



Operating Instructions

TIG 210/320/500 AC/DC

[www.r-techwelding.co.uk](http://www.r-techwelding.co.uk)



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# Contents

1.0	Recommended Safety Precautions	
1.1	Health Hazard Information	6
1.2	Personal Protection	6
1.3	Electric Shock	8
1.4	User Responsibility	8
2.0	Gas Tungsten Arc Welding (GTAW/TIG)	
2.1	Introduction	9
2.2	Process	9
2.3	Process Variables	9
2.4	Shielding Gas Selection	11
2.5	Consumable Selection	12
2.6	Welding Techniques	13
2.7	Torch Movement During Welding	8
2.8	Joint Preparation	17
3.0	TIG Welding of Materials	
3.1	Application Summary	21
3.2	C-Mn Steel	22
3.3	Alloyed Steel	23
3.4	Stainless Steel	24
3.5	Aluminium	25
3.6	Balanced Squarewave	25
3.7	Copper and Copper Alloys	26
4.0	Connection Your R-Tech AC/DC TIG210	
4.1	Power	28
4.2	Shielding Gas	28
4.3	TIG Torch Connection	28
4.4	MMA Operation	28
4.5	TIG Welding Operation	29
5.0	Technical Specifications	32
6.0	Warranty	
6.1	Terms of Warranty	33
6.2	Limitations on Warranty	33
6.3	Warranty Repairs	33

# 1.0 Recommended Safety Precautions

## 1.1 Health Hazard Information

The actual process of welding is one that can cause a variety of hazards. All appropriate safety equipment should be worn at all times, i.e. headwear, respiratory, hand and body protection. Electrical equipment should be used in accordance with the manufacturers recommendations.

### Eyes:

The process produces ultra violet rays that can injure and cause permanent damage. Fumes can cause irritation.

### Skin:

Arc rays are dangerous to uncovered skin.

### Inhalation:

Welding fumes and gases are dangerous to the health of the operator and to those in close proximity. The aggravation of pre-existing respiratory or allergic conditions may occur in some workers. Excessive exposure may cause conditions such as nausea, dizziness, dryness and irritation of eyes, nose and throat.

## 1.2 Personal Protection

### Respiratory

Confined space welding should be carried out with the aid of a fume respirator or air supplied respirator as per AS/NZS 1715 and AS/NZS 1716 Standards.

- You must always have enough ventilation in confined spaces. Be alert to this at all times.
- Keep your head out of the fumes rising from the arc.

- Fumes from the welding of some metals could have an adverse effect on your health. Don't breathe them in. If you are welding on material such as stainless steel, nickel, nickel alloys or galvanised steel, further precautions are necessary.
- Wear a respirator when natural or forced ventilation is not good enough.

### Eye protection

A welding helmet with the appropriate welding filter lens for the operation must be worn at all times in the work environment. The welding arc and the reflecting arc flash gives out ultraviolet and infrared rays. Protective welding screen and goggles should be provided for others working in the same area.

### Clothing

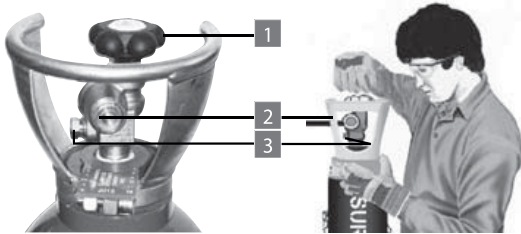
Suitable clothing must be worn to prevent excessive exposure to UV radiation and sparks. An adjustable helmet, flameproof loose fitting cotton clothing buttoned to the neck, protective leather gloves, spats, apron and steel capped safety boots are highly recommended. Recommended filter shades for arc welding

Less than 150 amps	Shade 10*
150 to 250 amps	Shade 11*
250 to 300 amps	Shade 12
300 to 350 amps	Shade 13
Over 350 amps	Shade 14

\*Use one shade darker for aluminium

## Cylinder Safety

1	Cylinder valve hand-wheel
2	Back-plug
3	Bursting disc



Backview of typical cylinder valve    Operator wearing personal protection equipment (PPE) in safe position

### Ten Points about Cylinder Safety

- 1 Read labels and Material Safety Data Sheet (MSDS) before use.
- 2 Store upright and use in well ventilated, secure areas away from pedestrian or vehicle thoroughfare.
- 3 Guard cylinders against being knocked violently or being allowed to fall.
- 4 Wear safety shoes, glasses and gloves when handling and connecting cylinders.
- 5 Always move cylinders securely with an appropriate trolley. Take care not to turn the valve on when moving a cylinder.
- 6 Keep in a cool, well ventilated area, away from heat sources, sources of ignition and combustible materials, especially flammable gases.
- 7 Keep full and empty cylinders separate.
- 8 Keep ammonia-based leak detection solutions, oil and grease away from cylinders and valves.
- 9 Never use force when opening or closing valves.
- 10 Don't repaint or disguise markings and damage. If damaged, return cylinders to your local supplier immediately.

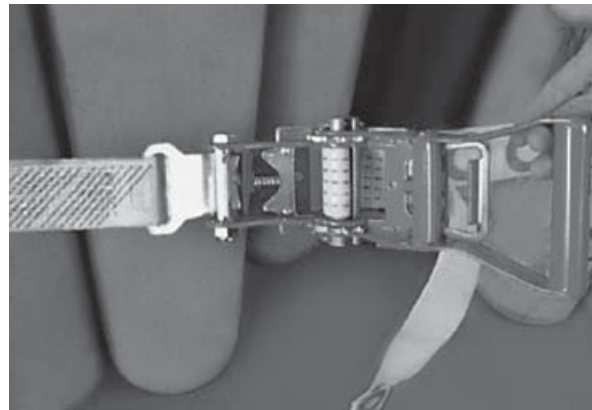
## Cylinder Valve Safety

When working with cylinders or operating cylinder valves, ensure that you wear appropriate protective clothing gloves, boots and safety glasses.

When moving cylinders, ensure that the valve is not accidentally opened in transit.

Before operating a cylinder valve:

- Ensure that the system you are connecting the cylinder into is suitable for the gas and pressure involved.
- Ensure that any accessories (such as hoses attached to the cylinder valve, or the system being connected to) are securely connected. A hose, for example, can potentially flail around dangerously if it is accidentally pressurised when not restrained at both ends.
- Stand to the side of the cylinder so that neither you nor anyone else is in line with the back of the cylinder valve. This is in case a back-plus is loose or a bursting disc vents. The correct stance is shown in the diagram above.



When operating the cylinder valve:

- Open it by hand by turning the valve hand-wheel anti-clockwise. Use only reasonable force.
- Ensure that no gas is leaking from the cylinder valve connection or the system to which the cylinder is connected. DO NOT use ammonia-based leak detection fluid as this can

damage the valve. Approved leak detection fluid, can be obtained from a BOC Gas & Gear centre.

- When finished with the cylinder, close the cylinder valve by hand by turning the valve hand-wheel in a clockwise direction. Use only reasonable force.



### 1.3 Electrical Shock

- Never touch & live electrical parts.
- Always repair or replace worn or damaged parts.
- Disconnect power source before performing any maintenance or service.
- Earth all work materials.
- Never work in moist or damp areas.

Avoid electric shock by:

- Wearing dry insulated boots
- Wearing dry leather gloves
- Never changing electrodes with bare hands or wet gloves
- Never cooling electrode holders in water
- Working on a dry insulated floor where possible
- Never hold the electrode and holder under your arm.

### 1.4 User Responsibility

- Read the Operating Manual prior to installation of this machine.
- Unauthorised repairs to this equipment may endanger the technician and operator and will void your Warranty. Only qualified personnel approved by R-Tech Welding should perform repairs.
- Always disconnect mains power before investigating equipment malfunctions.
- Parts that are broken, damaged, missing or worn should be replaced immediately.
- Equipment should be cleaned periodically.

PLEASE NOTE that under no circumstances should any equipment or parts be altered or changed in any way from the standard specification without written permission given by R-tech Welding. To do so, will void the Equipment Warranty.



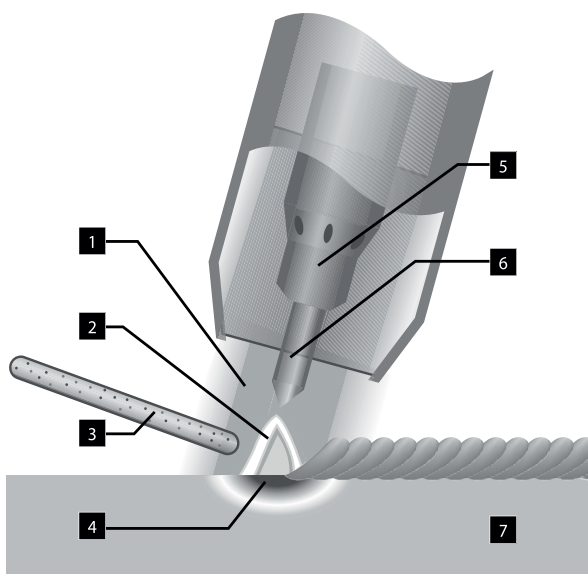
# 2.0 Gas Tungsten Arc Welding (GTAW/TIG)

## 2.1 Introduction

The Tungsten Inert Gas, or TIG process, uses the heat generated by an electric arc struck between a non-consumable tungsten electrode and the workpiece to fuse metal in the joint area and produce a molten weld pool. The arc area is shrouded in an inert or reducing gas shield to protect the weld pool and the non-consumable electrode. The process may be operated autogenously, that is, without filler, or filler may be added by feeding a consumable wire or rod into the established weld pool.

## 2.2 Process

1	Shielding gas
2	Arc
3	TIG filler rod
4	Weld pool
5	Collet
6	Tungsten Electrode
7	Workpiece



Schematic of the TIG welding process

Direct or alternating current power sources with constant current output characteristics are normally employed to supply the welding current. For DC operation the tungsten may be connected to either output terminal, but is most often connected to the negative pole. The output characteristics of the power source can have an effect on the quality of the welds produced.

Shielding gas is directed into the arc area by the welding torch and a gas lens within the torch distributes the shielding gas evenly over the weld area. In the torch the welding current is transferred to the tungsten electrode from the copper conductor. The arc is then initiated by one of several methods between the tungsten and the workpiece.

## 2.3 Process Variables

### DCEN

When direct-current electrode-negative (straight polarity) is used:

- Electrons strike the part being welded at a high speed.
- Intense heat on the base metal is produced.
- The base metal melts very quickly.
- Ions from the inert gas are directed towards the negative electrode at a relatively slow rate.
- Direct current with straight polarity does not require post-weld cleaning to remove metal oxides.

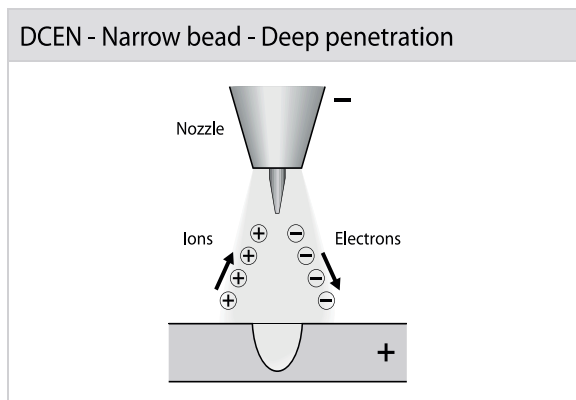
### Use of DCEN

For a given diameter of tungsten electrode, higher amperage can be used with straight polarity. Straight polarity is used mainly for welding:

- Carbon steels
- Stainless steels
- Copper alloys

The increased amperage provides:

- Deeper penetration
- Increased welding speed
- A narrower, deeper, weld bead.



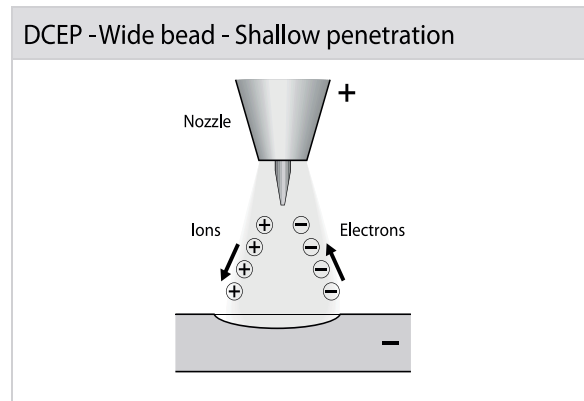
### DCEP

The DCEP (reverse polarity) are different from the DCEN in following ways:

- High heat is produced on the electrode rather on the base metal.
- The heat melts the tungsten electrode tip.
- The base metal remains relatively cool compared to sing straight polarity.
- Relatively shallow penetration is obtained.
- An electrode whose diameter is too large will reduce visibility and increase arc instability.

### Use of DCEP

- Intense heat means a larger diameter of electrode must be used with DCEP.
- Maximum welding amperage should be relatively low (approximately six times lower than with DCEN).

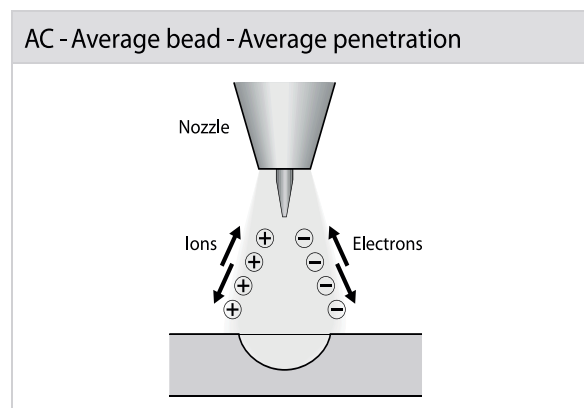


### Alternating Current with High-Frequency

#### Welding with alternating current

Welding with alternating current combines both direct-current characteristics:

- In the positive phase, cleaning action occurs in the weld puddle.
- During the negative phase, heat is concentrated in the weld puddle.
- The above causes increased penetration.





## 2.4 Shielding Gas Selection

Material	Shielding Gas	Benefits
Aluminium Alloys	Argon	1) Used with high frequency AC good stable arc good cleaning action
	Argon/Helium	1) Used with high frequency AC good cleaning action higher welding speed increased penetration
Aluminium Bronze	Argon	Reduces penetration during surfacing minimising dilution
Brass	Argon	Stable arc Low fume
Cobalt-based alloys	Argon	Stable and easy to control arc
Copper-nickel (Monel)	Argon	Stable and easy to control arc Can be used for copper-nickel to steel
Deoxised copper	Helium	Increased heat input Stable arc Good penetration
	Helium(75%)/	Stable arc
	Argon(25%)	Lower penetration
Nickel alloys (Inconel)	Argon	Stable arc Manual operation
	Helium	High speed automated welding
Steel	Argon	Stable arc Good penetration
	Helium	High speed automatic welding Deeper penetration Small concentrated HAZ
Magnesium Alloys	Argon	Used with continuous high frequency AC Good arc stability Good cleaning action
Stainless steel	Argon	Good penetration Good arc stability
	Helium	Deeper penetration
Titanium	Argon	Stable arc
	Helium	High speed welding

## 2.5 Consumable Selection

### a) Welding wire

The following table includes the recommended welding consumable for the most commonly welded materials.

Base Material	Consumable
C-Mn and low Carbon steels	Mild steel TIG wire
Low Alloy steels	
1.25Cr/0.5Mo	CrMo1
2.5Cr/1Mo	CrMo2
Stainless Steel	
304/304L	308L
316/316L	316L
309/309-C-Mn	309L
321/Stabilised grades	347L
Aluminium	
1000 series	1100
5000 series	4043/4047/5356
6000 series	4043/4047/5356

Filler rod diameter (mm)	Thickness of metal (mm)
2	0.5–2
3	2–5
4	5–8
4 or 5	8–12
5 or 6	12 or more

## 2.6 Welding Techniques

Welding techniques	
	<p>The suggested electrode and welding rod angles for welding a bead on plate. The same angles are used when making a butt weld. The torch is held 60–75° from the metal surface. This is the same as holding the torch 15–30° from the vertical. Take special note that the rod is in the shielding gas during the welding process.</p>

## 2.7 Torch Movement During Welding

Tungsten Without Filler Rod		
<p>Welding direction</p> <p>Form pool</p>	<p>Tilt torch</p>	<p>Move torch to front of pool. Repeat process.</p>
Tungsten With Filler Rod		
<p>Welding direction</p> <p>Form pool</p>	<p>Tilt torch</p>	<p>Add filler metal</p>
<p>Remove rod</p>	<p>Move torch to front of pool. Repeat process.</p>	

## 2.8 Positioning Torch Tungsten for Various Weld Joints

<p>Butt Weld and Stringer bead</p>	<p>T Joint</p>	<p>Corner Joint</p>	<p>Lap Joint</p>
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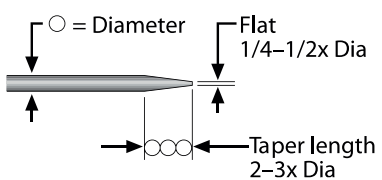
b) Non consumable Tungstens

Tungsten Electrode Selector Chart				
Base metal type	Thickness range	Desired results	Welding current	Electrode type
Aluminium alloys and Magnesium alloys	All	General purpose	ACHF	Pure (EW-P)
				Zirconiated (EW-Zr)
				2% Thoriated (EW-Th2)
	Only thin sections	Control penetration	DCRP	2% Ceriated (EW-Ce2)
	Only thick sections	Increase penetration or travel speed	DCSP	2% Thoriated (EW-Th2)
				2% Ceriated (EW-Ce2)
Copper alloys, Cu-Ni alloys and Nickel alloys	All	General purpose	DCSP	2% Thoriated (EW-Th2)
				2% Ceriated (EW-Ce2)
	Only thin sections	Control penetration	ACHF	Zirconiated (EW-Zr)
	Only thick sections	Increase penetration or travel speed	DCSP	2% Ceriated (EW-Ce2)
Mild Steels, Carbon Steels, Alloy Steels, Stainless Steels and Titanium alloys	All	General purpose	DCSP	2% Thoriated (EW-Th2)
				2% Ceriated (EW-Ce2)
				2% Lanthanated (EWG-La2)
	Only thin sections	Control penetration	ACHF	Zirconiated (EW-Zr)
	Only thick sections	Increase penetration or travel speed	DCSP	2% Ceriated (EW-Ce2)
				2% Lanthanated (EWG-La2)

Shielding gas	Tungsten performance characteristics
Argon	Balls easily. Low cost. Tends to spit at higher currents. Used for non-critical welds only.
Argon	Balls well. Takes higher current, with less spitting and with better arc starts and arc stability than pure tungsten.
75% Argon/ 25% Helium	Higher current range and stability. Better arc starts, with lower tendency to spit. Medium erosion.
Argon Helium	Lowest erosion rate. Widest current range. AC or DC. No spitting. Best arc starts and stability.
75% Argon/ 25% Helium	Best stability at medium currents. Good arc starts. Medium tendency to spit. Medium erosion rate.
Helium	Low erosion rate. Wide current range. AC or DC. No spitting. Consistent arc starts. Good stability.
75% Argon/ 25% Helium	Best stability at medium currents. Good arc starts. Medium tendency to spit. Medium erosion rate.
75% Argon/ 25% Helium	Low erosion rate. Wide current range. AC or DC. No spitting. Consistent arc starts. Good stability.
Argon	Use on lower currents only. Spitting on starts. Rapid erosion rates at higher currents.
75% Argon/ 25% Helium	Low erosion rate. Wide current range. AC or DC. No spitting. Consistent arc starts. Good stability.
75% Argon/ 25% Helium	Best stability at medium currents. Good arc starts. Medium tendency to spit. Medium erosion rate.
75% Argon/ 25% Helium	Low erosion rate. Wide current range. AC or DC. No spitting. Consistent arc starts. Good stability.
75% Argon/ 25% Helium	Lowest erosion rate. Widest current range on DC. No spitting. Best DC arc starts and stability.
Argon	Use on lower current only. Spitting on starts. Rapid erosion rates at higher currents.
75% Argon/ 25% Helium	Low erosion rate. Wide current range. No spitting. Consistent arc starts. Good stability.
Helium	Lowest erosion rate. Highest current range. No spitting. Best DC arc starts and stability.

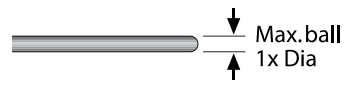
### Tungsten tip preparation

**DCSP (EN) or DCRP (EP)**



○ = Diameter  
 Flat 1/4–1/2x Dia  
 Taper length 2–3x Dia

**ACHP General Purpose**

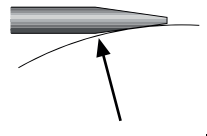


Max. ball 1x Dia

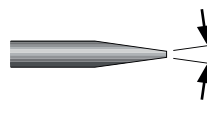
Ball tip by arcing on clean metal at low current DCRP (EP) then slowly increase current to form the desired ball diameter. Return setting to AC.

### Tungsten Grinding

Shape by grinding longitudinally (never radially). Remove the sharp point to leave a truncated point with a flat spot. Diameter of flat spot determines amperage capacity. (See below)



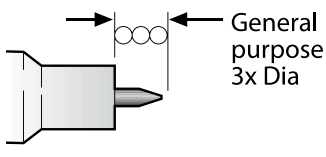
The included angle determines weld bead shape and size. Generally, as the included angle increases, penetration increases and bead width decreases.



Use a medium (60 grit or finer) aluminium oxide wheel.

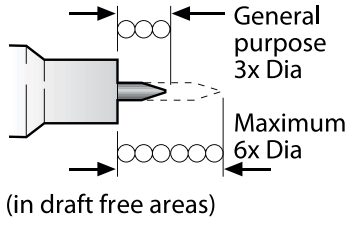
### Tungsten Extension

**Standard Parts**



General purpose 3x Dia

**Gas Lens Parts**



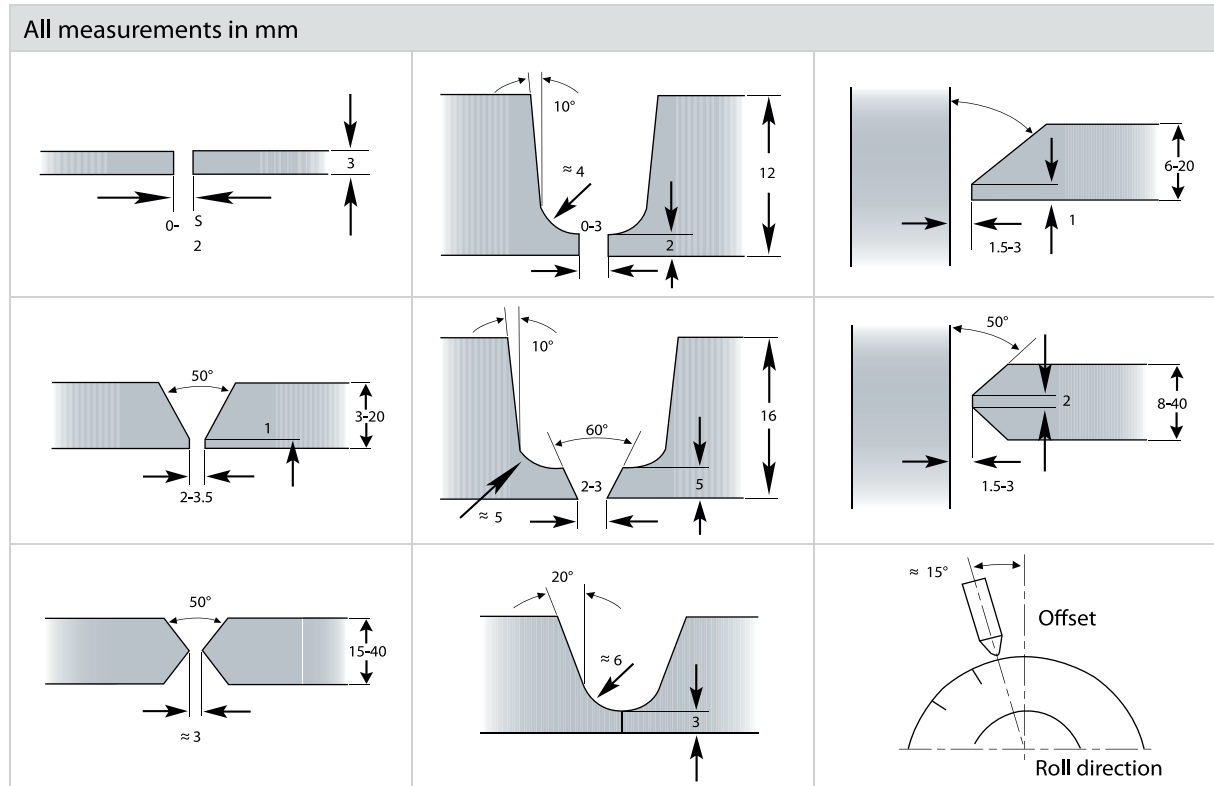
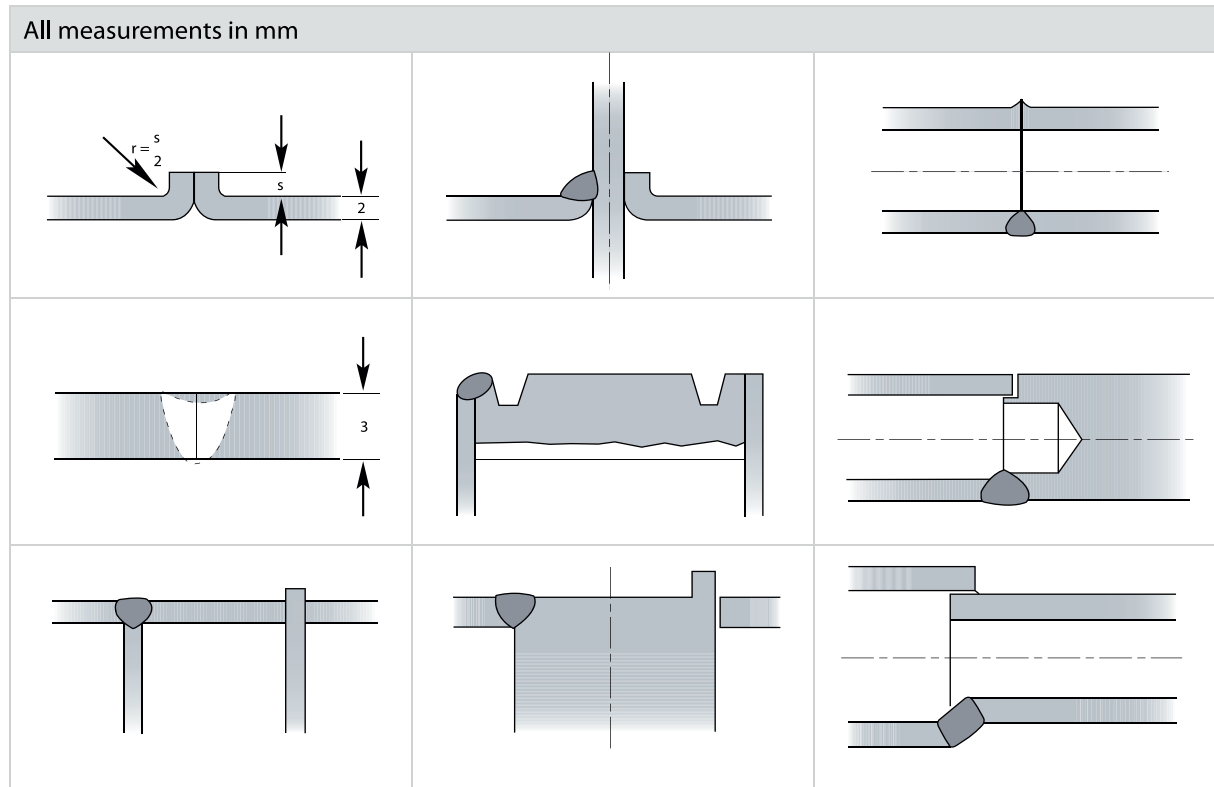
General purpose 3x Dia  
 Maximum 6x Dia  
 (in draft free areas)

### Tungsten electrode tip shapes and current ranges

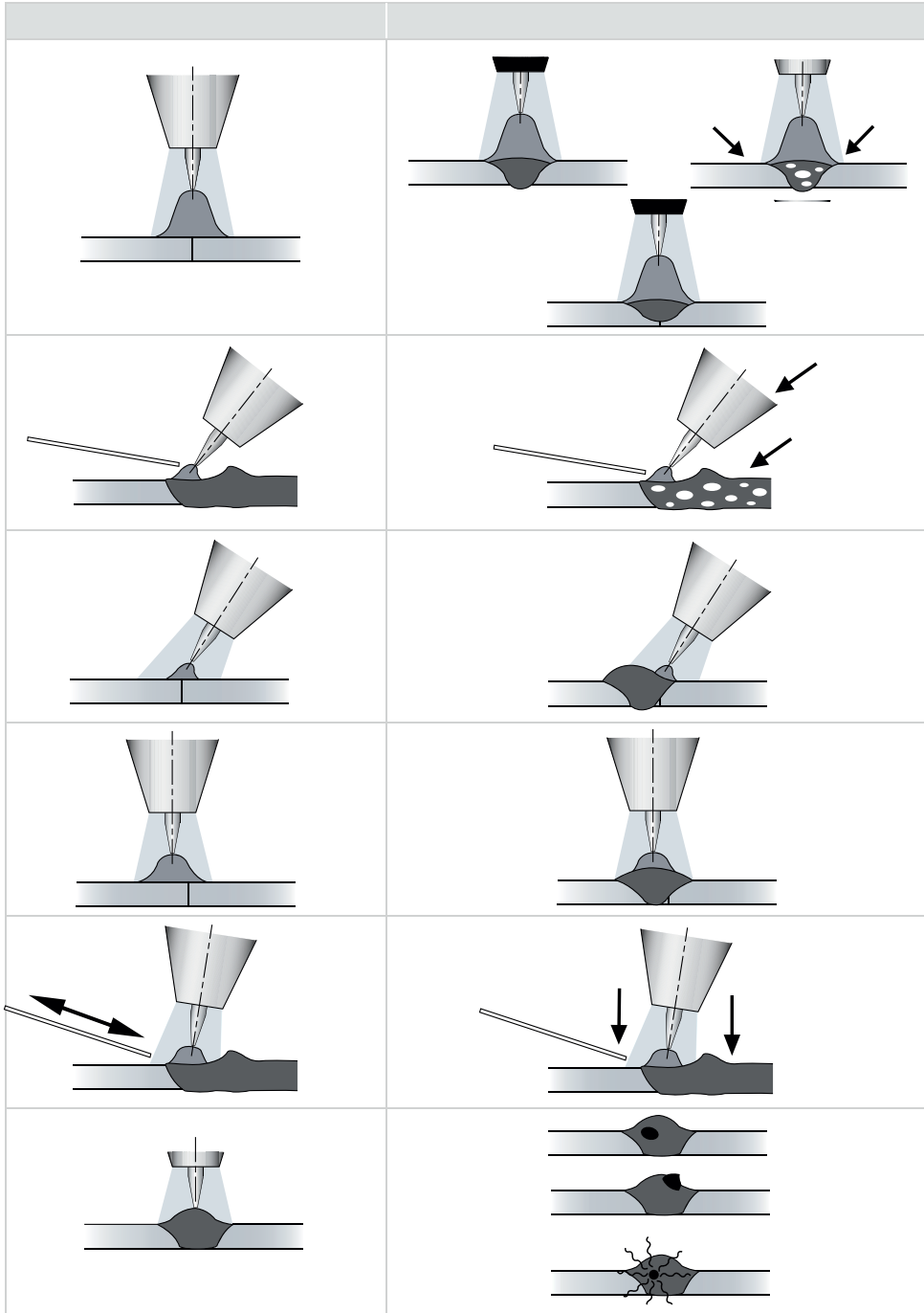
Thoriated, ceriated, and lanthanated tungsten electrodes do not ball as readily as pure or zirconiated tungsten electrodes, and as such are typically used for DCSP welding. These electrodes maintain a ground tip shape much better than the pure tungsten electrodes. If used on AC, thoriated and lanthanated electrodes often spit. Regardless of the electrode tip geometry selected, it is important that a consistent tip configuration be used once a welding procedure is established. Changes in electrode geometry can have a significant influence not only on the weld bead width, depth of penetration, and resultant quality, but also on the electrical characteristics of the arc. Below is a guide for electrode tip preparation for a range of sizes with recommended current ranges.

Electrode Diameter (mm)	Diameter at tip (mm)	Constant included angle, (degrees)	Current range (A)
1.0	0.125	12	2–15
1.0	0.250	20	5–30
1.6	0.500	25	8–50
1.6	0.800	30	10–70
2.4	0.800	35	12–90
2.4	1.100	45	15–150
3.2	1.100	60	20–200
3.2	1.500	90	25–250

## 2.9 Joint Preparation







## Troubleshooting guide

Problem	Cause	Solution
Excessive electrode consumption	<ol style="list-style-type: none"> <li>1. Inadequate gas flow</li> <li>2. Improper size electrode for current required</li> <li>3. Operating of reverse polarity</li> <li>4. Electrode contamination</li> <li>5. Excessive heating inside torch</li> <li>6. Electrode oxidising during cooling</li> <li>7. Shield gas incorrect</li> </ol>	<ol style="list-style-type: none"> <li>1. Increase gas flow</li> <li>2. Use larger electrode</li> <li>3. User larger electrode or change polarity</li> <li>4. Remove contaminated portion, then prepare again</li> <li>5. Replace collet. Try wedge collet or reverse collet.</li> <li>6. Increase gas flow post time to 1 sec per 10 amps</li> <li>7. Change to proper gas (no oxygen or CO<sub>2</sub>)</li> </ol>
Erratic Arc	<ol style="list-style-type: none"> <li>1. Incorrect voltage (arc too long)</li> <li>2. Current too low for electrode size</li> <li>3. Electrode contaminated</li> <li>4. Joint too narrow</li> <li>5. Contaminated shield gas. Dark stains on the electrode or weld bead indicate contamination</li> <li>6. Base metal is oxidised, dirty or oily</li> </ol>	<ol style="list-style-type: none"> <li>1. Maintain short arc length</li> <li>2. Use smaller electrode or increase current</li> <li>3. Remove contaminated portion, then prepare again</li> <li>4. Open joint groove</li> <li>5. The most common cause is moisture or aspirated air in gas stream. Use welding grade gas only. Find the source of the contamination and eliminate it promptly.</li> <li>6. Use appropriate chemical cleaners, wire brush, or abrasives prior to welding</li> </ol>
Inclusion of tungsten or oxides in weld	<ol style="list-style-type: none"> <li>1. Poor scratch starting technique</li> <li>2. Excessive current for tungsten size used</li> <li>3. Accidental contact of electrode with puddle</li> <li>4. Accidental contact of electrode to filler rod</li> <li>5. Using excessive electrode extension</li> <li>6. Inadequate shielding or excessive drafts</li> <li>7. Wrong gas</li> <li>8. Heavy surface oxides not being removed</li> </ol>	<ol style="list-style-type: none"> <li>1. Many codes do not allow scratch starts. Use copper strike plate. Use high frequency arc starter.</li> <li>2. Reduce the current or use larger electrode</li> <li>3. Maintain proper arc length</li> <li>4. Maintain a distance between electrode and filler metal</li> <li>5. Reduce the electrode extension to recommended limits</li> <li>6. Increase gas flow, shield arc from wind, or use gas lens</li> <li>7. Do not use ArO<sub>2</sub> or ArCO<sub>2</sub> GMAW (MIG) gases for TIG welding</li> <li>8. Use ACHF. Adjust balance control for maximum cleaning, or wire brush and clean the weld joint prior to welding</li> </ol>
Porosity in Weld Deposit	<ol style="list-style-type: none"> <li>1. Entrapped impurities, hydrogen, air, nitrogen, water vapour</li> <li>2. Defective gas hose or loose connection</li> <li>3. Filler material is damp (particularly aluminium)</li> <li>4. Filler material is oily or dusty</li> </ol>	<ol style="list-style-type: none"> <li>1. Do not weld on wet material. Remove condensation from line with adequate gas pre-flow time</li> <li>2. Check hoses and connections for leaks</li> <li>3. Dry filler metal in oven prior to welding</li> <li>4. Replace filler metal</li> </ol>

## Troubleshooting guide

Problem	Cause	Solution
Porosity in Weld Deposit	<ol style="list-style-type: none"> <li>5. Alloy impurities in the base metal such as sulphur, phosphorous, lead and zinc</li> <li>6. Excessive travel speed with rapid freezing of weld trapping gases before they escape</li> <li>7. Contaminated shield gas</li> </ol>	<ol style="list-style-type: none"> <li>5. Change to a different alloy composition which is weldable. These impurities can cause a tendency to crack when hot.</li> <li>6. Lower the travel speed</li> <li>7. Replace the shielding gas</li> </ol>
Cracking in Welds	<ol style="list-style-type: none"> <li>1. Hot cracking in heavy section or with metals which are hot shorts</li> <li>2. Crater cracks due to improperly breaking the arc or terminating the weld at the joint edge</li> <li>3. Post weld cold cracking due to excessive joint restraint, rapid cooling or hydrogen embrittlement</li> <li>4. Centreline cracks in single pass weld</li> <li>5. Underbead cracking from brittle microstructure</li> </ol>	<ol style="list-style-type: none"> <li>1. Preheat. Increase weld bead cross-section size. Change weld bead contour. Use metal with fewer alloy impurities</li> <li>2. Reverse direction and weld back into previous weld at edge. Use Amprak or foot control to manually down slope current</li> <li>3. Preheat prior to welding. Use pure or non-contaminated gas. Increase the bead size. Prevent craters or notches. Change the weld joint design.</li> <li>4. Increase bead size. Decrease root opening. Use preheat. Prevent craters.</li> <li>5. Eliminate sources of hydrogen, joint restraint, and use preheat</li> </ol>
Inadequate shielding	<ol style="list-style-type: none"> <li>1. Gas flow blockage or leak in hoses or torch</li> <li>2. Excessive travel speed exposes molten weld to atmospheric contamination</li> <li>3. Wind or drafts</li> <li>4. Excessive electrode stickout</li> <li>5. Excessive turbulence in gas stream</li> </ol>	<ol style="list-style-type: none"> <li>1. Locate and eliminate the blockage or leak</li> <li>2. Use slower travel speed or carefully increase the flow rate to a safe level below creating excessive turbulence. Use a trailing shield cup.</li> <li>3. Set up screens around the weld area</li> <li>4. Reduce electrode stickout. Use a larger size cup</li> <li>5. Change to gas safer parts or gas lens parts</li> </ol>
Arc Blow	<ol style="list-style-type: none"> <li>1. Induced magnetic field from DC weld current</li> <li>2. Arc is unstable due to magnetic influence</li> </ol>	<ol style="list-style-type: none"> <li>1. Change to ACHF current. Rearrange the split ground connection</li> <li>2. Reduce weld current and use arc length as short as possible</li> </ol>
Short parts Life	<ol style="list-style-type: none"> <li>1. Short water cooled leads life</li> <li>2. Cup shattering or cracking in use</li> <li>3. Short collet life</li> <li>4. Short torch head life</li> </ol>	<ol style="list-style-type: none"> <li>1. Verify coolant flow direction. Return flow must be on the power cable lead</li> <li>2. Change cup size or type. Change tungsten position</li> <li>3. Ordinary style is split and twists or jams. Change to wedge style</li> <li>4. Do not operate beyond rated capacity. Use water cooled model. Do not bend rigid torches</li> </ol>

## 3.0 TIG Welding of Materials

### 3.1 Application Summary

Material	Type of current	Polarity
C-Mn steel	Direct current (-)	DC negative
Alloyed steel	Direct current (-)	DC negative
Copper and Cu alloys	Direct current (-)	DC negative
Nickel and Ni alloys	Direct current (-)	DC negative
Titanium and Ti alloys	Direct current (-)	DC negative
Aluminum and Al alloys	Alternating current (~)	
	Direct current (-) with Helium	DC negative
Magnesium and Mg alloys	Alternating current (~)	

### 3.2 C-Mn Steel

TIG welding may be used for welding carbon steel but because deposition rates are low, it is usually only used for welding sheet and thin sections for high quality applications, small components, and root passes of multipass butt joints in plate and pipe.

Standard DC TIG equipment is normally suitable and DCEN polarity is usually chosen to provide good workpiece heating.

Only inert or reducing gases should be used for TIG welding and pure argon is normally

recommended as the shielding gas for steel.

Filler rods are usually selected to match the chemical composition and the mechanical properties of the parent plate. The weldability of the steel may impose restrictions on the choice of filler rod.

Steels with carbon contents above about 0.3% are hardenable, and fast cooling will produce a hard HAZ and this is liable to result in hydrogen cracking. This form of cracking can be prevented by use of preheat and suitable welding procedures.

Plate Thickness (mm)	Joint Type	Number of Passes	Tungsten Electrode Size (mm)	Consumable Size (mm)	Current (A)	Welding Travel Speed (cm/min)	Gasflow (l/min)
0.8	Fillet	1	1.6	1.5	70	30	5
1.0	Fillet	1	1.6	1.5	90	30	5
1.5	Fillet	1	1.6	2.0	110	30	6
2.0	Fillet	1	2.4	2.5	130	25	6
1.0	Butt	1	1.6	1.5	80	20	6
1.5	Butt	1	1.6	2.0	120	20	7
2.0	Butt	1	2.4	2.5	140	20	7

(Shielding gas: Argon, Consumable ER70S-6, Position: Downhand, Polarity: DC-)

### 3.3 Alloyed Steel

TIG welding may be used for welding alloy steels but because deposition rates are low, it is usually only used for welding sheet and thin sections for high quality applications, small components, and root passes of multipass butt joints in plate and pipe.

Standard DC TIG equipment is normally suitable and DCEN polarity is usually chosen to provide good workpiece heating. Tungsten electrodes with additions of thorium oxide, cerium oxide, or lanthanum oxide are used for welding steel and they give good arc stability. Only inert or reducing gases should be used

for TIG welding and pure argon is normally recommended as the shielding gas for welding alloy steel.

Filler rods are usually selected to match the chemical composition and the mechanical properties of the parent plate. The weldability of the steel may impose restrictions on the choice of filler rod.

Alloy steels with high carbon equivalents are hardenable, and fast cooling will produce a hard HAZ and this is liable to result in hydrogen cracking. This form of cracking can be prevented by use of preheat and suitable welding procedures.

#### General welding parameters

Plate Thickness (mm)	Tungsten Electrode (mm)	Gas Flow (l/min)	Current (A)	Consumable Size (mm)
1.0	1.0	3 – 4	30 – 60	1.0
1.5	1.6	3 – 4	70 – 100	1.5
2.0	1.6	4	90 – 110	1.5 – 2.0
3.0	1.6 – 2.4	4 – 5	120 – 150	2.0 – 3.0
5.0	2.4 – 3.2	4 – 6	190 – 250	3.0 – 4.0
6.0	3.2 – 4.0	5 – 6	220 – 340	4.0 – 6.0
8.0	4.0	5 – 6	300 – 360	4.0 – 6.0
12.0	4.8 – 6.4	5 – 7	350 – 450	4.0 – 6.0

Polarity DC –

### 3.4 Stainless Steel

Is a high quality process ideally suited for welding of stainless steels, particularly thin sheet up to about 5mm thick where weld integrity and good surface finish are critical. The process has a high degree of controllability resulting in clean, smooth, high quality welds with good penetration and strength with very low defect rates.

Standard TIG equipment is suitable and stainless steels are TIG welded using DCEN polarity. A thoriated tungsten electrode is normally used but health concerns have promoted use of ceriated or lanthanated instead. The filler rod used depends on the type of stainless being welded but, in general, is matching for austenitic

grades, enriched in nickel for duplex grades, and may be matching or an austenitic type for ferritic and martensitic grades.

Shielding gas is conventionally pure argon, but other gases are available to provide specific properties and these include argon-hydrogen, argon-helium mixtures, argon-helium-hydrogen, and argon-nitrogen mixtures.

When welding pipes an inert gas purge is required inside the pipe to prevent oxidation on the underside of the weld. Gas purging may also be used to protect the root side of butt welds in plate or sheet materials too.



### 3.5 Aluminium

Is a high quality process widely used for welding aluminium, particularly in section size up to about 6mm. The process may be operated with or without filler.

TIG welding of aluminium can be carried out using any of the three standard operating modes, alternating current (AC), direct current electrode negative (DCEN) and direct current electrode positive (DCEP).

AC is the most frequently used since with AC cleaning of the oxide film occurs on the electrode positive cycle and heating occurs on the electrode negative cycle. With aluminium the surface oxide film must be removed to allow full fusion to take place and AC TIG does this efficiently, allowing high quality joints

to be made. High purity argon and argonhelium shielding gas mixtures can be used.

The AC output may be conventional sine wave or square wave and many electronic power sources allow the AC waveform to be adjusted, and also provide facilities for pre- and post- gas flow and current slope-in and slope-out.

### 3.6 Balanced Squarewave

The balance on squarewave machines can be adjusted to achieve the desired results. Greater amounts of EN create a deeper, narrower weldbead and better joint penetration. This helps when welding thick material and promote faster welding speeds. Greater amounts of EP removes more oxides from the surface but also have a shallower penetration.

Plate Thickness (mm)	Joint type	Tungsten size (mm)	Consumable Size (mm)	Current (A)	Welding speed (mm/min)	Gas flow (l/min)
1	Square butt	1.6	1.6	75	26	5
2	Square butt	1.6	3.2	110	21	6
3	Square butt	2.4	3.2	125	17	6
4	Square butt	2.4	3.2	160	15	8
5	Square butt	2.4	3.2	185	14	10
5	V-butt (70)	3.2	3.2	165	14	12
6	Square butt	3.2	3.2	210	8	12
6	V-butt (70)	3.2	3.2	185	10	12

Alternating current, Welding position: Downhand: Pure Aluminium

### 3.7 Copper and Copper Alloys

Cleanliness is important when welding copper, and all dirt, grease, and other contaminants must be removed before welding. Copper alloys containing aluminium will form a surface oxide film and this must also be removed before welding. Preheat will be required for unalloyed copper but some copper alloys can be TIG welded without preheat except on thick sections.

Standard DC TIG welding equipment is suitable for most copper and copper alloys, but aluminium bronze is normally TIG welded using AC current to break down the tenacious oxide film on the surface.

Pure argon, helium, or argon-helium mixtures are standard shielding gases for DC TIG welding copper and copper alloys. Alushield Heavy is ideal for TIG welding copper and some copper

alloys, particularly in thicker sections. Pure argon is the shielding gas used for AC TIG welding.

TIG consumables are solid filler rods based on pure copper and several copper alloy compositions, including aluminium bronzes, silicon bronzes, and cupro-nickels. It is normal to try to use a filler material with a similar composition to that of the parent material but this is not always possible, and sometimes not desirable.

Porosity is the main welding problem encountered when TIG welding unalloyed copper and some copper alloys are prone to solidification cracking and porosity. Certain alloys are difficult to weld (brass will lose zinc if welding is attempted), and those containing lead are virtually unweldable.

## 4.0 Connecting your R-Tech TIG AC/DC machine

### 4.1.1 TIG210

The machine is designed to operate on a 240v +/- 15% input single phase AC outlet. The machine is supplied with a heavy duty 15A input plug. Ensure that there is adequate ventilation around the machine when it is connected to the mains power supply.

### 4.1.2 TIG320

The machine is designed to operate on a 415v +/- 15% input three phase supply. Ensure that there is adequate ventilation around the machine when it is connected to the mains power supply.

### 4.1 TIG500

The machine is designed to operate on a 415v +/- 15% input three phase supply. Ensure that there is adequate ventilation around the machine when it is connected to the mains power supply.

### 4.2 Shielding Gas

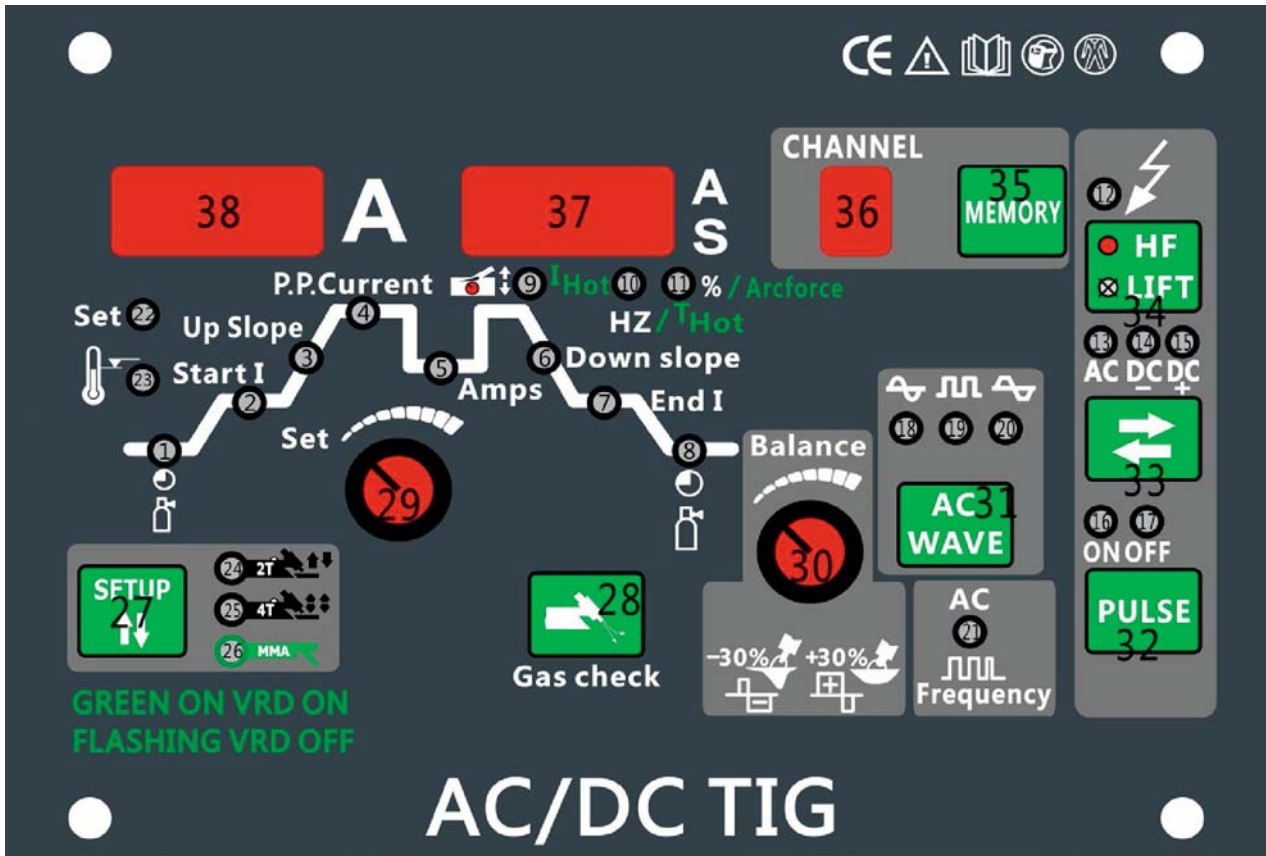
When working the machine in the TIG mode of welding the process requires a shielding gas. The shielding gas can be supplied via a pressure regulator to the machine from either a fixed installation or single cylinder of gas. If a cylinder of gas is used, please ensure that the cylinder is securely fastened (refer to the section on cylinder handling and safety), before starting any welding operation. Refer to the application section for the selection of the correct shielding gas.

### 4.3 TIG Torch Connection

1. The W26F/FX AC/DC TIG torch is fitted to the machine by means of the dinse back end. For DC (-) TIG operation fit the torch back end to the negative dinse connection (similarly for DC (+) fit the torch backend to the positive dinse connection).
2. The gas hose is fitted to the gas fitting (GAS) located on the front bottom panel of the machine.

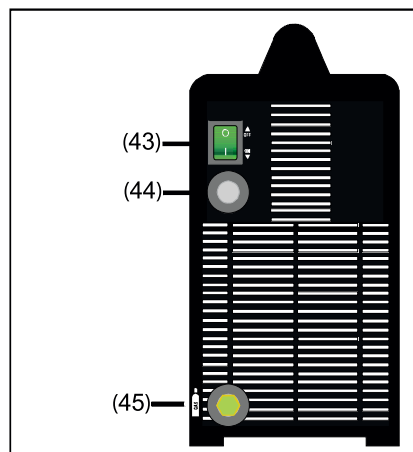
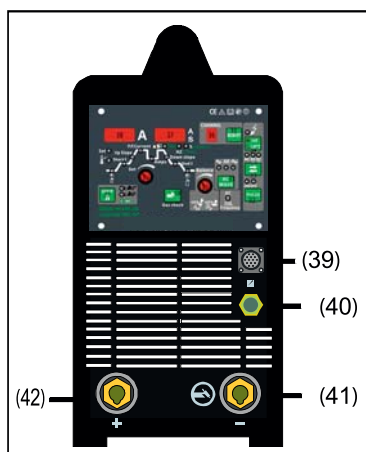
### 4.4 MMA Operation

The R-Tech AC/DC range can be used as a MMA welding machine by fitting a electrode holder and a work return lead to the respective dinse connectors (dependant on the type of electrodes being used. Please consult the packaging supplied by the manufacturer for the correct polarities).



Description of the control panels		
No.	Function	Description
1	Argon In Indicator	
2	Starting Current Indicator	For tig welding
3	Upslope Time Indicator	period in TIG welding during which the starting current IS is increased to the specified main current
4	P.P.Current Indicator	Pulse Peak Current (1- 100%)
5	Welding Current(Amps) Indicator	Main current
6	Downslope Time Indicator	period in TIG welding during which the specified main current I1 is lowered to the final current I
7	Ending Current I Indicator	For tig welding
8	Argon In Stopping Indicator	For tig welding
9	Foot Switch Indicator	Lights up if foot switch connected
10	Hot Start	For MMA welding
11	Arc Force	For MMA welding
12	HF Contact Indicator	ON/OFF
13	TIG AC Indicator	
14	TIG DC+ Welding Indicator	
15	TIG DC- Welding Indicator	
16	Pulse On Indicator	
17	Pulse Off Indicator	
18	Sin Indicator	Sinusoidal waveform indicator

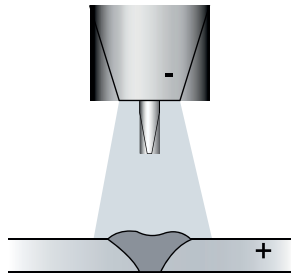
19	OFF Indicator	100% rectangular waveform
20	rEc Indicator	Rectangular waveform
21	AC Frequency Indicator	
22	Setup Indicator	Lights up if under setting status
23	Over-heat Indicator	Lights up if the power source overheats (e.g. because the duty cycle has been exceeded). For more information on this, see the "Troubleshooting" section.
	Save the data	
24	2-step Mode Indicator	
25	4-step Mode Indicator	
26	MMA Mode Indicator	
27	Mode Button	Used to select 2-step mode or 4-step mode or MMA Welding
28	Gas Test Button	Used to set the required amount of shielding gas at the pressure regulator. After you press this button, gas will flow out for 30s. Press the button again to stop the test gas flow before the 30 seconds are up.
29	Parameter Adjusting Knob	Used to adjust welding parameter
30	Balance	(- 30%+30%) Used to set the fusing power/cleaning action for TIG AC welding
31	Wave Pattern	Used to select wave form (Sin, OFF or rEc)
32	Pulse Selection Button	ON/OFF
33	Process Button	used to select the process depending on the mode that has been chosen
34	HF Contact Button	ON/OFF
35	Store Button	used to store 9 jobs
36	Memory Display	Memory display, 1 or 2 or 3.....9
37	Actual Output Current Display	
38	Current Presetting	
39	LocalNet connection	<b>standardised connection socket for system add - ons ( e.g remote control  TIG torch ,etc</b>
40	Output Nozzle	
41	" - " output	
42	" +" output	
43	power switch	<b>switching the power source on and off</b>
44	power input	
45	shielding gas connection	



#### 4.5.1 For Direct current (DC) TIG Welding

Select the correct size and type of non consumable tungsten and shielding gas for the application. (See selection chart at the end of the application section)

For (DC -) (most commonly used polarity connect the TIG torch to the negative Dinse plug connector and the work return lead to the positive dinse plug connector.



*GTAW with DCEN produces deep penetration because it concentrates the heat in the joint area. No cleaning action occurs with this. The heat generated by the arc using this polarity occurs in the work thus a smaller electrode can be used as well as a smaller gas cup and gas flow. The more concentrated arc allows for faster travel speeds.*

For (DC+) applications connect the TIG torch to the positive Dinse plug connector and the work return lead to the negative dinse plug connector. In this mode most of the heat is generated within the non-consumable tungsten and the heat input into the plate is reduced resulting in lower penetration depths. (Larger tungstens are normally selected for this application.

Ensure that the process selector switch (3) is switched to TIG.

Ensure that the AC/DC selector switch (4) is set on DC.

Select 4T/2T on the trigger selector switch (5).

#### For 2T operation:

Depress the contactor switch on the torch and hold this down for the entire weld.

Selecting the 2T function will disable the Start current (9) and the process will immediately rise to the selected welding current.

#### For 4T operation:

Depress the contactor switch on the torch and release it when welding starts. Depress the contactor switch again at the end of the weld.

Selecting the 4T function will enable the start current (9) and the downslope cycle (12). Both start current and downslope cycle time must be manually selected.

Using a remote control device (such as a foot control, or remote pendant).

When using a remote device ensure that the device is properly fitted by connecting it to the remote control outlet connector (21). The remote operating control switch (7) must be set in the on position.

#### 4.5.2 For DC Pulse TIG Welding

SDC welding of thin material can be enhanced by using the pulse mode.

When using the pulse mode for DC applications the current will be varied between the welding current and the set background current. Additionally the pulse width and pulse frequency can be adjusted. By adjusting the pulse frequency and width the optimum heat input for a particular application can be obtained.

As a general rule, increasing the frequency at a given set of welding and background current the heat input into the plate will increase.

#### 4.5.3 For AC TIG Welding

AC TIG welding is commonly used for the welding of Aluminium and Aluminium alloys. The positive half cycle of the AC current assist in the cleaning action required for successfully welding Aluminium.

Zirconiated tungstens are used for the welding and the size of the tungsten depends on the current employed.

In the normal AC sine wave equal time is spent in the positive and negative cycle of the current. This delivers a balanced weld with good penetration and a good cleaning action.(5).

#### AC balance control

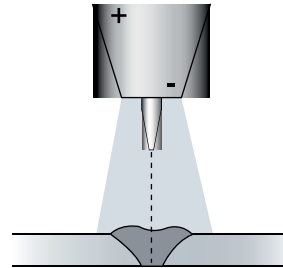
In addition to increasing the welding current in AC applications, a change in the penetration or cleaning when welding can be achieved by adjusting the AC Balance.

The AC balance (time spend in the positive (maximum cleaning) or negative (maximum penetration) can be adjusted by using the AC balance control knob (16).

By adjusting the AC balance control knob from 20-100% progressively increases the time in the positive side of the AC curve (higher heat concentration in the non-consumable tungsten electrode).

This has the result that the amount of penetration is decreased.

With the AC balance control set at 20%, higher currents can be used on thinner electrodes, resulting in the use of smaller gas cups, therefore increasing visibility and reducing gas flows.



*GTAW with AC combines the good weld penetration of DCEP with the desired cleaning action of DCEP. With certain types of AC waveforms high frequency helps re-establish the arc, which breaks each half cycle. Medium size tungstens are generally used with this process.*



## 5.0 Technical Specifications

Model No.	AC/DC TIG210	AC/DC TIG320	AC/DC TIG500
Part No.	AC/DC TIG210	AC/DC TIG320	AC/DC TIG500
Power voltage (V)	1 phase AC 240v	3 phase AC 415v	3 phase AC 415v
Frequency (HZ)	50/60	50/60	50/60
Fuse rating (A)	16	32	32
Output Current (A)	Stick 10-160 DC TIG 5-210 AC TIG 10-210	Stick 10-320 DC TIG 5-210 AC TIG 10-320	Stick 10-400 DC TIG 5-210 AC TIG 10-500
No-load voltage (V)	62	62	62
Duty Cycle 35% @	210a	320a	500a
Power Factor	0.95	0.95	0.95
Protection Grading	1P23	1P23	1P23
Weight (kg)	17	27	29
Dimensions (mm)	430 x 208 x 410	490 x 255 x 480	490 x 255 x 480
Warranty	3 Years	3 Years	3 Years

# 6.0 Warranty Information

## 6.1 Terms of Warranty

R-Tech Welding provide a Warranty for the TIG200/320/500 AC/DC against defects in manufacture and materials.

- Valid for 36 months (3 years) from date of purchase.
- An authorised R-Tech Welding Service Agent must carry out Warranty repairs.
- In the event a warranty claim is made then R-Tech Welding will pay all return and collection costs.
- No additional express Warranty is given unless in writing signed by an authorised manager of R-Tech Welding
- This Warranty is in addition to any other legal rights you may have.
- Welding leads (which include the electrode holder, gas lead, TIG torch and the work clamp) are covered by this warranty for 3 months from the date of purchase.

## 6.2 Limitations on Warranty

The following conditions are not covered:

- non compliance with operating and maintenance instructions such as connection to an incorrect faulty voltage supply including voltage surges outside equipment specs, and incorrect overloading
- natural wear and tear, and accidental damage
- transport or storage damage.

The Warranty is void if:

- changes are made to the product without the approval of the manufacturer
- repairs are carried out using non-approved spare parts
- a non-authorized agent carries out repairs.

## 6.3 Warranty Repairs

R-Tech Welding or their Authorised Service Agent must be informed of the Warranty defects, and the product returned within the Warranty Period.

- Before any Warranty work is undertaken, the customer must provide proof of purchase and serial number of the equipment in order to validate the Warranty.
- The parts replaced under the terms of the Warranty remain the property of R-Tech Welding

## 7.0 Recommended Safety Guidelines

Some safety precautions R-Tech Welding recommends are as follows:

- Repair or replace defective cables immediately.
- Never watch the arc except through lenses of the correct shade.
- In confined spaces, adequate ventilation and constant observation are essential.
- Leads and cables should be kept clear of passageways.
- Keep fire extinguishing equipment at a handy location in the shop.
- Keep primary terminals and live parts effectively covered.
- Never strike an electrode on any gas cylinder.
- Never use oxygen for venting containers.












Diagram and safety explanation	
Electrical safety alert	
Welding electrode causing electric shock	
Fumes and gases coming from welding process	
Welding arc rays	
Read instruction manual	
Become trained	

Diagram and safety explanation	
Wear dry, insulated gloves	
Insulate yourself from work and ground	
Disconnect input power before working on equipment	
Keep head out of fumes	
Use forced ventilation or local exhaust to remove fumes	
Use welding helmet with correct shade of filter	