.
d. Improved ease of operation.

Applications are as for electrode negative or a.c. modes of operation.

**A good weld –** under the correct operating conditions, excellent weld quality, surface finish and absence from defects can be obtained with TIG.

Certain defects can be produced by poor welding procedure. The most common problems and their remedies are shown for reference



**Porosity –** Surface porosity can arise for a variety of reasons. The most common causes being insufficient gas flow, bore of ceramic nozzle too small, excess degreasing agent present on the weld material, too long an arc, incorrect torch or rod angle and poor quality materials. Gases which cause porosity are nitrogen or carbon monoxide in mild steel and hydrogen in aluminium.

**Undercut –** Undercutting of the 'sides' of the weld is caused almost totally by bad welding technique. Typical causes include incorrect rod handling, high current setting, and high welding speed.

**Lack of Penetration –** if the heat from the arc is too low, poor penetration will result. To remedy this fault check that the current setting is high enough and decrease the welding speed. Argon/hydrogen and argon/helium gas mixtures may also be used to increase heat input (see 'Shielding Gas').