MIG/TIG/ARC WELDER
200 AMP INVERTER

TSW20M

www.thetoolshed.co.nz

TABLE OF CONTENTS

Thank You

For the purchase of this ToolShed product. We try our hardest to supply customers like you with the best quality products available, at the best price possible. We cant wait to continue working together in the future.

Please contact us for any servicing, replacement parts, or questions you might have about your ToolShed product by visiting our website, or calling: 0800 948 665.

PRODUCT DETAILS

Product Model	*ToolShed MIG/TIG/ARC Welder 200 Amp Inverter*
Product Code	*TSW20M*

DISTRIBUTED BY:

Note:

This manual is for your reference only. Due to the continuous improvement of the ToolShed products, changes may be made at any time without obligation or notice.

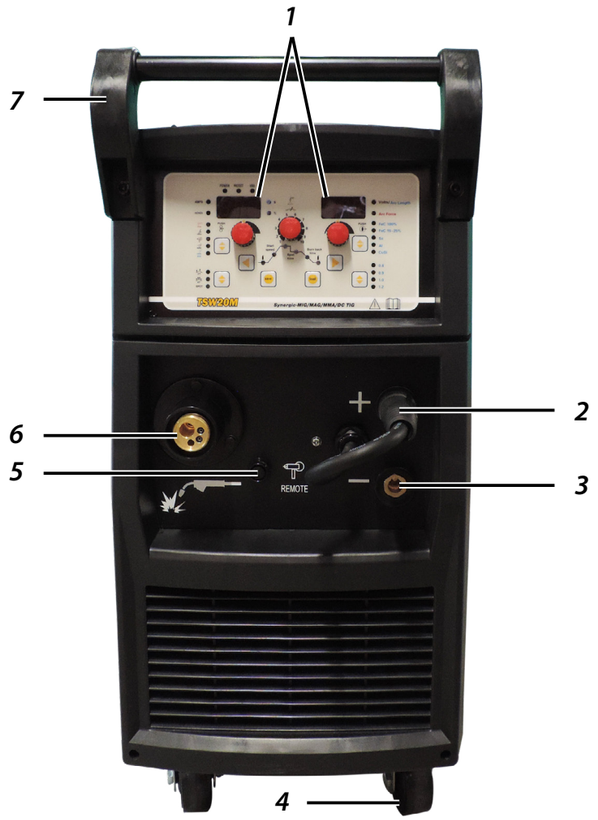
Warranty:

This product may be covered under The ToolShed warranty. For more information, see our Terms & Conditions at www.thetoolshed.co.nz

SPECIFICATIONS

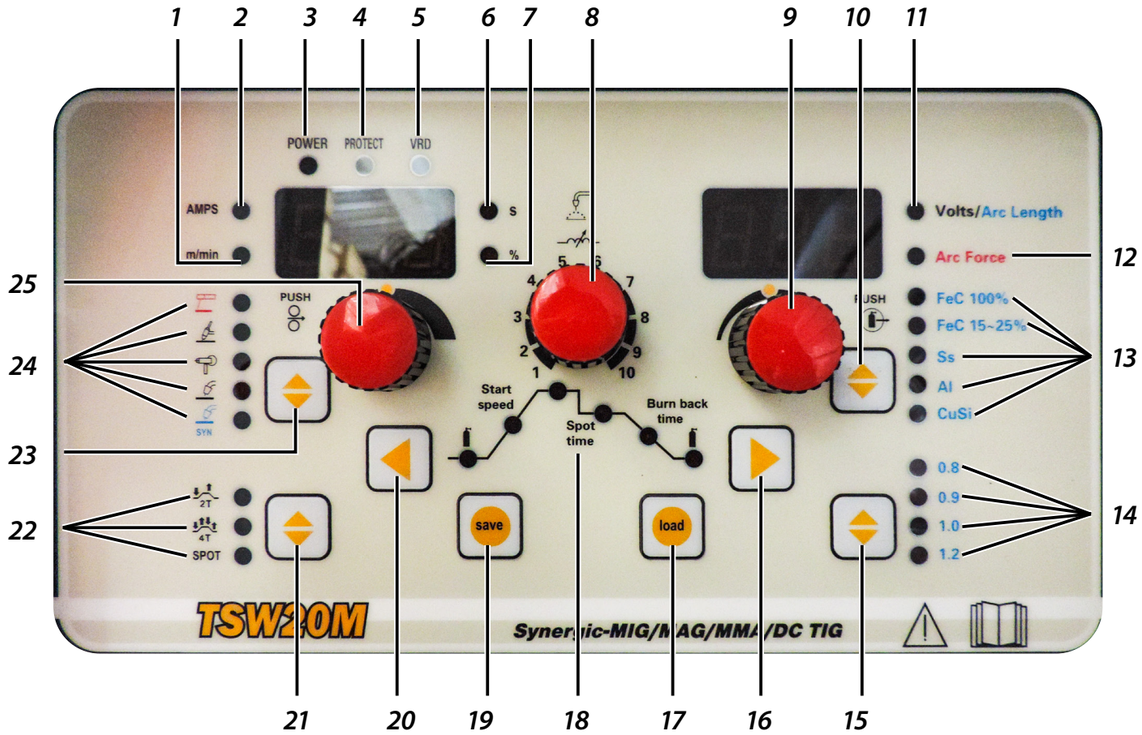
Voltage	220–240 Volts
Frequency	50/60 Hertz
I Max	38 Amps
I Eff	14.7 Amps
Rated Input Power	7.2 KVA
Rated Open Circuit Voltage	68 Volts
Welding Voltage	16.5–24 Volts
Rated Duty Cycle	60%
Welding Current 10min/60%	200 Amps
Welding Current & Related Load Voltage	MIG: 30A/15.5V — 200A/24V MMA: 20A/20.8V — 200A/28V TIG: 15A/10.6V — 200A/18V
Insulation Grade	Grade H
IP Rating	IP21S
Cooling	Fan Cooled
Net Weight	33kg
Dimensions (LxWxH)	621 x 300 x 681mm

PRODUCT IDENTIFICATION



1 Voltage & Current Display
2 Positive Terminal
3 Negative Terminal
4 Wheels
5 Spool Gun Connector
6 MIG Torch Connector
7 Handle

DISPLAY PANEL



1	Wire Speed Indicator	*13*	Material Selection Indicator
2	Amperage Indicator	*14*	Wire Selection Indicator
3	Power Indicator	*15*	Wire Selection Button
4	Protection Indicator	*16*	Menu Button Right
5	VRD Indicator	*17*	Load Saved Parameters
6		*18*	Welding Program Adjustment
7	Percentage Indicator	*19*	Save Button
8	Inducture Adjustment Knob	*20*	Menu Button Left
9	Adjustment Dial	*21*	Trigger Mode Selector
10	Material Selection Switch	*22*	Trigger Mode Indicator
11	Volts/Arc Length Indicator	*23*	Welding Mode Switch
12	Arc Force Indicator	*24*	Welding Mode Indicator
		25	Adjustment Knob

SAFETY GUIDELINES

WARNING

READ ALL SAFETY WARNINGS & INSTRUCTIONS. Failure to follow instructions and warnings could lead to serious injury, electric shock, or fire.

Work Area Safety

- **Ensure that your work area is kept clean and well lit.** Lack of visibility and clutter greatly increase the risk of accident when using tools.
- **Keep bystanders, pets, and children clear when operating this power tool or machine.** They can cause distraction or risk injury to themselves.
- **Ensure you are not operating the power tool or machinery in the presence of dust, liquids, flammable gases, or anything that can create an explosive atmosphere.** Power tools and machinery can create sparks which can lead to ignition and fire hazards in working environments.

Personal Safety

- **Always wear personal protective equipment (PPE).** Eye protection, ear protection, dust masks, and other protective equipment will help to reduce the risk of personal injury or long-term illnesses.
- **Dress appropriately. DO NOT wear loose clothing that can get caught in moving parts.** Keep hair, loose clothing, jewellery, and anything else that could be of risk, away from moving parts in the machine, or they could become caught therein.
- **Always remain alert and DO NOT operate power tools or machinery under the influence of any substances such as alcohol or drugs, including prescription medications.** Lack of focus could lead to injury or accidents while operating these power tools and machinery.
- **Always ensure proper footing and balance.** Overreaching can lead to slipping and falling which can result in injury or accident.
- **Ensure the power switch is in the OFF position before connecting any battery, or power source to the power tool or machinery.** This can cause injury as tools and machinery can suddenly fire incidentally when live, causing accidents.
- **Use all provided dust collection and extraction attachments, if included.** This equipment, along with the use of PPE dust masks, can help keep you safe from dust, and keep your work site clear from hazards.
- **Ensure loose parts such as wrenches or adjusting keys are removed before starting the power tool or machinery.**

SAFETY GUIDELINES

Electrical Safety

- **DO NOT use the power tool or machinery in rainy conditions or wet areas where the power tool or machinery could get wet.** Water in this power tool or machinery can lead to electric shock.
- **Only use the power tool or machinery when the plug correctly matches the power outlet.** Modifying plugs greatly increases the risk of electric shock.
- **Keep the power cord away from anything that could damage it such as sharp edges, moving parts or heat.** A damaged power cord increases the risk of electric shock.
- **Only operate outdoors with the use of an outdoor extension lead.** Not all extension leads are suited to outdoor use and using one which is not can greatly increase the risk of electric shock.
- **Avoid body contact with grounded or earthed surfaces.** Surfaces such as radiators, ranges, pipes, and refrigerators can increase the risk of electric shock due to your body being earthed or grounded.
- **Never carry the power tool by the cord, or yank the cable from the power outlet.** This can damage the internal wiring and may become a hazard.

WARNING

Electric shock can cause serious injury or, in some cases be fatal.

Power Tool & Machinery Use & Care

- **Use the correct tool for the job.** Forcing a tool to do a job it was not designed for increases the risk of accident or injury.
- **Disconnect tools and machinery from power, or remove batteries before doing any maintenance or adjustments, or before storing the tools and machinery.** This reduces or removes the risk of a power connection that causes the tool or machinery to accidentally fire, which can help prevent injury or accident.
- **Check the general condition of the power tool for damage or any problems that could affect the way the tool or machine works.** An unrepaired tool or machine can lead to accident and injury. Only have your tool or machine repaired with genuine parts from The ToolShed.
- **Only use the power tool and machinery with genuine parts or accessories that are designed to be used with this power tool and machinery.** Failure to do so could result in accident or injury or damage your tool or machinery.
- **Store your tool or machinery out of reach of children, and away from untrained personnel when not in use.** Use by somebody untrained, or a child, could lead to accident or serious injury.

OPERATION MANUAL

SAFETY GUIDELINES

Service

- **Have your tools and machinery serviced at The ToolShed with ToolShed replacement parts.** This will ensure that the safety of the power tool or machine is maintained.

WARNING

The warnings and precautions discussed in this manual cannot cover all possible conditions and situations that may occur. It must be understood by the operator that common sense and caution are factors which cannot be built into this product, but must be supplied by the operator.

Always Use Common Sense

- It is not possible to cover every conceivable situation you can face. Always exercise care and use your common sense. If you get into a situation where you feel unsafe, stop and seek expert advise. Contact your dealer, service agent, or an experienced user. Do not attempt any task you feel unsure of!
- **Do not let familiarity gained from the frequent use of tools allow you to become complacent and ignore tool safety principles.** A careless action can cause severe injury within a fraction of a second.

Welder Specific Safety

The Environment:

- The environment in which this welding equipment is installed must be free of grinding dust, corrosive chemicals, flammable gas or materials, and at no more than maximum of 80% humidity.
- Always keep a fire extinguisher near to your welding environment.
- Always ensure there is a qualified person to install and operate this equipment.
- Make sure the area is clean, dry and well ventilated. Do not operate the welder in humid, wet or poorly ventilated areas.
- Always have your welder maintained by a qualified technician.
- Always be aware of your work environment. Be sure to keep other people, especially children, away from you while welding.
- Keep harmful arc rays shielded from the view of others.
- Mount the welder on a secure bench or cart that will keep the welder secure and prevent it from tipping over or falling.
- Maintain good ventilation of this equipment. The minimum distance between this equipment and any other objects in or near the working area should be 30 cm.
- **The Welder:**
- Check ground cable, power cord and welding cable to be sure the insulation is not damaged. Always replace or repair damaged components before using the welder.
- Check all components to ensure they are clean and in good operating condition before use.

SAFETY GUIDELINES

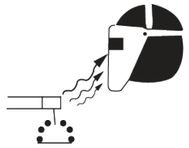
Personal Protective Equipment

- **A welding helmet is a crucial piece of PPE that shields the welder's face and eyes from the intense light, radiation, flying sparks, molten metal, and debris.** Without a welding helmet, welders risk suffering from arc eye, which is a painful condition caused by overexposure to the welding arc's ultraviolet (UV) and infrared (IR) rays. Long-term exposure can lead to permanent eye damage, including blindness.
- **Gloves provide protection from sparks, spatter, and hot metal that can result from the welding process.** Gloves prevent burns and injuries to the hands, which are particularly vulnerable to heat and molten metal.
- **Welders should wear flame-resistant overalls or clothing that covers their entire body.** Sparks or slag can ignite materials like cotton, proper welding attire protects from welding arc radiation, spatter, and potential fires.
- **Welding glasses:** Post welding can remove the helmet in use of Safety glasses that can protect your eyes when brushing, chipping, or grinding slag from the weld.
- **Ear Protection:** Earplugs or earmuffs can help protect against hearing damage from prolonged exposure to loud welding equipment.
- **Welding Respirator:** Welding produces fumes and gases that can be harmful when inhaled. A respirator with appropriate filters can help protect against inhaling these noxious substances.

ARC Welding Electric Shock Hazards

- Do not touch live electrical parts.
- Wear dry, hole-free insulating gloves and body protection.
- Insulate yourself from work and ground using dry insulating mats or covers.
- Disconnect input power or stop engine before installing or servicing this equipment.
- Turn off all equipment when not in use. Disconnect power to equipment if it will be left unattended or out of service.
- Use fully insulated electrode holders. Never dip holder in water to cool it, or lay it down on the ground or the work surface. Do not touch holders connected to two welding machines at the same time or touch other people with the holder or electrode.
- Do not use worn, damaged, undersized, or poorly spliced cables.
- Do not wrap cables around your body.
- Ground the workpiece to a good electrical (earth) ground.
- Do not touch electrode while in contact with the work (ground) circuit.
- Use only well-maintained equipment. Contact your nearest ToolShed to repair or replace damaged parts at once.
- In confined spaces or damp locations, do not use a welder with AC output unless it is equipped with a voltage reducer. Use equipment with DC output.
- Wear a safety harness to prevent falling if working above floor level.
- Keep all panels and covers securely in place.

SAFETY GUIDELINES



ARC Rays Hazards

WARNING

ARC RAYS can burn eyes and skin; NOISE can damage hearing.

Arc rays from the welding process produce intense heat and strong ultraviolet rays that can burn eyes and skin. Noise from some processes can damage hearing.

- Use a Welding Helmet or Welding Face shield fitted with a proper shade of filter to protect your face and eyes when welding or watching.
- Wear approved safety glasses. Side shields recommended.
- For welders under 160 Amps output, use a shade 10 lens; for those above 160 Amps, use a shade 12. Refer to the *Shade Guide Table* on page 12 for more information.
- Use protective screens or barriers to protect others from flash and glare; warn others not to watch the arc.
- Wear protective clothing made from durable, flame-resistant material (wool and leather) and foot protection.
- Use approved ear plugs or ear muffs if noise level is high.

Fumes & Gasses Hazards

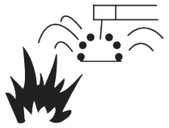
WARNING

FUMES AND GASES can be hazardous to your health.

Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health.

- Keep your head out of the fumes. Do not breath the fumes.
- If inside, ventilate the area and/or use exhaust at the arc to remove welding fumes and gases.
- If ventilation is poor, use an approved air-supplied respirator.
- Work in a confined space only if it is well ventilated, or while wearing an air-supplied respirator. Shielding gases used for welding can displace air causing injury or death. Be sure the breathing air is safe.
- Do not weld in locations near degreasing, cleaning, or spraying operations. The heat and rays of the arc can react with vapours to form highly toxic and irritating gases.
- Do not weld on coated metals, such as galvanised, lead, or cadmium plated steel, unless the coating is removed from the weld area, the area is well ventilated, and if necessary, while wearing an air supplied respirator. The coatings and any metals containing these elements can give off toxic fumes if welded.

SAFETY GUIDELINES



Fire & Explosion Hazards

⚠ WARNING

WELDING can cause fire or explosion.

The flying sparks and hot metal, weld spatter, hot workpiece, and hot equipment can cause fires and burns. Accidental contact of electrode or welding wire to metal objects can cause sparks, overheating, or fire.

- Do not weld where flying sparks can strike flammable material.
- Remove all flammables within 10m (35 ft) of the welding arc. If this is not possible, tightly cover them with approved covers.
- Be alert that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
- Always be alert for fire, and keep a fire extinguisher nearby.
- Be aware that welding on a ceiling, floor, bulkhead, or partition can cause fire on the hidden side.
- Do not weld on closed containers such as tanks or drums.
- Do not use welder to thaw frozen pipes.
- Remove stick electrode from holder or cut off welding wire at contact tip when not in use.
- Connect the work cable close to the welding area to prevent current from traveling long distances, reducing electric and fire hazards.

Cylinder Hazards

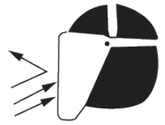
⚠ WARNING

CYLINDERS can explode if damaged.

Shielding gas cylinders contain gas under high pressure. If damaged, a cylinder can explode. Since gas cylinders are an important part of the welding process, be sure to treat them carefully.

- Protect compressed gas cylinders from excessive heat, mechanical shocks, and arcs.
- Install and secure cylinders in an upright position by chaining them to a stationary support or equipment cylinder rack to prevent falling or tipping.
- Keep cylinders away from any welding or other electrical circuits.
- Never allow a welding electrode to touch any cylinder.
- Use only correct shielding gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and all associated parts in good condition.
- Turn your face away from valve outlet when opening cylinder valve.
- Keep the protective cap in place over the valve except when the cylinder is in use, or connected for use.

SAFETY GUIDELINES



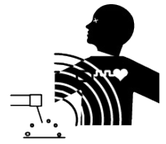
Flying Sparks Hazards

⚠ WARNING

FLYING SPARKS AND HOT METAL can cause injury.

Chipping and grinding causes flying metal. As welds cool, they can throw off slag.

- Wear approved face shield or safety goggles. Side shields recommended.
- Wear proper body protection to protect skin.



Electromagnetic Hazards

⚠ WARNING

Implanted Medical Device wearers should consult their doctor and the device manufacturer before going near any electric welding, cutting or heating operation.

- Electromagnetic fields can interfere with various electrical and electronic devices such as pacemakers.
- Consult your doctor before using any electric arc welder or cutting device
- Keep people with pacemakers away from your welding area when welding.
- Do not wrap the cable around your body while welding.

Shade Guide Table

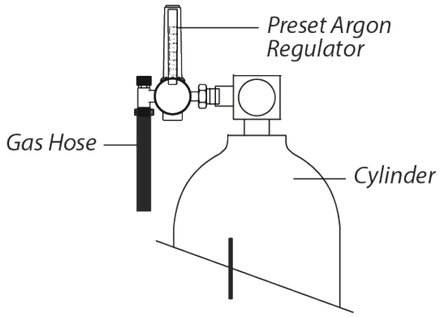
Welding Process	Arc Current(Amperes)																			
	1.5	6	10	15	30	40	60	70	100	125	150	175	200	225	250	300	350	400	450	500	600
SMAW					8			9		10		11		12			13			14	
MAG							8	9		10		11			12			13			14
TIG				8		9			10		11			12		13					
MIG(heavy)									9		10		11			12		13		14	
MIG(light)											10		11		12		13		14		
PAC										9		10		11		12			13		
PAW	4		5		6		7		8		9		10			11			12		

Note

★SMAW-Covered electrodes
★MAG-Metal arc Welding
★TIG-Gas Tungsten Arc Welding
★MIG(Heavy)-MIG with heavy metals
★MIG(light)-MIG with light alloys
★PAC-Plasma jet cutting
★PAW-Microplasma arc welding

MIG — WELDING ASSEMBLY

Set Up for MIG Welding



Fit Regulator/Flowmeter to the Cylinder

- A regulator, or flowmeter is designed to manage high-pressure gas from a cylinder or pipeline, adjusting it to the necessary working pressure for equipment. Improper use can lead to hazardous conditions and accidents. Users must assume responsibility for preventing such conditions and adhere to the safe practices outlined in this instruction before handling or using the equipment.

WARNING

Match the regulator/flowmeter to the corresponding cylinder gas; never connect a regulator intended for specific gas or gases to a cylinder with a different gas.

Regulator/Flowmeter Safety

- NEVER expose the regulator to inlet pressures surpassing its rated capacity.
- NEVER apply pressure to a regulator with loose or damaged components.
- NEVER loosen connections or attempt to dismantle any part of a regulator until gas pressure has been relieved, as pressurised gas can forcefully propel loose components.
- DO NOT detach the regulator from a cylinder without first closing the cylinder valve and releasing gas from both the high and low-pressure chambers of the regulator.
- DO NOT employ the regulator as a control valve. When downstream equipment remains inactive for extended periods, turn off the gas at the cylinder valve and release gas from the equipment.
- OPEN the cylinder valve SLOWLY. Always close it after use.

Cylinder Installation

- Remove the plastic dust seal from the cylinder valve. Prior to connecting the regulator, ensure the cylinder valve outlet is free from impurities that could obstruct or damage orifices and seats.
- Briefly crack the valve (open and then close), directing the outlet away from individuals and potential ignition sources. Use a clean, lint-free cloth to wipe the valve.
- Verify that the regulator corresponds to the cylinder. Prior to connection, confirm alignment between the regulator label and cylinder marking, and ensure compatibility between the regulator inlet and cylinder outlet. NEVER ATTACH a regulator designed for specific gases to a cylinder containing different gases.
- Attach the regulator inlet connection to the cylinder or pipeline, securing it firmly but not excessively with an appropriate spanner.
- Connect the outlet hose securely and tighten, then downstream equipment. For accurate

MIG — WELDING ASSEMBLY

Cylinder Installation Cont.

readings, position the regulator vertically.

- Note that the regulator includes a self-re-seating relief valve, which is not intended to safeguard downstream equipment. To safeguard sensitive downstream equipment, a separate safety device may be required.

Operation

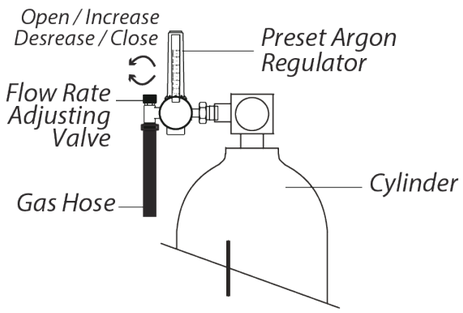
With the regulator connected to the cylinder:

- Stand to the side of the regulator and gradually turn the cylinder valve open. Rapid opening of the valve may result in a sudden surge of pressure, potentially causing harm to internal regulator components.
- If the regulator is preset, there is no need for any adjustments. Prior to opening the cylinder valve, ensure that the flow adjusting valve is securely in the "OFF" position (clockwise).
- Gradually turn the cylinder valve until the high-pressure gauge registers the maximum pressure.

WARNING

DO NOT purge oxidising or flammable gases in the presence of flame, lighted cigarettes, or other sources of ignition or in a confined space. Open each downstream valve in turn, if more than one regulator is used. Close one valve before opening the next one. This procedure will prevent explosive gas mixtures occurring in the welding hose between regulators and equipment.

Adjusting Flow Rate



Adjust the Flow Rate

With the regulator ready for operation, adjust working flow rate as follows:

- Gradually rotate the adjusting valve counter-clockwise to open and increase it until the bobbin in the flow tube or the dial on the gauge reflects the desired flow rate.
- To decrease the flow rate, permit the release of welding-grade shielding gas from the regulator by opening the downstream valve. Discharge welding-grade shielding gas in a well-ventilated area, away from any potential ignition sources. Rotate the adjusting screw clockwise until the gauge indicates the desired flow rate. Subsequently, close the downstream valve.

NOTE

It may be necessary to re-check the shielding gas regulator flow rate following the first weld sequence due to back pressure present within shielding gas hose assembly.

MIG — WELDING ASSEMBLY

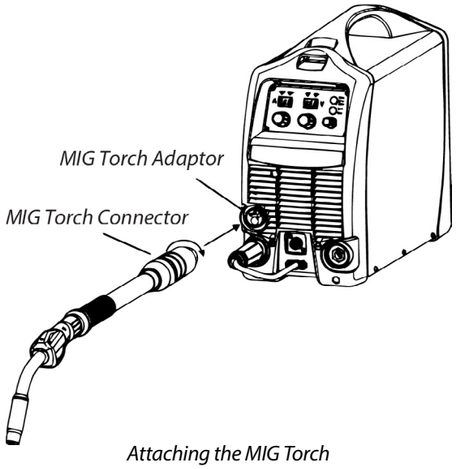
Shutdown of the Cylinder

Close the cylinder valve whenever the regulator is not in use. To shut down for extended periods (more than 30 minutes).

- Close cylinder or upstream valve tightly.
- Open downstream equipment valves to drain the lines. Bleed gas into a well ventilated area and away from any ignition source.
- After gas is drained completely, disengage adjusting screw and close downstream equipment valves.
- Before transporting cylinders that are not secured on a cart designed for such purposes, remove regulators.

Attach the MIG Torch

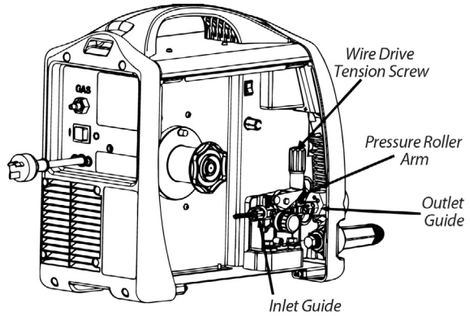
- Fit the MIG Torch to the power source by pushing the MIG torch connector into the MIG torch adaptor and screwing the plastic torch nut clockwise to secure the MIG torch to the MIG torch adaptor.



Attaching the MIG Torch

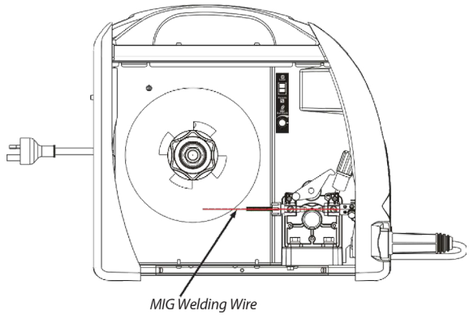
Inserting Wire into the Wire Feed Mechanism

- Ease pressure on the roller by turning the adjustable wire drive tension screw counter-clockwise. Push the tension screw towards the front of the machine to release the pressure roller arm, disengaging it.



Wire Drive Assembly Components

- Feed the MIG welding wire from the bottom of the spool. Pass the electrode wire through the inlet guide, between the rollers, through the outlet guide, and into the MIG torch.



Mig Welding Wire - Installation

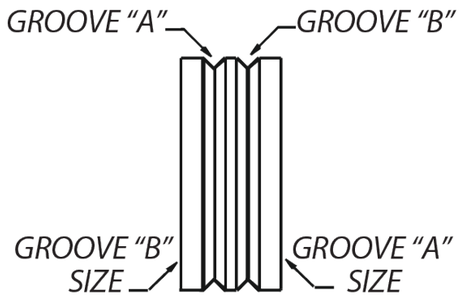
- Re-secure the pressure roller arm and wire drive tension screw, adjusting as necessary. Take off the contact tip from the MIG torch, straighten the MIG torch lead, and feed the wire through the torch by pressing the trigger switch. Install a suitable contact tip.

OPERATION MANUAL

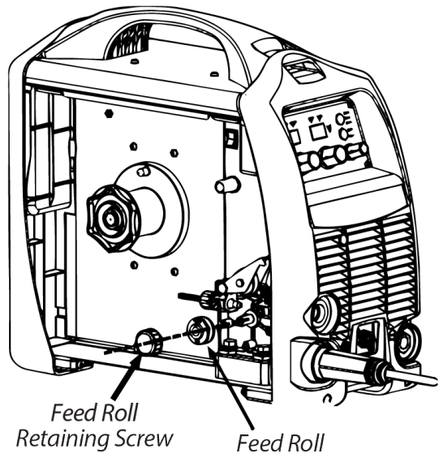
MIG — WELDING ASSEMBLY

Changing the Feed Roll

- To replace the feed roll, unscrew the feed roll retaining screw counter-clockwise. After removing the feed roll, follow the same steps in reverse to install a new one.
- A dual groove feed roller is provided as the default option, suitable for 0.6/0.8mm diameter hard wires. Choose the appropriate roller, ensuring that the selected wire size marking faces outward.



Dual Groove Feed Roller

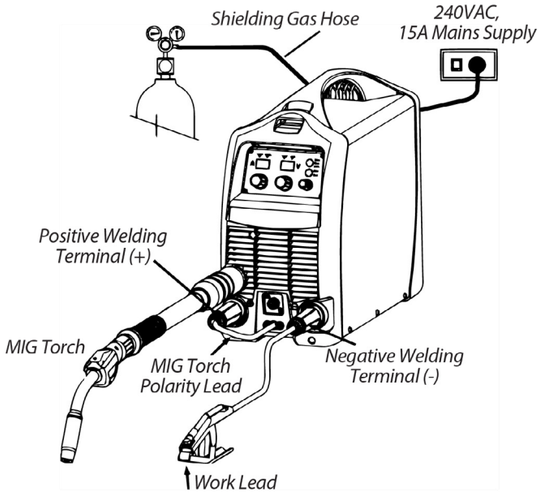


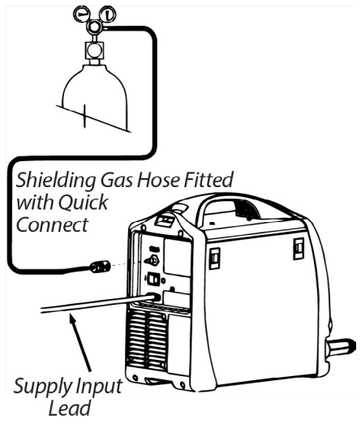
Changing the Feed Roll

MIG Welding with Gas Shielded MIG Wire

- Fit the MIG Torch to the Welder. Ensure that the power source, and the welder are both switched OFF.
- Connect the MIG torch polarity lead to the positive welding terminal (+). If uncertain, refer to the electrode wire manufacturer's instructions. Welding current travels from the Power Source through Dinse terminals. Ensure the male plug is securely inserted and turned to establish a reliable electrical connection.
- Fit the correct Feed Roll for the Gas Shielded MIG wire being used.
- Place the MIG wire spool onto the spool holder.
- Activate the Power Source by flipping the On/Off switch located on the rear of the unit to the ON position. Verify that the Power indicator on the Front Panel is illuminated.
- Select MIG Gas (Solid) Mode using the Process Selection Control button.
- Feed wire through the wire drive mechanism
- Attach the work lead to the negative welding terminal (-). The welding current travels from the Power Source through Dinse terminals. It is crucial to securely insert and turn the male plug for a reliable electrical connection.
- Install the welding-grade shielding gas regulator on the shielding gas cylinder. Confirm a securely tightened connection for the shielding gas hose at the regulator.

MIG — WELDING ASSEMBLY





Setup for MIG Welding with Gas Shielded MIG Wire

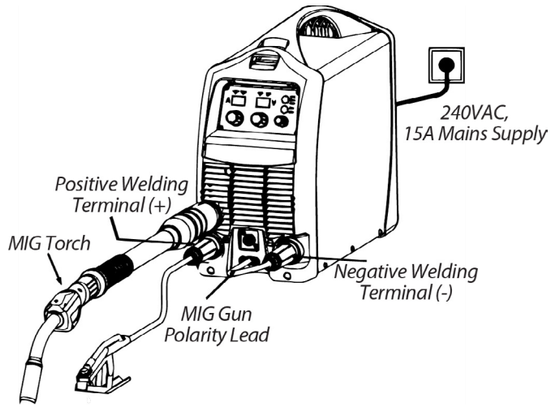
MIG Welding with Gasless MIG Wire

- Fit the MIG Torch to the Welder. Ensure that the power source, and the welder are both switched OFF.
- Attach the MIG Torch polarity lead to the negative welding terminal (-). Welding current travels from the power source through Dinse terminals. Ensure a secure electrical connection by firmly inserting and turning the male plug.
- Activate the Power Source by flipping the On/Off switch located on the rear of the unit to the ON position. Verify that the Power indicator on the Front Panel is illuminated.
- Set the MIG Torch trigger switch operation either 2T or 4T mode.

2T Mode: Means to press the gun/torch trigger to weld, and release to stop.

4T Mode: You presses and releases the trigger once to start the weld. The arc continues without needing to hold the trigger down. To stop the arc, press and releases the trigger again.

- Select MIG mode with the selection control.
- Fit the correct V Knurled Feed Roll for the Gasless MIG wire being used.
- Place the wire spool onto the spool holder.
- Feed wire through the wire drive mechanism.



Setup for MIG Welding with Gasless MIG Wire

- Link the work lead to the positive welding terminal (+). Welding current moves from the power source through Dinse terminals. Ensure a reliable electrical connection by firmly inserting and turning the male plug.

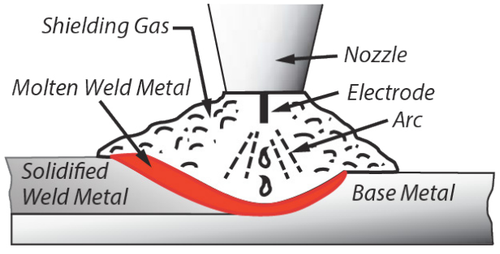
MIG — WELDING OPERATION

Basic MIG Welding Technique

- Offering fundamental guidance on using the MIG welding mode: a hand-held welding gun feeds the electrode (welding wire) into a weld puddle, while the arc is shielded by inert welding-grade shielding gas or a mixture thereof.

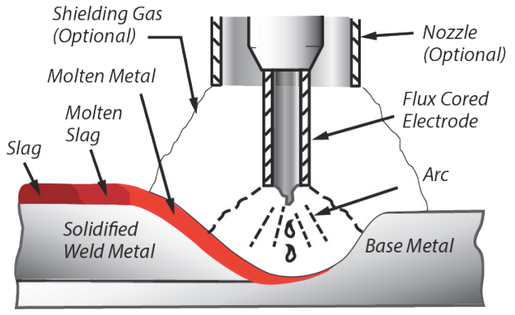
Gas Metal Arc Welding (GMAW)

- This process, also referred to as MIG welding, CO2 welding, Micro Wire Welding, short arc welding, dip transfer welding, wire welding, etc., is an electric arc welding method that fuses parts by heating them with an arc between a continuous consumable electrode and the work piece. Shielding comes from externally supplied welding-grade shielding gas or a mixture. Typically applied semi-automatically, it can also be operated automatically and by machine. Suitable for welding thin to fairly thick steels and some non-ferrous metals in all positions.



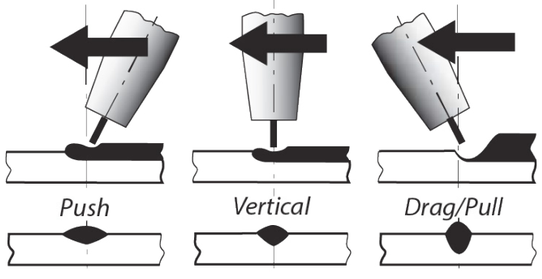
Flux Cored Arc Welding (FCAW)

- This electric arc welding method fuses parts by heating them with an arc between a continuous flux-filled electrode wire and the work. Shielding is achieved through flux decomposition within the tubular wire, and external gas may or may not be used for additional shielding. Typically applied semi-automatically, it can also be used automatically or by machine. Commonly employed for welding large electrode diameters in flat and horizontal positions, as well as smaller electrode diameters in all positions. Used to a lesser extent for welding stainless steel and overlay work.



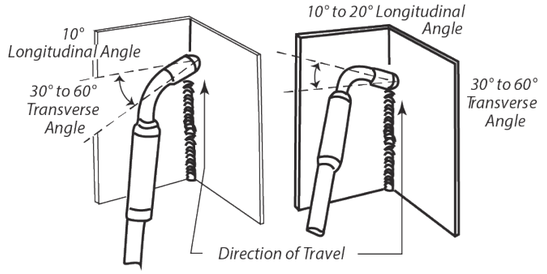
Positioning the MIG Torch

- The angle of MIG torch to the weld has an effect on the width of the weld.



MIG — WELDING OPERATION

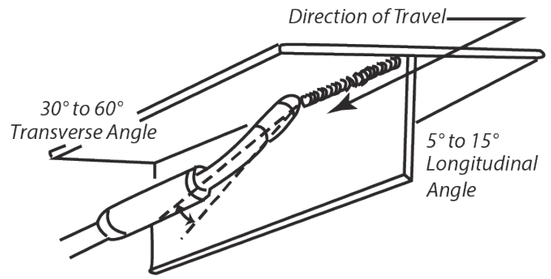
- The welding gun should be held at an angle to the weld joint. (See Secondary Adjustment Variables below).
- Hold the gun so that the welding seam is viewed at all times. Always wear the welding helmet with proper filter lenses and use the proper safety equipment.



Vertical Fillet Welds

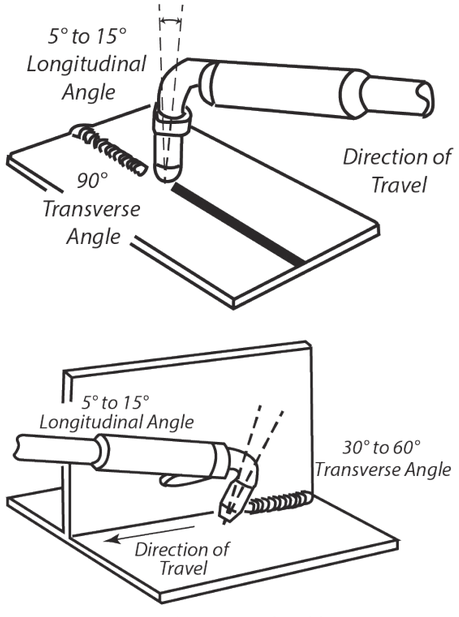
CAUTION

Do not pull the welding gun back when the arc is established. This will create excessive wire extension (stick-out) and make a very poor weld.



Overhead Welds

- The electrode wire remains unenergised until the gun trigger switch is pressed. Consequently, the wire can be positioned on the seam or joint before lowering the helmet.



Butt & Horizontal Welds

Distance from the MIG Gun Nozzle to the Work Piece:

- Maintain an electrode wire stick-out from the MIG Gun nozzle between 10mm to 20mm, with variations based on the specific joint being welded.

Travel Speed:

- The molten pool's travel speed impacts both the width of the weld and the penetration of the welding run.

MIG — WELDING OPERATION

MIG Welding (GMAW) Variables

- The majority of welding across various processes is conducted on Carbon Steel. The following points outline welding variables in short-arc welding of 24-gauge (0.6mm) to 6.4mm (1/4") mild sheet or plate. These variables govern the applied techniques and ultimate outcomes in the GMAW process.

Preselected Variables

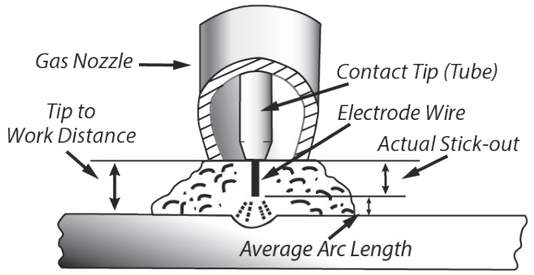
- The preselected variables are contingent on the material type, thickness, welding position, deposition rate, and mechanical properties. These variables include:
  - Type of electrode wire,
  - Size of electrode wire,
  - Type of gas (not applicable to self shielding wires FCAW),
  - Gas flow rate (not applicable to self shielding wires FCAW).

Primary Adjustable Variables

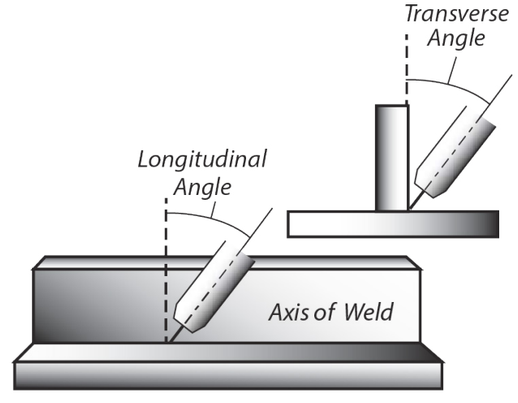
- These parameters regulate the process following the identification of preselected variables. They govern penetration, bead width, bead height, arc stability, deposition rate, and weld soundness. They include:
  - Arc Voltage,
  - Welding current (Wire Feed Speed),
  - Travel speed.

Secondary Adjustable Variables

- These variables induce modifications in primary adjustable factors, subsequently leading to the desired changes in bead formation. They include:
  - **Stick-out:** (distance between the end of the contact tube and the electrode wire). Maintain at about 10mm stick-out.
  - **Wire Feed Speed:** Increase in Wire Feed Speed increases weld current, Decrease in Wire Feed Speed decreases weld current.

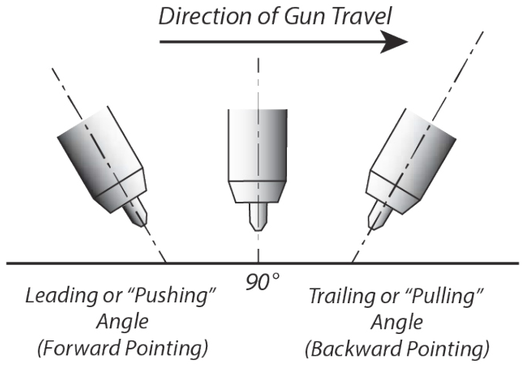


  - **Nozzle Angle:** This denotes the welding gun's position concerning the joint. The transverse angle is typically half the included angle between the plates forming the joint. The longitudinal angle, often termed the Nozzle Angle, is the angle between the welding gun's centerline and a line perpendicular to the weld axis. It can be either trailing (pulling) or leading (pushing). The operator's handedness should be taken into account to understand the impact of each angle relative to the direction of travel.



Transverse and Longitudinal Nozzle Axes

MIG — WELDING OPERATION



Establishing the Arc & Making Weld Beads

- Before attempting to weld a finished work-piece, it is best to practice on a sample similar in characteristics to that of the finished piece.
- The most beginner-friendly MIG welding position to experiment with is the flat position. The equipment is suitable for flat, vertical, and overhead positions.
- To practice MIG welding, obtain pieces of 16 or 18-gauge (1.5mm or 2.0mm) mild steel plates measuring 150 x 150mm (6x6"). Utilise 0.8mm flux-cored gasless wire or a solid wire with shielding gas.

Electrode Wire Size Selection

The choice of Electrode wire size and shielding gas used depends on the following:

- Thickness of the metal to be welded,
- Type of joint,
- Capacity of the wire feed unit and Power Source,
- The amount of penetration required,
- The deposition rate required,
- The bead profile desired,
- The position of welding,
- Cost of the wire.

ARC — PREPARATION

⚠ WARNING

EXPOSURE TO A WELDING ARC IS EXTREMELY HARMFUL TO THE EYES AND SKIN! Prolonged exposure to the welding arc can cause blindness and burns. Never strike an arc or begin welding until you are adequately protected. Wear welding gloves, heavy long sleeved shirt and trousers, shoes, and an ANSI approved welding helmet.

VRD – Voltage Reduction Device

- When the machine is turned on the VRD is always active as a safety feature. This reduces the open circuit voltage on the welder to about 20 Volts, significantly reducing the risk of electric shock. In this mode it maybe a little harder to initiate the arc due to the lower open circuit voltage.
- If all safety precautions are in place and the you are wearing the correct PPE, you can disable the VRD by holding the TIG/MMA selector switch for 5 seconds. The VRD light will turn off and the open circuit voltage will increase to about 75 Volts, making striking the arc a lot easier.

ARC Force

- When the welding machine senses a short circuit it will deliver a peak of current. This greatly assists in stabilising the arc, preventing the arc from cutting out while welding and preventing the electrode sticking. You can increase or decrease the arc force depending on your preferences.

Setting Up the Work Piece

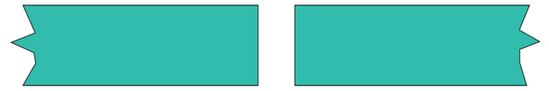
Welding Positions

- There are two basic positions, for welding: Flat and Horizontal.
- Flat welding is generally easier, faster, and allows for better penetration. If possible, the work piece should be positioned so that the bead will run on a flat surface.

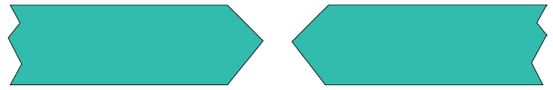
Preparing the Joint

- Before welding, the surface of work piece needs to be free of dirt, rust, scale, oil or paint, or it will create brittle and porous welds. If the base metal pieces to be joined are thick or heavy, it may be necessary to bevel the edges with a metal grinder, the correct bevel should be around 60 degree. See below:

INCORRECT



CORRECT



ARC Welding Practice

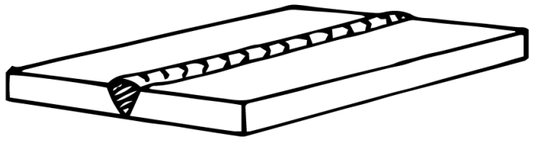
- The techniques used for arc welding are almost identical despite what types of metals are being joined. Different types of electrodes would be used for different metals.

Welding Position

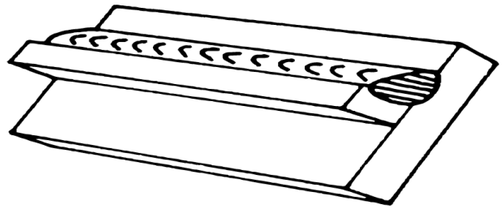
- These electrodes in the manual are versatile, suitable for flat, horizontal, vertical, and overhead welding, including positions in between. See some common welding positions on the following page.

ARC — PREPARATION

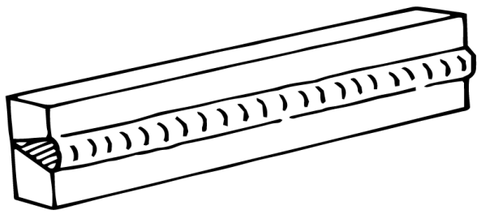
Some Common Welding Positions



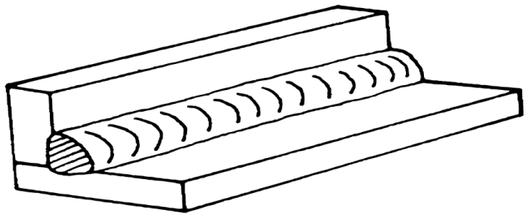
Flat Position, Down Hand Butt Weld



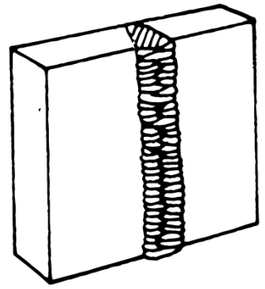
Flat Position, Gravity Fillet Weld



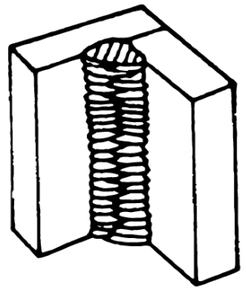
Horizontal Position, Butt Weld



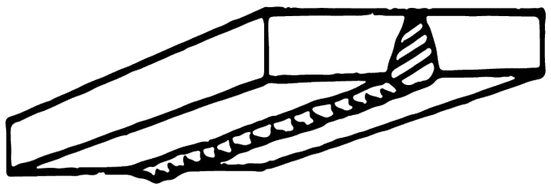
Horizontal - Vertical (HV) Position



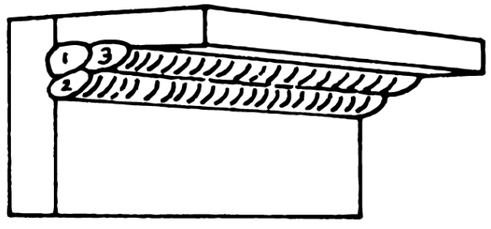
Vertical Position, Butt Weld



Vertical Position, Fillet Weld



Overhead Position, Butt Weld



Overhead Position, Fillet Weld

ARC — WELDING TECHNIQUE

Ground Clamp Connection

- Clear any dirt, rust, scale, oil or paint on the ground clamp. Ensure you have a good solid ground connection. A poor connection at the ground clamp will waste power and heat. Make sure the ground clamp touches the metal.

Electrode

- The welding electrode is a rod coated with a layer of flux. When welding, electrical current flows between the electrode (rod) and the grounded metal work piece. The intense heat of the arc between the rod and the grounded metal melts the electrode and the flux. For best performance on this unit, we suggest the use of 6013 electrodes. View the *Electrode Size Recommendation* chart on page 28 for more details.

ARC Welding Technique

A Word for Beginners

- For those new to welding, the easiest way to start is by practicing bead runs on a piece of scrap plate. Use a 6.0mm thick mild steel plate and a 3.2mm electrode. Ensure the plate is clean, free from paint, loose scale, or grease, and securely positioned on the workbench for down hand welding. Ensure that the work clamp maintains proper electrical contact with the work, either directly or through the work table. When working with light gauge materials, always attach the work lead directly to the job to avoid potential poor circuit connections.

The Welder

- Before you start welding, make sure you're in a comfortable position. Use a seat of the right height and try to do as much work as possible while sitting. Avoid holding your body in a tense manner, as a relaxed mindset and body will help you avoid feeling fatigued quickly. Wearing a leather apron and gauntlets can contribute to your peace of mind by protecting you from burns or sparks igniting your clothing.
- Position the workpiece so that the welding direction is from side to side rather than towards or away from your body. Ensure that the electrode holder lead remains unobstructed, allowing your arm to move freely as the electrode burns down. If you drape the lead over your shoulder, it provides increased freedom of movement and reduces the weight on your hand. Be certain that the cable and electrode holder's insulation is in good condition to avoid electric shock.

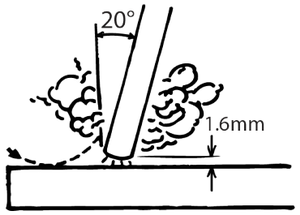
Striking the Arc

- Before moving on to more precise welding tasks, practice this technique on a scrap plate. You might initially face challenges like the electrode tip sticking to the workpiece, often due to excessive contact pressure with the workpiece and a slow withdrawal of the electrode. This problem can be aggravated with lower amperage settings. To prevent the tip from sticking, you can remedy it by scraping the electrode along the plate's surface, similar to striking a match. Once the arc is established, maintain a gap of 1.6mm to 3.2mm between the burning electrode tip and the base metal. Move the electrode slowly along as it melts.

ARC — WELDING TECHNIQUE

Striking the Arc Continued

- You might encounter another challenge, which is the tendency to withdraw the electrode too far after initiating the arc, causing it to break. With some practice, you can easily overcome both of these issues.



Arc Length

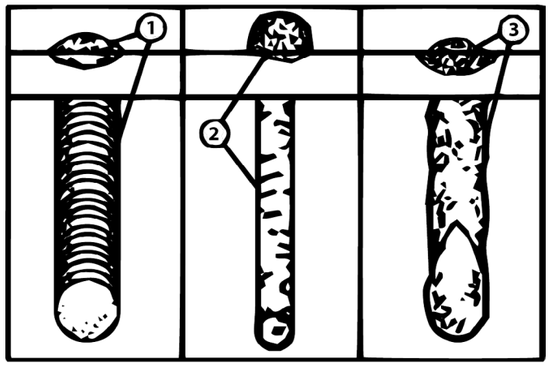
- Controlling the right arc length for a clean weld becomes almost automatic. A longer arc creates more heat, but if it's extremely long, you'll hear crackling or spluttering, and the weld metal will form large, uneven blobs. The weld bead becomes flat, and there's more spatter. To achieve a high-quality weld, you need a short arc, although if it's too short, it might get covered by slag, and the electrode tip could solidify. If that occurs, simply twist the electrode quickly to detach it.

Rate of Travel

- Once you've started the arc, your main task is to keep it going. This means you need to move the electrode tip toward the melting pool at the same speed it's melting. Simultaneously, you should move the electrode along the plate to create a bead. Aim the electrode at the weld pool with about a 20° angle from vertical. Adjust the travel speed so that you form a well-shaped bead.
- If you move too quickly, the bead will be narrow and stretched out, possibly breaking into separate droplets. If you move too slowly, the molten metal accumulates, resulting in an overly large bead.

Selecting the Right Electrode

- There is no golden rule that determine the exact rod or heat setting required for every situation. The type and thickness of metal and the position of the work piece determine the electrode type and the amount of heat needed in the welding process.



1. When a proper rod is used;

- The bead will lay smoothly over the work without ragged edges.
- The base metal puddle will be as deep as the bead that rises above it.
- The welding operation will make a crackling sound similar to that of frying eggs.

2. When a too small rod is used;

- The bead will be high and irregular.
- The arc will be difficult to maintain.

3. When the rod is too large;

- The arc will burn through light metals.
- The bead will undercut the work.
- The bead will be flat and porous.
- The rod may freeze or stick to the work piece.

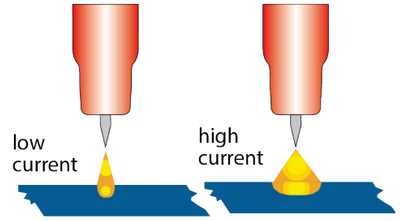
TIG — PREPARATION

WARNING

EXPOSURE TO A WELDING ARC IS EXTREMELY HARMFUL TO THE EYES AND SKIN! Prolonged exposure to the welding arc can cause blindness and burns. Never strike an arc or begin welding until you are adequately protected. Wear welding gloves, heavy long sleeved shirt and trousers, shoes, and an ANSI approved welding helmet.

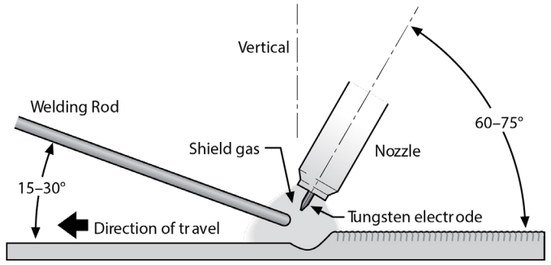
DC TIG Welding

- The DC power source uses what is known as DC (direct current) in which the main electrical component known as electrons flow in only one direction from the negative pole (terminal) to the positive pole (terminal).
- DC TIG welding is a process in which an arc is struck between a TUNGSTEN electrode and the metal work piece. The weld area is shielded by an inert gas flow to prevent contamination of the tungsten, molten pool, and weld area.
- The intensity of the arc is proportional to the current that flows from the tungsten. The welder regulates the welding current to adjust the power of the arc. Typically thin material requires a less powerful arc with less heat to melt the material so less current (amps) is required, thicker material requires a more powerful arc with more heat so more current (amps) are necessary to melt the material.



Starting Technique

- 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.



Starting the Arc

Scratch Start:

- Scratch Start is the most basic form of TIG welding and requires dragging the electrode across the surface of a workpiece to initiate the weld cycle.

High Frequency:

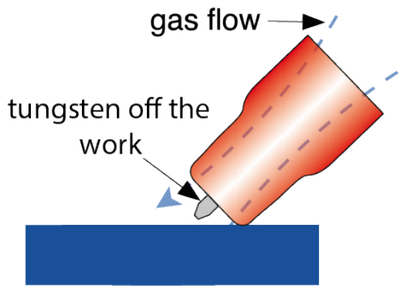
- A High Frequency start allows you to initiate the weld cycle by pressing a button, or foot pedal.

Lift Arc:

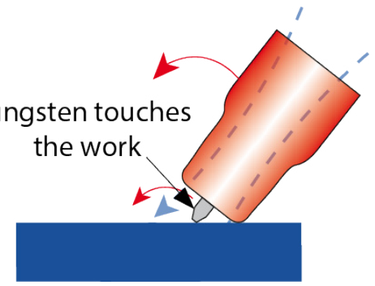
- Lift Arc requires touching the workpiece and lifting the torch to initiate the weld cycle.

TIG — IGNITION

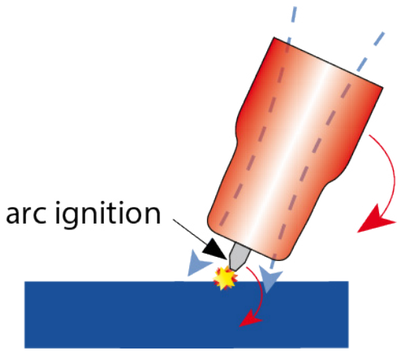
Lift Arc Ignition



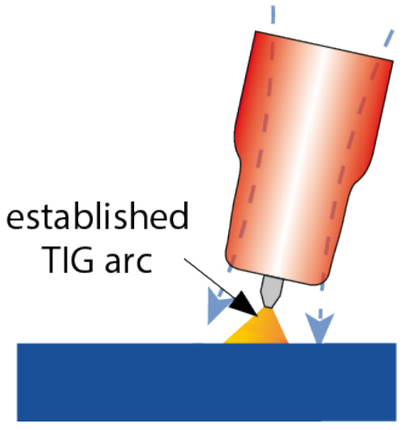
- Lay the nozzle on the workpiece without the tungsten touching the work.



- Rock the torch sideways so that the tungsten touches the work and hold momentarily.



- Rock the torch back in the opposite direction, the arc will ignite as the tungsten lifts off the work.

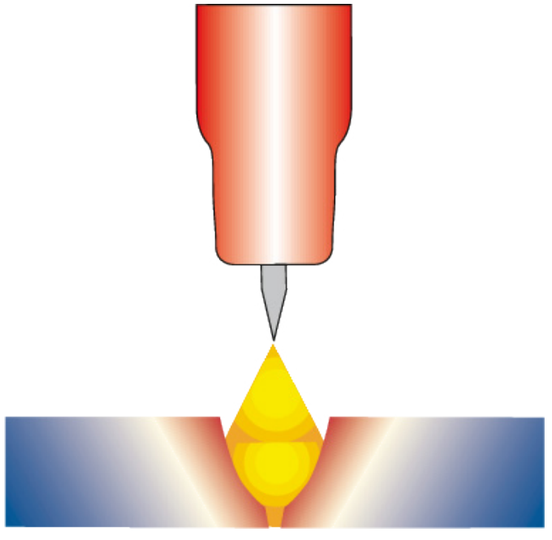


- Lift the torch to maintain the arc.

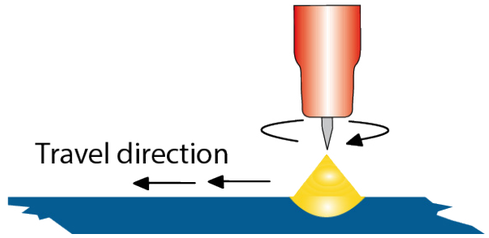
TIG — WELDING TECHNIQUE

TIG Welding Fusion Technique

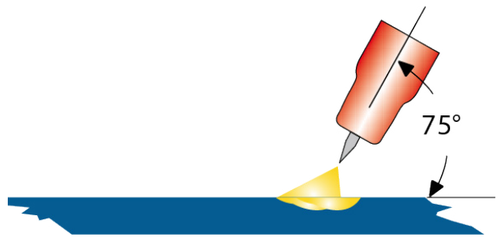
- TIG welding normally requires two hands and in most instances requires the welder to manually feed a filler wire into the weld pool with one hand while manipulating the welding torch in the other. However, some welds combining thin materials can be accomplished without filler metal like edge, corner, and butt joints.
- This is known as Fusion welding where the edges of the metal pieces are melted together using only the heat and arc force generated by the TIG arc. Once the arc is started the torch tungsten is held in place until a weld pool is created, a circular movement of the tungsten will assist is creating a weld pool of the desired size. Once the weld pool is established tilt the torch at about a 75° angle and move smoothly and evenly along the joint while fusing the materials together.



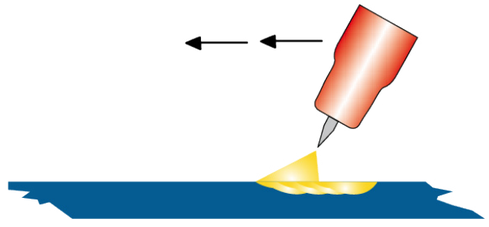
- Form a weld pool



- Angle the torch at approx a 75° angle.



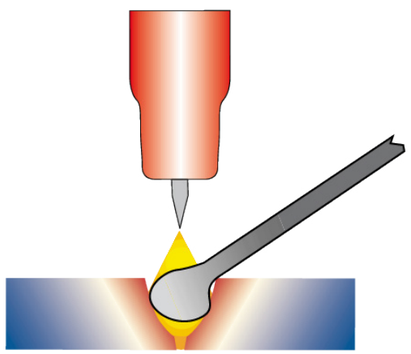
- Move the torch slowly and evenly forward.



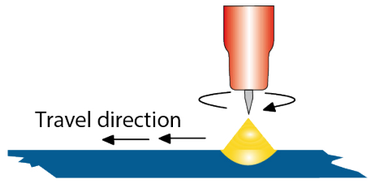
TIG — WELDING TECHNIQUE

TIG Welding with Filler Wire Technique

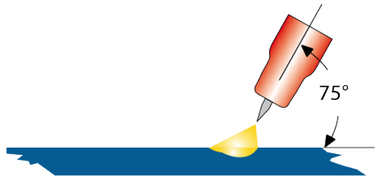
- It is necessary in many situations with TIG welding to add a filler wire into the weld pool to build up weld reinforcement and create a strong weld. Once the arc is started the torch tungsten is held in place until a weld pool is created, a circular movement of the tungsten will assist is creating a weld pool of the desired size.
- Once the weld pool is established, tilt the torch at a 75° angle and move smoothly and evenly along the joint. The filler metal is introduced to the leading edge of the weld pool.
- The filler wire is held at about a 15° angle and fed into the leading edge of the molten pool, the arc will melt the filler wire into the weld pool as the torch is moved forward.
- Also a dabbing technique can be used to control the amount of filler wire added, the wire is fed into the molten pool and retracted in a repeating sequence as the torch is moved slowly and evenly forward. It is important during the welding to keep the molten end of the filler wire inside the gas shield as this protects the end of the wire from being oxidised and contaminating the weld pool.



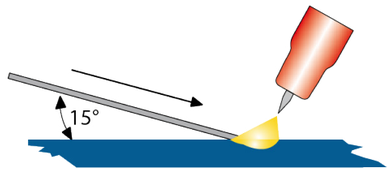
- Form a weld pool



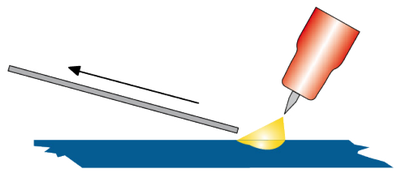
- Angle the torch at a 75° angle.



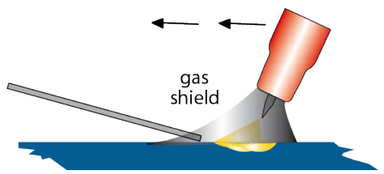
- Add TIG filler wire at a 15° angle.



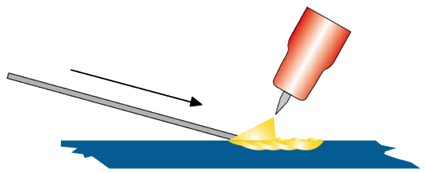
- Retract the filler wire.



- Move the torch forward to the front of the weld pool remaining within the shielding gas.

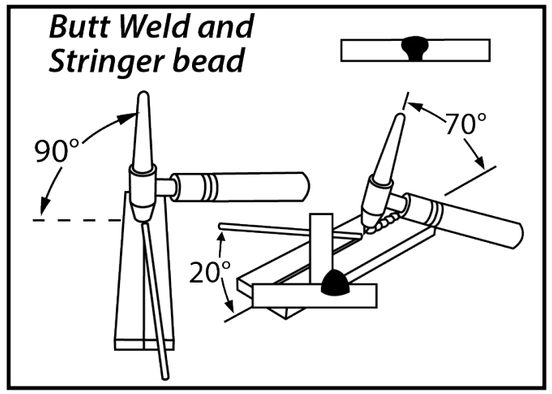


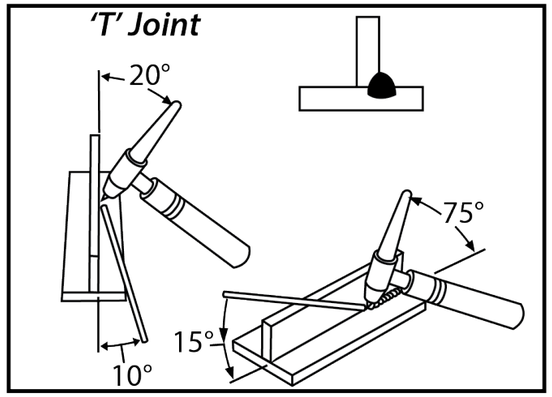
- Repeat the process consistently.

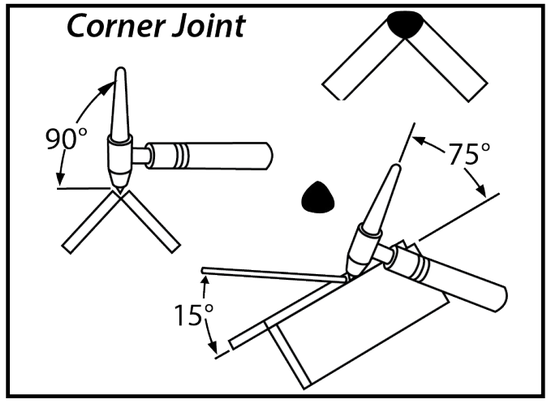


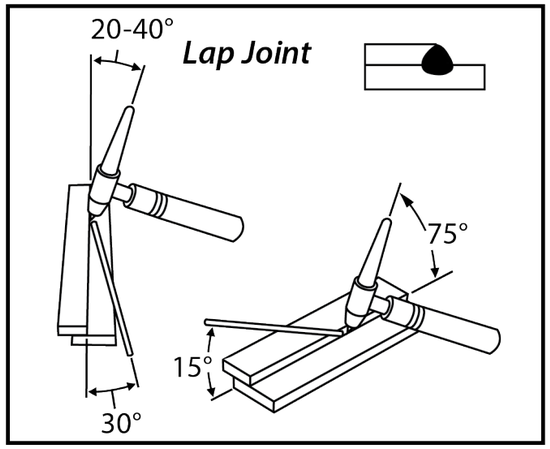
TIG — WELDING TECHNIQUE

Positioning the Torch for Various Weld Joints







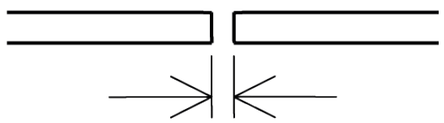


WELDING PREPARATION

Joint Preparations

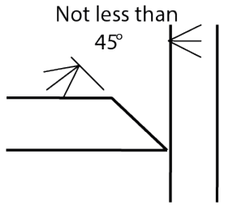
- In most instances, welding steel sections should not require any specific preparation. However, when dealing with thicker sections or repairing castings, it will be essential to cut or grind an angle between the pieces to enable proper weld penetration and create strong, secure joints.
- Surfaces being welded should be clean and free of rust, scale, dirt, grease, etc. Slag should be removed from oxy-cut surfaces.

Some Common Welding Joins

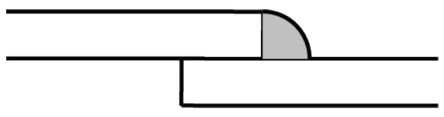


Gap varies from 1.6mm to 4.8mm depending on plate thickness

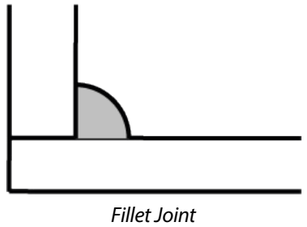
Open Square Butt Joint



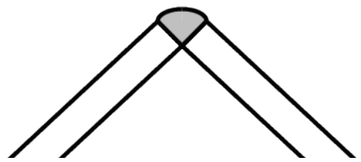
Single Vee Butt Joint



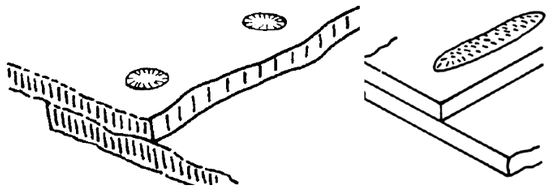
Lap Joint



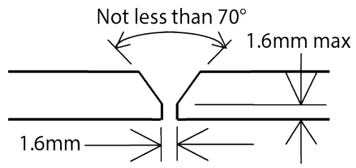
Fillet Joint



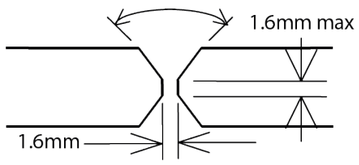
Corner Weld



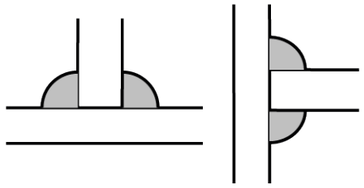
Plug Weld



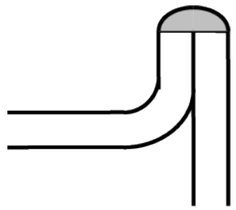
Single Vee Butt Joint



Double Vee Butt Joint



Tee Joints



Edge Joint

MAINTENANCE

- Before cleaning or performing any maintenance, you must ensure the tool is switched off and disconnected from the power supply.
- Compressed air is the most effective way to clean this tool. Always wear PPE safety goggles when cleaning tools with compressed air.
- Ventilation openings and switch levers must be kept clean. DO NOT attempt to clean by inserting pointed objects through openings.
- Do not use harsh chemicals or solvents when cleaning this tool.
- If you discover any damaged or broken parts, consult your nearest ToolShed for replacements and advise.
- Every six months, or as necessary, remove the cover panel from the welder and air-blow any accumulated dirt, metal filings, slag and loose material that may have accumulated inside the welder.

Electrode Size Recommendation

Average Thickness of Material	*Max. Recommended Electrode Diameter*
1.0 – 2.0mm	2.5mm Ø
2.0 – 5.0mm	3.2mm Ø
5.0 – 8.0mm	4.0mm Ø
8.0 – > mm	5.0mm Ø

Welding Current Recommendation

Electrode Size Diameter	*Current Range (Amps)*
2.5mm Ø	60 – 100 A
3.2mm Ø	100 – 130 A
4.0mm Ø	130 – 165 A
5.0mm Ø	165 – 260 A

MIG Welding Mild Steel Current Range to Wire Size

Welding Current Range	*Recommended Wire Size Diameter*
30 – 60 Amp	1 – 3mm Ø
60 – 120 Amp	3 – 5mm Ø
120 – 180 Amp	5 – 10mm Ø

ARC Welding Mild Steel Current Range to Wire Size

Welding Current Range	*Recommended Wire Size Diameter*
40 – 70 Amp	2 – 3mm Ø
55 – 90 Amp	2.5 – 5mm Ø
90 – 150 Amp	3.2 – 10mm Ø

MIG WELDING TROUBLESHOOTING

FAULT	POSSIBLE CAUSE	SUGGESTED SOLUTION
Undercut	Welding arc voltage too high	Decrease voltage or increase the Wire Feed Speed.
	Incorrect gun angle	Adjust angle.
	Excessive heat input	Speed up gun travel or reduce welding current by lowering voltage or decreasing Wire Feed Speed.
Lack Of Penetration	Welding current too low	Increase welding current by increasing Wire Feed Speed and increasing voltage.
	Joint preparation too narrow or gap too tight	Increase joint angle or gap.
	Incorrect shielding gas	Change to a gas which gives higher penetration.
Excessive Spatter	Voltage too high	Lower the voltage or raise the Wire Feed Speed.
	Voltage too low	Increase the voltage or decrease Wire Feed Speed.
Irregular Weld Shape	Incorrect voltage and current: Convex/ Concave signals low or high voltage	Adjust voltage and current by adjusting the voltage control and the Wire Feed Speed control.
	Wire is wandering	Replace contact tip.
	Incorrect shielding gas	Check shielding gas is correct.
	Insufficient or excessive heat input	Adjust Wire Feed Speed control or voltage control.
Weld Cracking	Weld beads too small	Decrease travel speed.
	Weld penetration narrow and deep	Lower current and voltage, increase MIG Gun travel speed, or opt for a lower penetration shielding gas.
	Excessive weld stresses	Increase weld metal strength or revise design.
	Excessive voltage	Decrease voltage.
	Cooling rate too fast	Slow the cooling rate by preheating work piece to be welded, or cool slowly.
Cold Weld Puddle	Loose welding cable	Check all welding cable connections.
	Low primary voltage	Contact supply authority.
	Fault in power source	Contact your nearest ToolShed.
Arc lacks the crispness of a properly set short arc with precise Wire Feed Speed and voltage.	The MIG Gun has been connected to the wrong voltage polarity on the front panel	Connect the MIG Gun to the positive (+) welding terminal for most solid wires and gas shielded flux cored wires. Connect MIG Gun to the negative (-) welding terminal for most Gasless Wires. Refer to the electrode wire manufacturer for the correct polarity.

MIG WELDER TROUBLESHOOTING

FAULT	POSSIBLE CAUSE	SUGGESTED SOLUTION
Mains Supply Voltage is On, the On/Off switch on the rear panel is in the On position and the Power indicator on the front panel is illuminated however the power source will not MIG weld.	Power source is not in the correct mode of operation	Set the power source to the correct MIG mode.
	MIG Gun Polarity Lead is not connected	Connect the MIG Gun Polarity Lead to the positive or negative output terminal.
	Work Lead is not connected to the work piece	Ensure that the Work Lead is connected to the work piece and has a good connection to the work piece.
When welding at maximum output (WFS and Volts) the machine stops welding.	When output amperage exceeds the rated maximum output of the machine by 15%, the welding machine will sense this and initiates a safety circuit which stops the output current	Reduce output amperage (WFS and Volts).
	Contact Tip of the MIG gun is too close to the work piece	Increase distance between the Contact Tip of the MIG gun and the work piece.
	The Pre-set voltage is too high	Decrease the Pre-set voltage.
	The MIG Welding Wire in use is not consistent with the selected MIG wire diameter, e.g. 0.8mm wire is selected but 0.9mm wire is used	Ensure that the correct MIG Welding Wire Diameter is selected for MIG Wire being used.
Mains Supply Voltage is On, the On/Off switch in the rear panel is in the On position but the Power On indicator on the front panel is Not illuminated and the digital displays on the front panel are also not illuminated and the power source will not weld.	This may occur due to the activation of an in-built protective device if the Power Source is repeatedly switched On then Off rapidly or the supply to the Power Source is switched On then Off rapidly	If this occurs leave the Power Source On/Off switch in the Off position for several minutes to allow the protective device to reset.
Over Temp Indicator is illuminated and the unit will not commence welding when the gun trigger switch is depressed.	Duty cycle of power source has been exceeded	Leave the power source switched ON and allow it to cool. Note that Over Temp indicator must be extinguished prior to commencement of welding.

MIG WELDER TROUBLESHOOTING

FAULT	POSSIBLE CAUSE	SUGGESTED SOLUTION
Unit will not feed wire in MIG mode.	Incorrect Feed Roll fitted for wire type being used	Fit the correct feed roll for MIG wire type being used.
	Pressure Roller Arm is not secured in the correct position or not correctly adjusted	Secure Pressure Roller in the correct position and ensure that it is correctly adjusted.
	Electrode wire stuck in conduit liner or contact tip (burn-back jam)	Check for clogged/kinked MIG Gun conduit liner or worn contact tip. Replace faulty components.
	Internal fault in power source	Contact your nearest ToolShed.
Welding wire continues to feed when MIG Gun trigger is released.	MIG Gun trigger leads shorted, or faulty MIG Gun Trigger	Repair or replace MIG Gun trigger switch/lead.
Welding arc cannot be established in MIG mode.	MIG Gun polarity lead is not connected into a welding output terminal	Connect the MIG Gun polarity lead to either the positive welding output terminal or the negative welding output terminal as required.
	Poor or no work lead contact	Clean work clamp area and ensure good electrical contact.
Inconsistent wire feed.	Worn or dirty contact tip	Replace as necessary.
	Incorrect or worn feed roll	Replace as necessary.
	Excessive brake tension on wire reel hub	Reduce brake tension on spool hub.
	Worn, kinked or dirty conduit liner	Clean or replace conduit liner.
	Pressure Roller Arm is not secured in the down position or not correctly adjusted	Secure Pressure Roller in the down position and ensure that it is correctly adjusted.
No gas flow in MIG Gas (Solid) mode.	Gas hose is damaged	Replace or repair.
	Gas passage contains impurities	Disconnect gas hose from the rear of power source or wirefeeder and blow out impurities.
	Empty gas cylinder	Replace gas cylinder.
	Cylinder Valve not turned on	Turn Cylinder valve in anticlockwise direction until gas is flowing.
Gas flow continues after the MIG Gun trigger switch has been released	Gas valve has jammed open due to impurities in the gas or the gas line	Contact your nearest ToolShed.

ARC/TIG WELDER TROUBLESHOOTING

FAULT	POSSIBLE CAUSE	SUGGESTED SOLUTION
Yellow Indicator Light Is On	Bad power ventilation leads to over-heat protection	Improve the ventilation condition.
	Circumstance temperature is too high	It will automatically recover when the temperature cools down.
	Using over the rated duty-cycle	It will automatically recover when the temperature cools down.
The Adjustment Knob On the Front Panel Doesn't Work	Potentiometer broken (current regulation)	Replace the potentiometer.
Cooling Fan Not Working or Turning Very Slowly	Scarcity of phase	Recover the phase.
	Switch broken	Replace the switch.
	Fan broken	Replace or repair the fan.
	Wire broken or falling off	Check the connection.
No No-Load Voltage	Welder getting overheated	Improve the ventilation condition.
	Switch broken	Replace the switch.
Electrode Holder And Cable Getting Hot; "+" "-" Polar Sockets Becoming Hot	Electrode Holder's capacity is too small	Replace it with a larger capacity one.
	Cable is of a small size	Replace it with another one in conformity with the requirement.
	Bigger resistance between the electrode holder and the cable	Remove the oxide skin and tighten it.
Power Source Tripping	Resume power over a long period of time (more than two days)	Not failure. Trip caused by the main power filter's capacity charging. Switch on the main power source.
	In the process of welding	Contact your nearest ToolShed.
TIG Electrode Melts When Arc Is Struck	TIG torch is connected to the (+) fast socket	Connect the TIG torch to the (-) fast socket.
Welding Current Reduces When Welding	Poor work lead connection to the work piece	Ensure that the work lead has a positive electrical connection to the work piece.

ARC/TIG WELDING TROUBLESHOOTING

FAULT	POSSIBLE CAUSE	SUGGESTED SOLUTION
Gas Pockets or Voids in Weld Metal (Porosity)	Electrodes are damp	Dry electrodes before use.
	Welding current is too high	Reduce welding current.
	Surface impurities such as oil, grease, paint, etc	Clean joint before welding.
Crack Occurring in Weld Metal Soon After Solidification Commences	Rigidity of joint	Redesign to relieve weld joint of severe stresses or use crack resistance electrodes.
	Insufficient throat thickness	Travel slightly slower to alloy greater build-up in throat.
	Cooling rate is too high	Preheat plate and cool slowly.
A Gap Is Left By Failure of The Weld Metal To Fill The Root of The Weld	Welding current is too low	Increase welding current.
	Electrode too large for joint	Use smaller diameter electrode.
	Insufficient gap	Allow wider gap.
	Incorrect sequence	Use correct build-up sequence.
Portions of The Weld Run Do Not Fuse To The Surface of The Metal or Edge of The Joint	Small electrodes used on heavy cold plate	Use larger electrodes and preheat the plate.
	Welding current is too low	Increase welding current.
	Wrong electrode angle	Adjust angle so the welding arc is directed more into the base metal.
	Travel speed of electrode is too high	Reduce travel speed of electrode.
	Scale or dirt on joint surface	Clean surface before welding.
A Groove Has Been Formed In The Base Metal Adjacent To The Toe of A Weld and Has Not Been Filled By The Weld Metal (Undercut).	Welding current is too high.	Reduce welding current.
	Welding arc is too long.	Reduce the length of the welding arc.
	Angle of the electrode is incorrect.	Electrode should not be inclined less than 45° to the vertical face.
	Joint preparation does not allow correct electrode angle.	Allow more room in joint for manipulation of the electrode.
	Electrode too large for joint.	Use smaller gauge electrode.
	Insufficient deposit time at edge of weave.	Pause for a moment at edge of weave to allow weld metal build-up.