Part # 521.0003

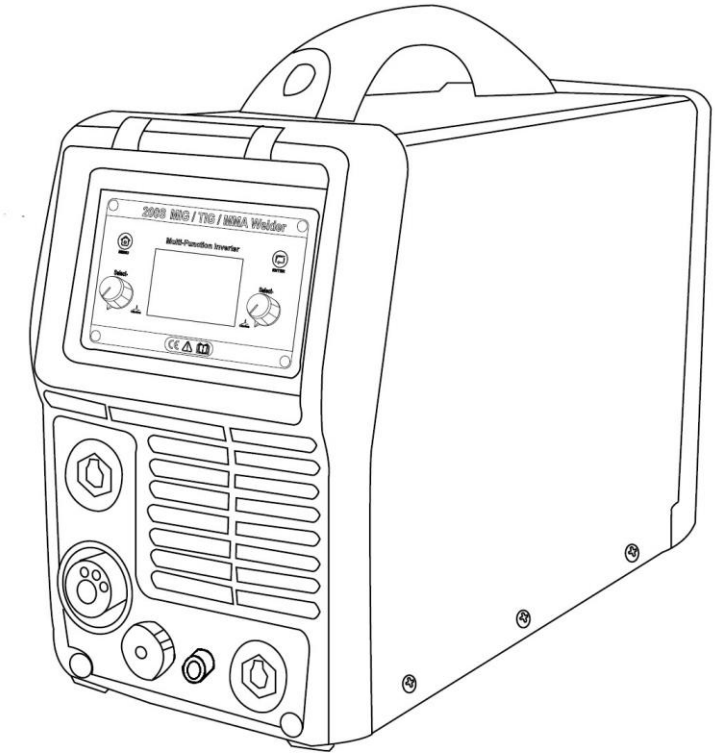
Processes

MIG (GMAW)

TIG (GTAW)

STICK (SMAW)

200S Synergic MIG / TIG / MMA Inverter Welder



OPERATORS' MANUAL

IMPORTANT: **Read this Owner's Manual Completely** before attempting to use this equipment. Save this manual and keep it handy for quick reference. Pay particular attention to the safety instructions we have provided for your protection. Contact your distributor if you do not fully understand this manual.

01/2022

CONTENT

§1 Safety

§1.1 Signal Explanation

• The above signals mean warning! Notice! Running parts and getting an electric shock or thermal parts will take damage for your body or others. The corresponding notices are as follows. It is quite a safe operation after taking several necessary protection measures.

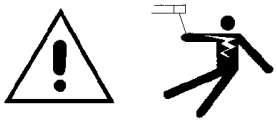
§1.2 Arc Welding Damage

• The following signals and word explanations are to some damages for your body or others happening on the welding operation. While seeing these, please remind of yourself or others to be dangerous.

• Only ones who are trained professionally can install, debug, operate, maintain and repair the equipment.

• During the operation, non-concerned people should be lift, especially for children.

• After shut off the machine power, please wait 5-7 minutes to allow for the discharge of the DC voltage existing in the electrolytic capacitors.



ELECTRIC SHOCK CAN KILL.

• Never touch electrical parts.

• Wear dry, hole-free gloves and clothes to insulate yourself.

• Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

• Take carefully when using the equipment in small place, falling-off and wet circumstance.

• Never close the machine power before installation and adjustment.

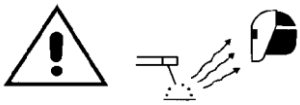
Ensure to install the equipment correctly and ground the work or metal to be welded to a good electrical (earth) ground according the operation manual.

•The electrode and work (or ground) circuits are electrically “hot” when the welder is on. Do not touch these “hot” parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

- In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically “hot”.
- Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.
- Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.
- Never dip the electrode in water for cooling.
- Never simultaneously touch electrically “hot” parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.
- When working above the floor level, use a safety belt to protect yourself from a fall should you get a shock.


FUMES AND GASES CAN BE DANGEROUS.

- Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. When welding with electrodes which require special ventilation such as stainless or hard facing or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and below Threshold Limit Values using local exhaust or mechanical ventilation. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.
- Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.
- Shielded gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.
- Read and understand the manufacturer’s instructions for this equipment and the consumables to be used, including the material safety data sheet and follow your employer’s safety practices.



ARC RAYS CAN BURN.

- Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding.
- Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.
- Protect other nearby personnel with suitable, non-flammable screening and /or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

SELF-PROTECTION

- Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

WELDING SPARKS CAN CAUSE FIRE OR INJURY

- Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines.
- Take precautions where gas cylinders are in use to prevent hazardous situation.
- When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.
- Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been “cleaned”.
- Vent hollow castings or containers before heating, cutting or welding. They may explode.
- Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuff less trousers, high shoes and a cap over your hair. Wear ear plugs when

welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

- Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

KNOWLEDGE OF ELECTRIC AND MAGNETIC FIELDS

Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). The discussion on the effect of EMF is ongoing all the world. Up to now, no material evidences show that EMF may have effects on health. However, the research on damage of EMF is still ongoing. Before any conclusion, we should minimize exposure to EMF as few as possible.

In order to minimize EMF, we should use the following procedures:

- Route the electrode and work cables together – Secure them with tape or sleeve.
- All cables should be kept as far away from the operator as possible.
- Never coil the power or earth cables around operator body.
- Connect the work cable to the workpiece as close as possible to the area being welded.
- The people with heart-pacemaker should be away from the welding area.

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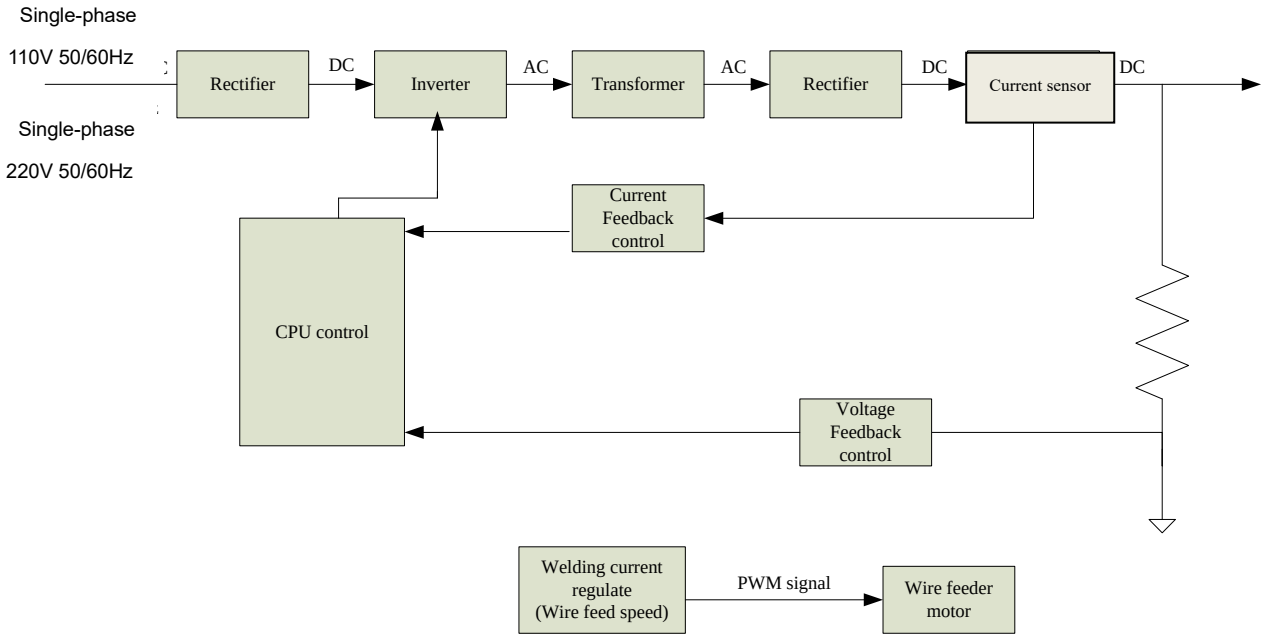
§2 Overview

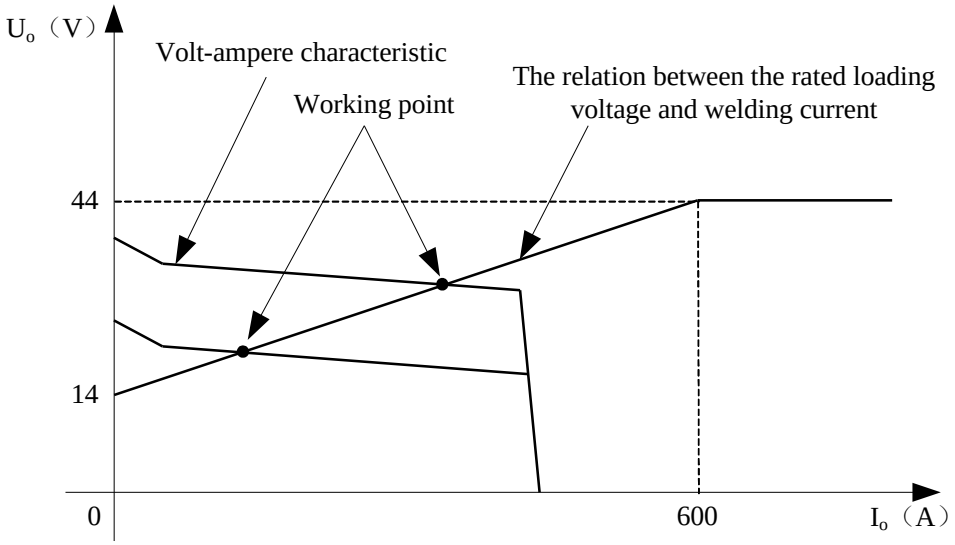
§2.1 Brief Introduction

The working principle of 200S Synergic MIG 3-in1 Inverter welder is shown as the following figure. Single-phase 110V/220V work frequency AC is rectified into DC, then is converted to medium frequency AC by inverter device (IGBT), after reducing voltage by medium transformer (the main transformer) and rectifying by medium frequency rectifier (fast recovery diodes), and is outputted by inductance filtering. The circuit adopts current feedback control technology to insure current output stably when MMA or TIG. And adopts voltage feedback control technology to insure voltage output stably when MIG.



§2.2 Volt-Ampere Characteristic

The 200S Synergic MIG 3-in1 Inverter welder welding machine has an excellent volt-ampere characteristic, whose graph is shown as the following figure. The relation between the rated loading voltage U_2 and welding current I_2 is as follows: $U_2=14+0.05I_2(V)$



§2.3 Parameters

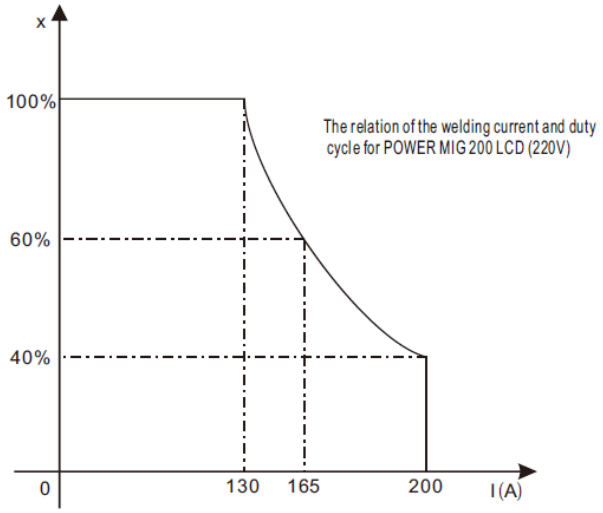
Model / Parameters	200S SYNERGIC MIG 3-in-1			
Input Voltage (V)	1~110/120/130±10%			1~220/230/240±10%
Input Current (A)	37 MIG 28 MMA 28 TIG			28 MIG 32 MMA 22 TIG
Input Power (KW)	4.0 MIG 3.1 MMA 3.1 TIG			6.2 MIG 7.3 MMA 4.9 TIG
Welding Current (A)	25-140 (MIG) 10~140 (TIG) 10~100 (MMA)			25-200 (MIG) 10~200(MMA/TIG)
Welding Voltage (V)	15.3-24 (MIG)			
No-load Voltage (V)	67 (MIG) 14 (TIG/MMA)			
Power Factor	0.99			
Duty cycle (40℃)	40%140A 60%115A 100%90A	40%100A 60%85A 100%65A	40%140A 60%115A 100%90A	40%200A 60%165A 100%130A
Diameter (mm)	Fe ：0.6、0.9、1.0 Ss ：0.8、0.9、1.0 Flux-Cored：0.6、0.8、0.9、1.0			
Protection class	IP23			
Insulation class	H			
Cooling	AF			
Dimensions (mm）	505*210*330			
Weight (Kg)	15.5			

Note: The above parameters are subject to change with the improvement of machines.

§2.4 CSA/UL Duty Cycle Rating

The letter “X” stands for the duty cycle, which is defined as the proportion of the time (10 minutes) that a machine can work continuously at 100% of rated welding current in an ambient temperature of 105°F.

The relation between the duty cycle “X” and the output current “I” is shown as the right figure.



If transformer is over-heat, the heat relay inside it will open and will output an instruction to circuit board, cut AC relay and the output welding current, and brighten the over-heat pilot lamp in the front panel. At this time, the machine should be allowed to cool down for 15 minutes with the fan. When operating the machine again, the welding output current or the duty cycle should be reduced.

§2.5 Operational Notices

▲ Height above sea level is below 3200 Ft. (1000 meters).

▲ NEMA power cord plug must be inserted directly into GROUNDED outlet by others.

▲ Insure that the input LINE circuit is rated at nameplate voltage with **20-amp** (Min.) breaker.

▲ Operation range: temperature 14^0F-104^0F (-10^0C-40^0C) & relative humidity below 90 % (20^0C).

▲ Make certain welding area is free of all flammable or combustible materials.

▲ Ventilation of at least 1 foot (30cm) free space between the machine and any structure.

▲When ALERT lamp illuminates, do not restart it until problem is resolved.

▲In case of problems, contact your local dealer or authorized repair center.

§3 Installation and Set-Up

§3.1 Unpacking & Inspection

Identify and account for each item per the following list:

1) 200S Synergic 3-IN-1 inverter power source (with NEMA6-50P cord).
2) SL15 MIG Torch 10’ with central adaptor power cable connector.
3) SR17-12-P9C TIG Torch 12.5’ with 35-50 power cable connector & 9-pin control plug.
4) EL200 Electrode Holder 10’ with 35-50 power cable connector.
5) 200A Earth Clamp 10’ with 35-50 power cable connector.
6) TIG Foot Pedal 16.5’ with 9-pin control plug.
7) Adapter plug NEMA5-15P to NEMA6-50R
8) AK-2A TIG 200A consumable kit with 57Y02 back cap
9) Operator Manual

Inspect each item for possible shipping damage. If damage is evident, contact your distributor and / or shipping company before proceeding with the installation.

§3.2 Input Power Connections

The 200S Synergic 3-IN-1 inverter machine features electronic switching power supply allowing it to be connected to any 110-240VAC, 1-Phase LINE power outlet.

208-240VAC LINE CONNECTION: Machine is provided with NEMA 6-50P LINE Service cord to be plugged into any 6-50R outlet with 208-240VAC, single-phase power and **50+ amp circuit breaker.**

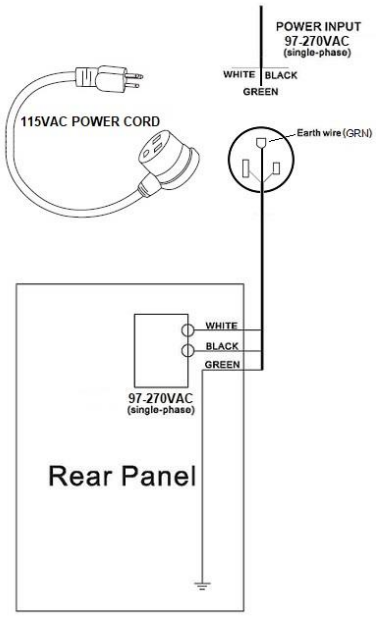
110-120VAC LINE CONNECTION: Machine is provided with NEMA 6-50R to NEMA 5-15P “Adapter” Service cord. This allows machine to be plugged into 5-15R standard outlet with **20+ amp circuit breaker.**

<u>NOTICE:</u> In the event NEMA6-50R or NEMA5-15R outlets, with rated circuit breaker amperage are not available, they should be installed by a licensed electrician.

In the event LINE power supply is over voltage (>245) or under voltage (<195), protection circuit inside the machine will illuminate alarm light and current will be cut off.

If the power supply voltage continually goes beyond the safe work voltage range, it will shorten the life of the machine. If this occurs, the below measures should be taken:

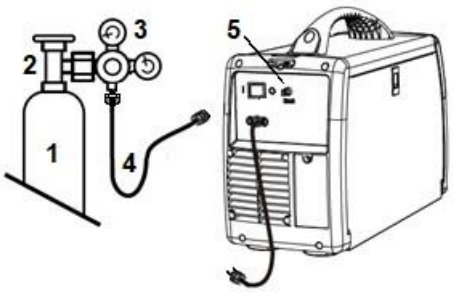
- Change the LINE power supply. Such as, connect the welder to a dedicated circuit.
- Shut off other machines using LINE power supply at the same time as welding.



WARNING: Any modification or removal of factory installed service power cords will VOID MACHINE WARRANTY!

§3.3 Shield Gas Connections

When using machine in MIG and/or TIG welding mode, it is necessary to use the appropriate shield gas with the welding torch. Carefully follow the instructions below on gas set-up.

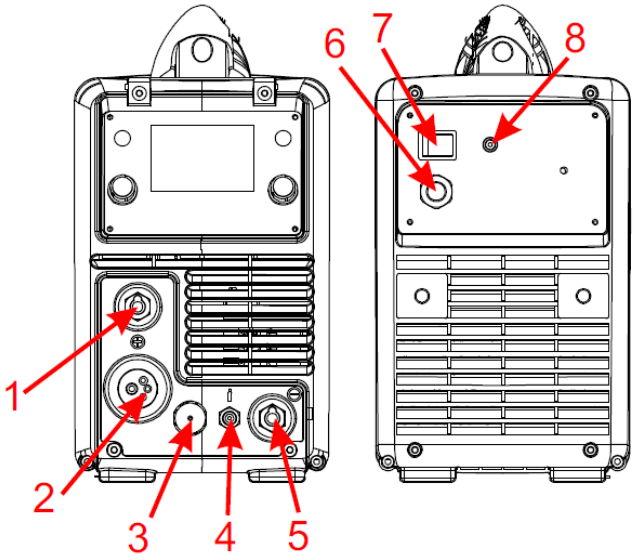


1) Shield gas cylinder AR, AR/C02, C02, Etc.
2) Gas valve. Must remained closed at all times except during welding operations.
3) Gas regulator must installed securely on cylinder valve. Tighten with wrench in clockwise direction.
4) Gas hose assembly with 5/8-18 RHT brass nipple fittings to be installed between regulator and machine input fitting.
5) Machine shield gas input fitting 5/8-18 RHT. Install gas line securely checking for no leaks.

§4 Operation

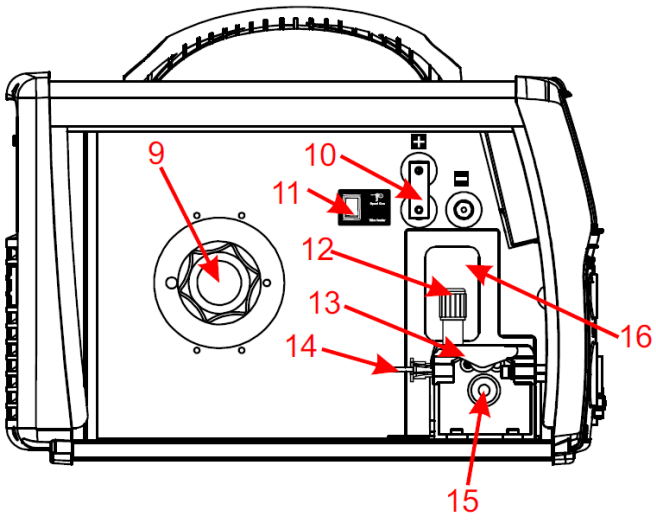
§4.1 Layout for the front and rear panel:

1. Welding output power connector 35-50 socket (+).
2. MIG torch euro connection (+).
3. Control connector 9-pin socket.
4. TIG torch gas line connector.
5. Welding output power connector 35-50 socket (-).
6. Input LINE power service cord.
7. Main power switch ON/OFF.
8. Shield gas LINE connector

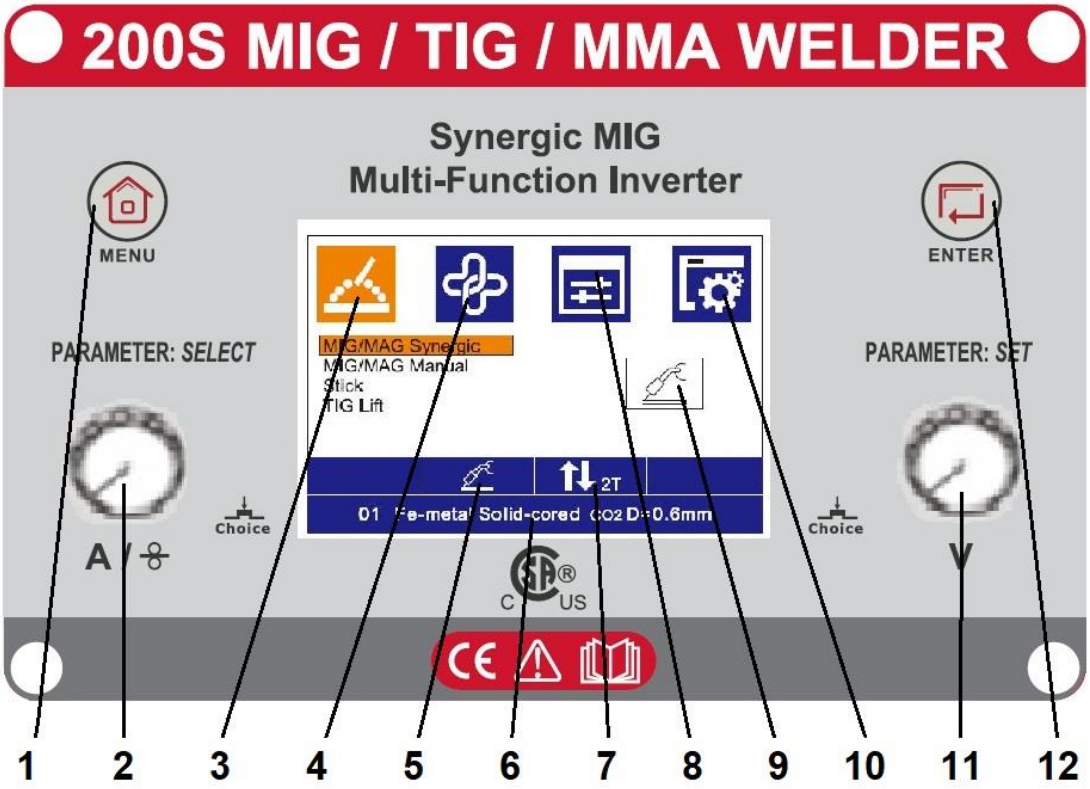


§4.2 Layout for the wire feed cabinet:

9. Spool holder.
10. MIG Torch Polarity Change Power Connection.
11. Wire feeder & Spool Gun switch.
12. Wire feed tension adjustment.
13. Wire feed tension arm.
14. Wire feeder inlet guide.
15. Wire drive roller.
16. Wire feed motor.



§4.3 Control Panel Functions：



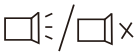
Main Start-up Interface:

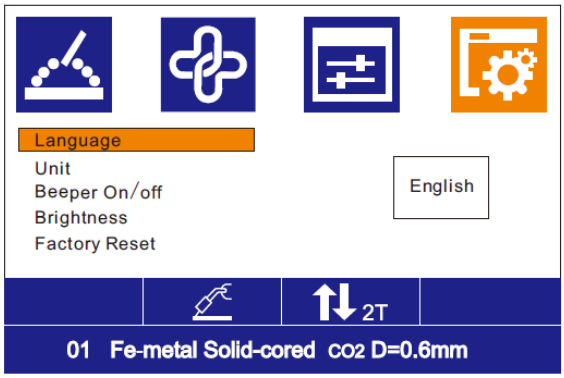
1) **Menu:** Push for MODE, SYNERGIC PROGRAMS, WELDING & SYSTEMS menus.
2) **Parameter Select:** Scroll down to desired menu parameter option and PUSH to select.
3) **Mode Parameter List:** Rotate *SELECT* knob to MIG Synergic, MIG Manual, MMA Stick or DC TIG lift-arc welding modes.
4) **Synergic Program List:** Rotate *SELECT* knob through all 16 synergic MIG welding programs.
5) **Mode Icon Display:** Displays the icon of welding mode currently selected.
6) **Operating Mode Display:** Displays the operational mode (or program) currently selected.
7) **Trigger Icon Display:** Displays the icon of the trigger mode (2T or 4T) currently selected.
8) **Welding Parameter List:** Rotated *SELECT* knob to view list of welding parameters for mode selected.
9) **Multifunction Display:** Displays the icon of the welding mode (Synergic MIG, Manual MIG, MMA Stick or DC TIG selected.
10) **Settings Parameter List:** Rotated *SELECT* knob to view list of welder burn back slow-feed, pre & post gas, inductance, hot start and arc force settings.
11) **Parameter Set:** Scroll through parameter subset (i.e.: Language / English) and *PUSH* to set.
12) **Enter:** Push for enter NEW setting(s) selected from previous settings.

§4.4 Explanation of Welder Operation

§4.4.1 Initial System Parameter Set-Up:

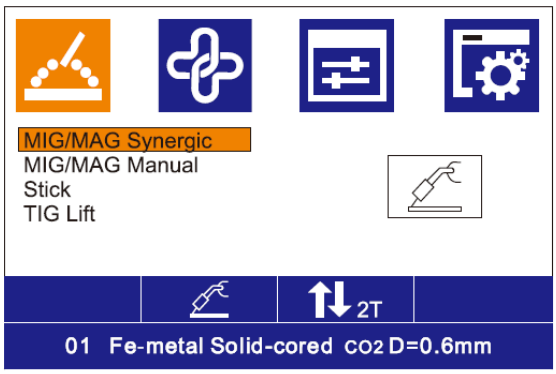
When getting started, it is important to set machine SYSTEM parameters to the operator's language and preferred settings. Press MENU button 4 times to SYSTEM icon:

Turn Parameter *SELECT* knob to desired	Turn Parameter *SET* knob to desired
Language	English / Spanish / French / Etc....
Unit	English / Metric
Beeper ON / OFF	
Brightness	1 (Dim) – 10 (Bright)
Factory Reset	Press to reset

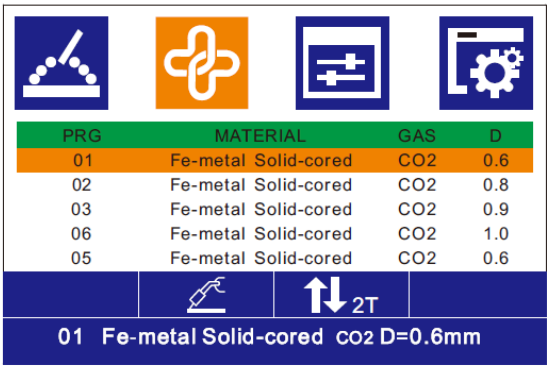


§4.4.2 Operation of MIG Synergic Welding:

1. ***Select MIG Synergic Mode:***
   - ***a.*** Press the MENU key to mode icon.
   - ***b.*** Rotate Parameter *Select* knob to MIG/MAG Synergic.
   - **c.** Push Parameter *Select* knob to set.
   - **d.** Press ENTER key to confirm.



2. ***Display MIG Synergic Programs:***
   - ***a.*** Press the MENU key to display program list.
   - **b.** Rotate Parameter *Select* knob to desired program.
   - **c.** Push Parameter *Select* knob to set.
   - **d.** Press ENTER key to confirm.



NOTE: When entered correctly, new program settings will appear at bottom of screen. If not confirmed, repeat steps above.

3. Adjustment of Synergic MIG Current and Voltage:

a. Rotate Parameter *Select* **A** knob to adjust output amps + or – for material thickness.

b. Rotate Parameter *Select* **V** knob to adjust output volts + or – synergic program settings.

c. Ready to weld.

§4.4.3 Operation of MIG Manual Welding

a. Press the MENU key to mode icon.

b. Rotate Parameter *Select* knob to MIG/MAG Manual.

c. Push Parameter *Select* knob to set.

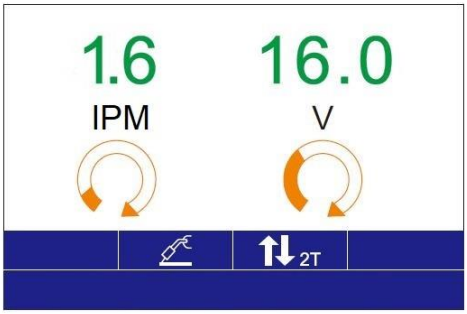
d. Press ENTER key to confirm.

2. Adjustment of Manual Wire Speed and Voltage:

a. Rotate Parameter *Select* knob **A** to adjust wire feeder speed.

b. Rotate Parameter *Set* knob **V** to adjust output volts + or – as required for job.

c. Ready to weld.



§4.4.4 Setting MIG Welding Parameters:

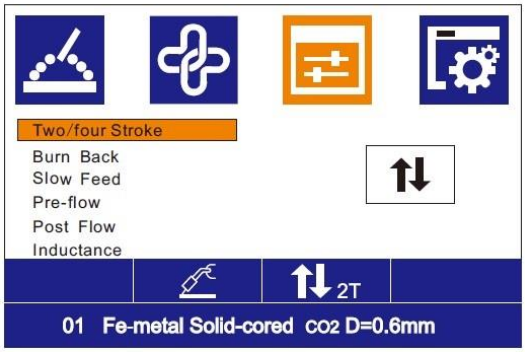
1. Select MIG Welding Parameters:

a. Press the MENU key to weld parameter icon.

b. Rotate Parameter *Select* knob to desired parameter from list in **Fig. 2** below.

c. Rotate Parameter *Set* knob to desired setting and push knob to set.

d. Press ENTER key to confirm.



Turn Parameter *SELECT* knob to desired	**Turn Parameter *SET* knob to desired**
Two/four Stroke	2T/4T
Burn Back	0-10
Slow Feed	0-10
Pre-flow	0-2 S
Post Flow	0-10 S
Inductance	0-10

Fig. 2

§4.4.5 Operation of MMA / Stick Welding:

1. Select MMA / Stick Welding

a. Press the MENU to Weld mode icon list.

b. Rotate Parameter *Select* knob to Stick and push to set.

c. Press ENTER key to confirm.

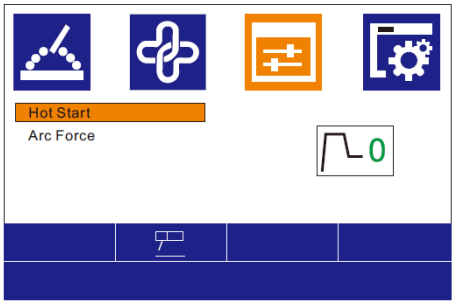
2. ***Setting Stick Weld Parameters***

a. Press MENU to parameter icon.

b. Rotate Parameter *Select* knob to desired parameter.

c. Rotate Parameter *Select* knob to 1-10 and push to set.

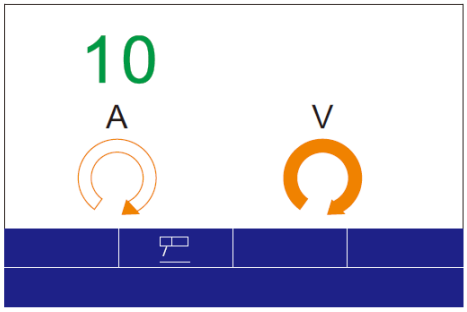
d. Press ENTER key to confirm.



3. ***Setting Stick Welding Voltage:***

a. Press the ENTER key to display the voltage screen as shown on right.

b. Rotate Parameter *Select* knob **A** to desired the welding current (10-200 Amps) and push knob to confirm.



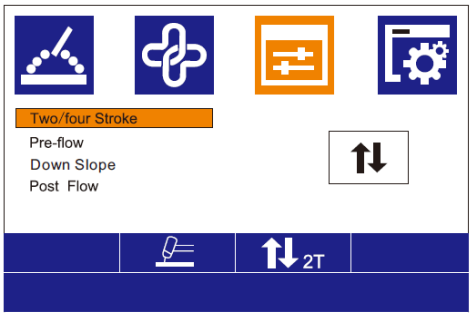
§4.4.6 Operation DC TIG Lift-Arc Welding:

1. ***Selection of the welding method:***

a. Press MENU to welding mode icon.
b. Rotate Parameter *Select* knob to TIG Lift on listing.
c. Push Parameter *Select* knob to set.
d. Press ENTER key to confirm.

2. ***Selection of TIG of Welding Parameters:***

a. Press MENU to parameter icon.
b. Rotate Parameter *Select* knob parameter
c. Rotate Parameter *Select* knob to desired parameter (See below) and push to set.
d. Press ENTER key to confirm.



Turn Parameter *SELECT* knob to desired	Turn Parameter *SET* knob to desired
Two/four Stroke	2T/4T
Pre-flow	0-2 S
Down Slope	0-10 S
Post Flow	0-10
	0-11

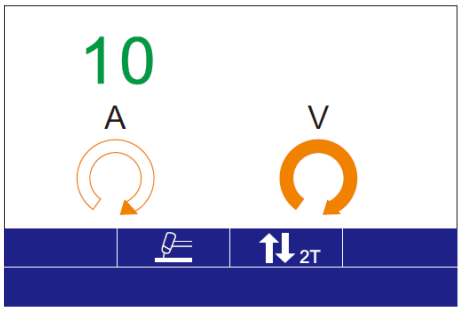
Fig.3

1. Setting of TIG Welding Current:

a. Press ENTER key to display the welding current screen.

b. Rotate Parameter *Select* knob **A** to the desired welding current (10-200 Amps) and push knob to confirm.

c. Press ENTER key to confirm.



§5.1 Machine Set-Up and Operational Modes for Welding

§5.1.1 Machine Set-up for MIG Torch Welding

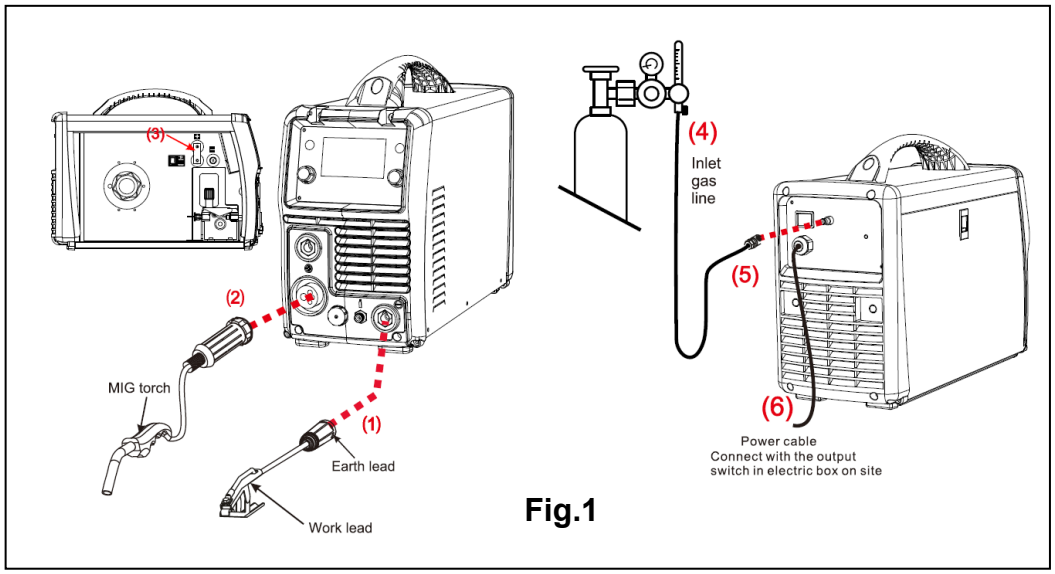


Fig.1

1) Insert the earth cable plug into the negative (-) socket on the front and “twist” to lock in place.

2) Insert the MIG torch plug into the euro-socket on the front and tighten mounting nut securely.

3) Confirm the power outlet terminal plate is connected to the positive (+) torch input terminal.

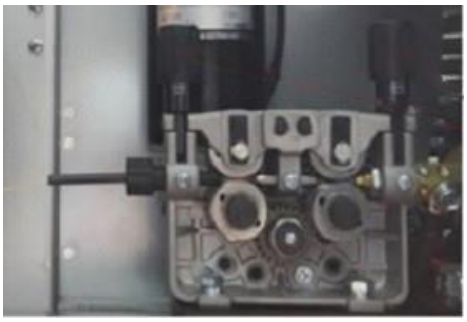
4) Connect the gas regulator to the Gas Cylinder and connect the gas line to the Gas Regulator.

5) Connect the gas line to gas fitting on the rear machine panel. **Check for Leaks!**

6) Remove the gas nozzle and contact tip from the torch neck and lay torch cable straight from machine, making sure there are no bends that could restrict the wire from feeding into cable.

7) Remove the spool holder nut and expose wire ***spool tension adjustment nut***. Adjust to create light “drag” so spool does not “coast” when wire feed stops! (This nut must be removed as well as the spool holder when installing 4” wire spool.) NOTE: Spool locator pin on spool holder. It must fit into mounting hole in spool.

8) Install spool onto holder, making sure to align locator pin with hole in spool, and re-install spool holder nut. Clip end of wire and feed from spool into wire feeder guide while holding the wire to prevent rapid uncoiling. Continue feeding over the roller groove and into the torch wire guide tube making sure about 6” (150mm) extends into the torch tube.



9) Confirm that the drive roller size and type of groove is compatible with the wire diameter and type. Change drive roller if necessary. Align the wire into the groove of the drive roller and close the tension arm making sure the wire is in the groove of the drive roller, lock the pressure arm into place. Adjust tension as required (**See #13 below**).

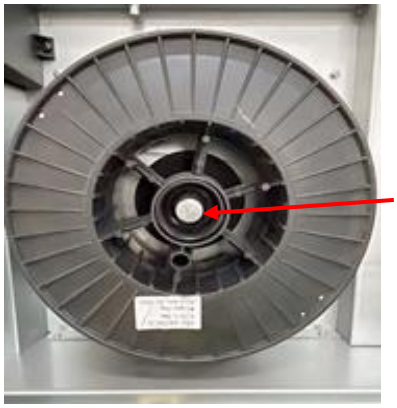
10) Connect the power cord of welding machine with the electrical outlet on site.

11) Press the trigger on MIG torch to feed the wire through to the torch neck, release the trigger when the wire exits the torch neck. ***IMPORTANT:*** *Point torch away when feeding!!*

12) Install the correct sized contact tip and secure with wrench. It must be tight!!

13) Install the gas nozzle to the torch head.

14) A simple check for the correct drive tension is to feed 6” of wire from nozzle and bend the end of the wire at 90-degrees. Then, hold it about 4” (100mm) from your **GLOVED** hand letting it run into your palm. It should coil (bow) round without stopping and slipping at the drive rollers, increase the drive roll tension knobs ½ turn until the welding wire does not slip over the rollers.



15) A simple check for the spool tension adjustment knob is to START & STOP the wire feeder with the torch trigger. If the weight and speed of the wire spool turning creates an inertia that causes the spool to run on or coast to a stop, TIGHTEN the knob until the spool stops when the trigger is relaeased. The knob should not be so tight as to restrict the wire feeder but act as a brake when it stops.

§5.1.2 Machine Set-up for MIG Spool Gun Welding

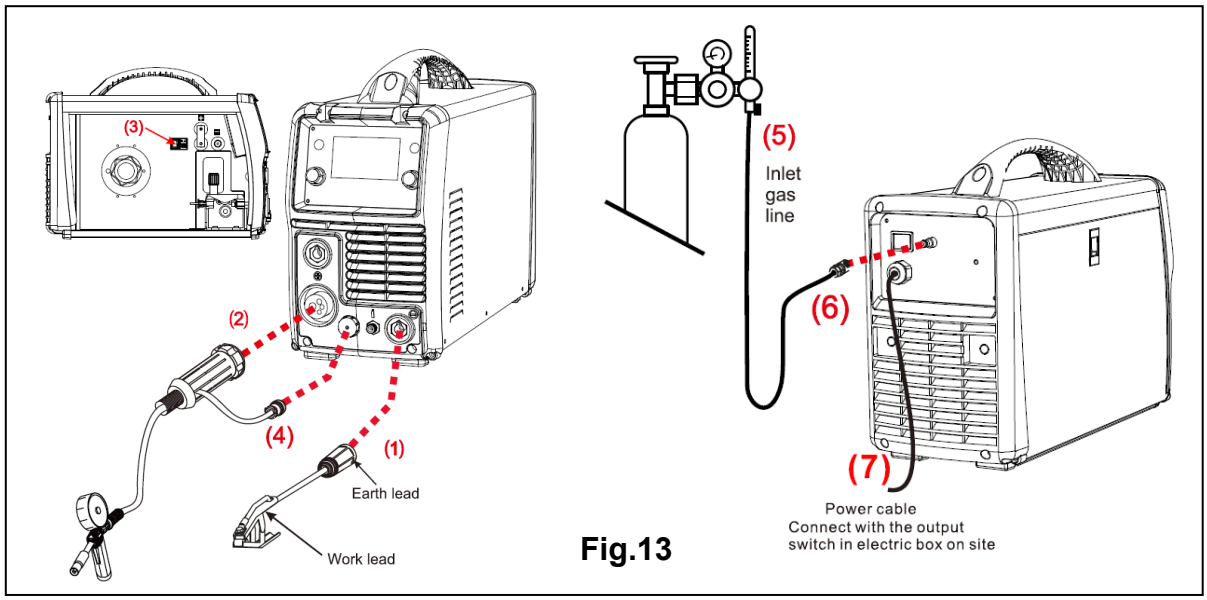


Fig.13

1) Install the earth cable plug to the negative (-) welding power output socket and “twist” to lock.

2) Connect the spool gun Euro plug to the machine Euro connector and tighten mounting nut.

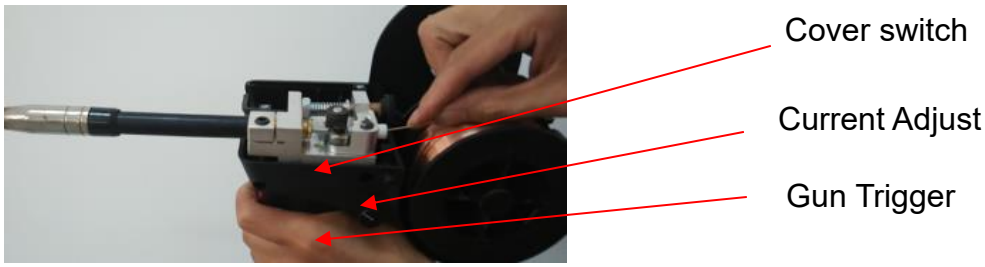
3) Set Wire Feed or Spool Gun selector switch to Spool Gun position. Press the Wire feeder & Spool Gun switch to open Spool Gun welding mode.

4) Connect the spool gun control cable plug to the machine control 9-pin socket.

5) Connect the gas regulator to the cylinder and connect the gas line to the gas regulator.

6) Connect the gas line to gas fitting on the rear machine panel. **Check for Leaks!**

7) Connect the power cord of welding machine to the electrical outlet on site.



8) Take spool gun and press button to open cover. Install wire spool over center post while holding the end of the wire to prevent rapid uncoiling.

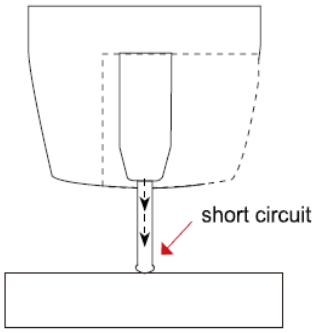
9) Push tension arm knob with thumb to compress spring and open gap between rollers. Feed 2” (50mm) of wire over drive roll groove and into neck guide tube. Release thumb knob making sure wire is “IN” groove.

10) Remove gas nozzle & contact tip from neck before pressing trigger to feed wire through neck.

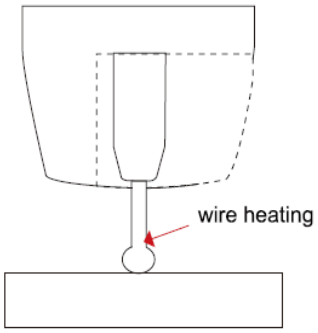
11) Re-install contact tip over wire, tighten with wrench and replace shield gas nozzle.

12) Carefully open the gas cylinder valve and set the required gas flow rate.

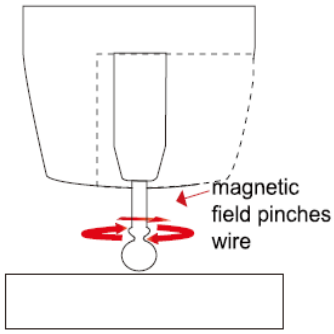
§5.1.3 Operating Mode for MIG Welding



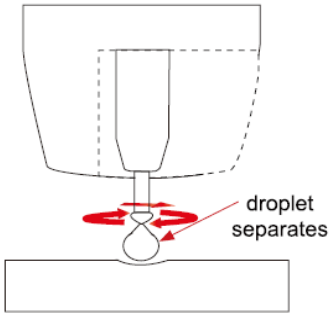
The wire touches the work creating a short circuit between it and the base metal, causing the current to flow through the welding wire.



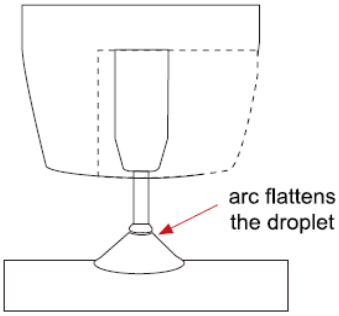
The wire cannot support all the current flow, resistance builds up and the wire becomes hot and weak and begins to melt.



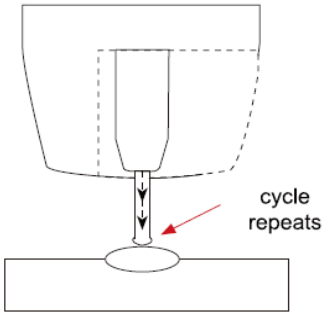
The current flow creates a magnetic field that begins to pinch the melting wire forming it into droplet.



The pinch causes the forming droplet to separate and fall towards the now creating weld pool.



An arc is created at the separation of the droplet and the heat & force of the arc flattens out the droplet.



The wire feed speed overcomes the heat of the arc and the wire again approaches the work to short circuit and repeat the cycle.

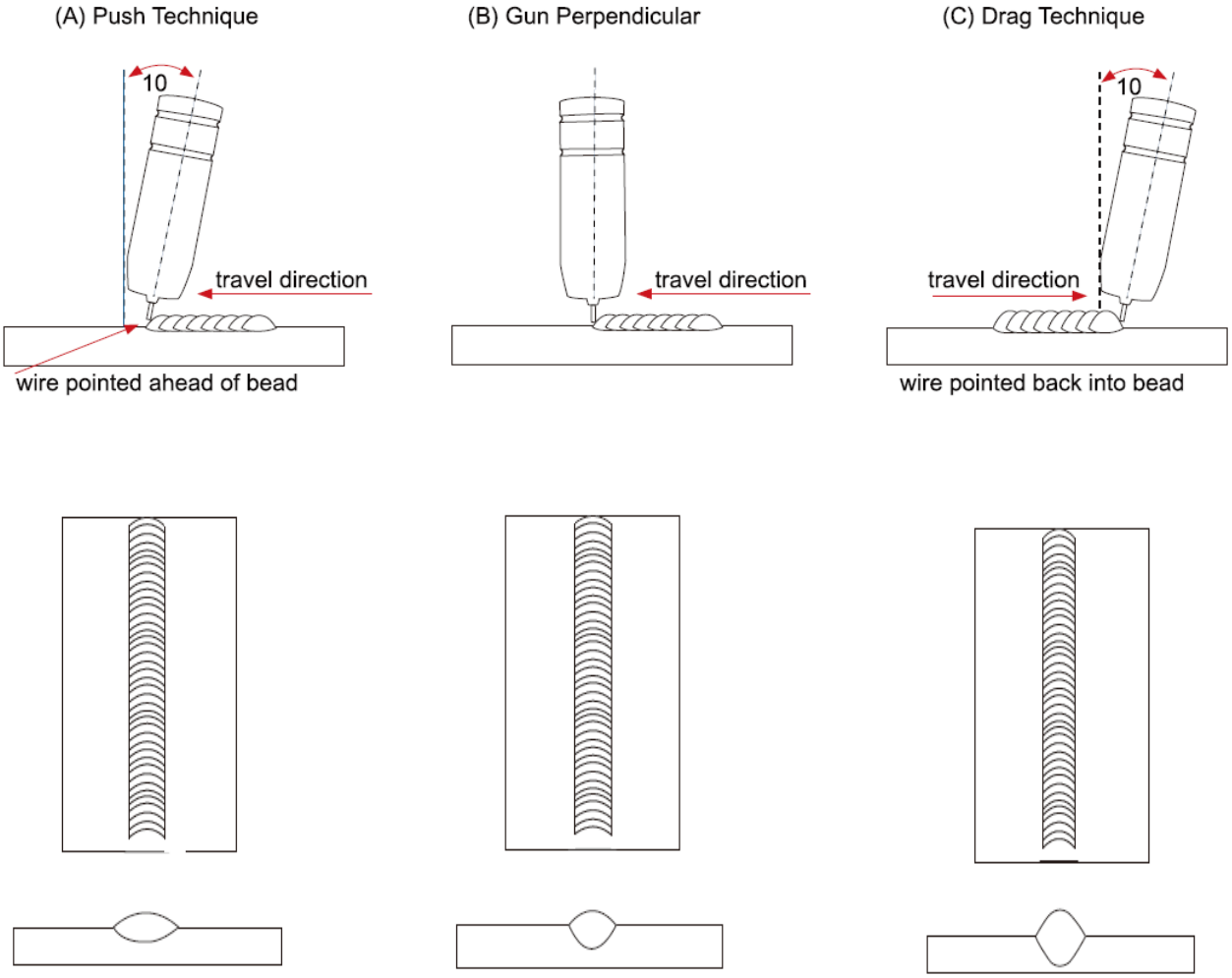
Good weld quality and weld profile depends on gun angle, direction of travel, electrode extension (stick out), travel speed, thickness of base metal, wire feed speed and arc voltage.

Gun Position: Gun position or technique usually refers to how the wire is directed at the base metal, the angle and travel direction chosen. Travel speed and work angle will determine the characteristic of the weld bead profile and degree of weld penetration.

Push Technique - The wire is located at the leading edge of the weld pool and pushed towards the un-melted work surface. This technique offers a better view of the weld joint and direction of the wire into the weld joint. Push technique directs the heat away from the weld puddle allowing faster travel speeds providing a flatter weld profile with light penetration - useful for welding thin materials. The welds are wider and flatter allowing for minimal clean up / grinding time.

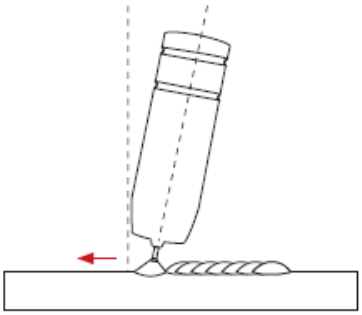
Perpendicular Technique - The wire is fed directly into the weld, this technique is used primarly for automated situations or when conditions make it necessary. The weld profile is generally higher and a deeper penetration is achieved.

Drag Technique - The gun and wire is dragged away from the weld bead. The arc and heat is concentrated on the weld pool, the base metal receives more heat, deeper melting, more penetration and the weld profile is higher with more build up.



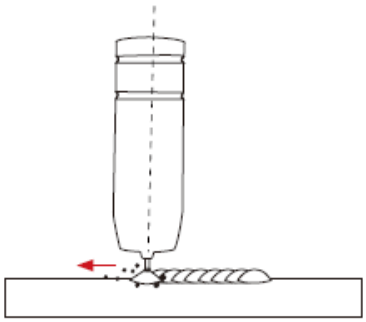
Travel Angle - Travel angle is the right to left angle relative to the direction of welding. A travel angle of 5°- 15° is ideal and produces a good level of control over the weld pool. A travel angle greater that 20° will give an unstable arc condition with poor weld metal transfer, less penetration, high levels of spatter, poor gas shield and poor quality finished weld.

Angle 5°- 15°



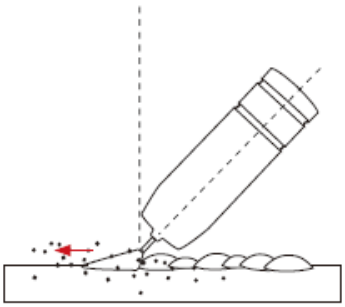
Good level of control over the weld pool, even flat weld.

Not enough angle



Less control over the weld pool more spatter.

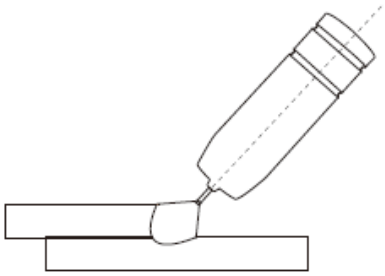
Angle more than 20°



poor control, unstable arc, less penetration, lots of spatter.

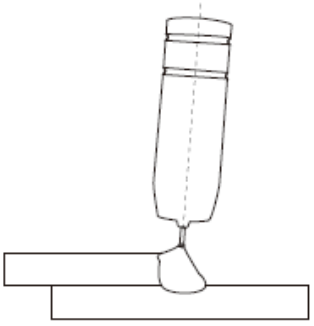
Angle to Work - The work angle is the forward back angle of the gun relative to the work piece. The correct work angle provides good bead shape, prevents undercut, uneven penetration, poor gas shield and poor quality finished weld.

Correct angle



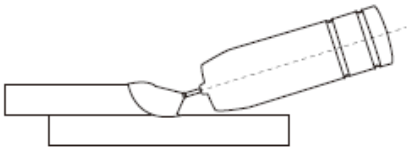
Good level of control over the weld pool, even flat weld.

Not enough angle



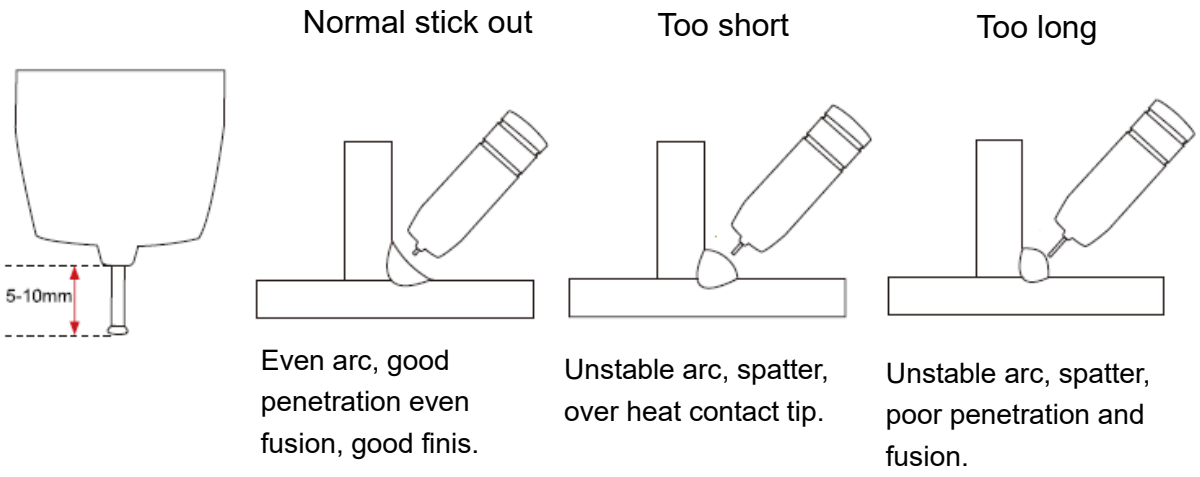
Less control over the weld pool more spatter.

Too much angle



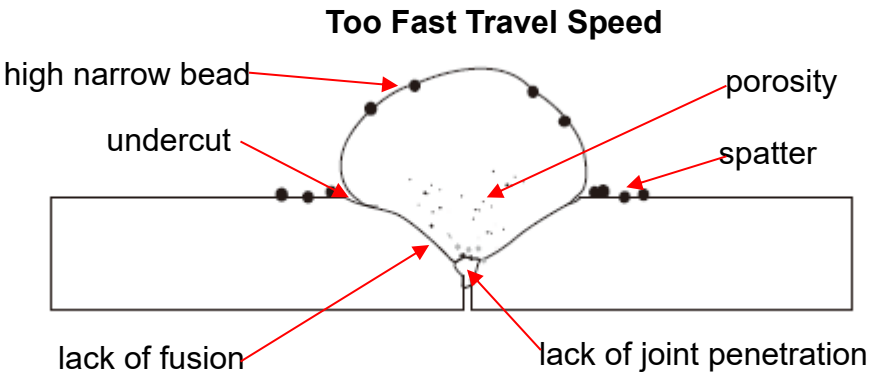
Poor control, unstable arc, less penetration, lots of spatter.

Stick Out- Stick out is the length of the unmelted wire protruding from the end of the contact tip. A constant even stick out of 5-10mm will produce a stable arc, and an even current flow providing good penetration and even fusion. Too short stick out will cause an unstable weld pool, produce spatter and over heat the contact tip. Too long stick out will cause an unstable arc, lack of penetration, lack of fusion and increase spatter.



Travel Speed - Travel speed is the rate that the gun is moved along the weld joint and is usually measured in mm per minute. Travel speeds can vary depending on conditions and the welders skill and is limited to the welders ability to control the weld pool. Push technique allows faster travel speeds than Drag technique. Gas flow must also correspond with the travel speed, increasing with faster travel speed and decreasing with slower speed. Travel speed needs to match the amperage and will decrease as the material thickness and amperage increase.

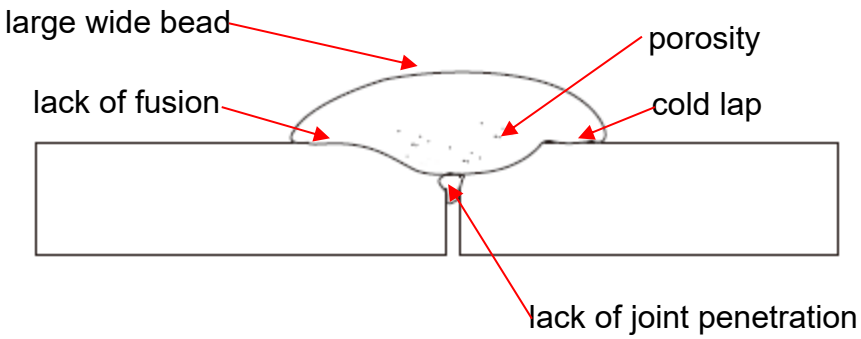
Too Fast Travel Speed - A too fast travel speed produces too little heat per mm of travel resulting in less penetration and reduced weld fusion, the weld bead solidifies very quickly trapping gases inside the weld metal causing porosity. Undercutting of the base metal can also occur and an unfilled groove in the base metal is created when the travel speed is too fast to allow molten metal to flow into the weld crater created by the arc heat.



Too Slow Travel Speed - A too slow travel speed produces a large weld with lack of penetration and fusion. The energy from the arc dwells on top of the weld pool rather than penetrating the base metal.

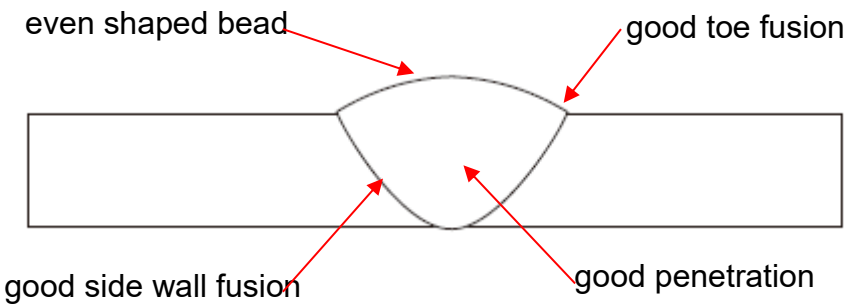
This produces a wider weld bead with more deposited weld metal per mm than is required resulting in a weld deposit of poor quality.

Too Slow Travel Speed



Correct Travel Speed - The correct travel speed keeps the arc at the leading edge of the weld pool allowing the base metal to melt sufficiently to create good penetration, fusion and wetting out of the weld pool producing a weld deposit of good quality.

Correct Travel Speed



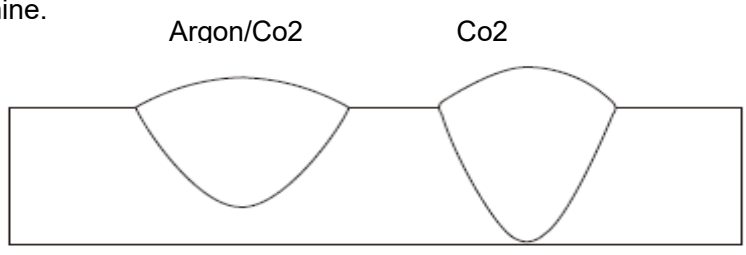
Wire types and sizes - Use the correct wire type for the base metal being welded. Use stainless steel wire for stainless steel, aluminum wires for aluminum and steel wires for steel.

Use a smaller diameter wire for thin base metals. For thicker materials use a larger wire diameter and larger machine, check the recommended welding capability of your machine. See chart below for reference:

Material	Wire diameter (mm)	GAS	Welding current (A)
Fe-metal Solid-cored	0.6	CO_2	25-90
Fe-metal Solid-cored	0.8	CO_2	40-150
Fe-metal Solid-cored	0.9	CO_2	50-180
Fe-metal Solid-cored	1.0	CO_2	60-200
Fe-metal Solid-cored	0.6	MIX	25-110
Fe-metal Solid-cored	0.8	MIX	40-180
Fe-metal Solid-cored	0.9	MIX	50-200
Fe-metal Solid-cored	1.0	MIX	60-200
Fe-metal Flux-cored	0.8	CO2	60-160
Fe-metal Flux-cored	0.9	CO2	60-180
Fe-metal Flux-cored	1.0	CO2	70-200
Ss-metal Solid - cored	0.8	MIX	60-160
Ss-metal Solid - cored	0.9	MIX	70-170
Ss-metal Solid - cored	1.0	MIX	70-200
AL-Mg Solid -cored	0.9	Ar	100-170

Gas selection - The purpose of the gas in the MIG process is to protect or “shield” the wire, the arc and the molten weld metal from the atmosphere. Without the protection of the shielding gas the weld produced would contain defects like porosity, lack of fusion and slag inclusions. Additionally some of the gas becomes ionized (electrically charged) and helps the current flow smoothly.

Use the correct shielding gas: Co2 is good for steel and offers good penetration characteristics, the weld profile is narrower and slightly more raised than the weld profile obtained from Argon/Co2 mixed gas. Argon/Co2 mix gas offers better weld ability for thin metals and has a wider range of setting tolerance on the machine.



Penetration Pattern for Steel

Gas flow rate - The correct gas flow is also very important. Too low flow will give inadequate coverage and result in weld defects and unstable arc conditions. Too high flow can cause air to be drawn into the gas column and contaminate the weld zone.

§5.1.4 MIG Welding Troubleshooting

The following chart addresses some of the common problems of MIG welding. In all cases of equipment malfunction, the manufacturer's recommendations should be strictly adhered to and followed.

NO.	Trouble	Possible Reason	Suggested Remedy
1	**Excessive Spatter**	Wire feed speed set too high	Select lower wire feed speed
		Voltage too high	Select a lower voltage setting
		Wrong polarity set	Select the correct polarity for the wire being used - see setup guide
		Stick out too long	Bring the torch closer to the work
		Contaminated base metal	Remove materials like paint, grease, oil, and dirt, including mill scale from base metal
		Contaminated MIG wire	Use clean, non-oxidated wire. Do not lubricate the wire with oils.
		Inadequate gas flow or too much gas flow	Check gas connections, check hoses, gas valve (Open?) and torch. Set the gas flow between 6-12 l/min flow rate. Protect the welding zone from wind and drafts
2	**Porosity - small cavities or holes resulting from gas pockets in weld metal.**	Wrong gas	Confirm correct gas for material.
		Inadequate gas flow or too much gas flow	Check gas connections, check hoses, gas valve (Open?) and torch. Set the gas flow between 6-12 l/min flow rate. Protect the welding zone from wind and drafts
		Moisture on the base metal	Remove all moisture from base metal before welding
		Contaminated base metal	Remove materials like paint, grease, oil, and dirt, including mill scale from base metal
		Contaminated mig wire	Use clean dry rust free wire. Do not lubricate the wire with oil, grease etc

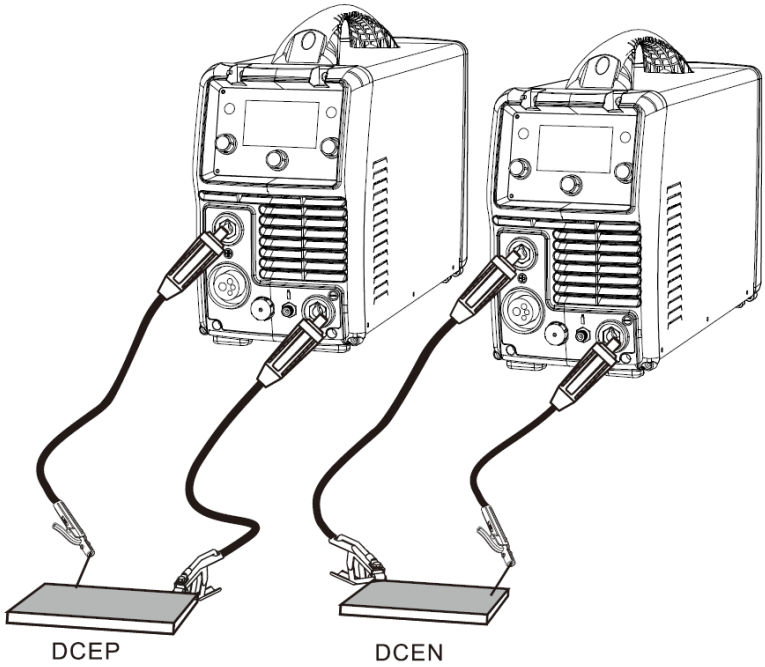
		Missing or damaged gas diffuser	Replace the gas diffuser
		Mig torch euro connect o-ring missing or damaged	Check and replace the o-ring
3	**Wire stubbing during welding**	Holding the torch too far away	Bring the torch closer to the work and maintain stick out of 5-10mm
		Welding voltage set too low	Increase the voltage
		Wire Speed set too high	Decrease the wire feed speed
4	**Lack of Fusion − failure of weld metal to fuse completely with base metal or a proceeding weld bead.**	Contaminated base metal	Remove materials like paint, grease, oil, and dirt, including mill scale from base metal
		Not enough heat input	Select a higher voltage range and /or adjust the wire speed to suit
		Improper welding technique	Keep the arc at the leading edge of the weld pool. Gun angle to work should be between 5 & 15° Direct the arc at the weld joint Adjust work angle or widen groove to access bottom during welding Momentarily hold arc on side walls if using weaving technique
5	**Excessive Penetration − weld melting through base**	Too much heat	Select a lower voltage range and /or adjust the wire speed to suit Increase travel speed
6	**Lack of Penetration − shallow fusion between weld metal and base metal**	Poor in incorrect joint preparation	Material too thick. Joint preparation and design needs to allow access to bottom of groove while maintaining proper welding wire extension and arc characteristics Keep the arc at the leading edge of the weld pool and maintain the gun angle at 5 & 15° keeping the stick out between 5-10mm
		Not enough heat input	Select a higher voltage range and /or adjust the wire speed to suit Reduce travel speed
		Contaminated base metal	Remove materials like paint, grease, oil, and dirt, including mill scale from base metal

Wire Feed Troubleshooting: In many cases, poor MIG welding performance may be caused by problems with the mechanical feeding of the wire. Check wire feed system if poor welding performance

NO.	Trouble	Possible Reason	Suggested Remedy
1	**No wire feed**	Wrong mode selected	Check that the TIG/MMA/MIG selector switch set to MIG position
		Wrong torch selector switch	Check that the Wire Feeder /Spool Gun selector switch is set to Wire Feeder position for MIG welding and Spool Gun when using the Spool gun
2	**Inconsistent / interrupted wire feed**	Adjusting wrong dial	Be sure to adjust the wire feed and voltage dials for MIG welding. The amperage dial is for MMA and TIG welding mode
		Wrong polarity selected	Select the correct polarity for the wire being used - see machine setup guide
		Incorrect wire speed setting	Adjust the wire feed speed
		Voltage setting incorrect	Adjust the voltage setting
		MIG torch lead too long	Small diameter wires and soft wires like aluminum don’t feed well through long torch leads - replace the torch with a lesser length torch
		Mig torch lead kinked or too sharp angle being held	Remove the kink, reduce the angle or bend
		Contact tip worn, wrong size, wrong type	Replace the tip with correct size and type
		Liner worn or clogged (the most common causes of bad feeding)	Try to clear the liner by blowing out with compressed air as a temporary cure, it is recommended to replace the liner
		Wrong size liner	Install the correct size liner
		Blocked or worn inlet guide tube	Clear or replace the inlet guide tube
		Wire misaligned in drive roller groove	Locate the wire into the groove of the drive roller
		Incorrect drive roller size	Fit the correct size drive roller eg; 0.8mm wire requires 0.8mm drive roller
		Wrong type of drive roller selected	Fit the correct type roller (e.g. knurled rollers needed for flux cored wires
		Worn drive rollers	Replace the drive rollers
		Drive roller pressure too high	Can flatten the wire electrode causing it to lodge in the contact tip - reduce the drive roller pressure

		Too much tension on wire spool hub	Reduce the spool hub brake tension
		Wire crossed over on the spool or tangled	Remove the spool untangle the wire or replace the wire
		Contaminated MIG wire	Use clean Non-oxidized wire. Do not lubricate the wire with oils.

§5.2.1 Machine Set-up for MMA / Stick Welding



Connection of electrode holder & workpiece cables for MMA/Stick welding may be attached to either Positive(+) or Negative(-) output sockets. While ***DCEP is most common***, various electrodes require different polarity for optimum results and careful attention should be paid to the polarity, refer to the electrode manufacturers information for the correct polarity.

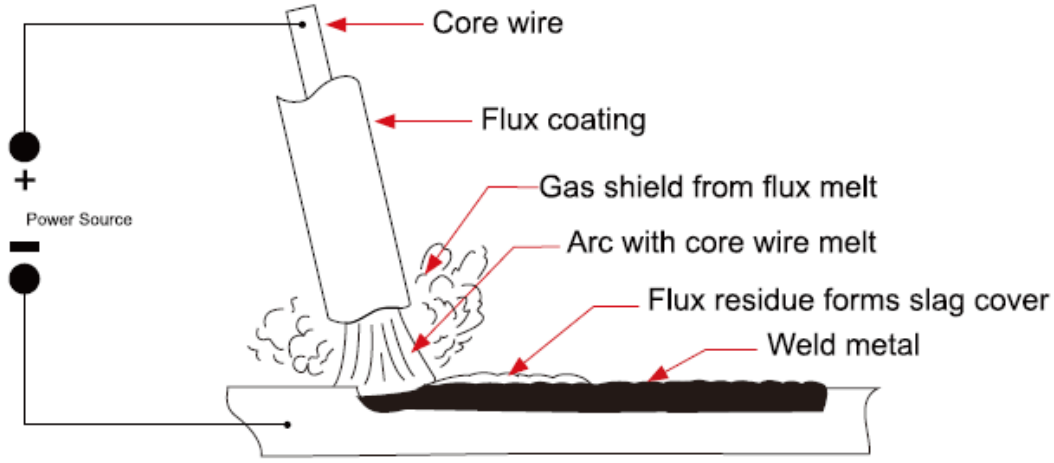
DCEP: Electrode connected to Positive (+) & Workpiece connected to Negative(-) output sockets.

DCEN: Electrode connected to Negative(-) & Workpiece connected to Positive(+) output sockets.

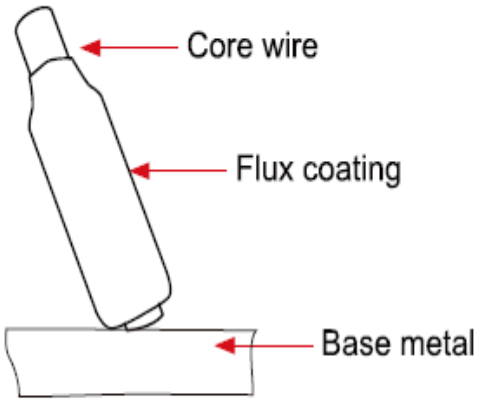
1) Set MMA/Stick machine parameters as described in **Section 4.4.5.**
2) Place the electrode (Stick) into the electrode holder and clamp tight.
3) Strike the electrode against the work piece to create an arc. Adjust Arc Force if ignition is sporadic or not steady.
4) Commence welding holding the electrode steady and in contact to maintain the arc.
5) If necessary, readjust the welding current control knob to obtain the welding condition required.
6) After completion of welding the Power Source should be left “ON” for 2-3 minutes. This allows the fan to run and cool the internal components.
7) Switch the ON/OFF Switch (located on the rear panel) to the OFF position.

§5.2.2 Operating Mode for MMA / Stick Welding

One of the most common types of arc welding is manual metal arc welding (MMA) or stick welding. An electric current is used to strike an arc between the base material and a consumable electrode rod or 'stick'. The electrode rod is made of a material that is compatible with the base material being welded and is covered with a flux that gives off gaseous vapors that serve as a shielding gas and providing a layer of slag, both of which protect the weld area from atmospheric contamination. The electrode core itself acts as filler material the residue from the flux that forms slag covering over the weld metal must be chipped away after welding.



MMA / Stick Process



●Arc started by contacting electrode to base metal.

●The heat of the arc melts the surface of the base metal to form a molten pool at the end of the electrode.

● The electrode melts into the molten pool and becomes the deposited weld metal.

● The arc is covered by gas from flux as it melts off..

● Weld covered by a slag which comes from the electrode coating. Chip off after cooling.

§5.2.3 MMA Welding Fundamentals

■ Electrode Selection

As a general rule, the selection of an electrode is straight forward,in that it is only a matter of selecting an electrode of similar composition to the parent metal. However, for some metals there is a choice of several electrodes, each of which has particular properties to suit specific classes of work. It is recommend to consult your welding supplier for the correct selection of electrode.

■ Electrode Size

AverageThickness of Material	Maximum Recommended Electrode Diameter
1.0-2.0 mm	2.5 mm
2.0-5.0 mm	3.2 mm
5.0-8.0 mm	4.0 mm
>8.0 mm	5.0 mm

The size of the electrode generally depends on the thickness of the section being welded, and the thicker the section the larger the electrode required. The table gives the maximum size of electrodes that maybe used for various thicknesses of section base on using a general purpose type 6013 electrode.

■ Welding Current (Amperage)

Electrode Size ø mm	Current Range (Amps)
2.5 mm	60-95
3.2 mm	100-130
4.0 mm	130-165
5.0 mm	165-260

Correct current selection for a particular job is an important factor in arc welding.With the current set too low, difficulty is experienced in striking and maintaining astable arc. The electrode tends to stick to the work, penetration is poor and beads with a distinct rounded profile will be deposited.Too high current is accompanied by overheating of the electrode resulting undercut and burning through of the base metal and producing excessive spatter. Normal current for a particular job may be considered as the maximum, which can be used without burning through the work, over-heating the electrode or producing a rough spattered surface.The table shows current ranges generally recommended for a general purpose type 6013 electrode.

- **Arc Length**

To strike the arc, the electrode should be gently scraped on the work until the arc is established. There is a simple rule for the proper arc length; it should be the shortest arc that gives a good surface to the weld. An arc too long reduces penetration, produces spatter and gives a rough surface finish to the weld. An excessively short arc will cause sticking of the electrode and result in poor quality welds. General rule of thumb for down hand welding is to have an arc length no greater than the diameter of the core wire.

- **Electrode Angle**

The angle that the electrode makes with the work is important to ensure a smooth, even transfer of metal. When welding in down hand, fillet, horizontal or overhead the angle of the electrode is generally between 5and 15 degrees towards the direction of travel. When vertical up welding the angle of the electrode should be between 80 and 90 degrees to the work piece.

- **Travel Speed**

The electrode should be moved along in the direction of the joint being welded at a speed that will give the size of run required. At the same time, the electrode is fed downwards to keep the correct arc length at all times. Excessive travel speeds lead to poor fusion, lack of penetration etc, while too slow a rate of travel will frequently lead to arc instability,slag inclusions and poor mechanical properties.

- **Material and Joint Preparation**

The material to be welded should be clean and free of any moisture, paint, oil, grease, mill scale, rust or any other material that will hinder the arc and contaminate the weld material. Joint preparation will depend on the method used include sawing, punching, shearing, machining, flame cutting and others. In all casesedges should be clean and free of any contaminates.

§5.2.4 MMA Welding Troubleshooting

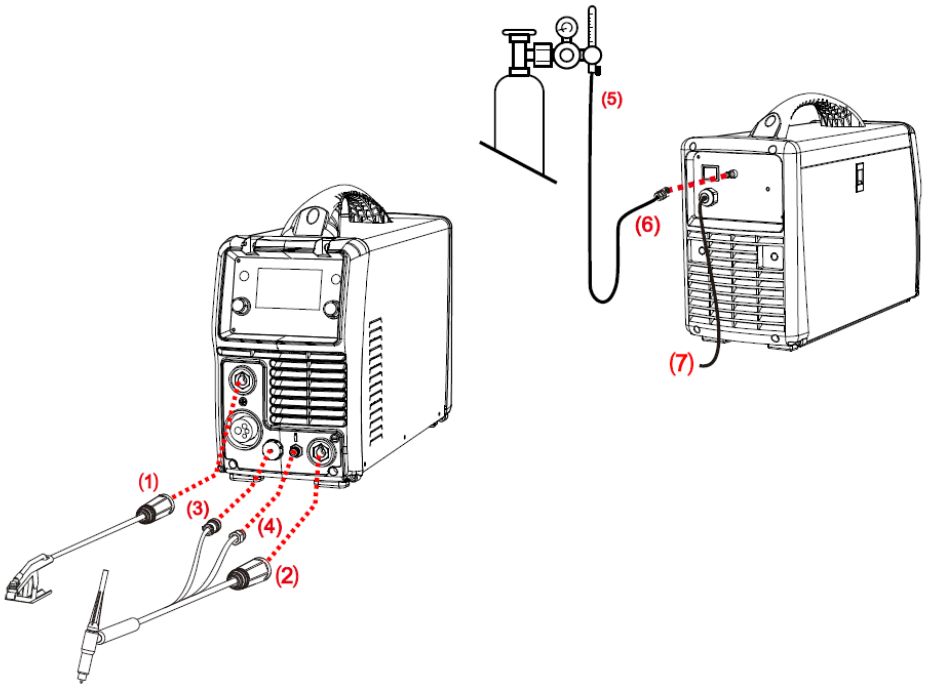
The following chart addresses some of the common problems of MMA welding. In all cases of equipment malfunction, the manufacturer’s recommendations should be strictly adhered to and followed.

NO.	Trouble	Possible Reason	Suggested Remedy
1	**No arc**	Incomplete welding circuit	Check earth lead is connected. Check all cable connections.

		No power supply	Check that the machine is switched on and has a power supply
		Wrong mode selected	Check the MMA selector switch is selected
2	**Porosity − small cavities or holes resulting from gas pockets in weld metal**	Arc length too long	Shorten the arc length
		Work piece dirty, contaminated or moisture	Remove moisture and materials like paint, grease, oil, and dirt, including mill scale from base metal
		Damp electrodes	Use only dry electrodes
3	**Excessive Spatter**	Amperage too high	Decrease the amperage or choose a larger electrode
		Arc length too long	Shorten the arc length
4	**Weld sits on top, lack of fusion**	Insufficient heat input	Increase the amperage or choose a larger electrode
		Work piece dirty, contaminated or moisture	Remove moisture and materials like paint, grease, oil, and dirt, including mill scale from base metal
		Poor welding technique	Use the correct welding technique or seek assistance for the correct technique
5	**Lack of penetration**	Insufficient heat input	Increase the amperage or choose a larger electrode
		Poor welding technique	Use the correct welding technique or seek assistance for the correct technique
		Poor joint preparation	Check the joint design and fit up, make sure the material is not too thick. Seek assistance for the correct joint design and fit up
6	**Excessive penetration - burn through**	Excessive heat input	Reduce the amperage or use a smaller electrode
		Incorrect travel speed	Try increasing the weld travel speed
7	**Uneven weld appearance**	Unsteady hand, wavering hand	Use two hands where possible to steady up, practise your technique
8	**Distortion − movement of base metal during welding**	Excessive heat input	Reduce the amperage or use a smaller electrode
		Poor welding technique	Use the correct welding technique or seek assistance for the correct technique
		Poor joint preparation and or joint design	Check the joint design and fit up, make sure the material is not too

			thick. Seek assistance for the correct joint design and fit up
9	**Electrode welds with different or unusual arc characteristic**	Incorrect polarity	Change the polarity, check the electrode manufacturer for correct polarity

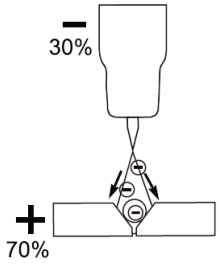
§5.3.1 Machine Set-up for DC Lift-Arc TIG Welding



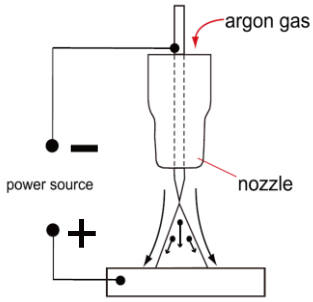
1) Connect the earth cable to Positive (+) socket and tighten clockwise. Connect the earth clamp to the work piece. Contact with the work piece must be firm contact with clean, bare metal, with no corrosion, paint or scale at the contact point.
2) Connect the TIG torch power cable to Negative(-) socket and tighten clockwise.
3) Connect ***TIG trigger*** 9-pin remote plug from torch to remote socket. Insert completely and lock.
   a) Connect ***Foot Pedal*** 9-pin remote plug to remote socket. Insert completely and lock ring.
4) Connect TIG torch gas connection to the TIG gas outlet, making sure connections are tight.
5) Connect the gas regulator to the gas cylinder making sure connections are tight.
6) Connect the gas hose to the regulator and to the machine gas fitting on back panel. Tighten.
7) Connect power cord to LINE power outlet.

NOTE: TIG “Remote” functions may be controlled by EITHER Trigger OR Foot Pedal, not both.

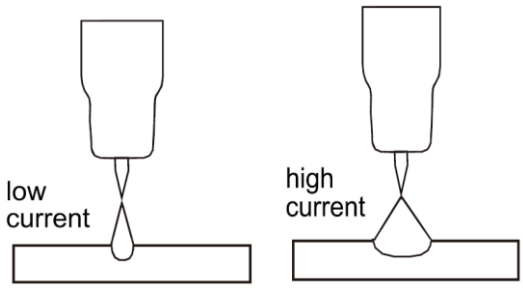
§5.3.2 Operation Mode for DC TIG Welding (Steel)



In the DC TIG electrical circuit there is an arc welding principle that dictates 70% of the energy (heat) is always on the positive(+) side. This needs to be understood because it determines what output socket the TIG torch will be connected to (this rule applies to all the other forms of DC welding as well).



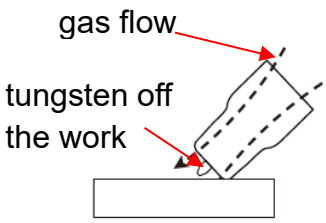
DC TIG welding is a process in which an arc is struck between a TUNGSTEN electrode and the metal work piece. The weld area is shielded by an inert gas flow to prevent contamination of tungsten electrode, filler rod, molten pool and weld area. When the TIG arc is struck the inert gas is ionized and superheated changing its' molecular structure which converts it into a plasma stream. This plasma stream flowing between the tungsten and the work piece is the TIG arc and can be as hot as 34,000°F (19,000°C). It is a very pure and concentrated arc which provides the controlled melting of most metals into a weld pool. TIG welding offers the user the greatest amount of flexibility with the widest range of material and thickness. DC TIG welding is also the cleanest weld with no sparks or spatter.



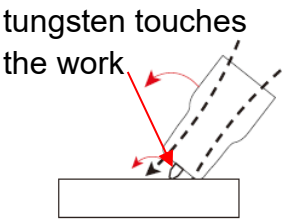
The intensity of the arc is proportional to the current that flows from the tungsten. Typically, thin material requires a less powerful arc with less heat to melt the material so less current (amps) are required, thicker material requires a more powerful arc with more heat and current (amps).

Lift Arc Ignition

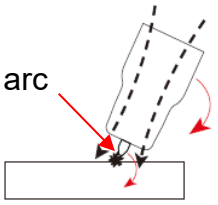
Lift Arc is a form of arc ignition where the machines applies low voltage on the electrode until it is short circuited to the base metal. When the machine detects that the tungsten has left the surface and an arc is present (Lift-Arc), it immediately (within microseconds) increases power, converting the spark to a full arc. It is a simple, lower cost alternative to HF(high frequency) ignition and creates no electrical noise.



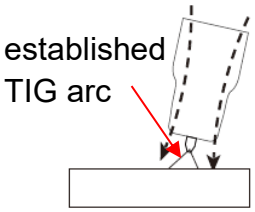
Lay the nozzle on the job without the tungsten touching the work.



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

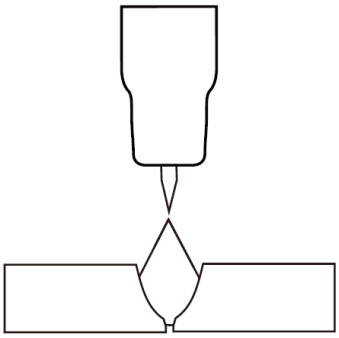


Rock the torch back and the arc will ignite as the tungsten lifts off the work.

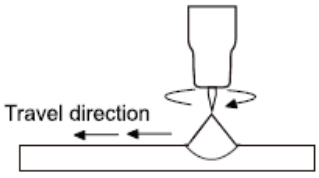


Hold torch as close to surface as possible to maintain the arc.

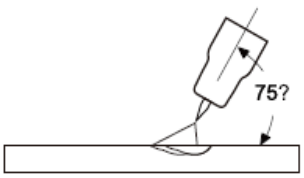
Fusion Technique (No Filler Rod)



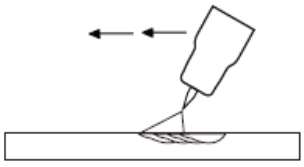
Manual TIG welding is often considered the most difficult of all the welding processes. Because the welder must maintain a short arc length and great skill is required to prevent contact between the electrode and the work piece. Similar to Oxygen/Acetylene welding, TIG welding normally requires two hands 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

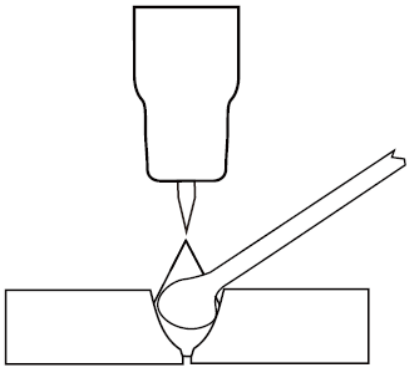


Angle torch

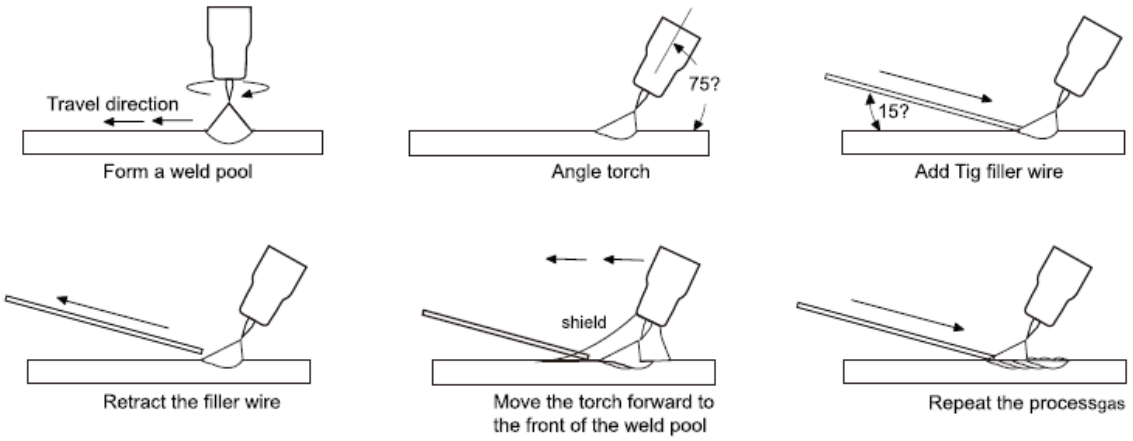


Move the torch slowly and evenly forward

TIG Filler Rod Welding Technique



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 along the joint. The filler rod is usually held at about a 15° angle and fed into the leading edge of the weld pool. The arc will melt the filler rod into the weld pool as the torch is moved forward. 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 rod inside the gas shield as this protects it from oxidation and contaminating the weld pool.



§5.3.3 Tungsten Electrode Selection

Tungsten is a rare metallic element used to manufacture TIG welding electrodes. The TIG process relies on tungsten’s hardness and high-temperature resistance to carry the welding current to the arc. Tungsten has the highest melting point of any metal at 6,200°F (3,400°C). Tungsten electrodes come in a variety of diameters and are made from pure tungsten or tungsten alloys. Choosing the correct tungsten depends on the material being welded, amps required and whether you are using AC or DC welding current. Tungsten electrodes are color-coded at the end for easy identification. Below are the most commonly used tungsten electrodes found in the North American market.

Thoriated (Color code: Red) 

Thoriated tungsten electrodes (AWS classification EWTh-2) contain a minimum of 97.30 percent tungsten and 1.70 to 2.20percent thorium and are called ***2% Thoriated.*** They are the most commonly used electrodes today and are preferred for their longevity and ease of use. Thorium however is a ***low-level radioactive hazard*** and many users have switched to other alternatives. Regarding the radioactivity, thorium is an alpha emitter but when it is enclosed in a tungsten matrix the risks are negligible. Thoriated tungsten should not get in contact with open cuts or wounds. The more significant danger to welders can occur when thorium oxide gets into the lungs. This can happen from the exposure to vapors during welding or from ingestion of material/dust in the grinding of the tungsten. Follow the manufacturer's warnings, instructions, and the Material Safety Data Sheet (MSDS)

.

Ceriated (Color Code: Grey) 

Ceriated tungsten electrodes (AWS classification EWCe-2) contain a minimum of 97.30 percent tungsten and 1.80 to 2.20 percent cerium and are referred to as ***2% Ceriated.*** Ceriated tungsten performs best in DC & AC welding at low to medium current settings. They have excellent arc starts at low amperages and become popular in such applications as orbital tube welding, thin sheet metal work. They are best used to weld carbon steel, stainless steel, nickel alloys, and titanium, and in most cases can replace 2% Thoriated electrodes. Ceriated tungsten is best suited for lower to medium amperages it should last longer than Thoriated. Higher amperage (>250A) applications are best left to Thoriated or Lanthanated tungsten.

Lanthanated (Color Code: Gold) 

Lanthanated tungsten electrodes (AWS classification EWLa-1.5) contain a minimum of 97.80 percent tungsten and 1.30 percent to 1.70 percent lanthanum and are known as ***1.5% Lanthanated.*** These electrodes have excellent arc starting, a low burn off rate, good arc stability, and excellent re-ignition characteristics. Lanthanated tungsten also share the conductivity characteristics of 2% Thoriated tungsten. Lanthanated tungsten electrodes are ideal if you want to optimise your welding capabilities. They work well on AC or DC electrode negative with a pointed end, or they can be balled for use with AC sine wave power sources. Lanthanated tungsten maintains a sharpened point well, which is an advantage for welding steel and stainless steel on DC or AC from square wave power sources.

Zirconiated (Color Code: White)

Zirconiated tungsten electrodes (AWS classification EWZr-1) contain a minimum of 99.10 percent tungsten and 0.7 to 0.9 percent zirconium oxide and are known as ***0.8% Zirconiated***. Most commonly used for AC welding, Zirconiated tungsten produces a very stable arc and is resistant to tungsten spitting. It is ideal for AC welding because it retains a balled tip and has a high resistance to contamination. Its current-carrying capacity is equal to or greater than that of thoriated tungsten. Zirconiated tungsten is not recommended for DC TIG welding.

§5.3.4 Tungsten Electrode Rating for Welding Currents

Tungsten Diameter mm	DC Current Amps Torch Negative 2% Thoriated	AC Current Amps Un-Balanced Wave 0.8% Zirconiated	AC Current Amps Balanced Wave 0.8% Zirconiated
1.0mm	15-80	15-80	20-60
1.6mm	70-150	70-150	60-120
2.4mm	150-250	140-235	100-180
3.2mm	250-400	225-325	160-250
4.0mm	400-500	300-400	200-320

§5.3.5 Tungsten Electrode Preparation

Always use **DIAMOND** wheels when grinding and cutting. While tungsten is a very hard material, the surface of a diamond wheel is harder, and this makes for smooth grinding. **WARNING:** ***Grinding with aluminum oxide wheels, can lead to jagged edges, imperfections, or poor surface finishes not visible to the eye that will contribute to weld inconsistency and weld defects.***

Longitudinal Grinding

Always ensure to grind the tungsten in a longitudinal direction on the grinding wheel. Tungsten electrodes are manufactured with the molecular structure of the grain running lengthwise and thus grinding crosswise is “grinding against the grain.” If electrodes are ground crosswise, the electrons

have to jump across the grinding marks and the arc can start before the tip and wander. Grinding longitudinally with the grain, the electrons flow steadily and easily to the end of the tungsten tip. The arc starts straight and remains narrow, concentrated, and stable.

Electrode Tip – Taper & Flat

The shape of the tungsten electrode tip is an important process variable in precision arc welding. A good selection of tip flat size will balance the need for several advantages. The bigger the flat, the more likely arc wander will occur and the more difficult it will be to arc start. However, increasing the flat to the maximum level that still allows arc start and eliminates arc wonder will improve the weld penetration and increase the electrode life. Some welders still grind electrodes to a sharp point, which makes arc starting easier. However, they risk decreased welding performance from melting at the tip and the possibility of the point falling off into the weld pool.

Tungsten electrodes for DC welding should be ground longitudinally and concentrically with diamond wheels to a specific included angle in conjunction with the tip/flat preparation. Different angles produce different arc shapes and offer different weld penetration capabilities.

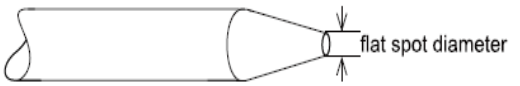
Blunt electrodes with larger included angle：

• Last Longer

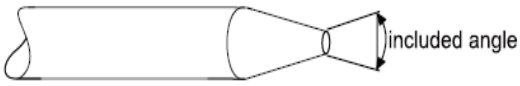
• Have better weld penetration

• Have a narrower arc shape

• Can handle more amperage without eroding.



Sharper electrodes with smaller included angle:



• Offer less arc weld

• Have a wider arc

• Have a more consistent arc

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

Electrode Angle Chart

Tungsten Diameter	Diameter at the Tip - mm	Constant Included Angle - Degrees	Current Range Amps	Current Range Pulsed Amps
1.0mm	.250	20	05 - 30	05 - 60
1.6mm	.500	25	08 - 50	05 - 100
1.6mm	.800	30	10 - 70	10 - 140
2.4mm	.800	35	12 - 90	12 - 180
2.4mm	1.100	45	15 - 150	15 - 250
3.2mm	1.100	60	20 - 200	20 - 300
3.2mm	1.500	90	25 - 250	25 - 350

§5.3.6 DC TIG welding trouble shooting

The following chart addresses some of the common problems of DC TIG welding. In all cases of equipment malfunction, the manufacturer’s recommendations should be strictly adhered to and followed.

NO.	Trouble	Possible Reason	Suggested Remedy
1	T**ungsten burning away quickly**	Incorrect Gas or No Gas	Use pure Argon. Check cylinder has gas, connected, turned on and torch valve is open
		Inadequate gas flow	Check the gas is connected, check hoses, gas valve and torch are not restricted.
		Back cap not fitted correctly	Make sure the torch back cap is fitted so that the o-ring is inside the torch body
		Torch connected to DC +	Connect the torch to the DC- output terminal
		Incorrect tungsten being used	Check and change the tungsten type if necessary
		Tungsten being oxidised after weld is finished	Keep shielding gas flowing 10–15 seconds after arc stoppage. 1 second for each 10amps of weld current.
2	**Contaminated tungsten**	Touching tungsten into the weld pool	Keep tungsten from contacting weld puddle. Raise the torch so that the tungsten is off of the work piece 2 - 5mm
		Touching the filler wire to the tungsten	Keep the filler wire from touching the tungsten during welding, feed the filler wire into the leading edge of the weld pool in front of the tungsten
3	**Porosity - poor weld appearance and colour**	Wrong gas / poor gas flow /gas leak	Use pure argon. Gas is connected, check hoses, gas valve and torch are not restricted. Set the gas flow between 6-12 l/min. Check hoses and fittings for holes, leaks et
		Contaminated base metal	Remove moisture and materials like paint, grease, oil, and dirt from base metal
		Contaminated filler wire	Remove all grease, oil, or moisture from filler metal
		Incorrect filler wire	Check the filler wire and change if necessary
4	**Yellowish residue / smoke on the alumina nozzle &**	Incorrect Gas	Use pure Argon gas
		Inadequate gas flow	Set the gas flow between 10 - 15 l/min flow rate

	discolored tungsten	Alumina gas nozzle too small	Increase the size of the alumina gas nozzle
5	**Unstable Arc during DC welding**	Torch connected to DC +	Connect the torch to the DC- output terminal
		Contaminated base metal	Remove materials like paint, grease, oil, and dirt, including mill scale from base metal.
		Tungsten is contaminated	Remove 10mm of contaminated tungsten and re grind the tungsten
		Arc length too long	Lower torch so that the tungsten is off of the work piece 2 - 5mm
6	**Arc wanders during DC welding**	Poor gas flow	Check and set the gas flow between 10 - 15 l/min flow rate
		Incorrect arc length	Lower torch so that the tungsten is off of the work piece 2 - 5mm
		Tungsten incorrect or in poor condition	Check that correct type of tungsten is being used. Remove 10mm from the weld end of the tungsten and re sharpen the tungsten
		Poorly prepared tungsten	Grind marks should run lengthwise with tungsten, not circular. Use proper grinding method and wheel.
		Contaminated base metal or filler wire	Remove contaminating materials like paint, grease, oil, and dirt, including mill scale from base metal. Remove all grease, oil, or moisture from filler metal
7	**Arc difficult to start or will not start DC welding**	Incorrect machine set up	Check machine set up is correct
		No gas, incorrect gas flow	Check the gas is connected and cylinder valve open, check hoses, gas valve and torch are not restricted. Set the gas flow between 10 - 15 l/min flow rate
		Incorrect tungsten size or type	Check and change the size and or the tungsten if required
		Loose connection	Check all connectors and tighten
		Earth clamp not connected to work	Connect the earth clamp directly to the work piece wherever possible

§6 Troubleshooting & Maintenance

§6.1 General Machine Maintenance

● ***Warning: For safety while maintaining the machine, please <u>disconnect</u> the supply power and wait for 5 minutes or until capacity voltage drops to 36 volts or lower.***

Frequency	Maintenance items
Daily Exam	Check panel knobs and switch on front and back of welding machine. If knobs or switches are loose or damaged, correct before operating. Turn power ON and observe whether the welding machine is vibrating, humming or whistling. Check cooling fan blade has no obstruction and heat-sink “tunnel” is clear of any contamination blocking air flow. Check display is not damaged and is functioning correctly. Keep display screen clean and out of direct sunlight for extended periods. If the display is damaged or faulty, replace the display PCB. Check torch and work clamp cables & connectors as loose connectors cause terminals to overheat. Loose connectors may also melt jacket off welding cables. Check power cord plug, cable and adaptor for wear or damage. If worn or damaged, repair or replace.
Monthly Exam	Remove cabinet cover and use dry compressed air to clear contamination on heat sink radiator fins, main voltage transformer, inductance coils, IGBT modules and all PCB surfaces. Dirt & dust when combined with humidity and moisture can damage electric components. Check output power connector terminal bolts, if loose, tighten. If terminal lugs are damaged or copper cable frayed, please replace.
Quarterly Exam	Confirm the current sensors are supply correct voltage to the display value. If not accurate, they should be adjusted. The actual current value can be measured by the plier-type ampere meter.
Annual Exam	Measure the insulating impedance among the main circuit, PCB and case, if it below 1MΩ, insulation could be damaged and may need to be replaced or strengthen to increase insulation value.

§6.2 Troubleshooting

- Before welding machines are shipped from the factory, they have been tested for accurately. No operator is authorized to modify or change the equipment!
- Only qualified electronic maintenance personal should maintain the machine!
- If no authorized maintenance personnel are available, contact local dealer or factory.

NO.	Troubles		Reasons	Solution
1	Close the breaker, but the power light isn't on		Breaker damaged	Change it
			Fuse damaged	Change it
			Power damaged	Change it
2	After welding machine is over-heat, the fan doesn't work		Fan damaged	Change it
			The cable is loosen	Screw the cable tightly
3	Press the gun switch, no output shielded gas	No output gas when test gas	No gas in the gas cylinder	Change it
			Gas pipe leaks gas	Change it
			Electromagnetic valve damaged	Change it
		Output gas when test gas	Control switch damaged	Repair the switch
			Control circuit damaged	Check the board
4	Wire-feeder doesn't work	Wire reel doesn't work	Motor damaged	Check and change it
			Control circuit damaged	Check the board
		Wire reel works	The press wheel is loosen or weld wire skids	Press it tightly again
			The wheel doesn't fit with the diameter of weld wire	Change the wheel
			Wire reel damaged	Change it
			Wire feed pipe is jammed	Repair or change it
			Tip is jammed because of splash	Repair or change it
5	No striking arc and no output voltage		Output cable is connected mistakenly, or loosen	Screw it down or change it
			Control circuit damaged	Check the circuit
6	Welding stops, and alarm light is on		Machine has self-protection	Check over-voltage, over-current, over-temperature, lower-voltage and over-temperature, and solve it
7	Welding current is run away and can be not controlled		The potentiometer damaged	Check or change it
			The control circuit damaged	Check the circuit
8	The crater current can be not adjusted		The PCB damaged	Check it
9	No post-gas		The PCB damaged	Check it

§6.3 Maintenance of Welding Torches & Cables

§6.3.1 Maintaining MIG Welding Torch

1) **Contact Tip** – Check condition of contact tip often as it is the primary wear component on the MIG torch. The contact tip provides a continuous flow of DC current to the welding wire and, as it wears, the gap between the bore and wire surface grows. This allows for arcing of DC current inside the tip rather than at the welding surface. Replace regularly.
2) **Gas Nozzle** – Check condition of nozzle often paying attention to the INSIDE of the bore. Weld spatter will build up inside nozzle blocking shield gas and creating an insulating skin over tip holder & diffusor that will over-heat and permanently damage MIG torch.
3) **Power Cable** – Check power cable for cuts or kinks that can obstruct wire and gas flow. Be sure to maintain the cable support springs at both ends as well as the machine connector body as “bending” can cause major damage to torch and welder.
4) **Wire Conduit Liner** – If wire does not easily feed through torch cable assembly with contact tip removed, it is time to change the wire conduit liner. It will wear-out over time.

§6.3.2 Selecting MIG Torch Conduit Liner

Steel Liners

Most MIG gun liners are made from coiled steel wire also known as piano wire, which provides the liner with good rigidity and flexibility and allows it to guide the welding wire smoothly through the welding cable. Steel liners are primarily used for feeding of solid steel wires. Other wires such as Aluminum and Silicon Bronze will perform better using a Teflon or Polyamide line. The internal diameter of the liner is designed to the welding wire diameter and must be selected accordningly. Most manufacturers will produce liners sized to match wire diameters and length of welding torch cable and are color coded to as follows:.

Steel Liners

Blue-0.6mm-0.8mm

Red - 0.9mm - 1.2mm

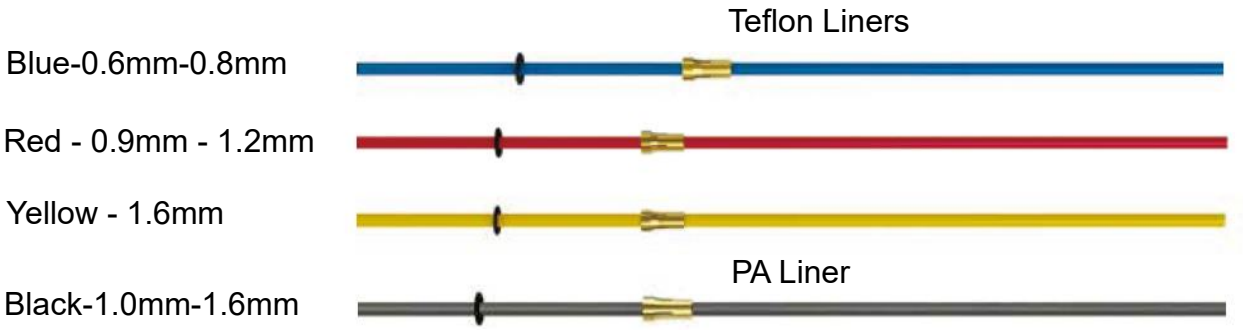
Yellow - 1.6mm

Green - 2.0mm - 2.4mm

Teflon and Polyamide (PA) Liners

Teflon liners are designed for feeding soft wires with poor column strength like aluminum wires. The interiors of these liners must be smooth and low-friction making Teflon ideal. Teflon has good abrasion resistance characteristics and can be used with a variety of wire types such as silicon bronze, stainless steel as well as aluminum. Polyamide Liners (PA) are made of carbon infused nylon and are ideal for softer aluminum, copper alloy welding wires and push pull torch applications.

NOTE: Be careful to inspect and be-burr the end of the welding wire prior to feeding it down the liner. Sharp edges and burrs can score or cut the liner causing catastrophic failure.



Teflon with Copper Neck Liner

For higher heat applications (>200A) fitting brass or copper wound neck liner extensions from the handle to the contact tip will increase the working temperature of the liner as well as improve the electrical conductivity of the welding power transfer to the wire. Teflon with copper neck extensions offers long life.

§6.3.2 Changing MIG Torch Conduit Liner

NOTE: Torch cable must be laid flat and completely straight to change conduit liner.

(1) Remove nozzle, tip, tip holder & diffuser.

(2) Remove the liner retaining nut on euro end..

(3) Carefully pull out and remove liner.

(4) Carefully unravel the new liner with no “kinks”.

(5) Carefully feed in the new liner all the way Until it extends out of the torch neck.

(6) Fit the liner retaining nut but only screw the nut 1/2 way down.

(7) Snip the liner off 1/8” (3mm) past the end of the torch neck.

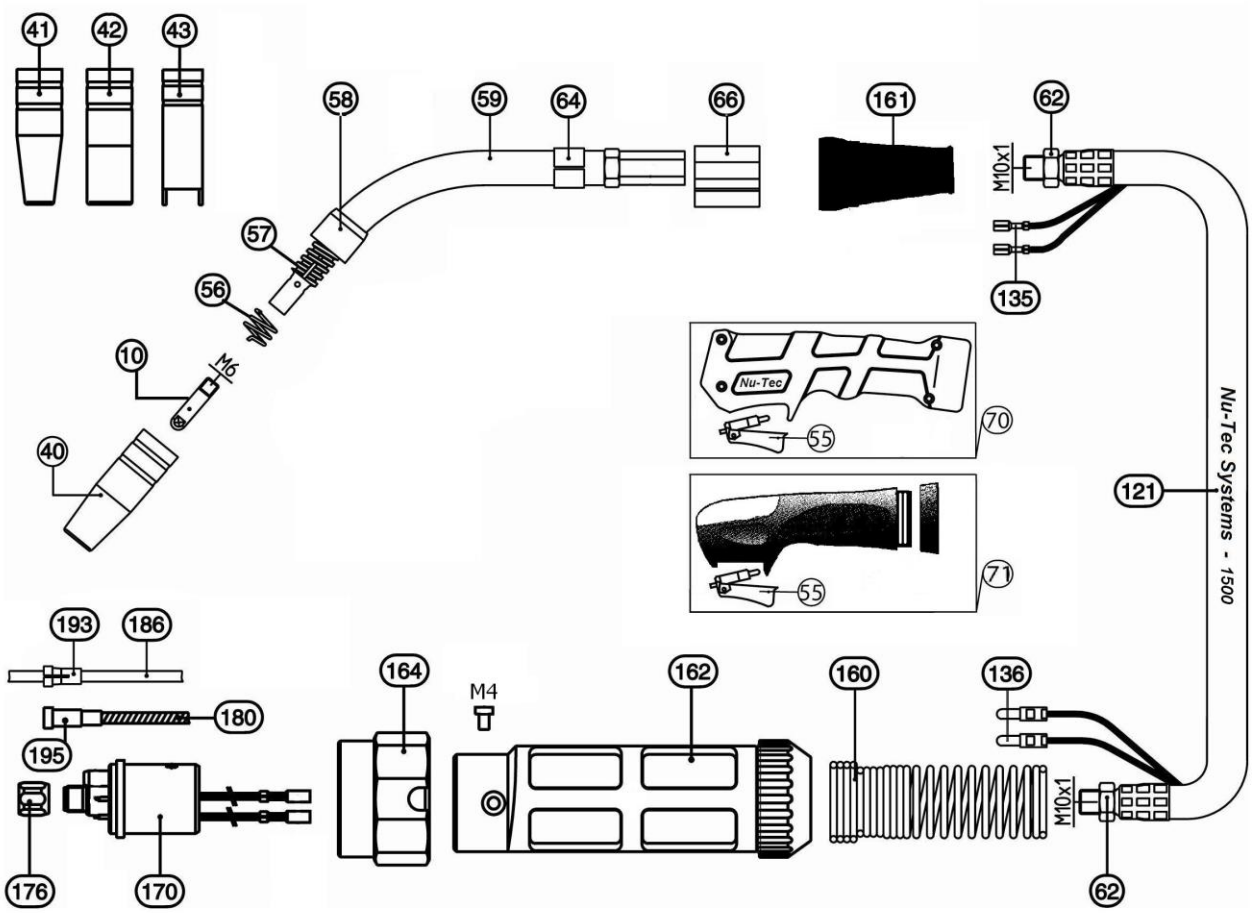
(8) Replace the tip holder/diffuser and contact tip being sure to tighten all with wrench.

(9) Fully screw down the liner retaining nut and tighten with wrench..

NOTE: If liner extension is required on euro-connect end to extend into drive rollers (i.e.: through retaining nut), set required extension and tighten retaining nut enough to “hold” liner in position while completing all other steps listed. Tighten retaining nut completely after replacing the tip holder/diffuser & contact tip.

§6.3.3 SL15-10 MIG Torch Parts List

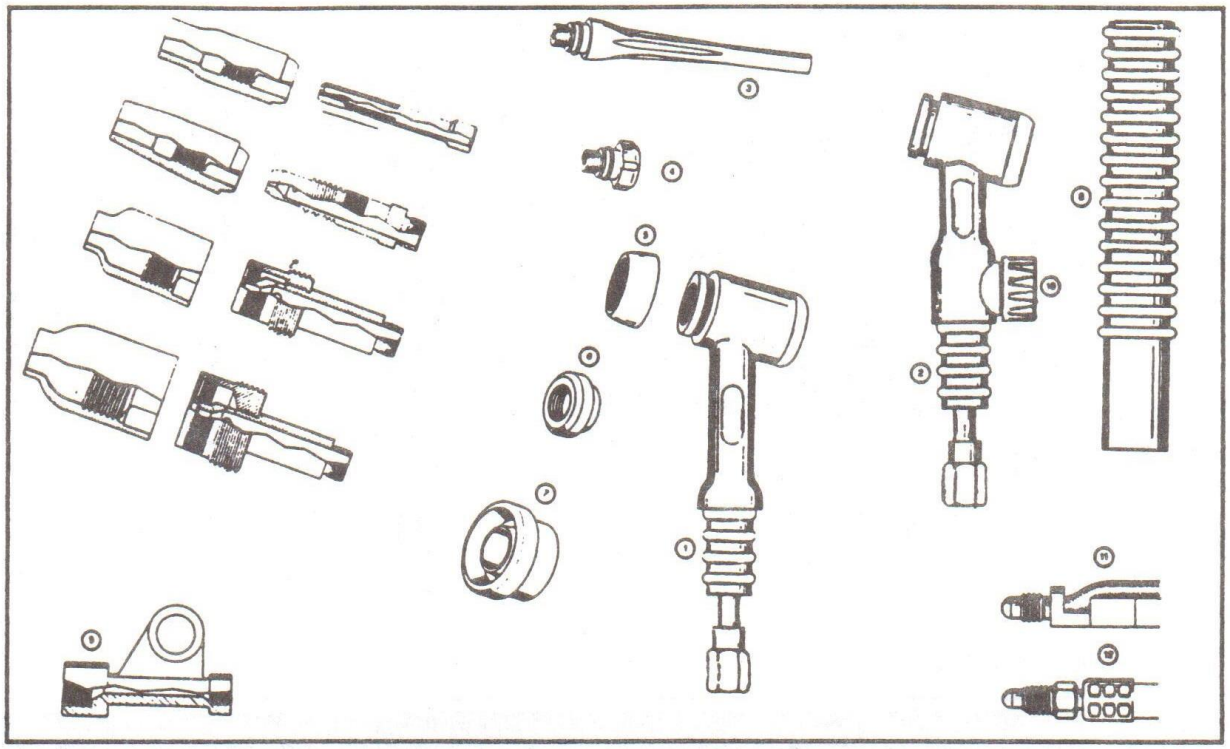
NU-TEC NM15 & SL15 MIG GUN PARTS LIST



10	**140N0008**	**CONTACT TIP .023"**
	140N0059	**CONTACT TIP .030"**
	140N0177	**CONTACT TIP .035"**
40	**145N0075**	**NOZZLE 1/2" (STANDARD)**
41	**145N0123**	**NOZZLE 3/8"**
42	**145N0041**	**NOZZLE 5/8"**
43	**145N0168**	**NOZZLE SPOT-WELD**
54	185N0005	TRIGGER NM STYLE
55	185N0006	TRIGGER SL STYLE
56	002N0058	NOZZLE SPRING #15
57	002N0078	GAS DIFFUSER/TIP HOLDER #15
58	002N0050	HEAD INSULATOR #15
59	002N0009	SWAN NECK #15
62	001N0009	BRASS NUT JAM
64	002N0064	SWAN NECK BUSHING #15
66	400N0044	TORCH BODY
70	180N0103	HANDLE NM-STYLE BLUE
71	180N0040	HANDLE SWIVEL BLUE
121	160N0065	POWER CABLE 10'
	160N0587	POWER CABLE 12'
135	175N0022	TERMINAL TRIGGER
136	175N0004	TERMINAL EURO
160	400N2099	CABLE SUPPORT SPRING
161	180N0046	CABLE SUPPORT SWIVEL
162	501N0045	CABLE SUPPORT BODY
164	501N0014	EURO CABLE NUT
170	501N0003	CENTRAL ADAPTOR A/C
176	501N0082	LINER POSITION NUT
180	124N0015	STEEL LINER .023"-.035"
186	126N9001	TEFLON LINER .023"- .035"
	126N9002	TEFLON W/COPPER .023'-.035"

§6.3.4 SR17 TIG Torch Parts List

SR-17, 17V *150 AMPS • AIR COOLED* TIG TORCH



Item	Part No.	Description	Item	Part No.	Description
1.	17	150 amp Torch Head	5.	18CG	Cup Gasket
2.	17V	150 amp Torch Head w/Valve	6.	54N01	Gas Lens Insulator
N/S	17-12R	150 amp Torch w/12½', 1 pc. Rubber Power Cable	7.	54N63	Large Diameter Gas Lens Insulator
N/S	17-25R	150 amp Torch w/25', 1 pc. Rubber Power Cable	8.	H-100R	Handle, Ribbed
N/S	17V12R	150 amp Torch w/valve, 12½', 1 pc. Rubber Power Cable	9.	105Z57	Power Cable Adapter
N/S	17V25R	150 amp Torch w/valve, 25', 1 pc. Rubber Power Cable	10.	VS-2	Valve Stem w/O'Ring
3.	57Y02	Long Back Cap	N/S	S-008	O'Ring for valve stem
4.	57Y04	Short Back Cap	11.	57Y01R	1 pc. Rubber Power Cable 12½'
				57Y03R	1 pc. Rubber Power Cable 25'
			12.	57Y01-2	Optional 2 pc. Power Cable 12½'
				57Y03-2	Optional 2 pc. Power Cable 25'

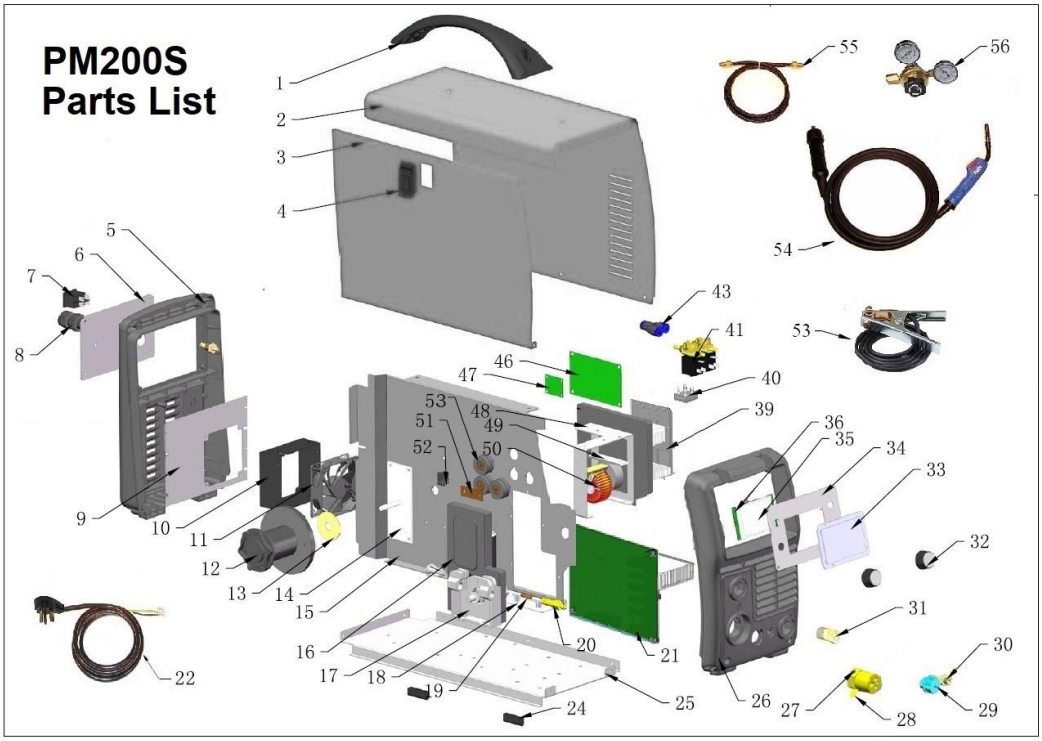
CHART A * COLLETS * COLLET BODIES * GAS LENS

Electrode Diameter	.020 (.5mm)	.040 (.1mm)	1/16 (1.6mm)	3/32 (2.4mm)
Collet	10N21	10N22	10N23	10N24
Collet Body	10N29	10N30	10N31	10N32
Gas Lens	45V29	45V24	45V25	45V26
Lg. Dia., Gas Lens	—	—	—	45V64

CHART B * GAS CUPS

SIZE	4	5	6	7	8	10	12
Alumina	10N50	10N49	10N48	10N47	10N46	10N45	10N44
Alumina Gas Lens	54N18	54N17	54N16	54N15	54N14	—	—
Alumina Lg. Dia. Gas Lens	—	—	57N75	—	57N74	53N88	53N87
Lava	105Z43	105Z42	105Z44	105Z45	06N78	06N79	06N80

§6.4 Machine Parts List



1	520.3010	Handle Machine 200S	27	520.0123	Euro-Torch Connect
2	521.3050	Cabinet Cover F200	28	521.3024	Euro-Gas Connect
3	521.3051	Cabinet Wire Door F200	29	521.0011	9-Pin Control Socket
4	538.0017	Latch Wire Feed Door	30	521.2526	Gas Out Connect
5	521.3052	Cabinet Frame Rear F200	31	740.0012	Dinse 3550 Socket
6	521.3049	Cabinet Plate Rear F200	32	520.3027	Knob
7	530.0020	Switch Power ON/OFF	33	521.3025	LCD Clear Cover F200
8	707.0170	Strain Relief Power Cord	34	521.3058	Cabinet Plate Front F200
9	521.3049	Cabinet Plate Fan F200	35	521.0211	LCD Display B
10	740.0122	Fan Mount Plenum	36	521.0210	PCB Front Panel B
11	740.0121	Fan Cooling	39	521.3059	Heat-Sink Plate
12	538.0016	Wire Spool Holder (Comp.)	40	521.0016	Rectifier
13	538.0028	Wire Spool Bushing	41	521.2523	Gas Solenoid Valves
14	520.3015	Spool Holder Mount Shaft	43	521.0105	Quick Connect Y-Fitting
15	521.3055	Cabinet Center Plate F200	46	521.0102	PCB Power Board
16	521.3020	Wire Feed Motor Guard	47	521.0131	PCB Board EMC
17	520.3019	Wire Feed Motor Drive	48	521.3060	Mount Plate Transformer
18	521.3054	Wire Feed Motor Mount	49	521.0132	Transformer 200S
19	520.3021	Wire Guide Tube	50	521.0133	PFC Inductance Coil
20	520.3022	Wire Guide Connector	51	521.0126	Buss Bar Copper
21	521.0103	PCB Main Inverter Block	52	521.0130	Switch Spool / MIG
22	570.0010	Power Cord NEMA6-50P	53	521.0134	Power Lug Terminal
23	521.0104	PCB Adjustment Board	54	513N0013	200A Earth Cable 3550
24	538.0019	Cabinet Hinge	55	SL15-10	SL15 MIG Gun (10 ft.)
25	521.3056	Cabinet Base F200	56	520.0009	Gas Hose 5/8-18 (3 ft.)
26	521.3057	Cabinet Frame front F200	57	721.0004	Gas Regulator 2-Gauge

§7 Electrical Schematic