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Processes



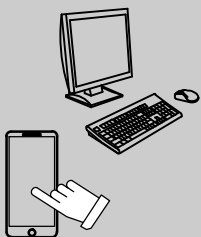
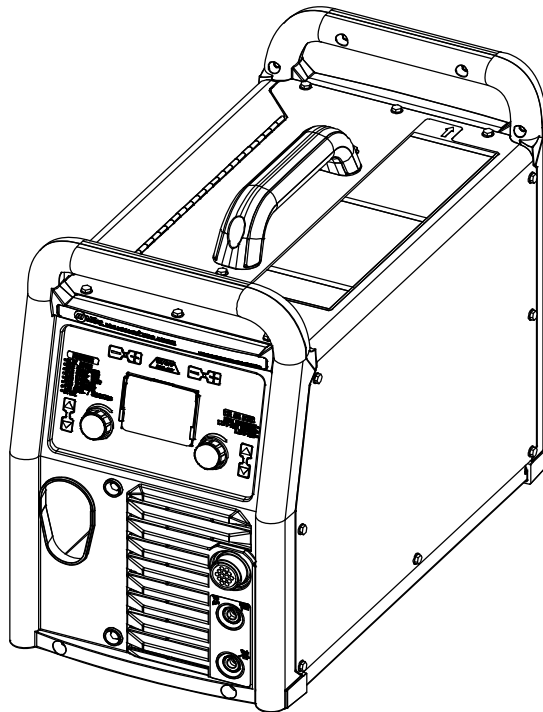
Multiprocess Welding

Description



Arc Welding Power Source
Wire Feeder

Multimatic[®] 220 AC/DC



For product information,
Owner's Manual translations,
and more, visit

www.MillerWelds.com

OWNER'S MANUAL

File: Multiprocess



From Miller to You

Thank you and congratulations on choosing Miller. Now you can get the job done and get it done right. We know you don't have time to do it any other way.

That's why when Niels Miller first started building arc welders in 1929, he made sure his products offered long-lasting value and superior quality. Like you, his customers couldn't afford anything less. Miller products had to be more than the best they could be. They had to be the best you could buy.

Today, the people that build and sell Miller products continue the tradition. They're just as committed to providing equipment and service that meets the high standards of quality and value established in 1929.

This Owner's Manual is designed to help you get the most out of your Miller products. Please take time to read the Safety Precautions. They will help you protect yourself against potential hazards on the worksite.



ISO 9001
Quality

Miller is the first welding equipment manufacturer in the U.S.A. to be registered to the ISO 9001 Quality System Standard.

We've made installation and operation quick and easy. With Miller, you can count on years of reliable service with proper maintenance. And if for some reason the unit needs repair, there's a Troubleshooting section that will help you figure out what the problem is, and our extensive service network is there to help fix the problem. Warranty and maintenance information for your particular model are also provided.



Miller Electric manufactures a full line of welders and welding-related equipment. For information on other quality Miller products, contact your local Miller distributor to receive the latest full line catalog or individual specification sheets. **To locate your nearest distributor or service agency call 1-800-4-A-Miller, or visit us at www.MillerWelds.com on the web.**



Working as hard as you do – every power source from Miller is backed by the most hassle-free warranty in the business.



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SECTION 1 – SAFETY PRECAUTIONS - READ BEFORE USING

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 **Protect yourself and others from injury — read, follow, and save these important safety precautions and operating instructions.**

1-1. Symbol Usage

 **DANGER!** – Indicates a hazardous situation which, if not avoided, will result in death or serious injury. The possible hazards are shown in the adjoining symbols or explained in the text.

 Indicates a hazardous situation which, if not avoided, could result in death or serious injury. The possible hazards are shown in the adjoining symbols or explained in the text.

NOTICE – Indicates statements not related to personal injury.

 Indicates special instructions.



This group of symbols means Warning! Watch Out! ELECTRIC SHOCK, MOVING PARTS, and HOT PARTS hazards. Consult symbols and related instructions below for necessary actions to avoid the hazards.

1-2. Arc Welding Hazards

 The symbols shown below are used throughout this manual to call attention to and identify possible hazards. When you see the symbol, watch out, and follow the related instructions to avoid the hazard. The safety information given below is only a summary of the more complete safety information found in the Safety Standards listed in Section 1-5. Read and follow all Safety Standards.

 Only qualified persons should install, operate, maintain, and repair this equipment. A qualified person is defined as one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated ability to solve or resolve problems relating to the subject matter, the work, or the project and has received safety training to recognize and avoid the hazards involved.

 During operation, keep everybody, especially children, away.



ELECTRIC SHOCK can kill.

Touching live electrical parts can cause fatal shocks or severe burns. The electrode and work circuit is electrically live whenever the output is on. The input power circuit and machine internal circuits are also live when power is on. In semiautomatic or automatic wire welding, the wire, wire reel, drive roll housing, and all metal parts touching the welding wire are electrically live. Incorrectly installed or improperly grounded equipment is a hazard.

- 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 big enough to prevent any physical contact with the work or ground.
- Do not use AC weld output in damp, wet, or confined spaces, or if there is a danger of falling.
- Use AC output ONLY if required for the welding process.
- If AC output is required, use remote output control if present on unit.
- Additional safety precautions are required when any of the following electrically hazardous conditions are present: in damp locations or while wearing wet clothing; on metal structures such as floors, gratings, or scaffolds; when in cramped positions such as sitting, kneeling, or lying; or when there is a high risk of unavoidable or accidental contact with the workpiece or ground. For these conditions, use the following equipment in order presented: 1) a semiautomatic DC constant voltage (wire) welder, 2) a DC manual (stick) welder, or 3) an AC welder with reduced open-circuit voltage. In most situations, use of a DC, constant voltage wire welder is recommended. And, do not work alone!
- Disconnect input power or stop engine before installing or servicing this equipment. Lockout/tagout input power according to OSHA 29 CFR 1910.147 (see Safety Standards).

- Properly install, ground, and operate this equipment according to its Owner's Manual and national, state, and local codes.
- Always verify the supply ground – check and be sure that input power cord ground wire is properly connected to ground terminal in disconnect box or that cord plug is connected to a properly grounded receptacle outlet.
- When making input connections, attach proper grounding conductor first – double-check connections.
- Keep cords dry, free of oil and grease, and protected from hot metal and sparks.
- Frequently inspect input power cord and ground conductor for damage or bare wiring – replace immediately if damaged – bare wiring can kill.
- Turn off all equipment when not in use.
- Do not use worn, damaged, undersized, or repaired cables.
- Do not drape cables over your body.
- If earth grounding of the workpiece is required, ground it directly with a separate cable.
- Do not touch electrode if you are in contact with the work, ground, or another electrode from a different machine.
- Do not touch electrode holders connected to two welding machines at the same time since double open-circuit voltage will be present.
- Use only well-maintained equipment. Repair or replace damaged parts at once. Maintain unit according to manual.
- Wear a safety harness if working above floor level.
- Keep all panels and covers securely in place.
- Clamp work cable with good metal-to-metal contact to workpiece or worktable as near the weld as practical.
- Insulate work clamp when not connected to workpiece to prevent contact with any metal object.
- Do not connect more than one electrode or work cable to any single weld output terminal. Disconnect cable for process not in use.
- Use GFCI protection when operating auxiliary equipment in damp or wet locations.

SIGNIFICANT DC VOLTAGE exists in inverter welding power sources AFTER removal of input power.

- Turn off unit, disconnect input power, and discharge input capacitors according to instructions in Manual before touching any parts.



HOT PARTS can burn.

- Do not touch hot parts bare handed.
- Allow cooling period before working on equipment.
- To handle hot parts, use proper tools and/or wear heavy, insulated welding gloves and clothing to prevent burns.



FUMES AND GASES can be hazardous.

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 breathe the fumes.
- Ventilate the work area and/or use local forced ventilation at the arc to remove welding fumes and gases. The recommended way to determine adequate ventilation is to sample for the composition and quantity of fumes and gases to which personnel are exposed.
- If ventilation is poor, wear an approved air-supplied respirator.
- Read and understand the Safety Data Sheets (SDSs) and the manufacturer's instructions for adhesives, coatings, cleaners, consumables, coolants, degreasers, fluxes, and metals.
- Work in a confined space only if it is well ventilated, or while wearing an air-supplied respirator. Always have a trained watchperson nearby. Welding fumes and gases can displace air and lower the oxygen level 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 vapors to form highly toxic and irritating gases.
- Do not weld on coated metals, such as galvanized, lead, or cadmium plated steel, unless the coating is removed from the weld area, the area is well ventilated, and while wearing an air-supplied respirator. The coatings and any metals containing these elements can give off toxic fumes if welded.



ARC RAYS can burn eyes and skin.

Arc rays from the welding process produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin. Sparks fly off from the weld.

- Wear an approved welding helmet fitted with a proper shade of filter lenses to protect your face and eyes from arc rays and sparks when welding or watching (see ANSI Z49.1 and Z87.1 listed in Safety Standards).
- Wear approved safety glasses with side shields under your helmet.
- Use protective screens or barriers to protect others from flash, glare and sparks; warn others not to watch the arc.
- Wear body protection made from durable, flame-resistant material (leather, heavy cotton, wool). Body protection includes oil-free clothing such as leather gloves, heavy shirt, cuffless trousers, high shoes, and a cap.

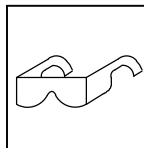


WELDING can cause fire or explosion.

Welding on closed containers, such as tanks, drums, or pipes, can cause them to blow up. Sparks can fly off from the welding arc. The flying sparks, hot workpiece, and hot equipment can cause fires and burns. Accidental contact of electrode to metal objects can cause sparks, explosion, overheating, or fire. Check and be sure the area is safe before doing any welding.

- Remove all flammables within 35 ft (10.7 m) of the welding arc. If this is not possible, tightly cover them with approved covers.
- Do not weld where flying sparks can strike flammable material.
- Protect yourself and others from flying sparks and hot metal.
- Be alert that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
- Watch 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 cut or weld on tire rims or wheels. Tires can explode if heated. Repaired rims and wheels can fail. See OSHA 29 CFR 1910.177 listed in Safety Standards.
- Do not weld on containers that have held combustibles, or on closed containers such as tanks, drums, or pipes unless they are properly prepared according to AWS F4.1 and AWS A6.0 (see Safety Standards).
- Do not weld where the atmosphere can contain flammable dust, gas, or liquid vapors (such as gasoline).
- Connect work cable to the work as close to the welding area as practical to prevent welding current from traveling long, possibly unknown paths and causing electric shock, sparks, and fire hazards.
- 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.
- Wear body protection made from durable, flame-resistant material (leather, heavy cotton, wool). Body protection includes oil-free clothing such as leather gloves, heavy shirt, cuffless trousers, high shoes, and a cap.
- Remove any combustibles, such as a butane lighter or matches, from your person before doing any welding.
- After completion of work, inspect area to ensure it is free of sparks, glowing embers, and flames.
- Use only correct fuses or circuit breakers. Do not oversize or bypass them.
- Follow requirements in OSHA 1910.252 (a) (2) (iv) and NFPA 51B for hot work and have a fire watcher and extinguisher nearby.
- Read and understand the Safety Data Sheets (SDSs) and the manufacturer's instructions for adhesives, coatings, cleaners, consumables, coolants, degreasers, fluxes, and metals.



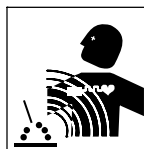
FLYING METAL or DIRT can injure eyes.

- Welding, chipping, wire brushing, and grinding cause sparks and flying metal. As welds cool, they can throw off slag.
- Wear approved safety glasses with side shields even under your welding helmet.



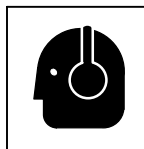
BUILDUP OF GAS can injure or kill.

- Shut off compressed gas supply when not in use.
- Always ventilate confined spaces or use approved air-supplied respirator.



ELECTRIC AND MAGNETIC FIELDS (EMF) can affect Implanted Medical Devices.

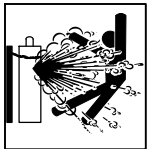
- Wearers of Pacemakers and other Implanted Medical Devices should keep away.
- Implanted Medical Device wearers should consult their doctor and the device manufacturer before going near arc welding, spot welding, gouging, plasma arc cutting, or induction heating operations.



NOISE can damage hearing.

Noise from some processes or equipment can damage hearing.

- Wear approved ear protection if noise level is high.



CYLINDERS can explode if damaged.

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

- Protect compressed gas cylinders from excessive heat, mechanical shocks, physical damage, slag, open flames, sparks, and arcs.
- Install cylinders in an upright position by securing to a stationary support or cylinder rack to prevent falling or tipping.
- Keep cylinders away from any welding or other electrical circuits.
- Never drape a welding torch over a gas cylinder.
- Never allow a welding electrode to touch any cylinder.

- Never weld on a pressurized cylinder – explosion will result.
- Use only correct compressed gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and associated parts in good condition.
- Turn face away from valve outlet when opening cylinder valve. Do not stand in front of or behind the regulator when opening the valve.
- Keep protective cap in place over valve except when cylinder is in use or connected for use.
- Use the proper equipment, correct procedures, and sufficient number of persons to lift, move, and transport cylinders.
- Read and follow instructions on compressed gas cylinders, associated equipment, and Compressed Gas Association (CGA) publication P-1 listed in Safety Standards.

1-3. Additional Symbols For Installation, Operation, And Maintenance



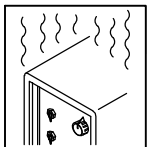
FIRE OR EXPLOSION hazard.

- Do not install or place unit on, over, or near combustible surfaces.
- Do not install unit near flammables.
- Do not overload building wiring – be sure power supply system is properly sized, rated, and protected to handle this unit.



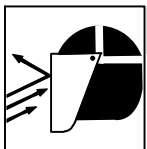
FALLING EQUIPMENT can injure.

- Use lifting eye to lift unit only, NOT running gear, gas cylinders, or any other accessories.
- Use correct procedures and equipment of adequate capacity to lift and support unit.
- If using lift forks to move unit, be sure forks are long enough to extend beyond opposite side of unit.
- Keep equipment (cables and cords) away from moving vehicles when working from an aerial location.
- Follow the guidelines in the Applications Manual for the Revised NIOSH Lifting Equation (Publication No. 94-110) when manually lifting heavy parts or equipment.



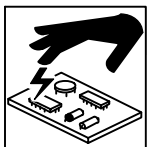
OVERUSE can cause OVERHEATING

- Allow cooling period; follow rated duty cycle.
- Reduce current or reduce duty cycle before starting to weld again.
- Do not block or filter airflow to unit.



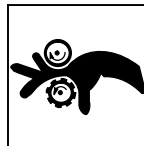
FLYING SPARKS can injure.

- Wear a face shield to protect eyes and face.
- Shape tungsten electrode only on grinder with proper guards in a safe location wearing proper face, hand, and body protection.
- Sparks can cause fires — keep flammables away.



STATIC (ESD) can damage PC boards.

- Put on grounded wrist strap BEFORE handling boards or parts.
- Use proper static-proof bags and boxes to store, move, or ship PC boards.



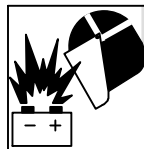
MOVING PARTS can injure.

- Keep away from moving parts.
- Keep away from pinch points such as drive rolls.



WELDING WIRE can injure.

- Do not press gun trigger until instructed to do so.
- Do not point gun toward any part of the body, other people, or any metal when threading welding wire.



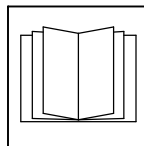
BATTERY EXPLOSION can injure.

- Do not use welder to charge batteries or jump start vehicles unless it has a battery charging feature designed for this purpose.



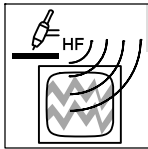
MOVING PARTS can injure.

- Keep away from moving parts such as fans.
- Keep all doors, panels, covers, and guards closed and securely in place.
- Have only qualified persons remove doors, panels, covers, or guards for maintenance and troubleshooting as necessary.
- Reinstall doors, panels, covers, or guards when maintenance is finished and before reconnecting input power.



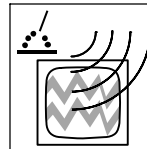
READ INSTRUCTIONS.

- Read and follow all labels and the Owner's Manual carefully before installing, operating, or servicing unit. Read the safety information at the beginning of the manual and in each section.
- Use only genuine replacement parts from the manufacturer.
- Perform installation, maintenance, and service according to the Owner's Manuals, industry standards, and national, state, and local codes.



H.F. RADIATION can cause interference.

- High-frequency (H.F.) can interfere with radio navigation, safety services, computers, and communications equipment.
- Have only qualified persons familiar with electronic equipment perform this installation.
- The user is responsible for having a qualified electrician promptly correct any interference problem resulting from the installation.
- If notified by the FCC about interference, stop using the equipment at once.
- Have the installation regularly checked and maintained.
- Keep high-frequency source doors and panels tightly shut, keep spark gaps at correct setting, and use grounding and shielding to minimize the possibility of interference.



ARC WELDING can cause interference.

- Electromagnetic energy can interfere with sensitive electronic equipment such as computers and computer-driven equipment such as robots.
- Be sure all equipment in the welding area is electromagnetically compatible.
- To reduce possible interference, keep weld cables as short as possible, close together, and down low, such as on the floor.
- Locate welding operation 100 meters from any sensitive electronic equipment.
- Be sure this welding machine is installed and grounded according to this manual.
- If interference still occurs, the user must take extra measures such as moving the welding machine, using shielded cables, using line filters, or shielding the work area.

1-4. California Proposition 65 Warnings

⚠ WARNING: This product can expose you to chemicals including lead, which are known to the state of California to cause cancer and birth defects or other reproductive harm.

For more information, go to www.P65Warnings.ca.gov.

1-5. Principal Safety Standards

Safety in Welding, Cutting, and Allied Processes, ANSI Standard Z49.1, is available as a free download from the American Welding Society at <http://www.aws.org> or purchased from Global Engineering Documents (phone: 1-877-413-5184, website: www.global.ihs.com).

Safe Practices for the Preparation of Containers and Piping for Welding and Cutting, American Welding Society Standard AWS F4.1, from Global Engineering Documents (phone: 1-877-413-5184, website: www.global.ihs.com).

Safe Practices for Welding and Cutting Containers that have Held Combustibles, American Welding Society Standard AWS A6.0, from Global Engineering Documents (phone: 1-877-413-5184, website: www.global.ihs.com).

National Electrical Code, NFPA Standard 70, from National Fire Protection Association, Quincy, MA 02169 (phone: 1-800-344-3555, website: www.nfpa.org and www.sparky.org).

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, from Compressed Gas Association, 14501 George Carter Way, Suite 103, Chantilly, VA 20151 (phone: 703-788-2700, website: www.cga-net.com).

Safety in Welding, Cutting, and Allied Processes, CSA Standard W117.2, from Canadian Standards Association, Standards Sales, 5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N5 (phone: 800-463-6727, website: www.csagroup.org).

Safe Practice For Occupational And Educational Eye And Face Protection, ANSI Standard Z87.1, from American National Standards Institute, 25 West 43rd Street, New York, NY 10036 (phone: 212-642-4900, website: www.ansi.org).

Standard for Fire Prevention During Welding, Cutting, and Other Hot Work, NFPA Standard 51B, from National Fire Protection Association, Quincy, MA 02169 (phone: 1-800-344-3555, website: www.nfpa.org).

OSHA, Occupational Safety and Health Standards for General Industry, Title 29, Code of Federal Regulations (CFR), Part 1910.177 Subpart N, Part 1910 Subpart Q, and Part 1926, Subpart J, from U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954 (phone: 1-866-512-1800) (there are 10 OSHA Regional Offices—phone for Region 5, Chicago, is 312-353-2220, website: www.osha.gov).

Applications Manual for the Revised NIOSH Lifting Equation, The National Institute for Occupational Safety and Health (NIOSH), 1600 Clifton Rd, Atlanta, GA 30329-4027 (phone: 1-800-232-4636, website: www.cdc.gov/NIOSH).

1-6. EMF Information

Electric current flowing through any conductor causes localized electric and magnetic fields (EMF). The current from arc welding (and allied processes including spot welding, gouging, plasma arc cutting, and induction heating operations) creates an EMF field around the welding circuit. EMF fields can interfere with some medical implants, e.g. pacemakers. Protective measures for persons wearing medical implants have to be taken. For example, restrict access for passers-by or conduct individual risk assessment for welders. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:

1. Keep cables close together by twisting or taping them, or using a cable cover.
2. Do not place your body between welding cables. Arrange cables to one side and away from the operator.
3. Do not coil or drape cables around your body.

4. Keep head and trunk as far away from the equipment in the welding circuit as possible.
5. Connect work clamp to workpiece as close to the weld as possible.
6. Do not work next to, sit or lean on the welding power source.
7. Do not weld whilst carrying the welding power source or wire feeder.

About Implanted Medical Devices:

Implanted Medical Device wearers should consult their doctor and the device manufacturer before performing or going near arc welding, spot welding, gouging, plasma arc cutting, or induction heating operations. If cleared by your doctor, then following the above procedures is recommended.

SECTION 2 – CONSIGNES DE SÉCURITÉ – LIRE AVANT UTILISATION

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⚠ Pour écarter les risques de blessure pour vous-même et pour autrui — lire, appliquer et ranger en lieu sûr ces consignes relatives aux précautions de sécurité et au mode opératoire.

2-1. Symboles utilisés



DANGER! – Indique une situation dangereuse qui si on l'évite pas peut donner la mort ou des blessures graves. Les dangers possibles sont montrés par les symboles joints ou sont expliqués dans le texte.



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AVIS – Indique des déclarations pas en relation avec des blessures personnelles.

 Indique des instructions spécifiques.



Ce groupe de symboles veut dire Avertissement! Attention! DANGER DE CHOC ÉLECTRIQUE, PIÈCES EN MOUVEMENT, et PIÈCES CHAUDES. Consulter les symboles et les instructions ci-dessous y afférant pour les actions nécessaires afin d'éviter le danger.

2-2. Dangers relatifs au soudage à l'arc



Les symboles représentés ci-dessous sont utilisés dans ce manuel pour attirer l'attention et identifier les dangers possibles. En présence de l'un de ces symboles, prendre garde et suivre les instructions afférentes pour éviter tout risque. Les instructions en matière de sécurité indiquées ci-dessous ne constituent qu'un sommaire des instructions de sécurité plus complètes fournies dans les normes de sécurité énumérées dans la Section 2-5. Lire et observer toutes les normes de sécurité.



L'installation, l'utilisation, l'entretien et les réparations ne doivent être confiés qu'à des personnes qualifiées. Une personne qualifiée est définie comme celle qui, par la possession d'un diplôme reconnu, d'un certificat ou d'un statut professionnel, ou qui, par une connaissance, une formation et une expérience approfondies, a démontré avec succès sa capacité à résoudre les problèmes liés à la tâche, le travail ou le projet et a reçu une formation en sécurité afin de reconnaître et d'éviter les risques inhérents.



Pendant le fonctionnement, maintenir à distance toutes les personnes, notamment les enfants de l'appareil.



UNE DÉCHARGE ÉLECTRIQUE peut entraîner la mort.

Le contact d'organes électriques sous tension peut provoquer des accidents mortels ou des brûlures graves. Le circuit de l'électrode et de la pièce est sous tension lorsque le courant est délivré à la sortie. Le circuit d'alimentation et les circuits internes de la machine sont également sous tension lorsque l'alimentation est sur Marche. Dans le mode de soudage avec du fil, le fil, le dérouleur, le bloc de commande du rouleau et toutes les parties métalliques en contact avec le fil sont sous tension électrique. Un équipement installé ou mis à la terre de manière incorrecte ou impropre constitue un danger.

- Ne pas toucher aux pièces électriques sous tension.
- Porter des gants isolants et des vêtements de protection secs et sans trous.
- S'isoler de la pièce à couper et du sol en utilisant des housses ou des tapis assez grands afin d'éviter tout contact physique avec la pièce à couper ou le sol.
- Ne pas utiliser de sortie de soudage CA dans des zones humides ou confinées ou s'il y a un risque de chute.
- Se servir d'une source électrique à courant électrique UNIQUEMENT si le procédé de soudage le demande.
- Si l'utilisation d'une source électrique à courant électrique s'avère nécessaire, se servir de la fonction de télécommande si l'appareil en est équipé.
- D'autres consignes de sécurité sont nécessaires dans les conditions suivantes : risques électriques dans un environnement humide ou si l'on porte des vêtements mouillés ; sur des structures métalliques telles que sols, grilles ou échafaudages ; en position coincée comme assise, à genoux ou couchée ; ou s'il y a un risque élevé de contact inévitable ou accidentel avec la pièce à souder ou le sol. Dans ces conditions, utiliser les équipements suivants, dans l'ordre indiqué : 1) un poste à souder DC à tension constante (à fil), 2) un poste à souder DC manuel (électrode) ou 3) un poste à souder AC à tension à vide réduite. Dans la plupart des situations,

l'utilisation d'un poste à souder DC à fil à tension constante est recommandée. En outre, ne pas travailler seul !

- Couper l'alimentation ou arrêter le moteur avant de procéder à l'installation, à la réparation ou à l'entretien de l'appareil. Déverrouiller l'alimentation selon la norme OSHA 29 CFR 1910.147 (voir normes de sécurité).
- Installez, mettez à la terre et utilisez correctement cet équipement conformément à son Manuel d'Utilisation et aux réglementations nationales, gouvernementales et locales.
- Toujours vérifier la terre du cordon d'alimentation. Vérifier et s'assurer que le fil de terre du cordon d'alimentation est bien raccordé à la borne de terre du sectionneur ou que la fiche du cordon est raccordée à une prise correctement mise à la terre.
- En effectuant les raccordements d'entrée, fixer d'abord le conducteur de mise à la terre approprié et contre-vérifier les connexions.
- Les câbles doivent être exempts d'humidité, d'huile et de graisse ; protégez-les contre les étincelles et les pièces métalliques chaudes.
- Vérifier fréquemment le cordon d'alimentation et le conducteur de mise à la terre afin de s'assurer qu'il n'est pas altéré ou dénudé – le remplacer immédiatement s'il l'est –. Un fil dénudé peut entraîner la mort.
- L'équipement doit être hors tension lorsqu'il n'est pas utilisé.
- Ne pas utiliser des câbles usés, endommagés, de grosseur insuffisante ou mal épissés.
- Ne pas enrouler les câbles autour du corps.
- Si la pièce soudée doit être mise à la terre, le faire directement avec un câble distinct.
- Ne pas toucher l'électrode quand on est en contact avec la pièce, la terre ou une électrode provenant d'une autre machine.
- Ne pas toucher des porte électrodes connectés à deux machines en même temps à cause de la présence d'une tension à vide doublée.
- N'utiliser qu'un matériel en bon état. Réparer ou remplacer sur-le-champ les pièces endommagées. Entretenir l'appareil conformément à ce manuel.
- Porter un harnais de sécurité si l'on doit travailler au-dessus du sol.
- S'assurer que tous les panneaux et couvercles sont correctement en place.
- Fixer le câble de retour de façon à obtenir un bon contact métal-métal avec la pièce à souder ou la table de travail, le plus près possible de la soudure.
- Isoler la pince de masse quand pas mis à la pièce pour éviter le contact avec tout objet métallique.
- Ne pas raccorder plus d'une électrode ou plus d'un câble de masse à une même borne de sortie de soudage. Débrancher le câble pour le procédé non utilisé.
- Utiliser une protection différentielle lors de l'utilisation d'un équipement auxiliaire dans des endroits humides ou mouillés.

Il reste une TENSION DC NON NÉGLIGEABLE dans les sources de soudage onduleur UNE FOIS l'alimentation coupée.

- Éteignez l'unité, débranchez le courant électrique, et déchargez les condensateurs d'alimentation selon les instructions indiquées dans le manuel avant de toucher les pièces.



LES PIÈCES CHAUDES peuvent provoquer des brûlures.

- Ne pas toucher à mains nues les parties chaudes.
- Prévoir une période de refroidissement avant de travailler à l'équipement.

- Ne pas toucher aux pièces chaudes, utiliser les outils recommandés et porter des gants de soudage et des vêtements épais pour éviter les brûlures.



LES FUMÉES ET LES GAZ peuvent être dangereux.

Le soudage génère des fumées et des gaz. Leur inhalation peut être dangereux pour votre santé.

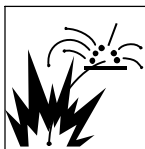
- Eloigner votre tête des fumées. Ne pas respirer les fumées.
- À l'intérieur, ventiler la zone et/ou utiliser une ventilation forcée au niveau de l'arc pour l'évacuation des fumées et des gaz de soudage. Pour déterminer la bonne ventilation, il est recommandé de procéder à un prélèvement pour la composition et la quantité de fumées et de gaz auxquelles est exposé le personnel.
- Si la ventilation est médiocre, porter un respirateur anti-vapeurs approuvé.
- Lire et comprendre les fiches de données de sécurité et les instructions du fabricant concernant les adhésifs, les revêtements, les nettoyants, les consommables, les produits de refroidissement, les dégraisseurs, les flux et les métaux.
- Travailler dans un espace fermé seulement s'il est bien ventilé ou en portant un respirateur à alimentation d'air. Demander toujours à un surveillant dûment formé de se tenir à proximité. Des fumées et des gaz de soudage peuvent déplacer l'air et abaisser le niveau d'oxygène provoquant des blessures ou des accidents mortels. S'assurer que l'air de respiration ne présente aucun danger.
- Ne pas souder dans des endroits situés à proximité d'opérations de dégraissage, de nettoyage ou de pulvérisation. La chaleur et les rayons de l'arc peuvent réagir en présence de vapeurs et former des gaz hautement toxiques et irritants.
- Ne pas souder des métaux munis d'un revêtement, tels que l'acier galvanisé, plaqué en plomb ou au cadmium à moins que le revêtement n'ait été enlevé dans la zone de soudure, que l'endroit soit bien ventilé, et en portant un respirateur à alimentation d'air. Les revêtements et tous les métaux renfermant ces éléments peuvent dégager des fumées toxiques en cas de soudage.



LES RAYONS DE L'ARC peuvent provoquer des brûlures dans les yeux et sur la peau.

Le rayonnement de l'arc du procédé de soudage génère des rayons visibles et invisibles intenses (ultraviolets et infrarouges) susceptibles de provoquer des brûlures dans les yeux et sur la peau. Des étincelles sont projetées pendant le soudage.

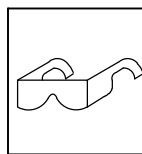
- Porter un casque de soudage approuvé muni de verres filtrants approprié pour protéger visage et yeux pour protéger votre visage et vos yeux pendant le soudage ou pour regarder (voir ANSI Z49.1 et Z87.1 énuméré dans les normes de sécurité).
- Porter des lunettes de sécurité avec écrans latéraux même sous votre casque.
- Avoir recours à des écrans protecteurs ou à des rideaux pour protéger les autres contre les rayonnements les éblouissements et les étincelles ; prévenir toute personne sur les lieux de ne pas regarder l'arc.
- Porter un équipement de protection pour le corps fait d'un matériau résistant et ignifuge (cuir, coton robuste, laine). La protection du corps comporte des vêtements sans huile comme par ex. des gants de cuir, une chemise solide, des pantalons sans revers, des chaussures hautes et une casquette.



LE SOUDAGE peut provoquer un incendie ou une explosion.

Le soudage effectué sur des conteneurs fermés tels que des réservoirs, tambours ou des conduites peut provoquer leur éclatement. Des étincelles peuvent être projetées de l'arc de soudure. La projection d'étincelles, des pièces chaudes et des équipements chauds peut provoquer des incendies et des brûlures. Le contact accidentel de l'électrode avec des objets métalliques peut provoquer des étincelles, une explosion, un surchauffement ou un incendie. Avant de commencer le soudage, vérifier et s'assurer que l'endroit ne présente pas de danger.

- Déplacer toutes les substances inflammables à une distance de 10,7 m de l'arc de soudage. En cas d'impossibilité les recouvrir soigneusement avec des protections homologués.
- Ne pas souder dans un endroit où des étincelles peuvent tomber sur des substances inflammables.
- Se protéger et d'autres personnes de la projection d'étincelles et de métal chaud.
- Des étincelles et des matériaux chauds du soudage peuvent facilement passer dans d'autres zones en traversant de petites fissures et des ouvertures.
- Surveiller tout déclenchement d'incendie et tenir un extincteur à proximité.
- Le soudage effectué sur un plafond, plancher, paroi ou séparation peut déclencher un incendie de l'autre côté.
- Ne pas couper ou souder des jantes ou des roues. Les pneus peuvent exploser s'ils sont chauffés. Les jantes et les roues réparées peuvent défaillir. Voir OSHA 29 CFR 1910.177 énuméré dans les normes de sécurité.
- Ne pas effectuer le soudage sur des conteneurs fermés tels que des réservoirs, tambours, ou conduites, à moins qu'ils n'aient été préparés correctement conformément à AWS F4.1 et AWS A6.0 (voir les Normes de Sécurité).
- Ne pas souder là où l'air ambiant pourrait contenir des poussières, gaz ou émanations inflammables (vapeur d'essence, par exemple).
- Brancher le câble de masse sur la pièce la plus près possible de la zone de soudage pour éviter le transport du courant sur une longue distance par des chemins inconnus éventuels en provoquant des risques d'électrocution, d'étincelles et d'incendie.
- Ne pas utiliser le poste de soudage pour dégelier des conduites gelées.
- En cas de non utilisation, enlever la baguette d'électrode du porte-électrode ou couper le fil à la pointe de contact.
- Porter un équipement de protection pour le corps fait d'un matériau résistant et ignifuge (cuir, coton robuste, laine). La protection du corps comporte des vêtements sans huile comme par ex. des gants de cuir, une chemise solide, des pantalons sans revers, des chaussures hautes et une casquette.
- Avant de souder, retirer toute substance combustible de vos poches telles qu'un allumeur au butane ou des allumettes.
- Une fois le travail achevé, assurez-vous qu'il ne reste aucune trace d'étincelles incandescentes ni de flammes.
- Utiliser exclusivement des fusibles ou coupe-circuits appropriés. Ne pas augmenter leur puissance; ne pas les ponter.
- Suivre les recommandations dans OSHA 1910.252(a)(2)(iv) et NFPA 51B pour les travaux à chaud et avoir de la surveillance et un extincteur à proximité.
- Lire et comprendre les fiches de données de sécurité et les instructions du fabricant concernant les adhésifs, les revêtements, les nettoyants, les consommables, les produits de refroidissement, les dégraisseurs, les flux et les métaux.



DES PIÈCES DE METAL ou DES SALETES peuvent provoquer des blessures dans les yeux.

- Le soudage, l'écaillage, le passage de la pièce à la brosse en fil de fer, et le meulage génèrent des étincelles et des particules métalliques volantes. Pendant la période de refroidissement des soudures, elles risquent de projeter du laitier.
- Porter des lunettes de sécurité avec écrans latéraux ou un écran facial.



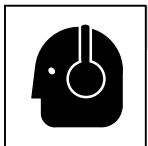
LES ACCUMULATIONS DE GAZ risquent de provoquer des blessures ou même la mort.

- Fermer l'alimentation du gaz comprimé en cas de non utilisation.
- Veiller toujours à bien aérer les espaces confinés ou se servir d'un respirateur d'adduction d'air homologué.



Les CHAMPS ÉLECTROMAGNÉTIQUES (CEM) peuvent affecter les implants médicaux.

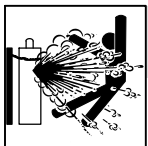
- Les porteurs de stimulateurs cardiaques et autres implants médicaux doivent rester à distance.
- Les porteurs d'implants médicaux doivent consulter leur médecin et le fabricant du dispositif avant de s'approcher de la zone où se déroule du soudage à l'arc, du soudage par points, du gougeage, de la découpe plasma ou une opération de chauffage par induction.



LE BRUIT peut endommager l'ouïe.

Le bruit des processus et des équipements peut affecter l'ouïe.

- Porter des protections approuvées pour les oreilles si le niveau sonore est trop élevé.



LES BOUTEILLES peuvent exploser si elles sont endommagées.

Les bouteilles de gaz comprimé contiennent du gaz sous haute pression. Si une bouteille est endommagée, elle peut exploser. Du fait que

les bouteilles de gaz font normalement partie du procédé de soudage, les manipuler avec précaution.

- Protéger les bouteilles de gaz comprimé d'une chaleur excessive, des chocs mécaniques, des dommages physiques, du laitier, des flammes ouvertes, des étincelles et des arcs.
- Placer les bouteilles debout en les fixant dans un support stationnaire ou dans un porte-bouteilles pour les empêcher de tomber ou de se renverser.
- Tenir les bouteilles éloignées des circuits de soudage ou autres circuits électriques.
- Ne jamais placer une torche de soudage sur une bouteille à gaz.
- Une électrode de soudage ne doit jamais entrer en contact avec une bouteille.
- Ne jamais souder une bouteille pressurisée – risque d'explosion.
- Utiliser seulement des bouteilles de gaz comprimé, régulateurs, tuyaux et raccords convenables pour cette application spécifique; les maintenir ainsi que les éléments associés en bon état.
- Tourner le dos à la sortie de vanne lors de l'ouverture de la vanne de la bouteille. Ne pas se tenir devant ou derrière le régulateur lors de l'ouverture de la vanne.
- Le couvercle du détendeur doit toujours être en place, sauf lorsque la bouteille est utilisée ou qu'elle est reliée pour usage ultérieur.
- Utilisez les équipements corrects, les bonnes procédures et suffisamment de personnes pour soulever, déplacer et transporter les bouteilles.
- Lire et suivre les instructions sur les bouteilles de gaz comprimé, l'équipement connexe et le dépliant P-1 de la CGA (Compressed Gas Association) mentionné dans les principales normes de sécurité.

2-3. Dangers supplémentaires en relation avec l'installation, le fonctionnement et la maintenance



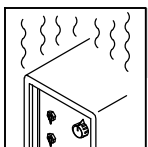
Risque D'INCENDIE OU D'EXPLOSION.

- Ne pas placer l'appareil sur, au-dessus ou à proximité de surfaces inflammables.
- Ne pas installer l'appareil à proximité de produits inflammables.
- Ne pas surcharger l'installation électrique – s'assurer que l'alimentation est correctement dimensionnée et protégée avant de mettre l'appareil en service.



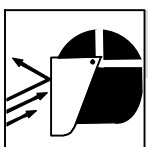
LA CHUTE DE L'ÉQUIPEMENT peut provoquer des blessures.

- Utiliser l'anneau de levage uniquement pour soulever l'appareil, NON PAS les chariots, les bouteilles de gaz ou tout autre accessoire.
- Utilisez les procédures correctes et des équipements d'une capacité appropriée pour soulever et supporter l'appareil.
- En utilisant des fourches de levage pour déplacer l'unité, s'assurer que les fourches sont suffisamment longues pour dépasser du côté opposé de l'appareil.
- Tenir l'équipement (câbles et cordons) à distance des véhicules mobiles lors de toute opération en hauteur.
- Suivre les consignes du Manuel des applications pour l'équation de levage NIOSH révisée (Publication N°94-110) lors du levage manuel de pièces ou équipements lourds.



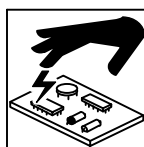
L'EMPLOI EXCESSIF peut SURCHAUFFER L'ÉQUIPEMENT.

- Prévoir une période de refroidissement ; respecter le cycle opératoire nominal.
- Réduire le courant ou le facteur de marche avant de poursuivre le soudage.
- Ne pas obstruer les passages d'air du poste.



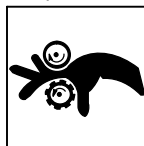
LES ÉTINCELLES PROJÉTÉES peuvent provoquer des blessures.

- Porter un écran facial pour protéger le visage et les yeux.
- Affûter l'électrode au tungstène uniquement à la meuleuse dotée de protecteurs. Cette manœuvre est à exécuter dans un endroit sûr lorsque l'on porte l'équipement homologué de protection du visage, des mains et du corps.
- Les étincelles risquent de causer un incendie – éloigner toute substance inflammable.



LES CHARGES ÉLECTROSTATIQUES peuvent endommager les circuits imprimés.

- Établir la connexion avec la barrette de terre avant de manipuler des cartes ou des pièces.
- Utiliser des pochettes et des boîtes antistatiques pour stocker, déplacer ou expédier des cartes de circuits imprimés.



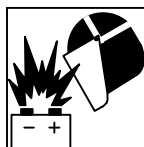
Les PIÈCES MOBILES peuvent causer des blessures.

- Ne pas s'approcher des organes mobiles.
- Ne pas s'approcher des points de coincement tels que des rouleaux de commande.



LES FILS DE SOUDAGE peuvent provoquer des blessures.

- Ne pas appuyer sur la gâchette avant d'en avoir reçu l'instruction.
- Ne pas diriger le pistolet vers soi, d'autres personnes ou toute pièce mécanique en engageant le fil de soudage.



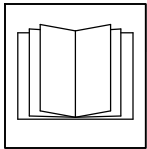
L'EXPLOSION DE LA BATTERIE peut provoquer des blessures.

- Ne pas utiliser l'appareil de soudage pour charger des batteries ou faire démarrer des véhicules à l'aide de câbles de démarrage, sauf si l'appareil dispose d'une fonctionnalité de charge de batterie destinée à cet usage.



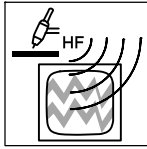
Les PIÈCES MOBILES peuvent causer des blessures.

- S'abstenir de toucher des organes mobiles tels que des ventilateurs.
- Maintenir fermés et verrouillés les portes, panneaux, recouvrements et dispositifs de protection.
- Lorsque cela est nécessaire pour des travaux d'entretien et de dépannage, faire retirer les portes, panneaux, recouvrements ou dispositifs de protection uniquement par du personnel qualifié.
- Remettre les portes, panneaux, recouvrements ou dispositifs de protection quand l'entretien est terminé et avant de rebrancher l'alimentation électrique.



LIRE LES INSTRUCTIONS.

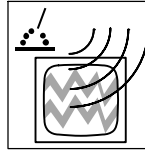
- Lire et appliquer les instructions sur les étiquettes et le Mode d'emploi avant l'installation, l'utilisation ou l'entretien de l'appareil. Lire les informations de sécurité au début du manuel et dans chaque section.
- N'utiliser que les pièces de rechange recommandées par le constructeur.
- Effectuer l'installation, l'entretien et toute intervention selon les manuels d'utilisateurs, les normes nationales, provinciales et de l'industrie, ainsi que les codes municipaux.



LE RAYONNEMENT HAUTE FRÉQUENCE (H.F.) risque de provoquer des interférences.

- Le rayonnement haute fréquence (H.F.) peut provoquer des interférences avec les équipements de radio-navigation et de communication, les services de sécurité et les ordinateurs.
- Demander seulement à des personnes qualifiées familiarisées avec des équipements électroniques de faire fonctionner l'installation.
- L'utilisateur est tenu de faire corriger rapidement par un électricien qualifié les interférences résultant de l'installation.
- Si le FCC signale des interférences, arrêter immédiatement l'appareil.

- Effectuer régulièrement le contrôle et l'entretien de l'installation.
- Maintenir soigneusement fermés les portes et les panneaux des sources de haute fréquence, maintenir les éclateurs à une distance correcte et utiliser une terre et un blindage pour réduire les interférences éventuelles.



LE SOUDAGE À L'ARC risque de provoquer des interférences.

- L'énergie électromagnétique risque de provoquer des interférences pour l'équipement électronique sensible tel que les ordinateurs et l'équipement commandé par ordinateur tel que les robots.
- Veiller à ce que tout l'équipement de la zone de soudage soit compatible électromagnétiquement.
- Pour réduire la possibilité d'interférence, maintenir les câbles de soudage aussi courts que possible, les grouper, et les poser aussi bas que possible (ex. par terre).
- Veiller à souder à une distance de 100 mètres de tout équipement électronique sensible.
- Veiller à ce que ce poste de soudage soit posé et mis à la terre conformément à ce mode d'emploi.
- En cas d'interférences après avoir pris les mesures précédentes, il incombe à l'utilisateur de prendre des mesures supplémentaires telles que le déplacement du poste, l'utilisation de câbles blindés, l'utilisation de filtres de ligne ou la pose de protecteurs dans la zone de travail.

2-4. Proposition californienne 65 Avertissements

AVERTISSEMENT : ce produit peut vous exposer à des produits chimiques tels que le plomb, reconnus par l'État de Californie comme cancérigènes et sources de malformations ou d'autres troubles de la reproduction.

Pour plus d'informations, consulter www.P65Warnings.ca.gov.

2-5. Principales normes de sécurité

Safety in Welding, Cutting, and Allied Processes, ANSI Standard Z49.1, is available as a free download from the American Welding Society at <http://www.aws.org> or purchased from Global Engineering Documents (phone: 1-877-413-5184, website: www.global.ihs.com).

Safe Practices for the Preparation of Containers and Piping for Welding and Cutting, American Welding Society Standard AWS F4.1, from Global Engineering Documents (phone: 1-877-413-5184, website: www.global.ihs.com).

Safe Practices for Welding and Cutting Containers that have Held Combustibles, American Welding Society Standard AWS A6.0, from Global Engineering Documents (phone: 1-877-413-5184, website: www.global.ihs.com).

National Electrical Code, NFPA Standard 70, from National Fire Protection Association, Quincy, MA 02169 (phone: 1-800-344-3555, website: www.nfpa.org and www.sparky.org).

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, from Compressed Gas Association, 14501 George Carter Way, Suite 103, Chantilly, VA 20151 (phone: 703-788-2700, website: www.cganet.com).

Safety in Welding, Cutting, and Allied Processes, CSA Standard W117.2, from Canadian Standards Association, Standards Sales, 5060 Spec-

trum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N5 (phone: 800-463-6727, website: www.csagroup.org).

Safe Practice For Occupational And Educational Eye And Face Protection, ANSI Standard Z87.1, from American National Standards Institute, 25 West 43rd Street, New York, NY 10036 (phone: 212-642-4900, website: www.ansi.org).

Standard for Fire Prevention During Welding, Cutting, and Other Hot Work, NFPA Standard 51B, from National Fire Protection Association, Quincy, MA 02169 (phone: 1-800-344-3555, website: www.nfpa.org). OSHA, Occupational Safety and Health Standards for General Industry, Title 29, Code of Federal Regulations (CFR), Part 1910.177 Subpart N, Part 1910 Subpart Q, and Part 1926, Subpart J, from U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954 (phone: 1-866-512-1800) (there are 10 OSHA Regional Offices—phone for Region 5, Chicago, is 312-353-2220, website: www.osha.gov).

Applications Manual for the Revised NIOSH Lifting Equation, The National Institute for Occupational Safety and Health (NIOSH), 1600 Clifton Rd, Atlanta, GA 30329-4027 (phone: 1-800-232-4636, website: www.cdc.gov/NIOSH).

2-6. Informations relatives aux CEM

Le courant électrique qui traverse tout conducteur génère des champs électromagnétiques (CEM) à certains endroits. Le courant issu d'un soudage à l'arc (et de procédés connexes, y compris le soudage par points, le gougeage, le découpage plasma et les opérations de chauffage par induction) crée un champ électromagnétique (CEM) autour du circuit de soudage. Les champs électromagnétiques produits peuvent causer interférence à certains implants médicaux, p. ex. les stimulateurs cardiaques. Des mesures de protection pour les porteurs d'implants médicaux doivent être prises: Limiter par exemple tout accès aux passants ou procéder à une évaluation des risques individuels pour les soudeurs. Tous les soudeurs doivent appliquer les procédures suivantes pour minimiser l'exposition aux CEM provenant du circuit de soudage:

1. Rassembler les câbles en les torsadant ou en les attachant avec du ruban adhésif ou avec une housse.
2. Ne pas se tenir au milieu des câbles de soudage. Disposer les

câbles d'un côté et à distance de l'opérateur.

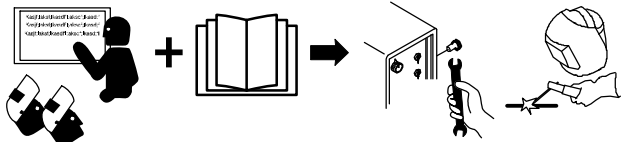
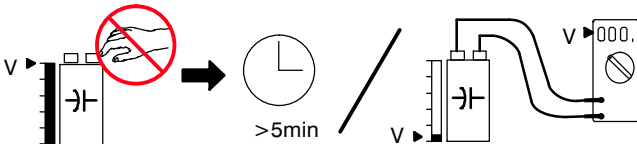
3. Ne pas courber et ne pas entourer les câbles autour de votre corps.
4. Maintenir la tête et le torse aussi loin que possible du matériel du circuit de soudage.
5. Connecter la pince sur la pièce aussi près que possible de la soudure.
6. Ne pas travailler à proximité d'une source de soudage, ni s'asseoir ou se pencher dessus.
7. Ne pas souder tout en portant la source de soudage ou le dévidoir.

En ce qui concerne les implants médicaux :

Les porteurs d'implants doivent d'abord consulter leur médecin avant de s'approcher des opérations de soudage à l'arc, de soudage par points, de gougeage, du coupage plasma ou de chauffage par induction. Si le médecin approuve, il est recommandé de suivre les procédures précédentes.

SECTION 3 – DEFINITIONS

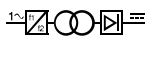
3-1. Additional Safety Symbols And Definitions

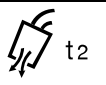
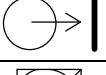
	Warning! Watch Out! There are possible hazards as shown by the symbols. Safe1 2012-05
	Drive rolls can injure fingers. Welding wire and drive parts are at welding voltage during operation – keep hands and metal objects away. Safe95 2012-05
	Beware of electric shock from wiring. Safe94 2012-08
	When power is applied failed parts can explode or cause other parts to explode. Safe26 2012-05
	Become trained and read the instructions before working on the machine or welding. Safe40 2012-05
	Hazardous voltage remains on input capacitors after power is turned off. Do not touch fully charged capacitors. Always wait 5 minutes after power is turned off before working on unit, OR check input capacitor voltage, and be sure it is near 0 before touching any parts. Safe43 2017-04

Notes

3-2. Miscellaneous Symbols And Definitions

A	Amperage
V	Voltage
U₀	Rated No Load Voltage (OCV)
==	Direct Current (DC)
~	Alternating Current (AC)
U₁	Primary Voltage
U₂	Conventional Load Voltage
I₂	Rated Welding Current
→V	Input Power Or Input Voltage
→I	Gas Input
IP	Internal Protection Rating
1~	Single Phase
	Unlocked
	Locked

	Remote
	Circuit Breaker
+	Positive
-	Negative
X	Duty Cycle
	Line Connection
S	Suitable for Some Hazardous Locations
	Increase
Hz	Hertz
	Single Phase Static Frequency Converter-Transformer-Rectifier
	Lift Arc (GTAW) TIG / Remote
	Wire Feed Slow Run-In
	Work Connection
HF 	High Frequency On- Continuous

	Gas Tungsten Arc Welding (GTAW) Torch
	Shielded Metal Arc Welding (SMAW)
	Shielded Metal Arc (SMAW) Electrode Holder
	Gas Metal Arc Welding (GMAW)
	Gas Metal Arc Welding (GMAW) MIG / Gun Control
	Self-Shielded Flux Cored Arc Welding (FCAW)
	Wire Feed Spool Gun
	Gas Tungsten Arc Welding (GTAW) / Tungsten Inert Gas (TIG) Welding
	Gas Postflow
	Gas Preflow
	Cold Jog (Inch) Toward Workpiece
	Output Enabled
	Reverse Polarity

Notes

SECTION 4 – SPECIFICATIONS

4-1. Serial Number And Rating Label Location

The serial number and rating information for this product is located on the back of unit. Use rating label to determine input power requirements and/or rated output. For future reference, write serial number in space provided on back cover of this manual.

4-2. Unit Specifications For MIG (GMAW)

Do not use information in unit specifications table to determine electrical service requirements. See Sections 5-3, 5-5, and 5-6 for information on connecting input power.

Input Voltage	Rated Welding Output	Amperage Range	Maximum Open-Circuit Voltage DC	Amperes Input at Rated Load Output, 50/60 Hz, Single-Phase
120 VAC	105 A @ 19.2 Volts DC 60% Duty Cycle	30 – 125	45	23.6
	Wire Type And Diameter	Solid/Stainless	Flux Cored	Wire Feed Speed Range
		.024 - .035 in. (0.6 - 0.8 mm)	.030 - .035 in. (0.8 - 0.9 mm)	60 – 600 IPM (1.5 – 15.2 m/min)
240 VAC	200 A @ 24.0 Volts DC 20% Duty Cycle	30 – 230	45	27.2
	170 A @ 21.5 Volts DC 40% Duty Cycle			21.5
	Wire Type And Diameter	Solid/Stainless	Flux Cored	Wire Feed Speed Range
		.024 – .035 in. (0.6 – 0.9 mm)	.030 – .045 in. (0.8 – 1.2 mm)	60 – 600 IPM (1.5 – 15.2 m/min)

4-3. Unit Specifications For TIG (GTAW)

Do not use information in unit specifications table to determine electrical service requirements. See Sections 5-3, 5-5, and 5-6 for information on connecting input power.

Input Voltage	Rated Welding Output	Amperage Range	Maximum Open-Circuit Voltage DC	Amperes Input at Rated DC Load Output, 50/60 Hz, Single-Phase
120 VAC	130 A @ 15.2 Volts AC/DC 40% Duty Cycle	20 – 140	46	21.2
240 VAC	210 A @ 18.4 Volts AC/DC 20% Duty Cycle	20 – 210	46	22.4

4-4. Unit Specifications For Stick (SMAW)

Do not use information in unit specifications table to determine electrical service requirements. See Sections 5-3, 5-5, and 5-6 for information on connecting input power.

Input Voltage	Rated Welding Output	Amperage Range	Maximum Open-Circuit Voltage DC	Amperes Input at Rated DC Load Output, 50/60 Hz, Single-Phase
120 VAC	90 A @ 23.6 Volts AC/DC 40% Duty Cycle	30 – 90	46	24.5
240 VAC	200 A @ 28.4 Volts AC/DC 15% Duty Cycle	30 – 200	46	31.3

4-5. Environmental Specifications

A. IP Rating

IP Rating
IP21
This equipment is designed for indoor use and is not intended to be used or stored outside.
IP21 2014-06

B. Temperature Specifications

Operating Temperature Range*	Storage/Transportation Temperature Range
14 to 104°F (–10 to 40°C)	–4 to 131°F (–20 to 55°C)
*Output is degraded at temperatures above 104°F (40°C).	Temp_2016-07

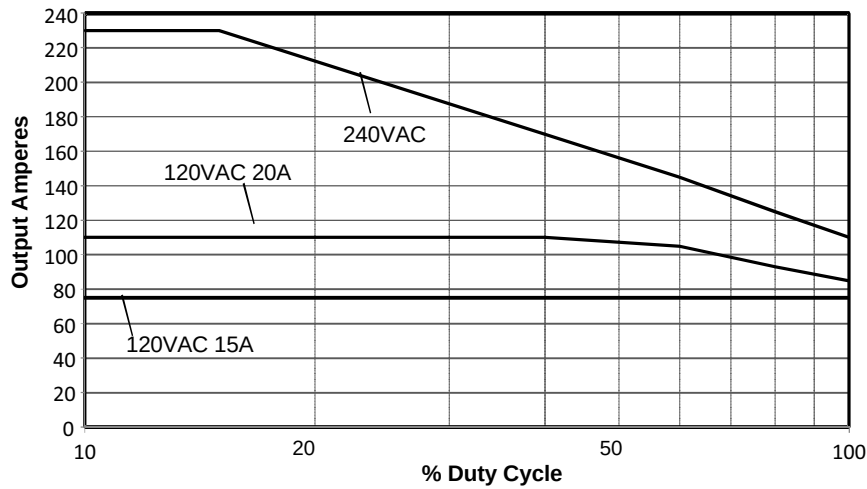
4-7. Duty Cycle And Overheating For MIG (GMAW)



Duty Cycle is percentage of 10 minutes that unit can weld at rated load without overheating.

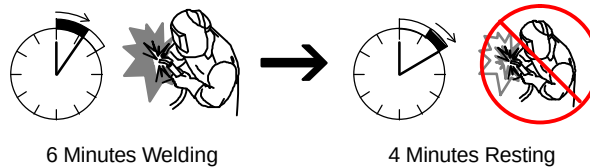
If unit overheats, output stops. Wait fifteen minutes for unit to cool. Reduce amperage or duty cycle before starting to weld again.

NOTICE – Exceeding duty cycle can damage unit and void warranty.



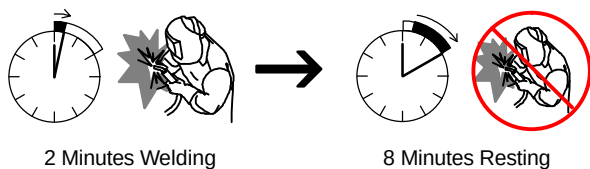
120V Input

60% Duty Cycle At 105A

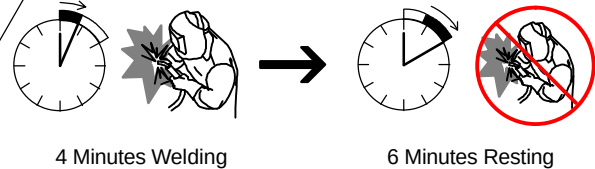


240V Input

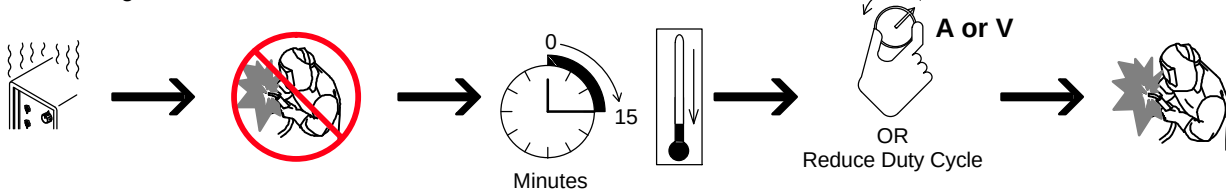
20% Duty Cycle At 200A



40% Duty Cycle At 170A



Overheating



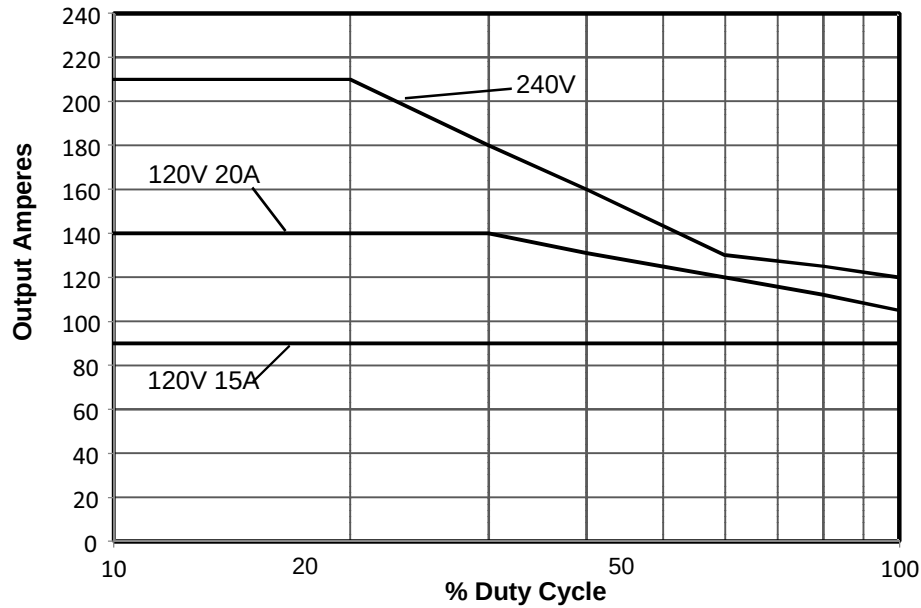
4-8. Duty Cycle And Overheating For TIG (GTAW)



Duty Cycle is percentage of 10 minutes that unit can weld at rated load without overheating.

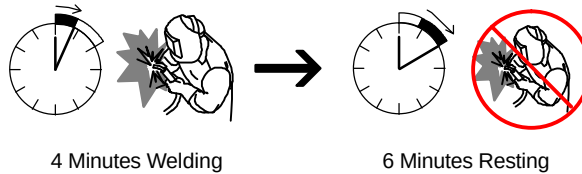
If unit overheats, output stops. Wait fifteen minutes for unit to cool. Reduce amperage or duty cycle before starting to weld again.

NOTICE – Exceeding duty cycle can damage unit and void warranty.



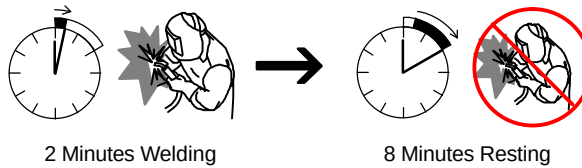
120V Input

40% Duty Cycle At 130A

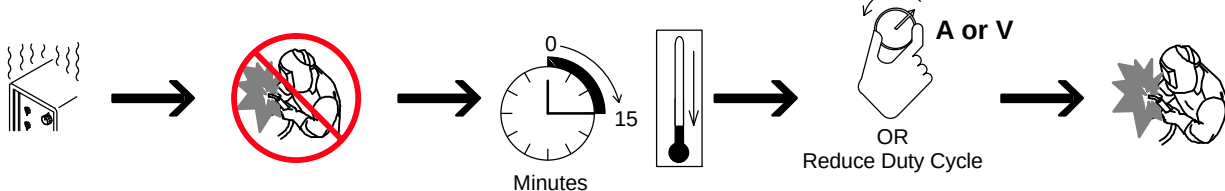


240V Input

20% Duty Cycle At 210A



Overheating



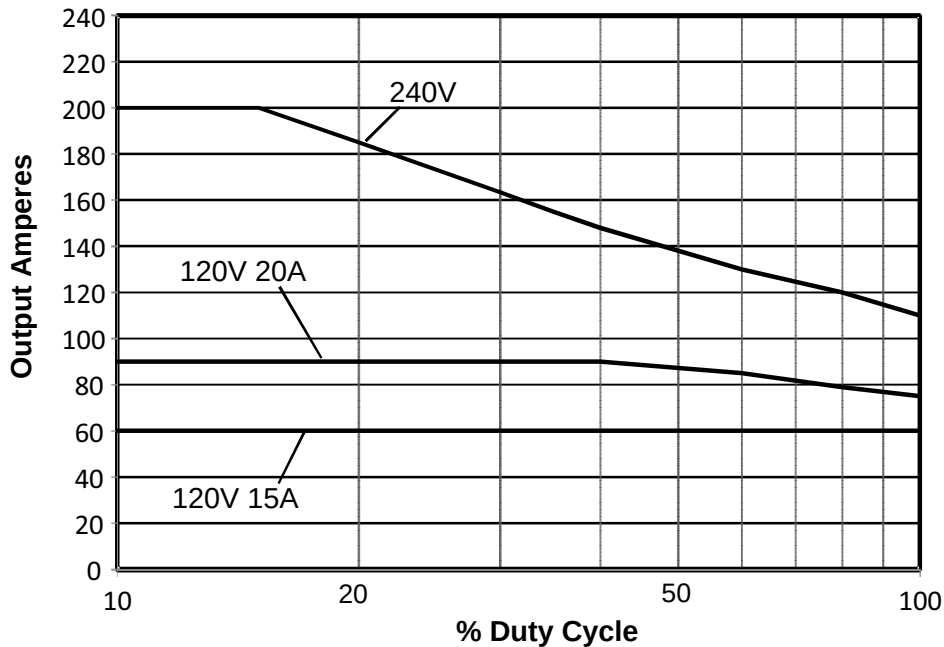
4-9. Duty Cycle And Overheating For Stick (SMAW)



Duty Cycle is percentage of 10 minutes that unit can weld at rated load without overheating.

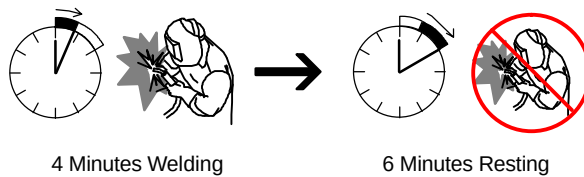
If unit overheats, output stops. Wait fifteen minutes for unit to cool. Reduce amperage or duty cycle before starting to weld again.

NOTICE – Exceeding duty cycle can damage unit and void warranty.



120V Input

40% Duty Cycle At 90A

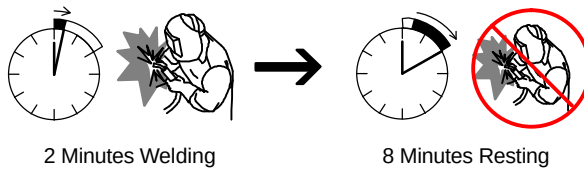


4 Minutes Welding

6 Minutes Resting

240V Input

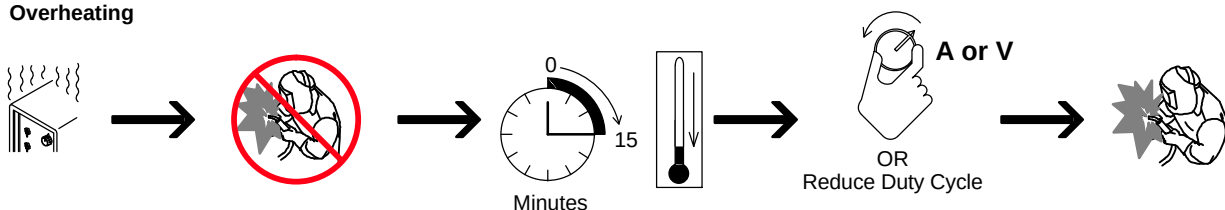
20% Duty Cycle At 185A



2 Minutes Welding

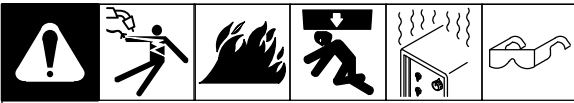
8 Minutes Resting

Overheating



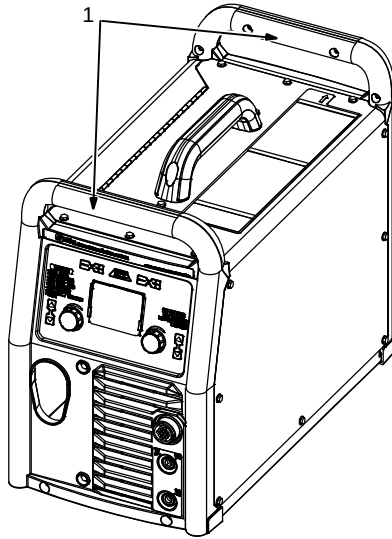
SECTION 5 – INSTALLATION

5-1. Selecting A Location

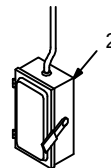


⚠ Do not move or operate unit where it could tip.

Movement

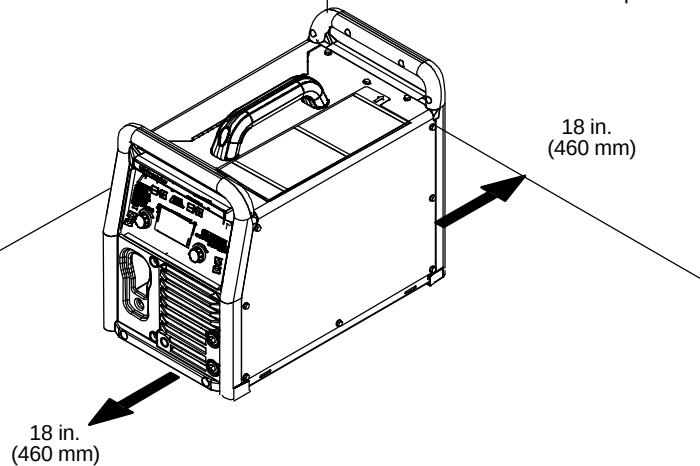


Location And Airflow



⚠ Special installation may be required where gasoline or volatile liquids are present – see NEC Article 511 or CEC Section 20.

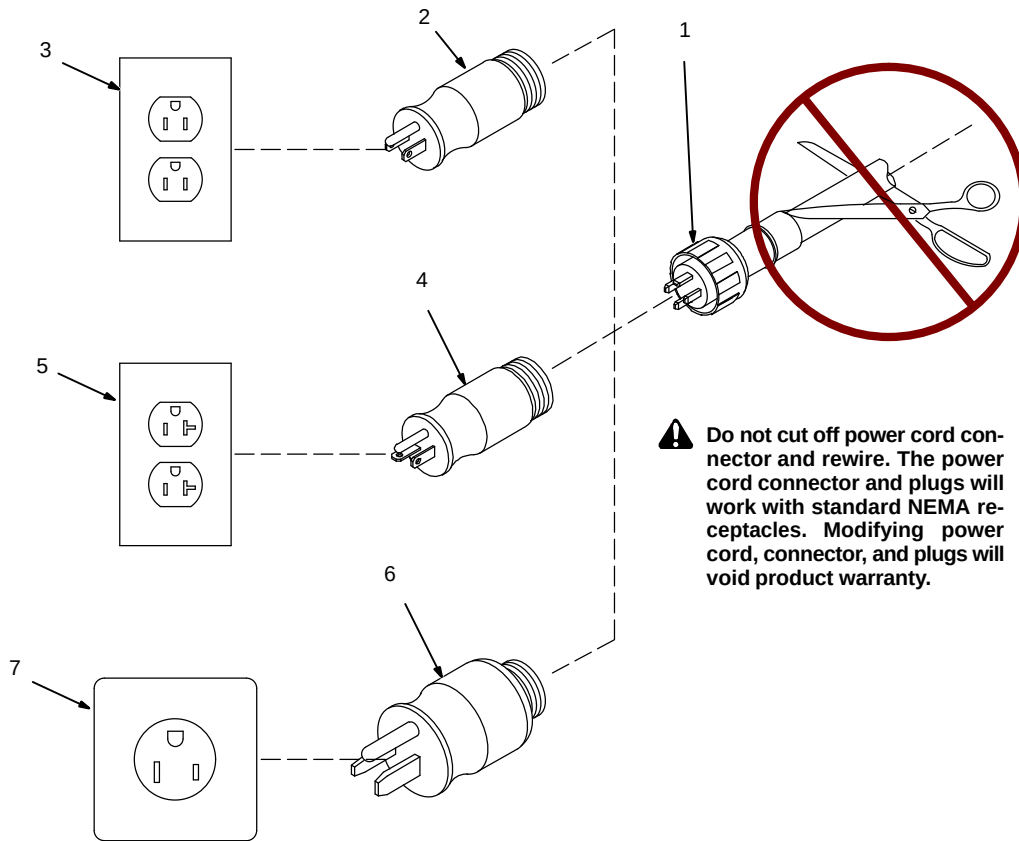
- 1 Lifting Handles
Use handles to lift unit.
- 2 Line Disconnect Device
Locate unit near correct input power supply.



5-2. Multi-Voltage Plug (MVP) Connection

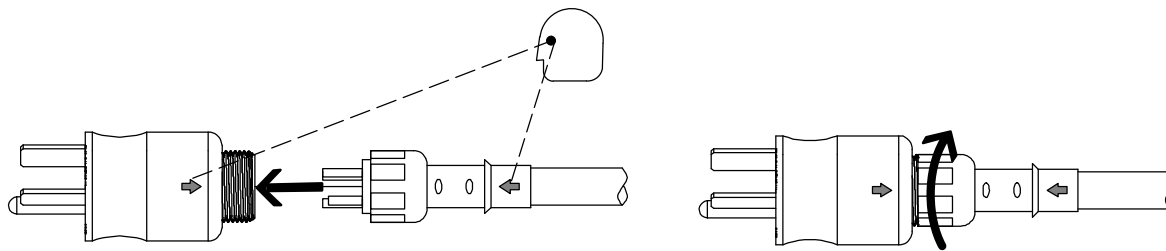


Selecting Plug



⚠ Do not cut off power cord connector and rewire. The power cord connector and plugs will work with standard NEMA receptacles. Modifying power cord, connector, and plugs will void product warranty.

Connecting Plug To Power Cord



Selecting Plug

- 1 Power Cord Connector From Welding Power Source

Select plug for power supply receptacle available at site. Not all plugs shown are provided as standard with unit.

- 2 Plug – NEMA Type 5–15P
- 3 Receptacle – NEMA Type 5–15R (Customer Supplied)

- 4 Plug – NEMA Type 5–20P (Optional)
- 5 Receptacle – NEMA Type 5–20R (Customer Supplied)
- 6 Plug – NEMA Type 6–50P
- 7 Receptacle – NEMA Type 6–50R (Customer Supplied)

⚠ Follow electrical service guide for 240 VAC in Section 5-3. Do not use plug rating to size branch circuit protection.

Connecting Plug To Power Cord

Align arrow on plug with arrow on power cord connector. Push together.

Tighten threaded collar. As threaded collar is tightened, push plug onto adapter until collar is completely tight.

Connect plug to receptacle.

5-3. Electrical Service Guide



Failure to follow these electrical service guide recommendations could create an electric shock or fire hazard. These recommendations are for a dedicated circuit sized for the rated output and duty cycle of the welding power source.

In dedicated circuit installations, the National Electrical Code (NEC) allows the receptacle or conductor rating to be less than the rating of the circuit protection device. All components of the circuit must be physically compatible. See NEC articles 210.21, 630.11, and 630.12.

	50/60 Hz 1-Phase	50/60 Hz 1-Phase
Input Voltage (V)	120	240
Rated Maximum Supply Current I_{1max} (A)	A 15 or 20 ampere individual branch circuit protected by time-delay fuses or circuit breaker is required. See Section 5-5.	32
Maximum Effective Supply Current I_{1eff} (A)		15
Max Recommended Standard Fuse Rating In Amperes ¹		40
Time-Delay Fuses ²		
Normal Operating Fuses ³		45
Min Input Conductor Size In AWG (mm ²) ⁴		12
Max Recommended Input Conductor Length In Feet (Meters)		34 (10)
Min Grounding Conductor Size In AWG (mm ²) ⁴		12

Reference: 2017 National Electrical Code (NEC) (including article 630)

1 If a circuit breaker is used in place of a fuse, choose a circuit breaker with time-current curves comparable to the recommended fuse.

2 "Time-Delay" fuses are UL class "RK5" . See UL 248.

3 "Normal Operating" (general purpose - no intentional delay) fuses are UL class "K5" (up to and including 60 amps), and UL class "H" (65 amps and above).

4 Conductor data in this section specifies conductor size (excluding flexible cord or cable) between the panelboard and the equipment per NEC Table 310.15(B)(16) and is based on allowable ampacities of insulated copper conductors having a temperature rating of 167°F (75°C) with not more than three single current-carrying conductors in a raceway. If a flexible cord or cable is used, minimum conductor size may increase. See NEC Table 400.5(A) for flexible cord and cable requirements.

5-4. Input Power Extension Cord Data



Use extension cord only for temporary wiring. Remove extension cord immediately after completing the project.

Input 17 2018-11

Cord Type	Minimum Conductor Size	Number of Conductors	Maximum Cord Length
Heavy Duty (Hard Usage)	12 AWG (4 mm ²)	3	50 ft (15 m)

 Read OSHA Standard 1910.334 for more information on the use of cord and plug connected equipment.

Read National Electrical Code (NEC) Article 590 for more information on temporary wiring.

5-5. Connecting 120 Volt Input Power



⚠ Installation must meet all National and Local Codes – have only qualified persons make this installation.

⚠ Special installation may be required where gasoline or volatile liquids are present – see NEC Article 511 or CEC Section 20.

NOTICE – The Auto-Line circuitry in this unit automatically links the power source to the primary voltage being applied, either 120 or 240 VAC.

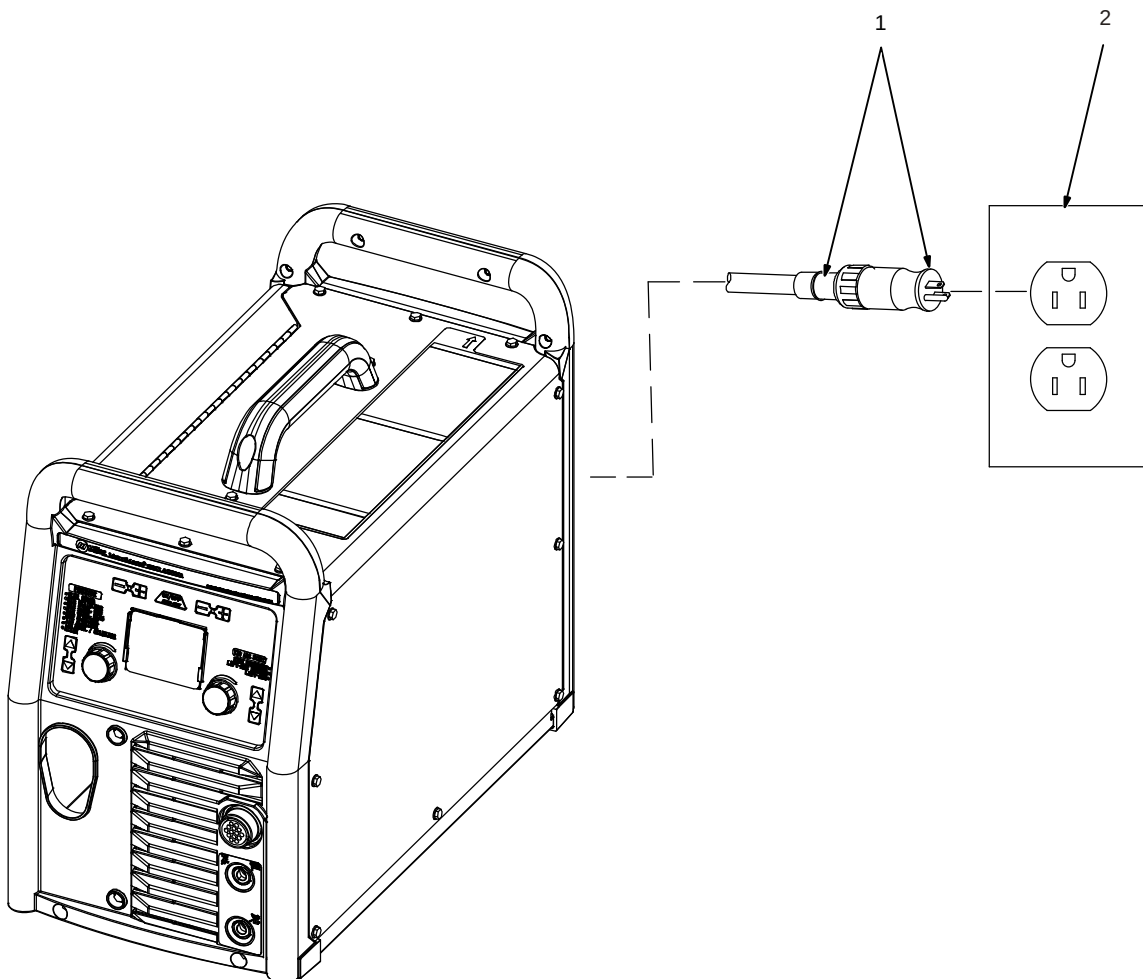
See rating label on unit and check input voltage available at site.

For 120 volts AC input power, a 15 or 20 ampere individual branch circuit protected by time-delay fuses or circuit breaker is required.

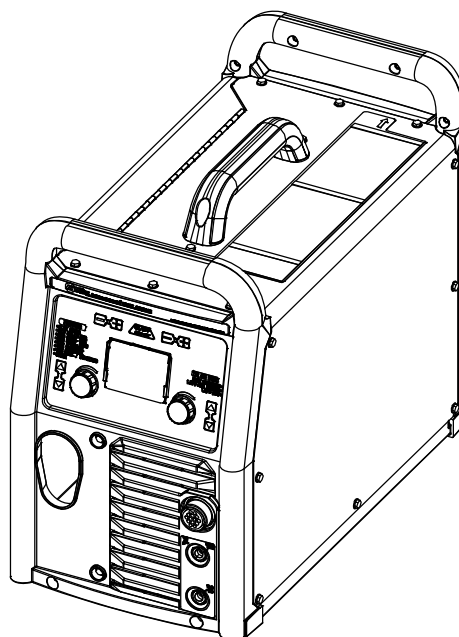
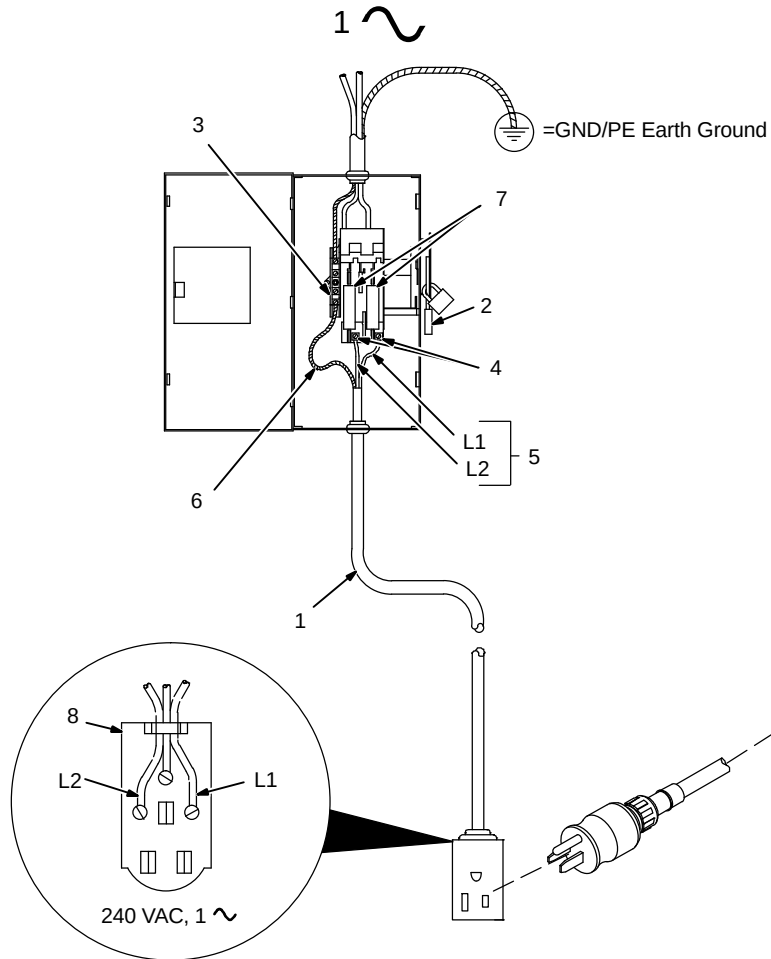
- 1 Multi-Voltage Plug And Power Cord Connector (NEMA Type 5–15P Plug Shown)

For multi-voltage plug connections, see Section 5-2.

- 2 Receptacle – NEMA Type 5–15R (Customer Supplied)



5-6. Connecting 1-Phase Input Power For 240 VAC



Tools Needed:



5-6. Connecting 1-Phase Input Power For 240 VAC (Continued)



⚠ Installation must meet all National and Local Codes – have only qualified persons make this installation.

⚠ Disconnect and lockout/tagout input power before connecting input conductors from unit. Follow established procedures regarding the installation and removal of lockout/tagout devices.

⚠ Always connect green or green/yellow conductor to supply grounding terminal first, and never to a line terminal.

NOTICE – The Auto-Line circuitry in this unit automatically links the power source to the

primary voltage being applied, either 120 or 240 VAC.

See rating label on unit and check input voltage available at site.

- 1 Input Power Cord
- 2 Disconnect Device (switch shown in the OFF position)
- 3 Disconnect Device Grounding Terminal
- 4 Disconnect Device Line Terminals
- 5 Black And White Input Conductor (L1 And L2)
- 6 Green Or Green/Yellow Grounding Conductor

Connect green or green/yellow grounding conductor to disconnect device grounding terminal first.

Connect input conductors L1 and L2 to disconnect device line terminals.

7 Over-Current Protection

Select type and size of over-current protection using Section 5-3 (fused disconnect switch shown).

8 Receptacle (NEMA 6-50R) Customer Supplied

Close and secure door on disconnect device. Remove lockout/tagout device, and place switch in the On position.

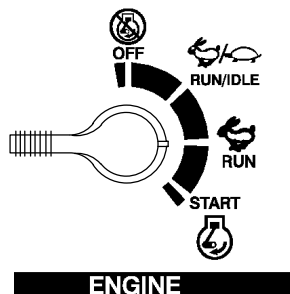
input4 2012-05 – 803 766-C

5-7. Generator / Inverter Requirements

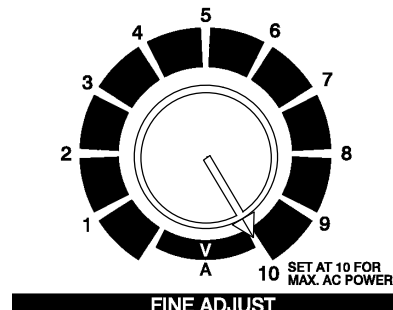


Generator settings, if applicable.

⚠ Engine Control Switch must be set at “RUN” position – not “RUN/IDLE”.



⚠ Set generator Fine Adjustment Control to 10 for maximum auxiliary power.



Minimum auxiliary power requirement at rated load is 10 KW continuous/12.5 KW peak at 240 volts AC for full output. Smaller generators will reduce output capability.

5-8. Stick Welding Connections



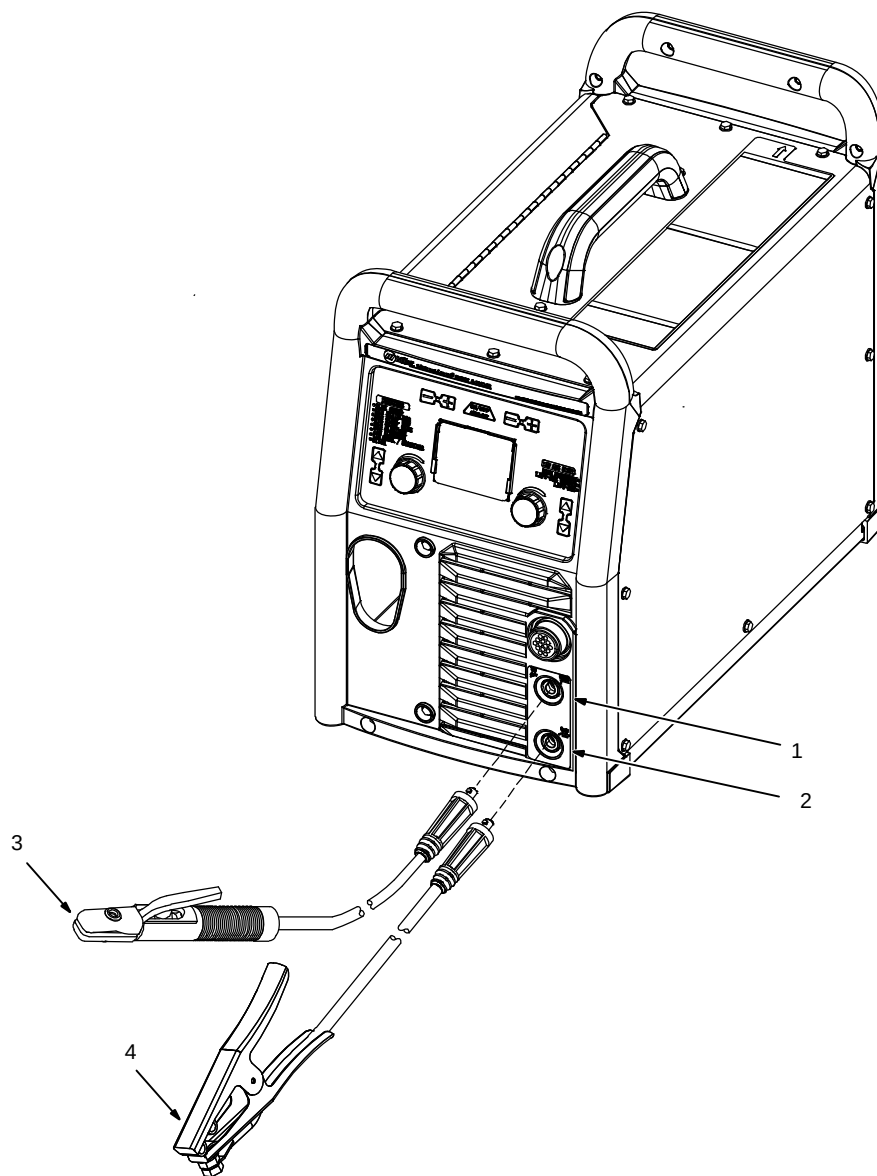
! Turn off unit and disconnect input power before making connections.

! Do not use worn, damaged, undersized, or repaired cables.

- 1 Weld Output Receptacle
- 2 Work Clamp Receptacle
- 3 Stick Electrode Holder And Cable
- 4 Work Clamp And Cable

Connect stick electrode holder cable to the electrode output receptacle, and connect work clamp to work output receptacle. Turn connectors clockwise.

Ensure all connections are tight.



5-9. TIG Welding Connections



⚠ Turn off unit and disconnect input power before making connections.

⚠ Do not use worn, damaged, undersized, or repaired cables.

- 1 Weld Output Receptacle
- 2 Work Clamp Receptacle
- 3 TIG Torch And Cable
- 4 Work Clamp And Cable

Connect TIG torch cable to the electrode receptacle and connect work cable to work receptacle. Turn connectors clockwise.

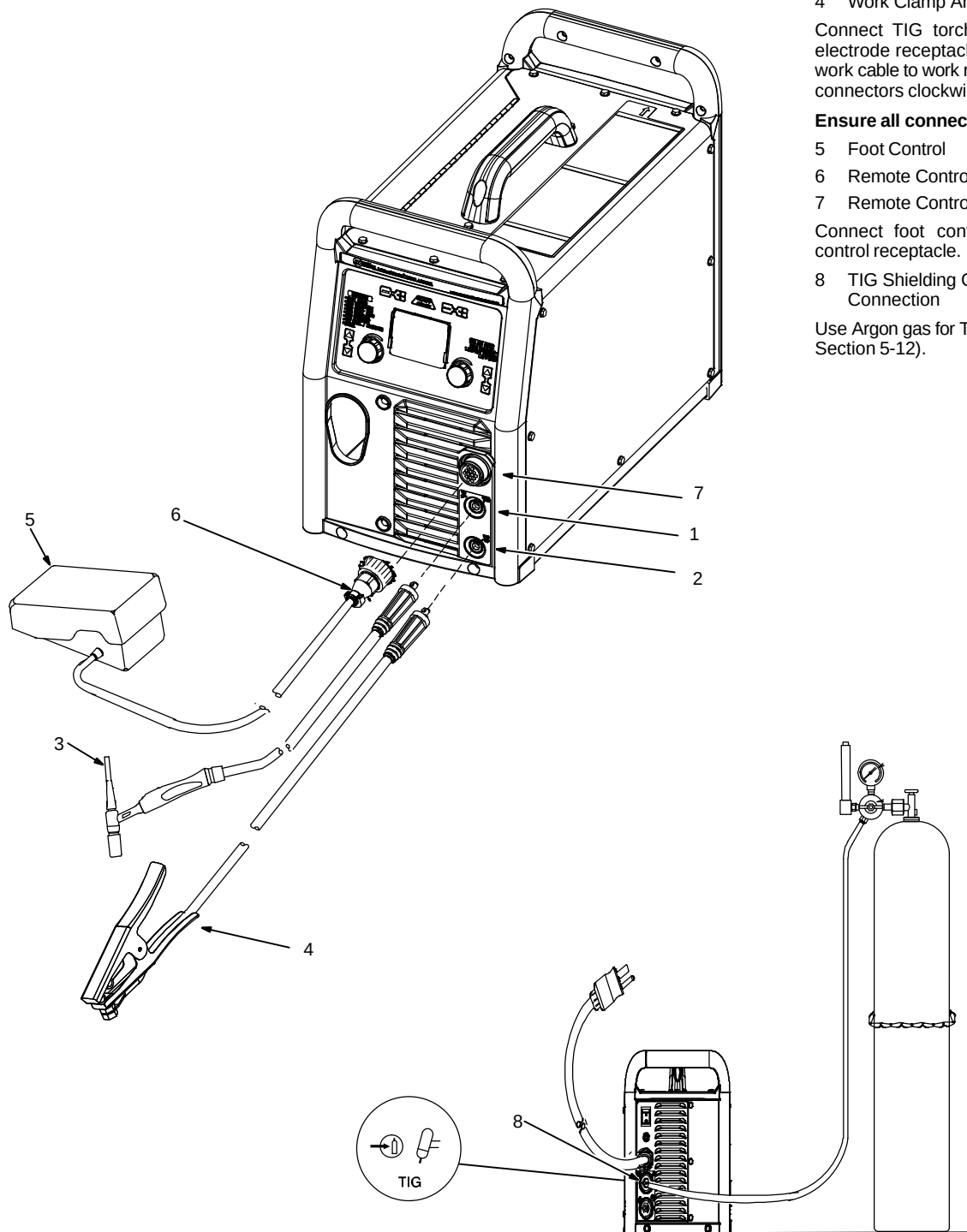
Ensure all connections are tight.

- 5 Foot Control
- 6 Remote Control Cable
- 7 Remote Control Receptacle

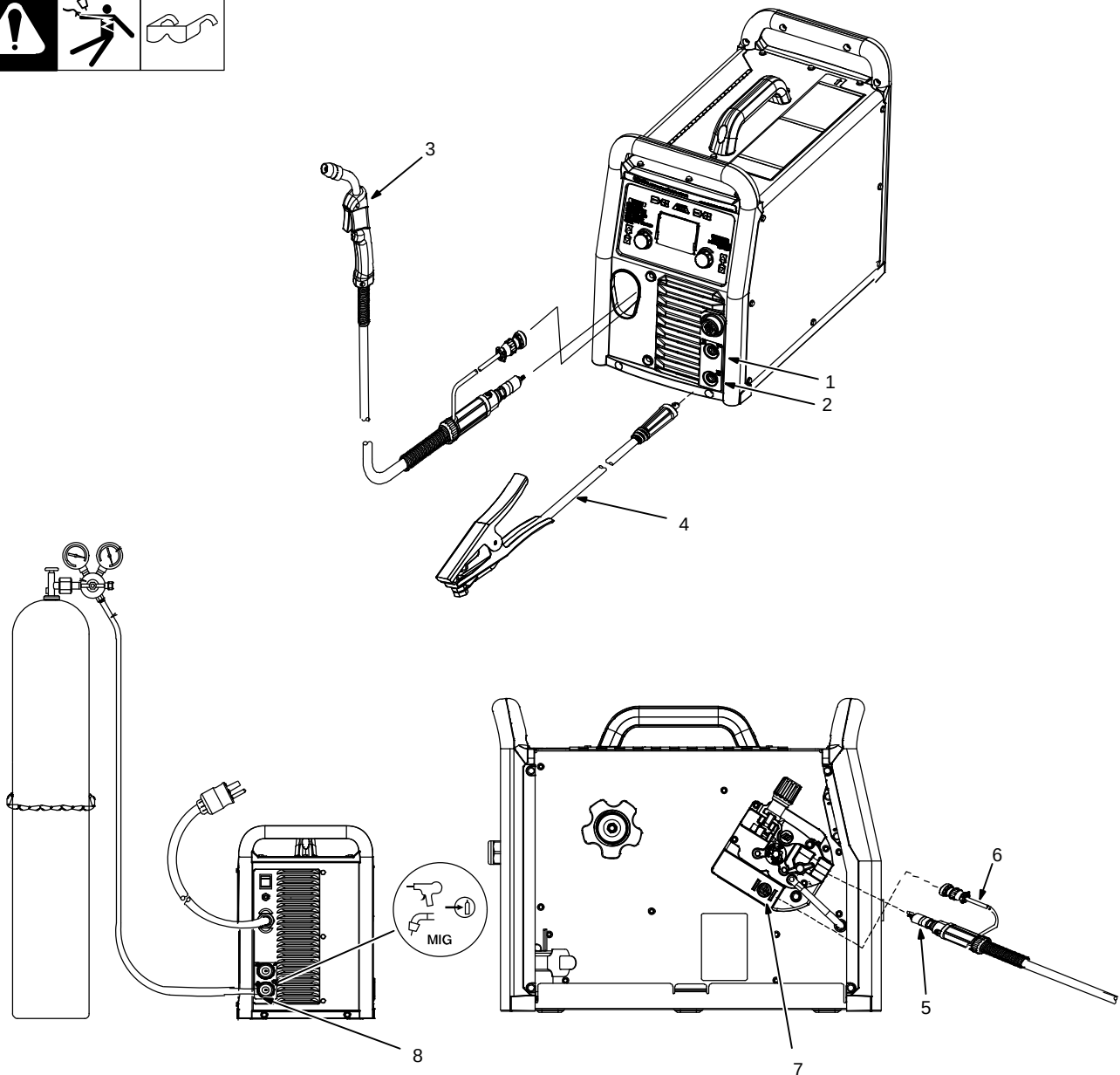
Connect foot control to remote control receptacle.

- 8 TIG Shielding Gas Connection

Use Argon gas for TIG welding (see Section 5-12).



5-10. MIG Welding Connections



Ref. 275172A / Ref. 275167A / Ref. 275168A

⚠ Turn off unit and disconnect input power before making connections.

⚠ Do not use worn, damaged, undersized, or repaired cables.

- 1 Weld Output Receptacle
- 2 Work Clamp Receptacle
- 3 MIG Gun
- 4 Work Clamp And Cable

Connect work cable to work receptacle. Turn connector clockwise.

Ensure all connections are tight.

- 5 Gun End
- Connect gun end to drive assembly (see Section 5-11).
- 6 Trigger Control Cable
- 7 Four Pin Trigger Control Cable Receptacle

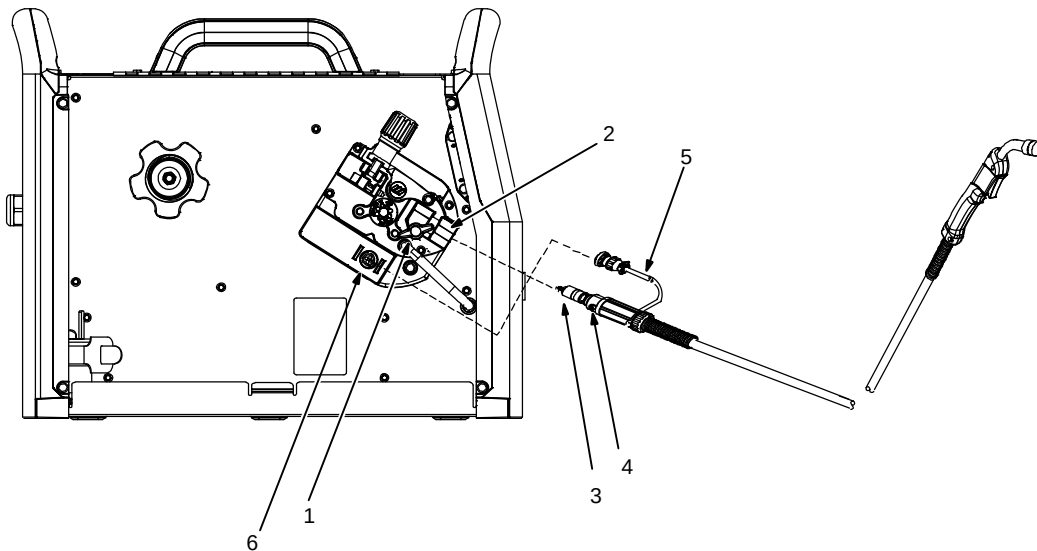
Route trigger control cable through MIG gun hole.

Connect plug on end of cable to four pin receptacle inside unit.

8 MIG Shielding Gas Connection

Use 75/25 mix or CO₂ shielding gas for solid wire. Use Argon shielding gas for aluminum wire with spool gun (see Section 5-12).

5-11. MIG Gun Connection Inside Unit



Ref. 275167A

1 Gun Securing Knob

2 Gun Block

3 Gun Outlet Wire Guide

4 Gun End

Loosen knob. **Insert end of gun through opening in front panel until gun end bottoms against gun block.** Tighten knob.

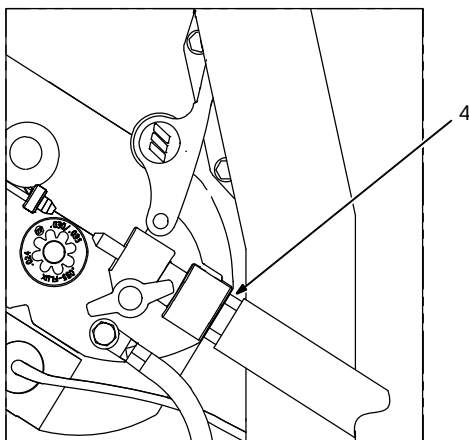
5 Trigger Control Cable

6 Four Pin Trigger Control Cable Receptacle

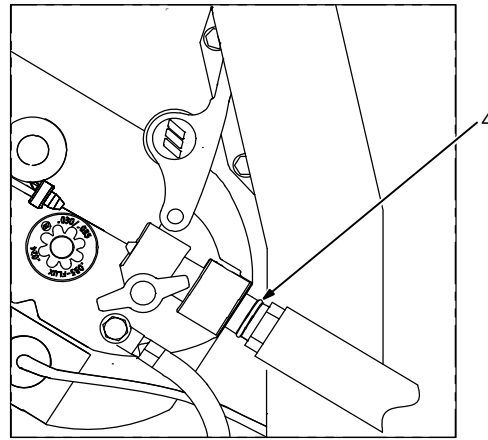
Route trigger control cable through MIG gun hole.

Connect plug on end of cable to four pin receptacle inside unit.

Be sure that gun end is tight against drive assembly.



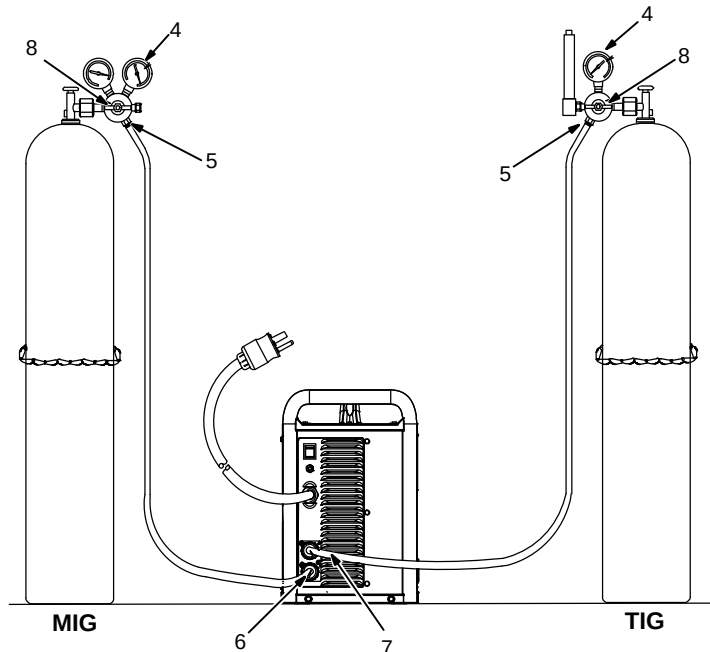
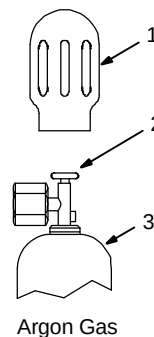
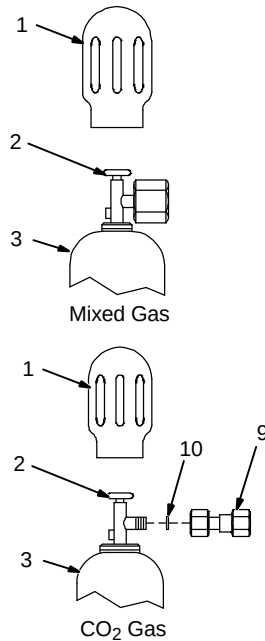
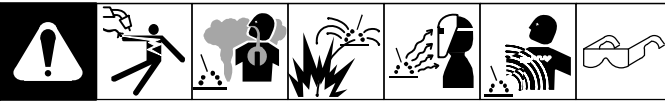
CORRECT



INCORRECT

Ref. 267807A

5-12. Connecting Shielding Gas Supply



Obtain gas cylinder and chain to running gear, wall, or other stationary support so cylinder cannot fall and break off valve.

- 1 Cap
- 2 Cylinder Valve

Remove cap, stand to side of valve, and open valve slightly. Gas flow blows dust and dirt from valve. Close valve.

- 3 Cylinder
- 4 Regulator/Flowmeter

Install Regulator/Flowmeter so face is vertical.

- 5 Regulator/Flowmeter Gas Hose Connection
- 6 Welding Power Source CO₂ And Mixed Gas Hose Connection
- 7 Welding Power Source Argon Gas Hose Connection

Connect gas hose between regulator/flowmeter gas hose connection, and the appropriate fitting for the gas type on rear of welding power source.

- 8 Flow Adjust

Typical flow rate for CO₂ shielding gas and MIG (GMAW) welding is 15 to 30 CFH (cubic feet per hour) and mixed gas is 25 to 45 CFH.

Typical flow rate for Argon shielding gas and TIG (GTAW) welding is 15 to 25 CFH and aluminum MIG (GMAW) welding is 35 to 45 CFH. Check wire manufacturer's recommended flow rate.

- 9 CO₂ Adapter (Customer Supplied)
- 10 O-Ring (Customer Supplied)

Install adapter with O-ring between regulator/flowmeter and CO₂ cylinder.

Tools Needed:

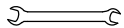


5-13. Installing Wire Spool And Adjusting Hub Tension

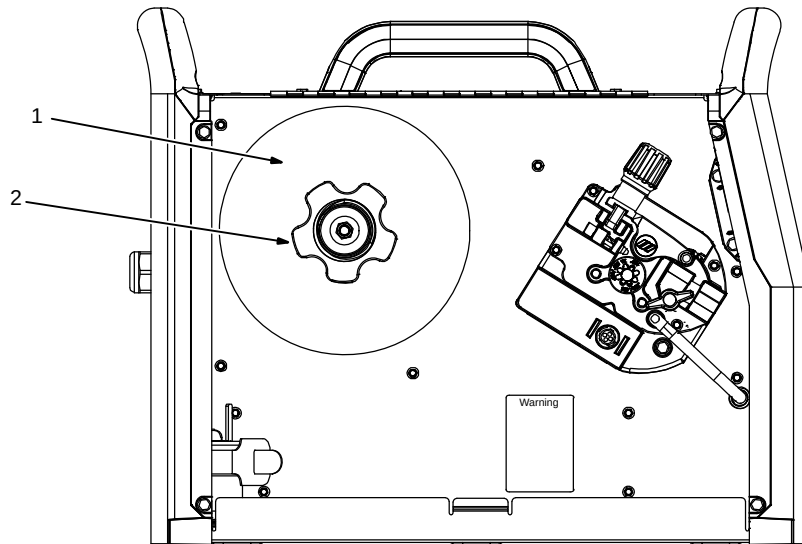


- 1 Wire Spool
- 2 Retaining Nut – For 8 in. (203 mm) Spool Only

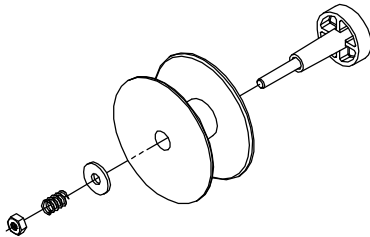
Tools Needed:



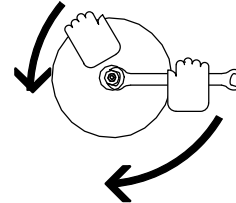
1/2 in.



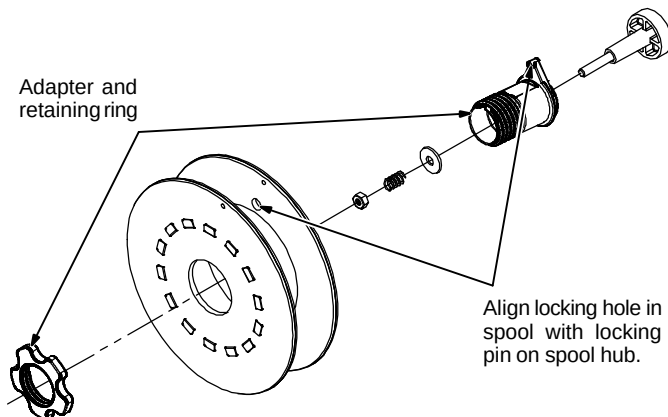
Installing 4 in. (102 mm) Wire Spool



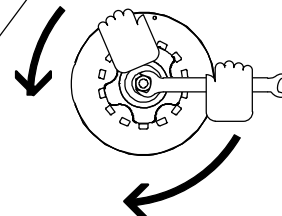
When a slight force is needed to turn spool, tension is set.



Installing 8 in. (203 mm) Wire Spool



When a slight force is needed to turn spool, tension is set.

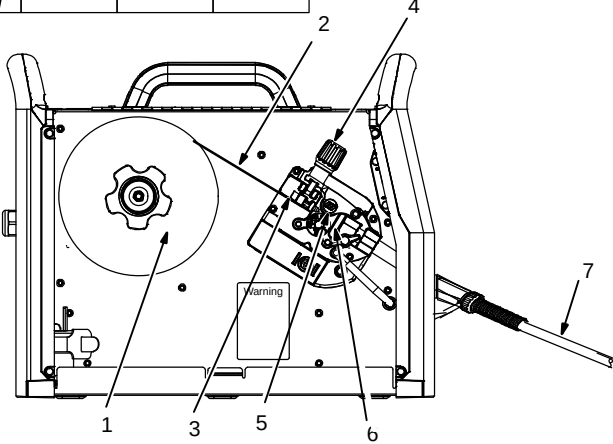


5-14. Threading Welding Wire



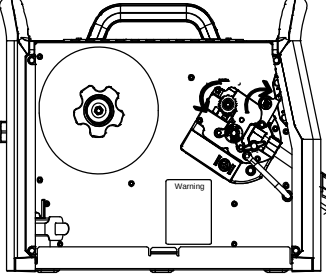
- 1 Wire Spool
- 2 Welding Wire
- 3 Inlet Wire Guide
- 4 Pressure Adjustment Knob
- 5 Drive Roll
- 6 Outlet Wire Guide
- 7 Gun Conduit Cable

Lay gun cable out straight.

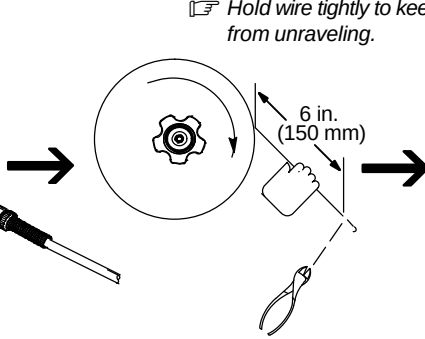


Tools Needed:





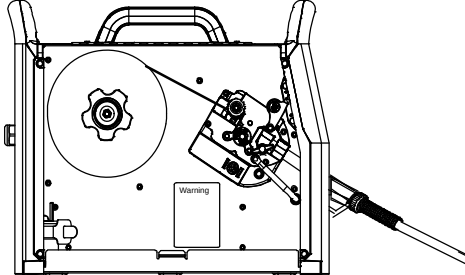
Open pressure assembly.



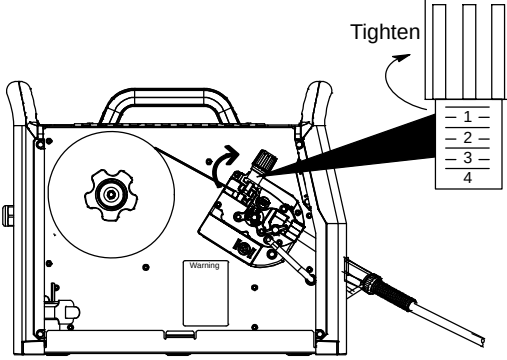
Hold wire tightly to keep it from unraveling.

6 in. (150 mm)

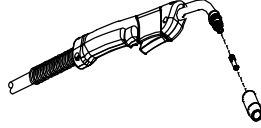
Pull and hold wire; cut off end.



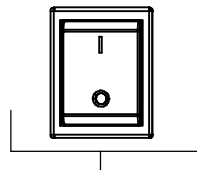
Push wire through guides into gun; continue to hold wire.



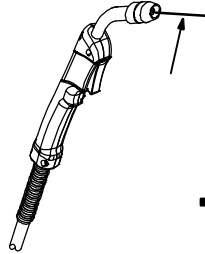
Close and tighten pressure assembly, and let go of wire.



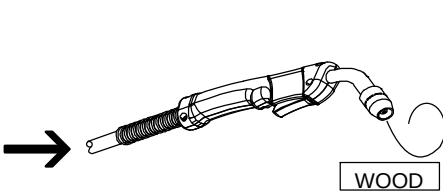
Remove gun nozzle and contact tip.



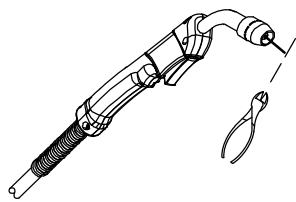
Turn On.



Press gun trigger until wire comes out of gun. Reinstall contact tip and nozzle



Feed wire to check drive roll pressure. Tighten knob enough to prevent slipping.



Cut off wire. Close and latch door.

Pressure Indicator Scale

1
2
3
4

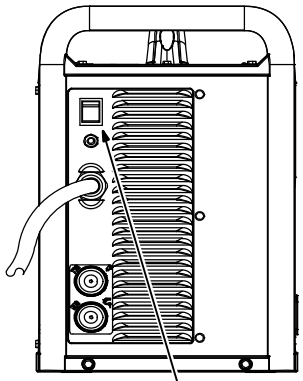
Use pressure indicator scale to set a desired drive roll pressure. Begin with a setting of 2. If necessary, make additional adjustments after trying this initial setting.

WOOD

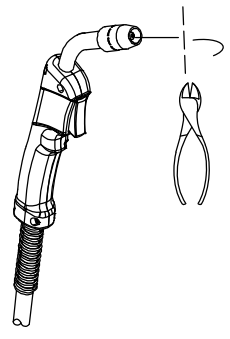


Ref. 282721A / 275167A / 801 083 / Ref. 800 924-D

5-15. Removing MIG Gun To Replace With A Spool Gun

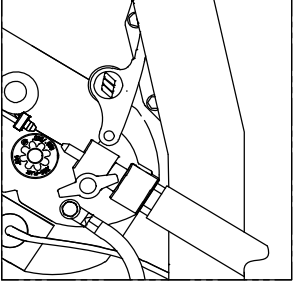


Turn Off Power.



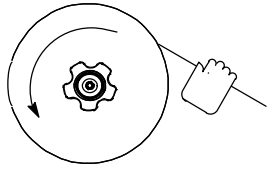
Cut Off End Of Wire.

Tools Needed:

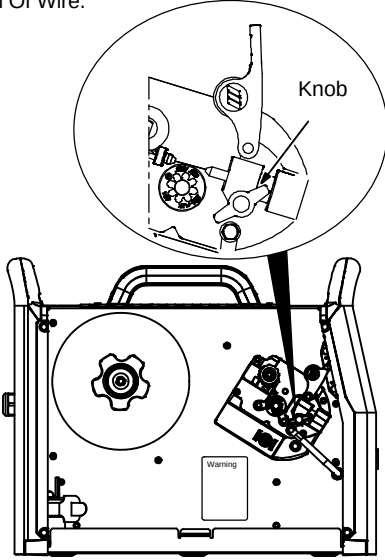



Open Pressure Assembly.

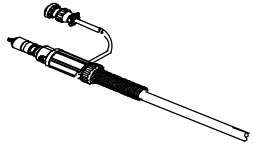
Hold wire tightly to keep it from unraveling.

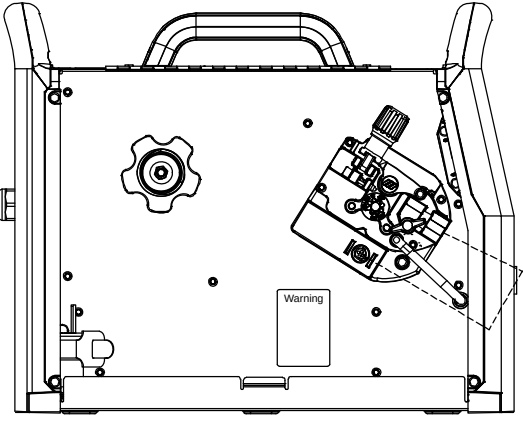


Rewind Wire Onto Spool, Fasten End Of Wire To Spool.

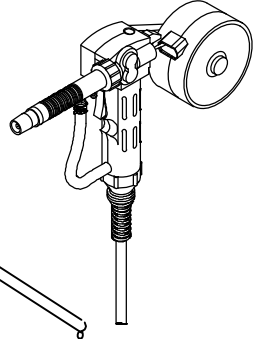


Loosen Knob, Disconnect Gun Trigger Plug, And Remove Gun From Unit.



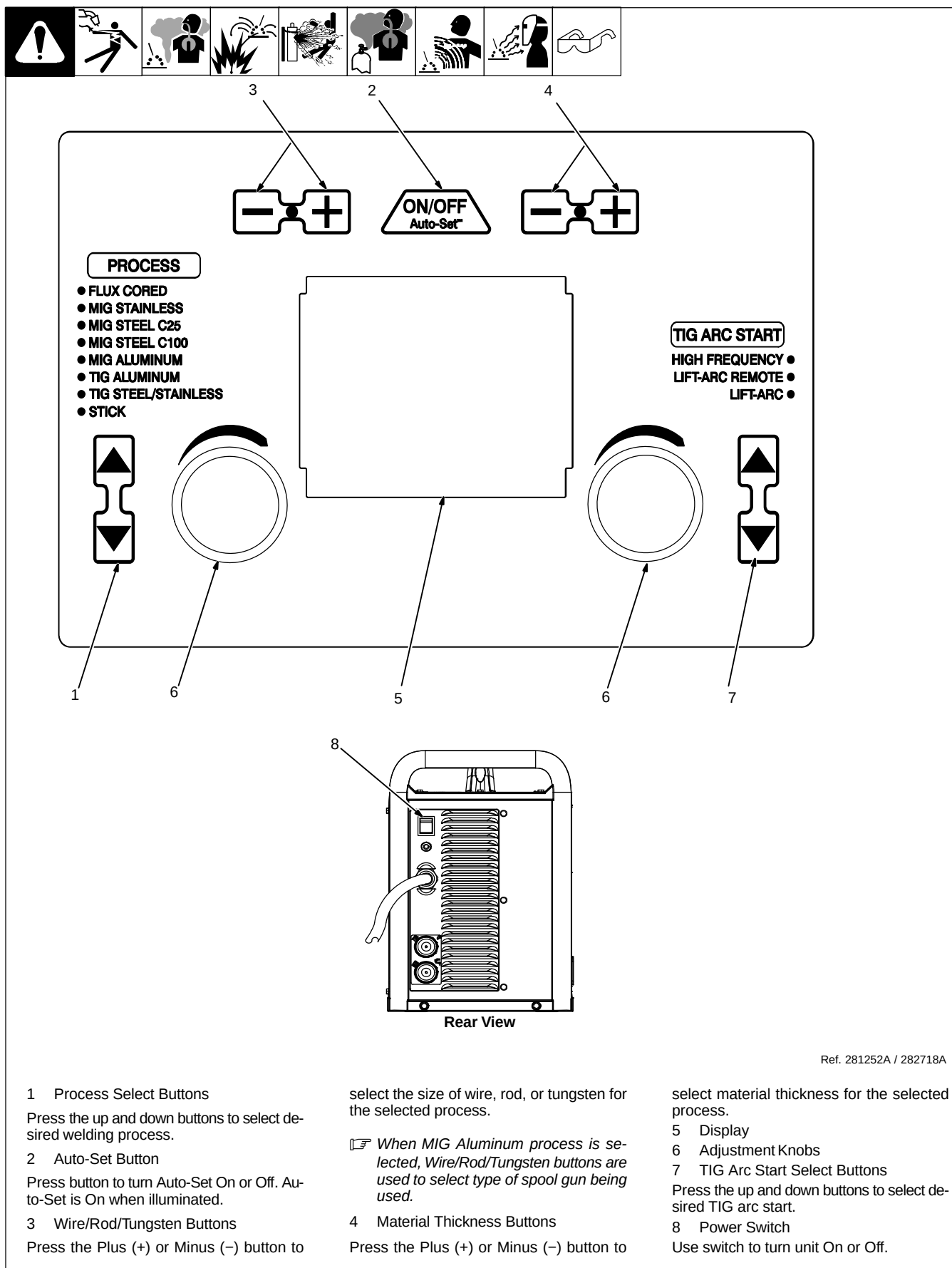


Insert Power Pin, Connect Spool Gun Trigger Plug, And Tighten Knob.



SECTION 6 – OPERATION

6-1. Controls



6-2. Controls, TIG Aluminum Manual Mode

- 1 Auto-Set Button
Press button to turn Auto-Set feature On or Off. Auto-Set is On when illuminated.
- 2 Tungsten Size Buttons
Press the Plus (+) or Minus (-) button to adjust up or down.
- 3 Balance Adjustment Buttons
Press the Plus (+) or Minus (-) button to adjust up or down. The range is 60-80%. Pro-Set value is 75% (See tip below).
- 4 Frequency Adjustment Knob
Frequency range is 60-150 Hz. Pro-Set value is 120 Hz (See tip below).
- 5 Amperage Adjustment Knob
- 6 TIG Arc Start Select Buttons
Press the up and down buttons to select desired TIG arc start. Lift-Arc not available for TIG aluminum.

TIP: AC Frequency controls the width of the arc cone. Increasing the AC Frequency provides a more focused arc and increased directional control.

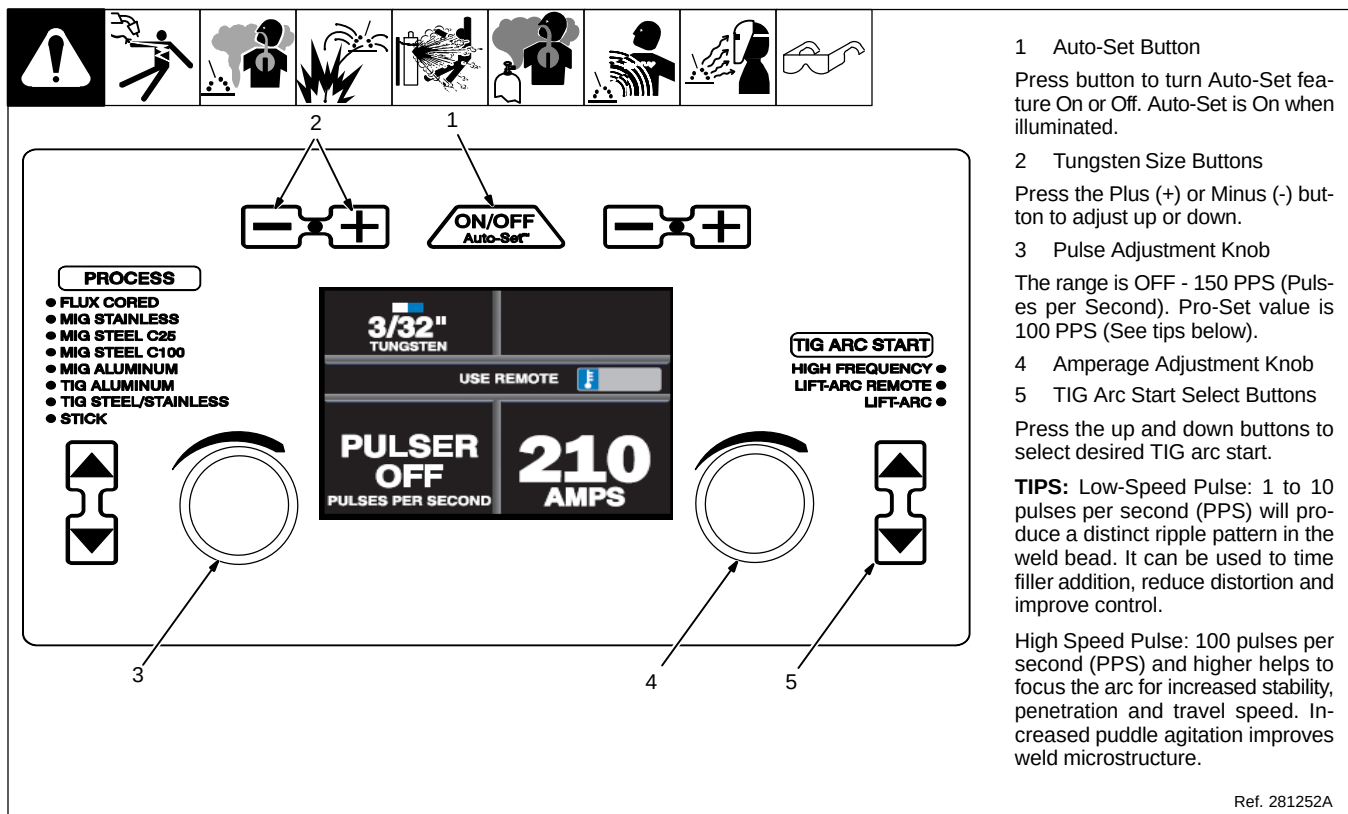
Note: Decreasing the AC Frequency softens the arc and broadens the weld puddle for a wider weld.

TIP: AC Balance controls the cleaning action. If floating black spots appear in the puddle the balance setting is too high. Turn the balance down until the puddle becomes clear.

Ref. 281252A

Notes

6-3. Controls, TIG Steel/Stainless Manual Mode



1 Auto-Set Button
Press button to turn Auto-Set feature On or Off. Auto-Set is On when illuminated.

2 Tungsten Size Buttons
Press the Plus (+) or Minus (-) button to adjust up or down.

3 Pulse Adjustment Knob
The range is OFF - 150 PPS (Pulses per Second). Pro-Set value is 100 PPS (See tips below).

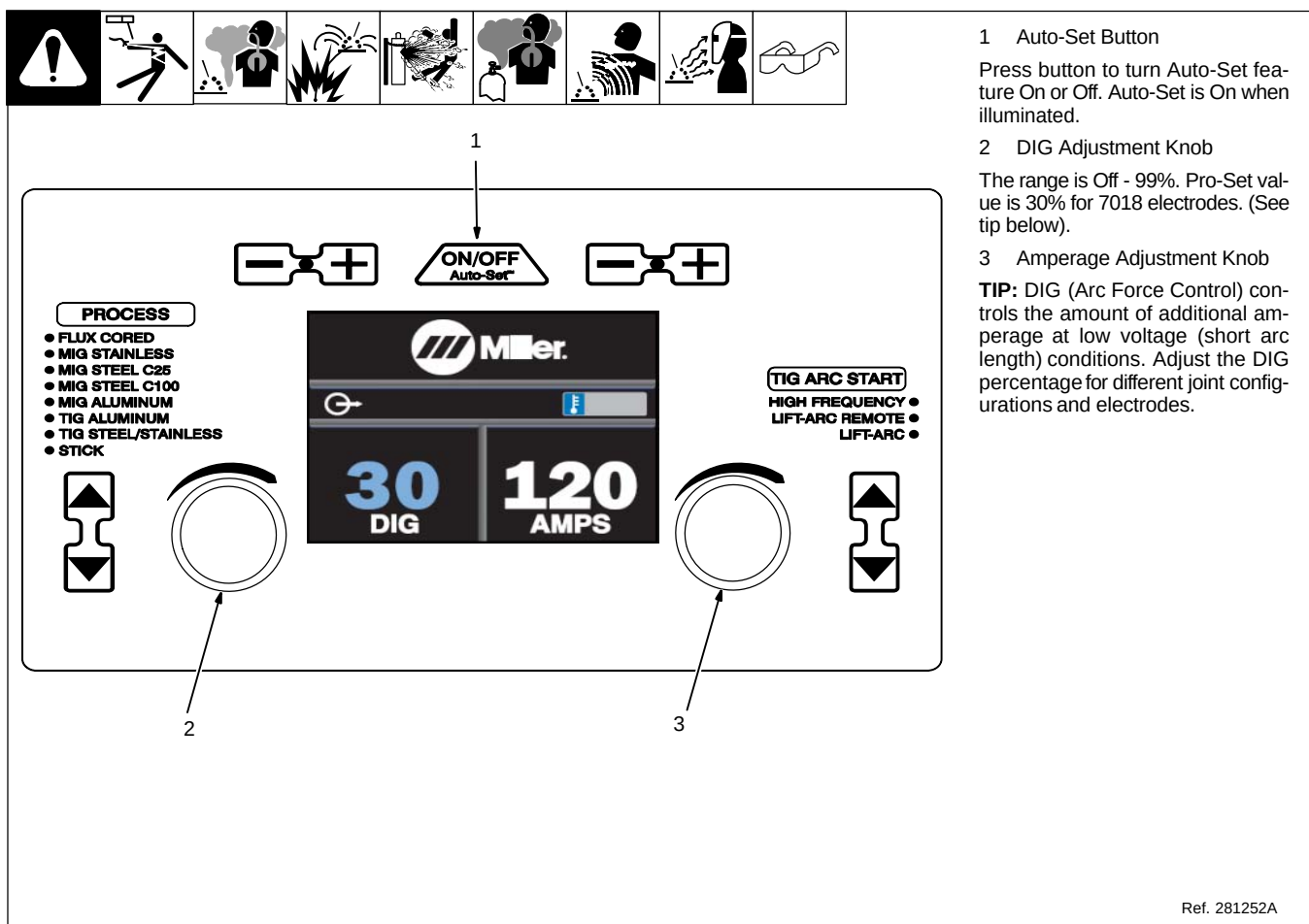
4 Amperage Adjustment Knob
5 TIG Arc Start Select Buttons
Press the up and down buttons to select desired TIG arc start.

TIPS: Low-Speed Pulse: 1 to 10 pulses per second (PPS) will produce a distinct ripple pattern in the weld bead. It can be used to time filler addition, reduce distortion and improve control.

High Speed Pulse: 100 pulses per second (PPS) and higher helps to focus the arc for increased stability, penetration and travel speed. Increased puddle agitation improves weld microstructure.

Ref. 281252A

6-4. Controls, Stick Manual Mode



1 Auto-Set Button
Press button to turn Auto-Set feature On or Off. Auto-Set is On when illuminated.

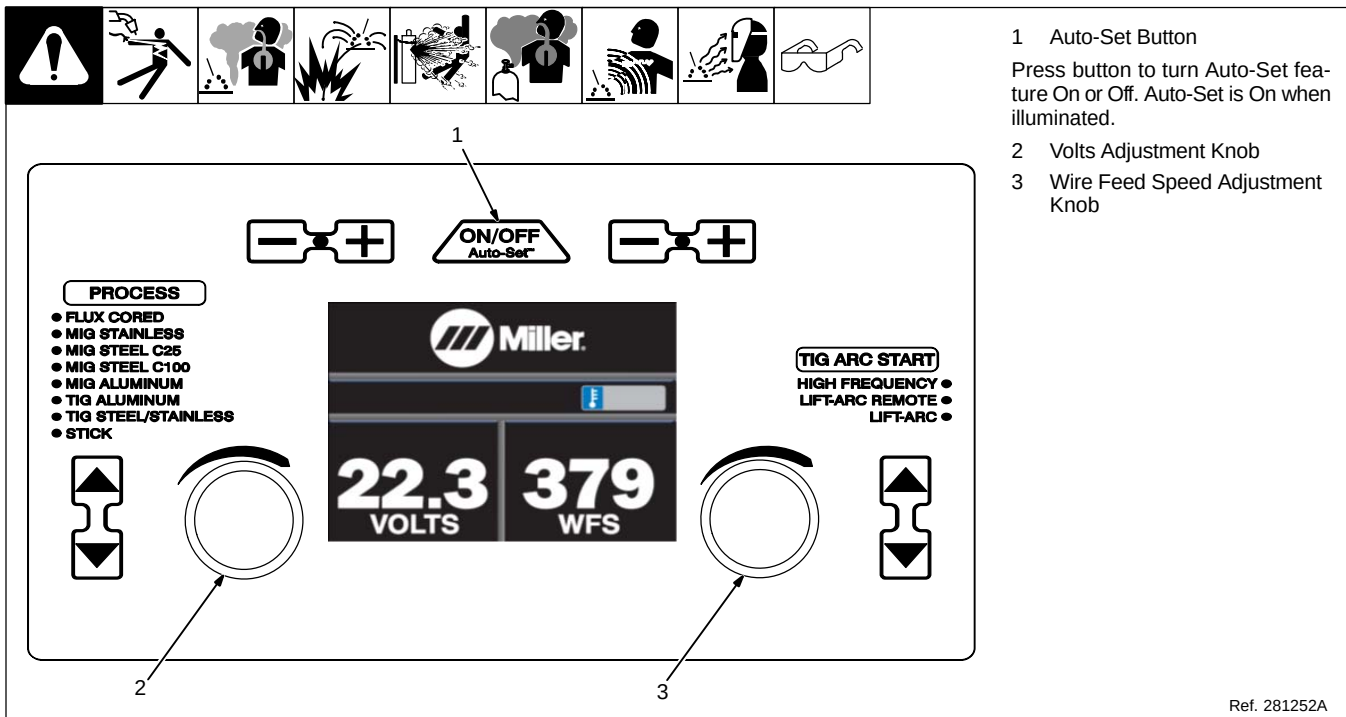
2 DIG Adjustment Knob
The range is Off - 99%. Pro-Set value is 30% for 7018 electrodes. (See tip below).

3 Amperage Adjustment Knob

TIP: DIG (Arc Force Control) controls the amount of additional amperage at low voltage (short arc length) conditions. Adjust the DIG percentage for different joint configurations and electrodes.

Ref. 281252A

6-5. Controls, MIG Manual Mode



Notes

6-6. Welding Parameter Chart – 120V

Steel Wire Welding (MIG/Flux-Cored) Parameters													
Material	Polarity	Shielding Gas*	Wire Type	Wire Size	120 Volt								
					24 ga (V/WFS)	22 ga (V/WFS)	20 ga (V/WFS)	18 ga (V/WFS)	16 ga (V/WFS)	14 ga (V/WFS)	1/8" (V/WFS)	3/16" (V/WFS)	1/4" (V/WFS)
Steel	DCEP	C25	Solid Wire ER70S-6	0.024	14.2/137	14.2/191	15.2/211	16.1/271	16.2/322	17.4/400	19.0/533	19.7/600	-
				0.030	14.1/95	14.7/107	15.0/120	15.4/195	15.8/218	16.0/275	17.7/298	18.4/284	-
				0.035	-	14.0/117	14.4/121	14.8/172	15.7/216	16.3/233	17.7/202	18.0/195	-
		C100		0.024	-	16.4/180	16.8/190	17.4/260	19.1/300	20.2/514	21.8/575	22.0/600	-
				0.030	-	15.8/95	16.0/112	16.0/170	16.4/190	17.3/225	18.8/270	20.1/350	-
				0.035	-	14.8/87	16.0/111	16.3/138	16.7/190	17.7/233	19.1/245	20.4/293	-
	DCEN	None	Flux-Cored E71T-11	0.030	-	-	-	13.6/92	15.2/110	15.7/167	18.0/238	-	-
				0.035	-	-	-	13.4/73	14.2/82	16.0/133	19.7/160	-	-
				0.045	-	-	-	-	-	-	-	-	-
Stainless Steel	DCEP	Tri-Mix	Stainless Steel 308L	0.024	-	18.4/261	18.5/282	18.9/356	19.2/421	19.6/487	22.2/520	-	-
				0.030	-	17.5/237	17.9/244	18.1/266	18.6/340	19.6/400	21.0/505	-	-
				0.035	-	17.4/121	17.6/126	18.0/181	18.2/213	18.6/250	20.0/287	-	-
Aluminum Wire Welding (MIG) Parameters													
Material	Polarity	Shielding Gas*	Wire Type	Wire Size	120 Volt								
					24 ga (V/WFS)	22 ga (V/WFS)	20 ga (V/WFS)	18 ga (V/WFS)	16 ga (V/WFS)	14 ga (V/WFS)	1/8" (V/WFS)	3/16" (V/WFS)	1/4" (V/WFS)
Alum. w/ Optional Spoolmate 100	DCEP	Argon	ER4043	0.030	-	-	-	11.6/193	13.4/345	13.8/400	21.8/424	-	-
				0.035	-	-	-	-	13.0/273	14.3/350	21.0/350	-	-
Alum. w/ Optional Spoolmate 150			ER4043	0.030	-	-	-	10.8/274	12.8/368	13.8/410	21.8/424	-	-
				0.035	-	-	-	-	13.0/333	14.2/350	21.3/350	-	-
Alum. w/ Optional Spoolmate 150			ER5356	0.030	-	-	-	10.4/352	13.6/478	14.2/534	21.3/600	-	-
	0.035	-		-	-	-	13.1/383	14.5/450	21.6/525	-	-		
TIG Welding Parameters													
Material	Polarity	Shielding Gas*	Tungsten Size		120 Volt								
					24 ga (Amps)	22 ga (Amps)	20 ga (Amps)	18 ga (Amps)	16 ga (Amps)	14 ga (Amps)	1/8" (Amps)	3/16" (Amps)	1/4" (Amps)
Steel, Stainless Steel	DCEN	Argon	1/16"	-	35	40	45	55	70	120	-	-	
			3/32"	-	35	40	45	55	70	120	-	-	
Aluminum	AC	Argon	1/16"	-	30	55	65	95	105	135	-	-	
			3/32"	-	30	55	65	95	105	135	-	-	
Stick Welding Parameters													
Material	Polarity	Electrode Type	Electrode Size		120 Volt								
					24 ga (Amps)	22 ga (Amps)	20 ga (Amps)	18 ga (Amps)	16 ga (Amps)	14 ga (Amps)	1/8" (Amps)	3/16" (Amps)	1/4" (Amps)
Steel	DCEP	6011	3/32"	-	-	-	-	-	50	60	90	-	
			1/8"	-	-	-	-	-	80	90	-		
			5/32"	-	-	-	-	-	-	-	-		
		6013	3/32"	-	-	-	-	45	55	70	90	-	
			1/8"	-	-	-	-	-	80	-	-		
			5/32"	-	-	-	-	-	-	-	-		
		7018	3/32"	-	-	-	-	-	70	-	-	-	
			1/8"	-	-	-	-	-	-	-	-	-	
			5/32"	-	-	-	-	-	-	-	-	-	
*Please see Owner's Manual for detailed information on welding gas selection and mixtures.													

*Please see Owner's Manual for detailed information on welding gas selection and mixtures.

6-7. Welding Parameter Chart – 240V

Steel Wire Welding (MIG/Flux-Cored) Parameters

Material	Polarity	Shielding Gas*	Wire Type	Wire Size	240 Volt										
					24 ga (V/WFS)	22 ga (V/WFS)	20 ga (V/WFS)	18 ga (V/WFS)	16 ga (V/WFS)	14 ga (V/WFS)	1/8" (V/WFS)	3/16" (V/WFS)	1/4" (V/WFS)	5/16" (V/WFS)	3/8" (V/WFS)
Steel	DCEP	C25	Solid Wire	0.024	14.2/137	14.2/191	15.2/211	16.1/271	16.2/322	17.4/400	19.0/533	19.7/600	-	-	-
				0.030	14.1/95	14.7/107	15.0/120	15.4/195	15.8/227	16.0/286	17.7/304	19.7/413	20.9/456	21.2/471	21.6/480
				0.035	-	14.0/117	14.4/121	14.8/177	15.7/211	16.3/221	18.2/293	19.5/342	21.0/355	21.7/365	22.3/384
		C100		0.024	-	16.4/180	16.8/200	17.4/260	19.1/300	20.0/514	22.5/575	22.7/600	-	-	-
				0.030	-	15.8/106	16.0/112	16.0/170	16.4/190	17.2/225	18.2/270	20.5/350	23.0/430	23.6/450	24.0/460
				0.035	-	14.8/87	15.3/92	15.8/163	16.0/200	18.0/233	19.1/280	21.7/290	22.9/342	23.5/360	24.5/365
	DCEN	None	Flux-Cored E71T-11	0.030	-	-	-	13.6/92	15.2/110	15.7/167	19.7/350	21.6/379	23.7/402	-	-
				0.035	-	-	-	13.4/73	14.2/82	16.0/133	19.9/283	21.8/377	22.3/377	23.6/377	24.1/377
				0.045	-	-	-	-	14.2/82	15.3/86	19.0/131	19.9/175	20.7/203	20.7/210	21.0/221
				0.024	-	18.4/261	18.5/282	18.9/356	19.2/421	19.6/487	22.2/520	24.0/600	-	-	-
Stainless Steel	DCEP	Tri-Mix	Stainless Steel 308L	0.030	-	17.5/237	17.9/244	18.1/266	18.6/340	19.6/400	21.0/505	23.0/539	24.3/570	24.5/600	25.0/600
				0.035	-	17.4/121	17.6/126	18.0/181	18.2/213	18.6/250	20.0/287	21.8/397	24.2/477	24.6/486	25.0/500

Aluminum Wire Welding (MIG) Parameters

Material	Polarity	Shielding Gas*	Wire Type	Wire Size	240 Volt										
					24 ga (V/WFS)	22 ga (V/WFS)	20 ga (V/WFS)	18 ga (V/WFS)	16 ga (V/WFS)	14 ga (V/WFS)	1/8" (V/WFS)	3/16" (V/WFS)	1/4" (V/WFS)	5/16" (V/WFS)	3/8" (V/WFS)
Alum. w/ Optional	DCEP	Argon	ER4043	0.030	-	-	-	11.6/193	13.4/345	13.8/400	21.8/424	23.4/552	25.3/600	-	-
				0.035	-	-	-	-	13.0/273	14.3/350	21.0/350	23.2/368	23.5/431	23.9/455	25.0/541
Alum. w/ Optional			ER4043	0.030	-	-	-	10.8/274	12.8/368	13.8/410	21.8/424	23.4/552	25.3/600	-	-
				0.035	-	-	-	-	13.0/333	14.2/350	21.3/350	22.3/375	23.5/430	23.9/455	24.3/460
Alum. w/ Optional			ER5356	0.030	-	-	-	10.4/352	13.6/478	14.2/534	21.3/600	-	-	-	-
				0.035	-	-	-	-	13.1/383	14.5/450	21.6/525	23.1/600	-	-	-

TIG Welding Parameters

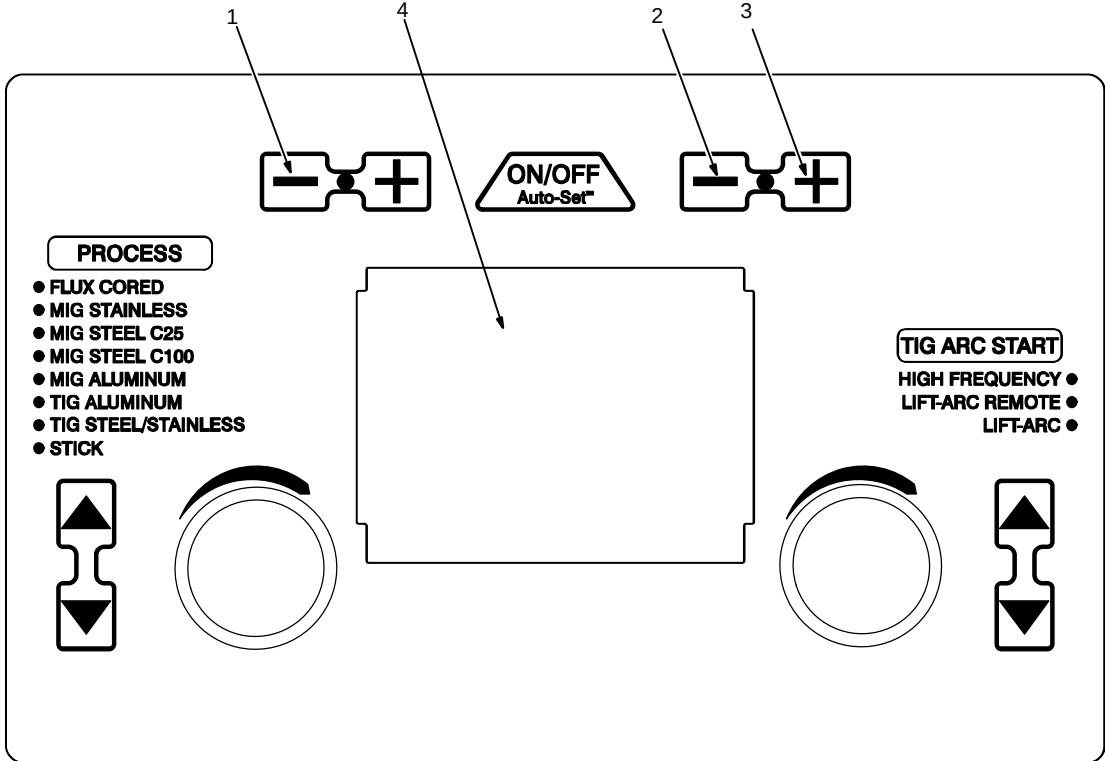
Material	Polarity	Shielding Gas*	Tungsten Size	240 Volt										
				24 ga (Amps)	22 ga (Amps)	20 ga (Amps)	18 ga (Amps)	16 ga (Amps)	14 ga (Amps)	1/8" (Amps)	3/16" (Amps)	1/4" (Amps)	5/16" (Amps)	3/8" (Amps)
Steel, Stainless Steel	DCEN	Argon	1/16"	-	35	40	45	55	70	120	-	-	-	-
			3/32"	-	35	40	45	55	70	120	150	190	-	-
Aluminum	AC	Argon	1/16"	-	30	55	65	95	105	135	-	-	-	-
			3/32"	-	30	55	65	95	105	135	185	210	-	-

Stick Welding Parameters

Material	Polarity	Electrode Type	Electrode Size	240 Volt										
				24 ga (Amps)	22 ga (Amps)	20 ga (Amps)	18 ga (Amps)	16 ga (Amps)	14 ga (Amps)	1/8" (Amps)	3/16" (Amps)	1/4" (Amps)	5/16" (Amps)	3/8" (Amps)
Steel	DCEP	6011	3/32"	-	-	-	-	-	50	60	90	-	-	-
			1/8"	-	-	-	-	-	80	90	100	110	-	
			5/32"	-	-	-	-	-	130	140	150	160	-	
		6013	3/32"	-	-	-	-	45	55	70	90	-	-	-
			1/8"	-	-	-	-	-	80	95	115	130	-	
			5/32"	-	-	-	-	-	120	140	155	165	165	
		7018	3/32"	-	-	-	-	-	70	95	100	-	-	-
			1/8"	-	-	-	-	-	-	-	120	125	130	140
			5/32"	-	-	-	-	-	-	125	145	170	180	190

6-8. Entering Setup Menu





1 Wire/Rod/Tungsten Minus (-) Button

2 Material Thickness Minus (-) Button

3 Material Thickness Plus (+) Button

4 Display

To enter the setup menu, simultaneously

press then release the Wire/Rod/Tungsten Minus (-) button and Material Thickness Plus (+) button. After entering the setup menu, the Material Thickness light will flash.

To move to the next setup menu, press the Material Thickness Plus (+) button.

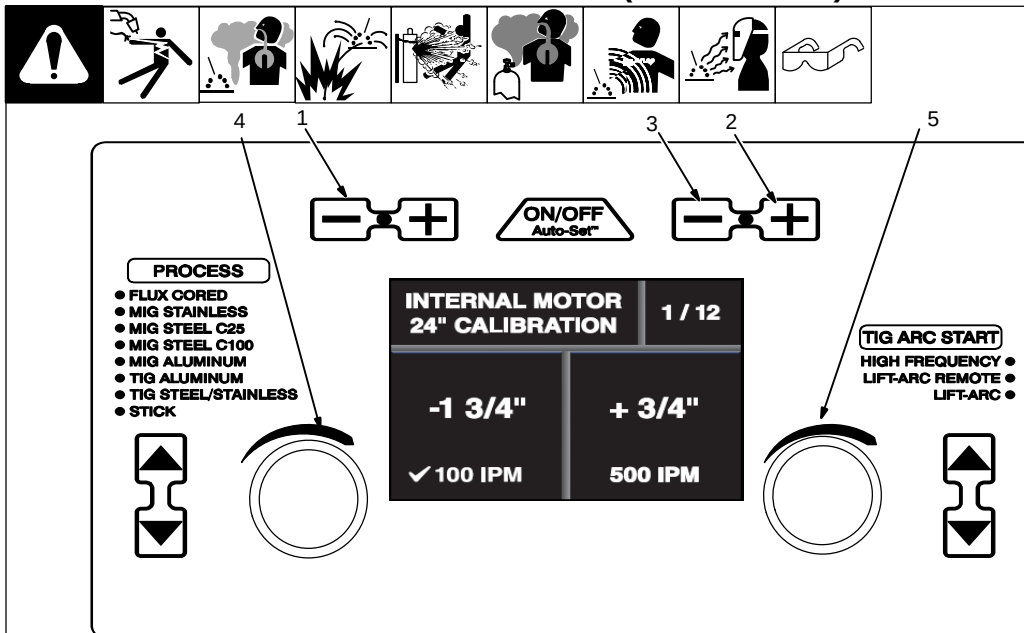
To move to the previous setup menu, press the Material Thickness Minus (-) button.

To exit the setup menu, simultaneously press then release the Wire/Rod/ Tungsten Minus (-) button and the Material Thickness Plus (+) button.

Ref. 281252A

Notes

6-9. Internal Motor 24 Inch Calibration (Menu 1 Of 12)



Ref. 281252A

The unit's internal drive motor is calibrated at the factory. No calibration is needed unless drive motor or control board is changed.

- 1 Wire/Rod/Tungsten Minus (-) Button
- 2 Material Thickness Plus (+) Button
- 3 Material Thickness Minus (-) Button
- 4 Left Adjustment Knob
- 5 Right Adjustment Knob

Cut wire flush at nozzle.

Follow instructions in Section 6-8 to enter the

setup menu.

To perform a motor calibration 24 in. run-out test at 100 ipm, turn left Adjustment knob, and verify that a check mark appears next to 100 ipm.

Be sure wire is cut flush at nozzle, then trigger the MIG gun. Motor will feed approximately 24 in. of wire through gun.

Cut wire flush at nozzle and measure run-out. If length of run-out is not 24 in., turn left Adjustment knob to increase/decrease length of run-out.

To perform a motor calibration 24 in. run-out test at 500 ipm, turn right Adjustment knob,

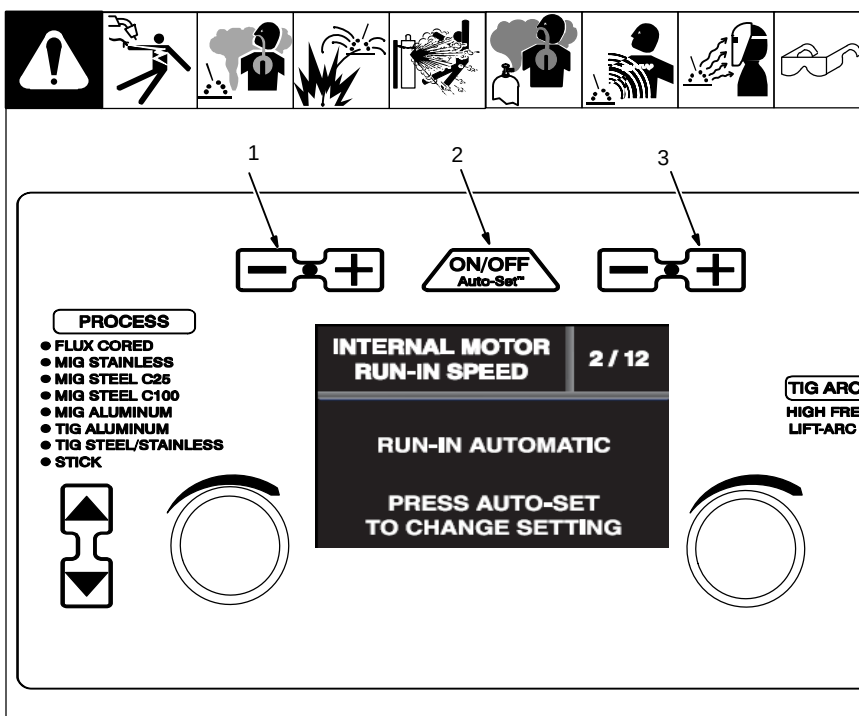
and verify that a check mark appears next to 500 ipm.

Be sure wire is cut flush at nozzle, then trigger the MIG gun. Motor will feed approximately 24 in. of wire through gun.

Cut wire flush at nozzle and measure run-out. If length of run-out is not 24 in., turn right Adjustment knob to increase/decrease length of run-out.

To exit menu, simultaneously press and release the Wire/Rod/Tungsten Minus (-) button and Material Thickness Plus (+) button, or turn unit off and on.

6-10. Internal Motor Run-In Speed (Menu 2 Of 12)



- 1 Wire/Rod/Tungsten Minus (-) Button
- 2 Auto-Set Button
- 3 Material Thickness Plus (+) Button

Follow instructions in Section 6-8 to enter the setup menu.

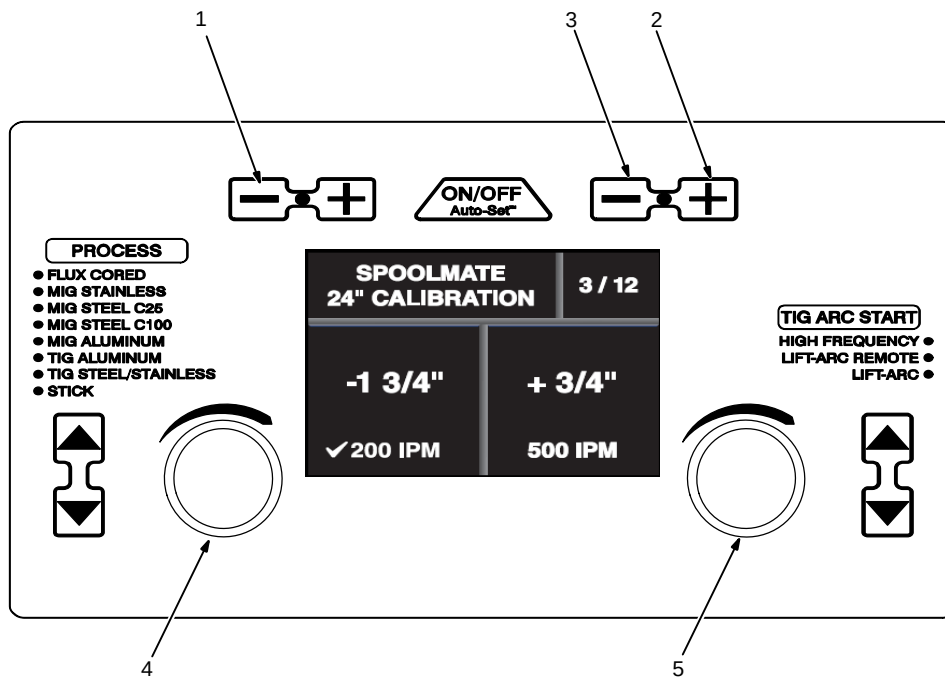
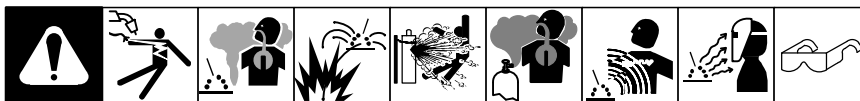
To change the run-in setting, press the Auto-Set button.

Run-in is the wire speed prior to the welding arc being struck. When set to Automatic, the welder determines the optimal run-in speed for each start. When set to disabled, the run-in speed is the same as the weld wire speed.

To exit the menu, simultaneously press and release the Wire/Rod/Tungsten Minus(-) button and Material Thickness Plus (+) button, or turn unit off and on.

Ref. 281252A

6-11. Spoolmate™ 24 Inch Calibration (Menu 3 Of 12)



- 1 Wire/Rod/Tungsten Minus (-) Button
- 2 Material Thickness Plus (+) Button
- 3 Material Thickness Minus (-) Button
- 4 Left Adjustment Knob
- 5 Right Adjustment Knob

Spoolmate 100 and 150 drive motors are unique to this welding power source. Motor calibration is necessary any time a different Spoolmate 100 or 150 is connected to the Multimatic 220.

Connect Spoolmate to unit.

Cut wire flush at nozzle.

Follow instructions in Section 6-8 to enter the setup menu.

To perform a Spoolmate calibration 24 in. run-out test at 200 ipm, turn left Adjustment knob, and verify that a check mark appears next to 200 ipm.

Cut wire flush at nozzle and then trigger the Spoolmate.

Spoolmate will feed approximately 24 in. of wire through gun.

Cut wire flush at nozzle and measure run-out.

If wire length is not 24 in., use left Adjustment knob to increase/decrease length of the run-out.

To perform a Spoolmate calibration 24 in. run-out test at 500 ipm, turn right Adjustment knob and verify that a check mark appears next to 500 ipm.

Cut wire flush at nozzle and then trigger the Spoolmate.

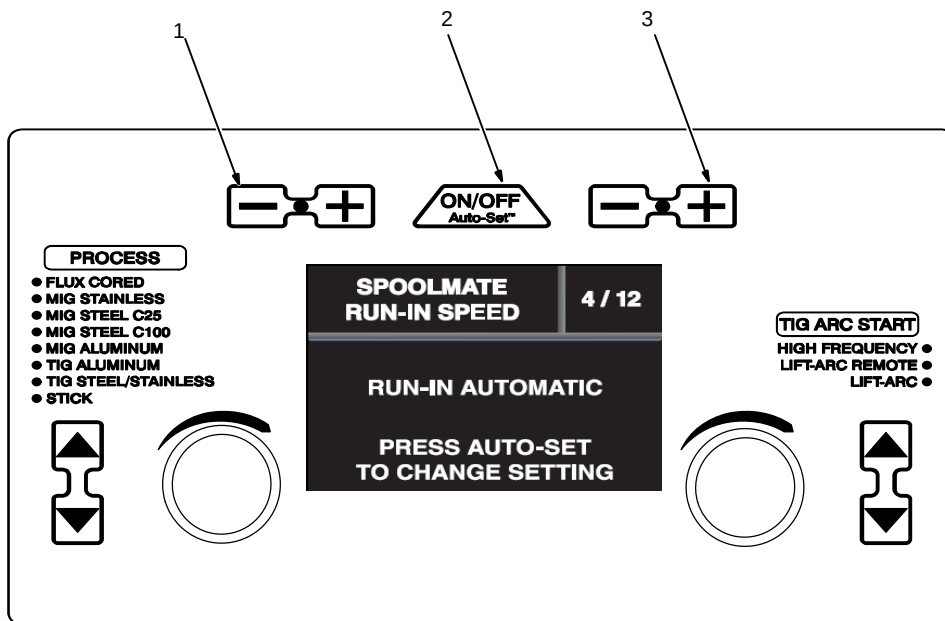
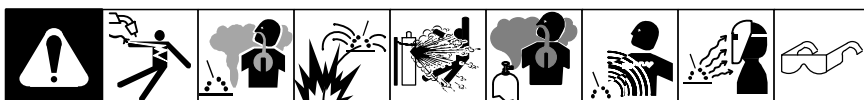
Spoolmate will feed approximately 24 in. of wire through gun.

Cut wire flush at nozzle and measure run-out.

If wire length is not 24 in., use right Adjustment knob to increase/decrease length of the run-out.

To exit menu, simultaneously press and release the Wire/Rod/Tungsten Minus (-) button and Material Thickness Plus (+) button, or turn unit off and on.

6-12. Spoolmate Run-In Speed (Menu 4 Of 12)



- 1 Wire/Rod/Tungsten Minus (-) Button
- 2 Auto-Set Button
- 3 Material Thickness Plus (+) Button

Follow instructions in Section 6-8 to enter the setup menu.

To change the run-in setting, press the Auto-Set button.

Run-in is the speed of the wire prior to the welding arc being struck.

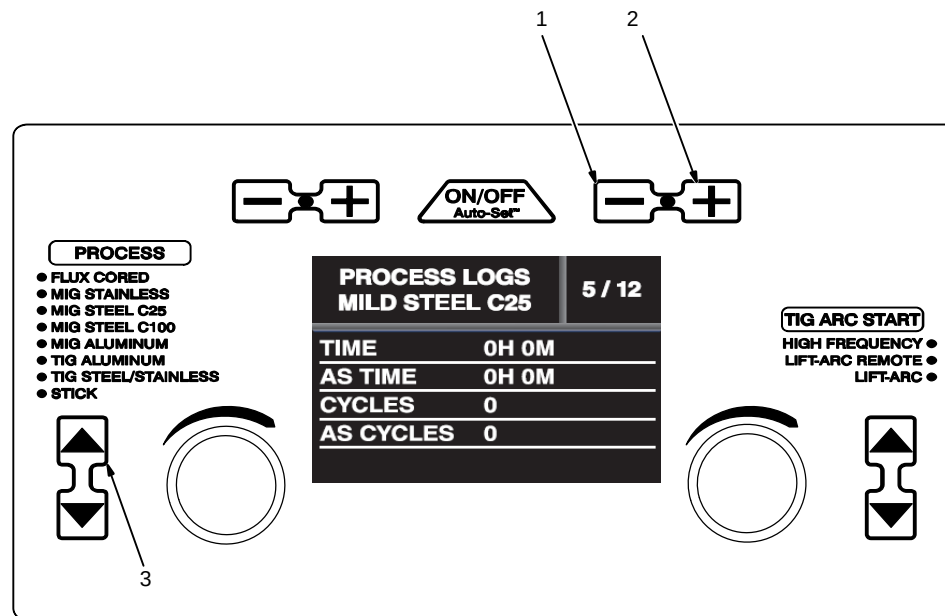
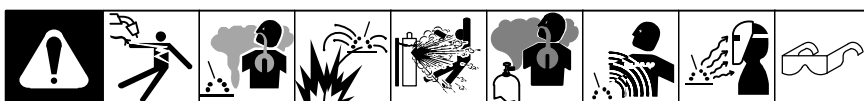
When set to Automatic, the welder determines the optimal run-in speed for each start.

When set to Disabled, the run-in speed is the same as the weld wire speed.

To exit menu, simultaneously press and release the Wire/Rod/Tungsten Minus (-) button and Material Thickness Plus (+) button, or turn unit off and on.

Ref. 281252A

6-13. Process Logs (Menu 5 Of 12)



- 1 Material Thickness Minus (-) Button
- 2 Material Thickness Plus (+) Button
- 3 Process Select

Follow instructions in Section 6-8 to enter the setup menu.

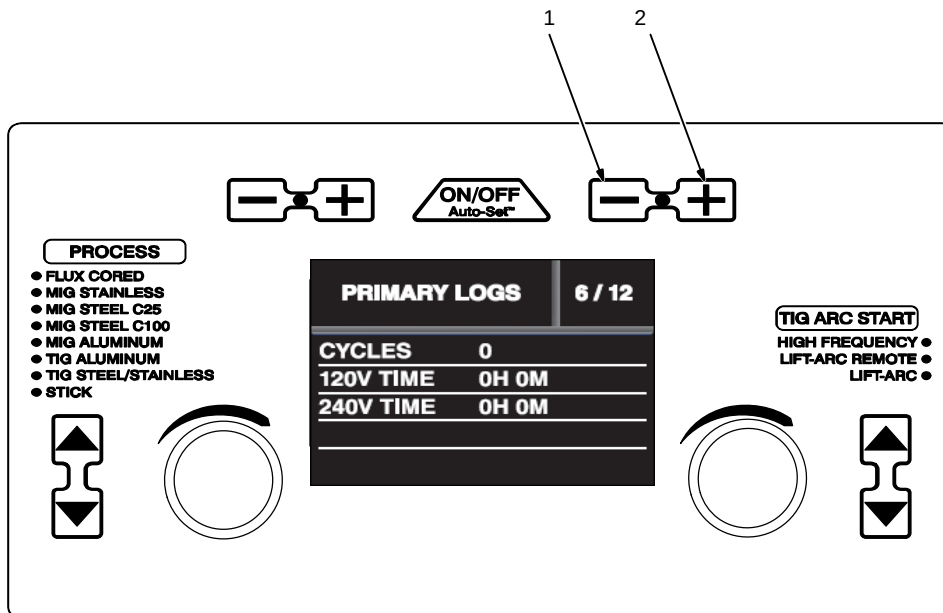
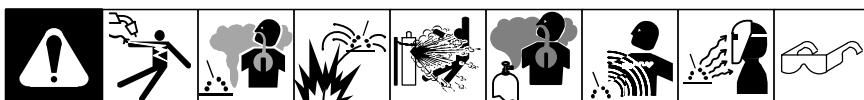
Process Logs menu displays manual time, Auto-Set time, weld cycles, and Auto-Set cycles for the selected process.

To view other processes, use the Process Select buttons to select the desired weld process.

To exit menu, simultaneously press and release the Wire/Rod/Tungsten Minus (-) button and Material Thickness Plus (+) button, or turn unit off and on.

Ref. 281252A

6-14. Primary Logs (Menu 6 Of 12)



- 1 Material Thickness Minus (-) Button
- 2 Material Thickness Plus (+) Button

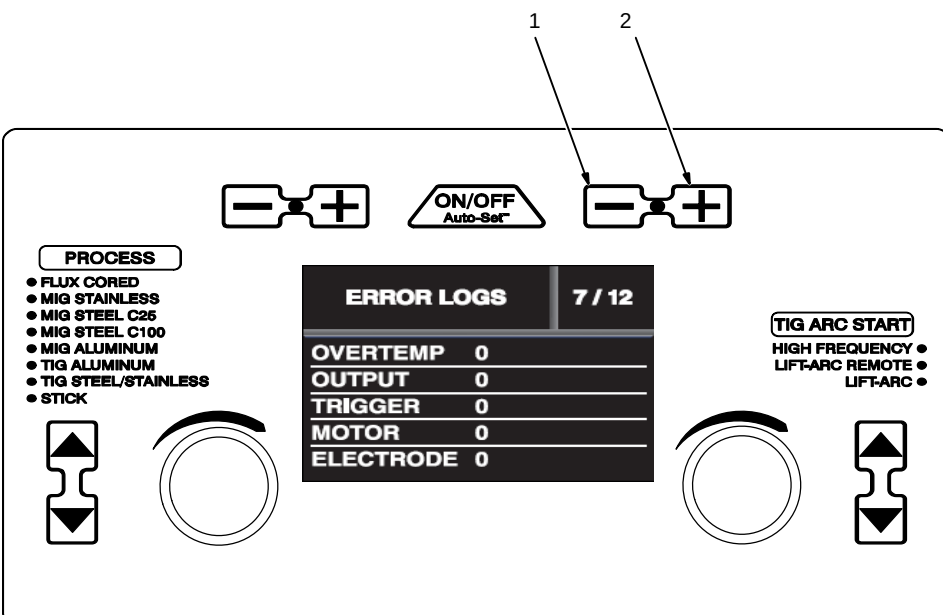
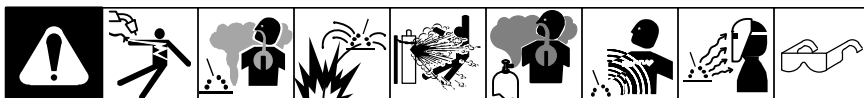
Follow instructions in Section 6-8 to enter the setup menu.

Primary Logs menu displays power cycles, 120 volt time, and 240 volt time.

To exit menu, simultaneously press and release the Wire/Rod/Tungsten Minus (-) button and Material Thickness Plus (+) button, or turn unit off and on.

Ref. 281252A

6-15. Error Logs (Menu 7 Of 12)



- 1 Material Thickness Minus (-) Button
- 2 Material Thickness Plus (+) Button

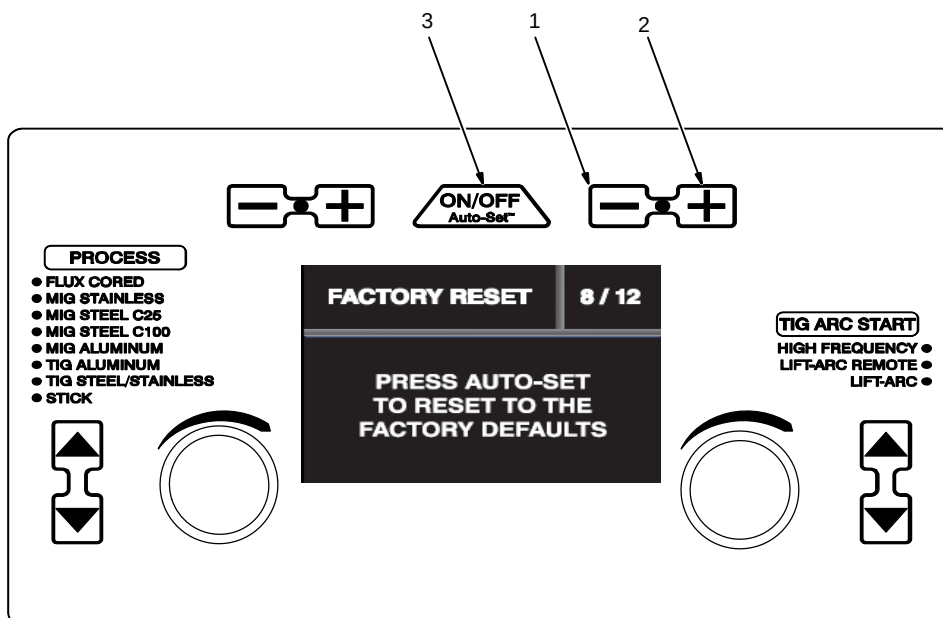
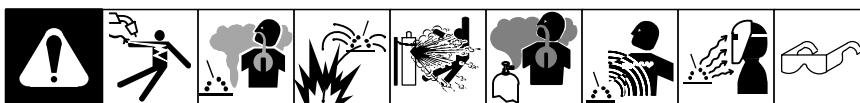
Follow instructions in Section 6-8 to enter the setup menu.

Error Logs screen displays welder over-temperature errors, shorted output errors, shorted trigger errors, motor current errors, and stuck electrode errors.

To exit menu, simultaneously press and release the Wire/Rod/Tungsten Minus (-) button and Material Thickness Plus (+) button, or turn unit off and on.

Ref. 281252A

6-16. Factory Reset (Menu 8 Of 12)



- 1 Material Thickness Minus (-) Button
- 2 Material Thickness Plus (+) Button
- 3 Auto-Set Button

A Factory Reset will reset the primary logs data, process logs data, error logs data, selected process, and all process settings. Motor calibration settings, Spoolmate Calibration settings, and software information will all be retained.

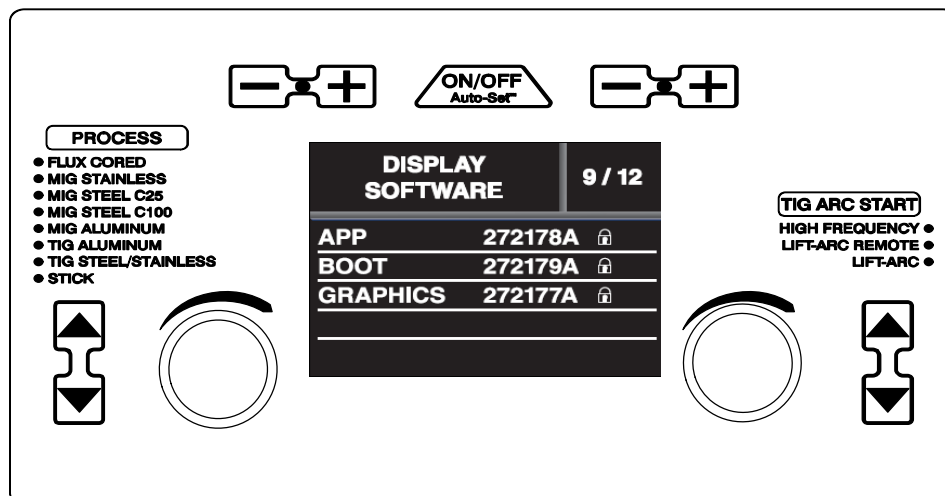
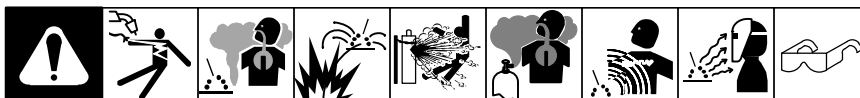
Follow instructions in Section 6-8 to enter the setup menu.

To perform a Factory Reset, press the Auto-Set button.

To exit menu, simultaneously press and release the Wire/Rod/Tungsten Minus (-) button and Material Thickness Plus (+) button, or turn unit off and on.

Ref. 281252A

6-17. Display Software (Menu 9 Of 12)



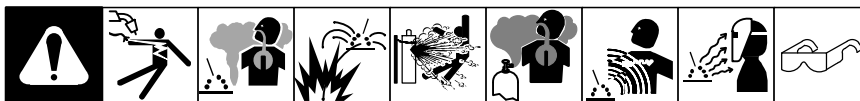
Display Software information is for factory and service use only.

Follow instructions in Section 6-8 to enter the setup menu.

To exit menu, simultaneously press and release the Wire/Rod/Tungsten Minus (-) button and Material Thickness Plus (+) button, or turn unit off and on.

Ref. 281252A

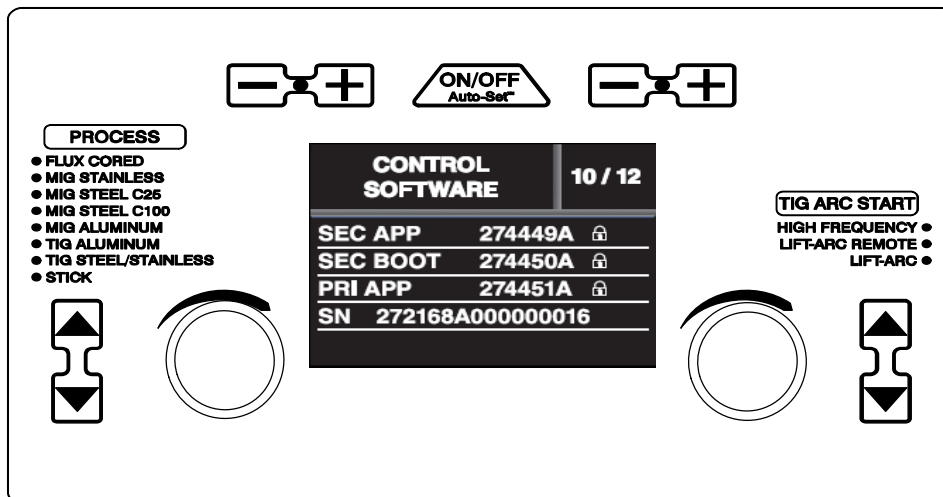
6-18. Control Software (Menu 10 Of 12)



Control Software information is for factory and service use only.

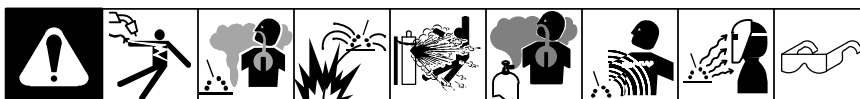
Follow instructions in Section 6-8 to enter the setup menu.

To exit menu, simultaneously press and release the Wire/Rod/Tungsten Minus (-) button and Material Thickness Plus (+) button, or turn unit off and on.



Ref. 281252A

6-19. QuickTech™ (Menu 11 Of 12)



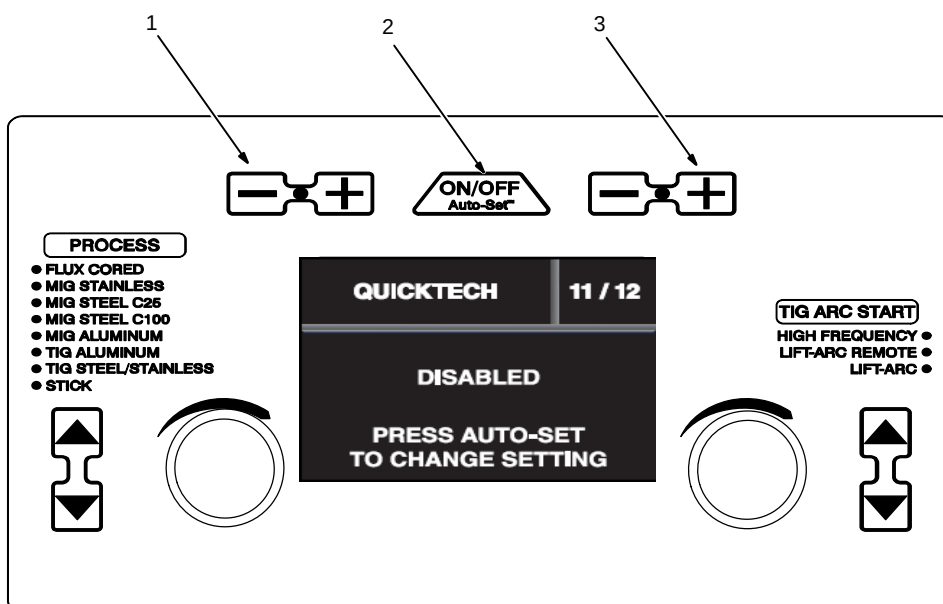
- 1 Wire/Rod/Tungsten Minus (-) Button
- 2 Auto-Set Button
- 3 Material Thickness Plus (+) Button

Follow instructions in Section 6-8 to enter the setup menu.

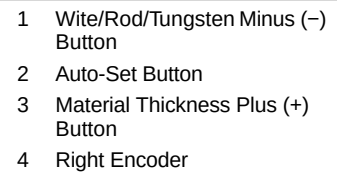
To enable or disable QuickTech™, press the Auto-Set button.

QuickTech automatically selects the right process and polarity. Just hit the trigger or foot control and the machine automatically switches to the correct process recalling the last process settings used.

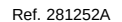
To exit menu, simultaneously press and release the Wire/Rod/Tungsten Minus (-) button and Material Thickness Plus (+) button, or turn unit off and on.



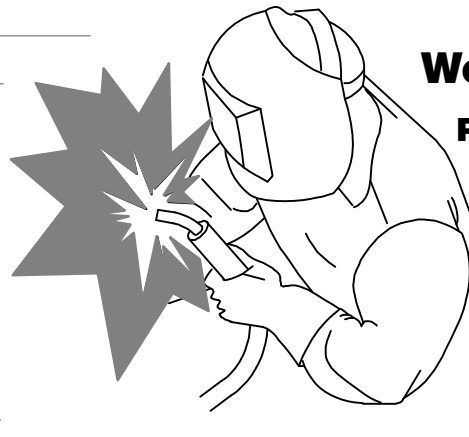
Ref. 281252A



To exit menu, simultaneously press and release the Wire/Rod/Tungsten Minus (–) button and Material Thickness Plus (+) button, or turn unit off and on.



Notes



Pros weld and cut safely. Read the safety rules at the beginning of this manual.

SECTION 7 – MAINTENANCE & TROUBLESHOOTING

7-1. Routine Maintenance

Disconnect power before maintaining.

Maintain more often during severe conditions.

	✓ = Check ◇ = Change ● = Clean ☆ = Replace * To be done by Factory Authorized Service Agent				Reference
Every 3 Months	 ☆ Damaged Or Unreadable Labels	 ☆ Repair Or Replace Cracked Weld Cable			
Every 6 Months	 OR ● Inside Unit	 ● Clean Drive Rolls			

7-2. Overload Protection

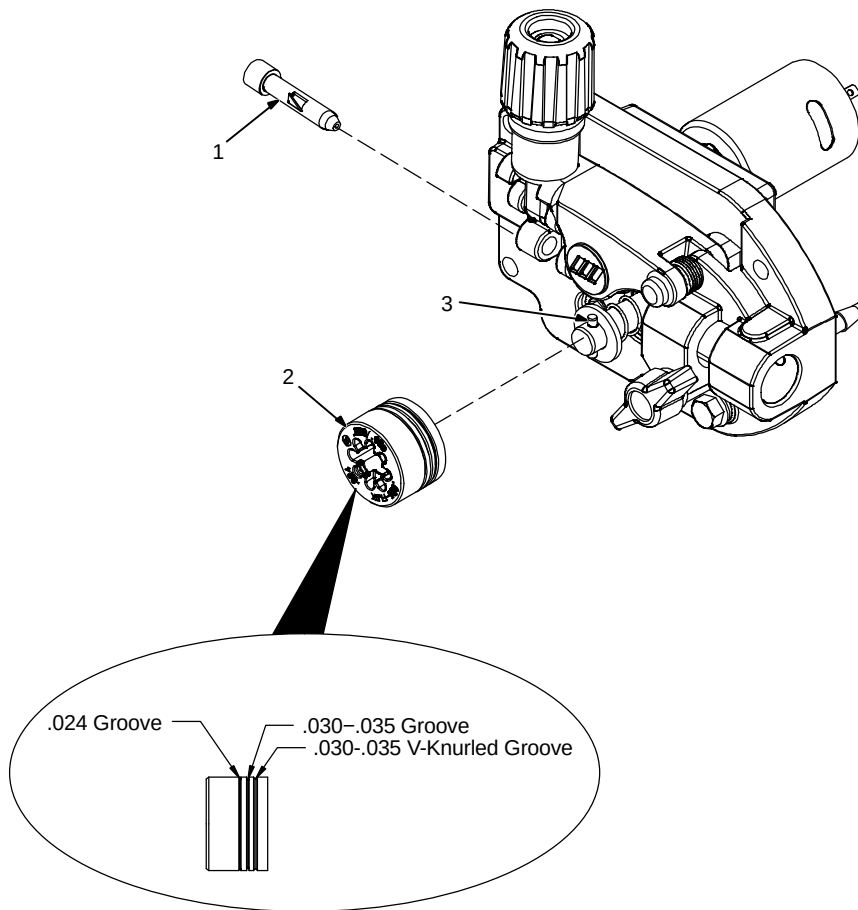
1 Supplementary Protector CB1

CB1 protects unit from overload. If CB1 opens, unit shuts down.

Reset supplementary protector.

282718A

7-3. Changing Drive Roll Or Wire Inlet Guide



1 Inlet Wire Guide

Remove guide by pressing on barbed area or cutting off one end near housing and pulling it out of hole. Push new guide into hole from rear until it snaps in place.

2 Drive Roll

The drive roll includes three different sized grooves. The text aligned with the drive roll retaining pin indicates the selected groove.

3 Retaining Pin

To secure drive roll, locate open slot and push drive roll completely over retaining pin, then rotate drive roll to desired slot.

See Section 14-1 for optional drive rolls.

Table 7-1. Drive Roll Grooves And Wire Type Compatibility

Groove	Compatible Wire
.024	.024 Solid Wire
.030-.035	.030-.035 Solid Wire
.030-.035 V-Knurled	.030-.035 Flux-Core

7-4. Error Messages



Message	Error	Remedy
Overtemp—Please wait while the welder cools down.	Internal temperature of welder has exceeded the maximum limit.	Wait for unit to cool down. If the fan is not running, contact Miller Electric Mfg. LLC service department.
Shorted trigger—Release 4-pin trigger to clear error.	MIG gun or spool gun trigger is engaged on power up.	Release 4-pin trigger to clear error.
	MIG gun trigger is held during jog for more than 16 feet of wire.	
	Spool gun trigger is held during jog for more than 10 seconds.	
	MIG gun or spool gun trigger is engaged for more than 1 second after the arc is broken.	
	After an overtemp error, the MIG or spool gun trigger is held after the welder has completed cooling.	
	MIG gun or spool gun trigger is engaged while the process is changed to Flux Cored or a MIG process.	
	MIG gun or spool gun trigger lead voltage exceeds 9 volts caused by the electrode being shorted to the trigger lead.	Fix or replace damaged gun.
	MIG gun or spool gun trigger leads are shorted together.	
Shorted trigger—Release trigger to clear error.	The 14-pin trigger is engaged on power up.	Release the 14-pin trigger.
	The 14-pin trigger is held during TIG preflow for more than 15 seconds.	
Shorted output—First remove short, then pull trigger to clear error.	The welding wire came into contact with the workpiece while jogging wire.	Remove short and pull trigger, or wait 30 seconds to clear error.
	MIG gun or spool gun contact tip came into contact with the workpiece while welding.	
	The weld voltage is less than 10 volts for more than 0.2 seconds while welding.	
	Output rectifier is damaged.	Contact Miller Electric Mfg. LLC service department
	The secondary control board is damaged.	
	The primary control board is damaged.	
Stuck electrode—Free stuck electrode to clear error.	Stick welding electrode has become stuck in weld puddle and turned output off.	Remove Stick welding electrode from workpiece and output will turn back on after about one second.
Stuck electrode—Free tungsten to clear error.	Tungsten electrode has become stuck in weld puddle and turned output off.	Remove the tungsten from workpiece and output will turn back on after about one second.
	Tungsten has contacted workpiece for more than 5 seconds without starting an arc.	
Motor error—Motor has drawn too much current.	Too much pressure on pressure adjust knob.	Reduce pressure on the pressure adjust knob.
	The gun liner is obstructed.	Clear obstruction or replace gun liner.
	The gun contact tip is obstructed.	Clear obstruction or replace contact tip.
	The welding wire is entangled.	Untangle welding wire.
	The internal motor is damaged.	Contact Miller Electric Mfg. LLC service department.

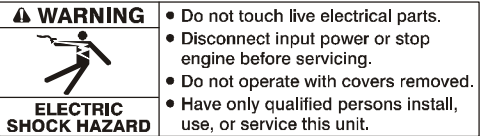
Message	Error	Remedy
Motor error—Motor has drawn too much current.	The primary control board is damaged.	Contact Miller Electric Mfg. LLC service department.
Motor error—Motor has drawn too much current.	The spool gun motor is damaged.	Fix or replace damaged gun.
Fan error—The fan is running too slow or is damaged.	The fan blades are obstructed.	Clear obstruction from fan.
	The fan wiring harness is disconnected.	Contact Miller Electric Mfg. LLC service department
	The fan is damaged.	
	The primary control board is damaged.	
Thermal error—Primary thermistor range error.	The primary circuit thermistor is unplugged.	Contact Miller Electric Mfg. LLC service department
	The primary circuit thermistor is reading too high or too low for a valid temperature.	
	The primary control board is damaged.	
Thermal error—Secondary thermistor range error.	The secondary circuit thermistor is unplugged.	Contact Miller Electric Mfg. LLC service department
	The secondary circuit thermistor is reading too high or too low for a valid temperature.	
	The control board is damaged.	
Thermal error—Magnetic thermistor range error.	The magnetic circuit thermistor is unplugged.	Contact Miller Electric Mfg. LLC service department
	The magnetic circuit thermistor is reading too high or too low for a valid temperature.	
	The primary control board is damaged.	
Boost error—Cycle power to clear error.	The primary boost has not successfully been established.	Cycle power to clear error. If this error persists after a power cycle, contact Miller Electric Mfg. LLC service department.
Over voltage—Cycle power to clear error.	Primary voltage is above 310 volts.	Reduce primary voltage below 310 volts.
Under voltage—Cycle power to clear error.	The primary voltage is below 90 volts.	Increase primary voltage above 90 volts.
Network error—Communication between micros has been lost.	The two microcontrollers on the control board are no longer communicating.	Cycle power to clear error. If this error persists after a power cycle, contact Miller Electric Mfg. LLC service department.
Network error—Communication between boards has been lost.	The wiring harness between the control board and interface board is damaged.	Cycle power to clear error. If this error persists after a power cycle, contact Miller Electric Mfg. LLC service department.
	The primary control board is damaged.	
	The interface board is damaged.	
Secondary Current FB error—Check Weld Current FB device.	The wiring harness between the control board and weld current sensor is damaged.	Cycle power to clear error. If this error persists after a power cycle, contact Miller Electric Mfg. LLC service department.
	The weld current sensor is damaged.	
Weld over voltage error - Cycle power to clear error.	The secondary control board is damaged.	Cycle power to clear error. If this error persists after a power cycle, contact Miller Electric Mfg. LLC service department.
Clamp error - Cycle power to clear error.	The secondary control board is damaged.	Cycle power to clear error. If this error persists after a power cycle, contact Miller Electric Mfg. LLC service department.

7-5. Troubleshooting

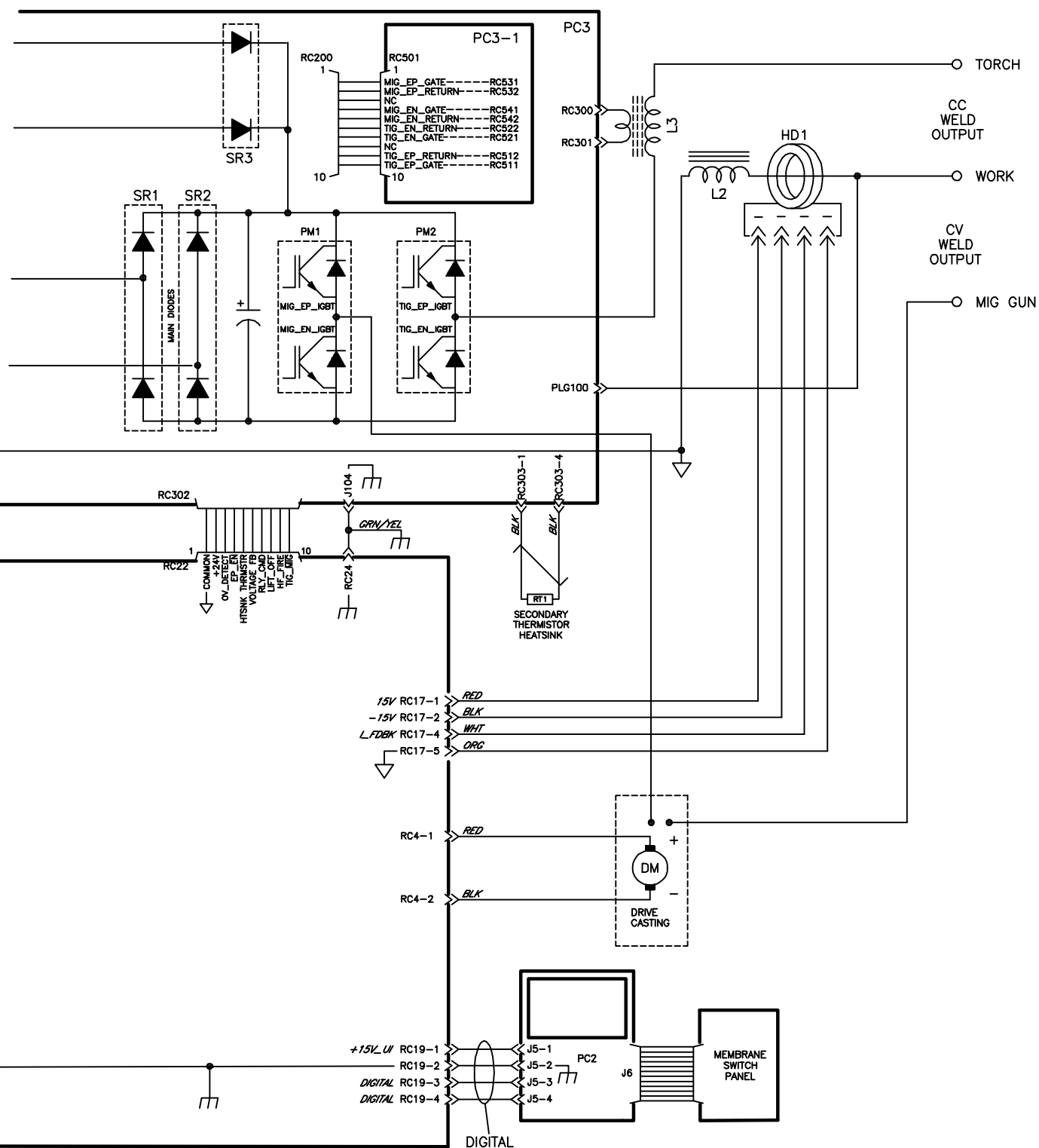


Trouble	Remedy
No weld output; unit completely inoperative.	Place line disconnect switch in On position.
	Check and replace line fuse(s), if necessary, or reset supplementary protector.
	Be sure power cord is plugged in and that receptacle is receiving input power.
No weld output; unit is on.	Check and secure loose weld cable(s) into receptacle(s).
	Check and correct poor connection of work clamp to workpiece.
Erratic or improper welding arc or output.	Use proper size and type of weld cable (see your Distributor).
	Clean and tighten weld connections.
	Verify electrode polarity; check and correct poor connections to workpiece.
Fan not operating.	Unit not warmed up enough to require fan cooling.
	Check for and remove anything blocking fan movement.
	Have Factory Authorized Service Agent check fan motor and control circuitry.
Stick welding problems: Hard starts; poor welding characteristics; unusual spattering.	Use proper type and size of electrode.
	Verify electrode polarity; check and correct poor connections.
	Make sure a remote control is not connected.
TIG welding problems: Wandering arc; hard starts; poor welding characteristics; spattering problems.	Use proper type and size of tungsten.
	Use properly prepared tungsten.
	Verify electrode polarity.
TIG welding problems: Tungsten electrode oxidizing and not remaining bright after welding.	Shield weld zone from drafts.
	Check for correct type shielding gas.
	Check and tighten gas fittings.
	Verify electrode polarity.

[illegible]

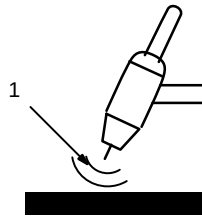


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SECTION 9 – HIGH FREQUENCY

9-1. Welding Processes Requiring High Frequency



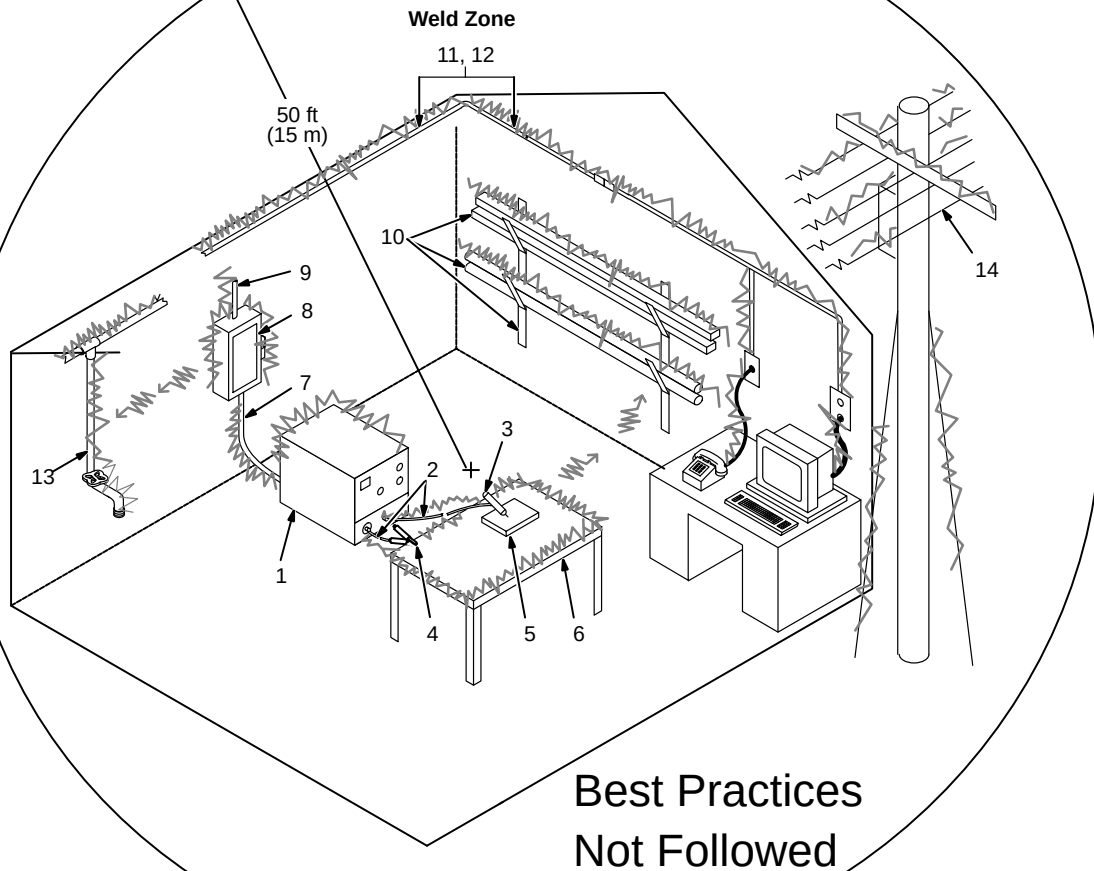
TIG

1 High-Frequency Voltage

TIG – helps arc jump air gap between torch and workpiece and/or stabilize the arc.

high_freq 2018-01

9-2. Installation Showing Possible Sources Of HF Interference



Sources of Direct High-Frequency Radiation

- 1 High-Frequency Source (welding power source with built-in HF or separate HF unit)
- 2 Weld Cables
- 3 Torch
- 4 Work Clamp
- 5 Workpiece
- 6 Work Table

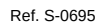
Sources of Conduction of High Frequency

- 7 Input Power Cable
- 8 Line Disconnect Device
- 9 Input Supply Wiring

Sources of Reradiation of High Frequency

- 10 Ungrounded Metal Objects
- 11 Lighting
- 12 Wiring
- 13 Water Pipes and Fixtures
- 14 External Phone and Power Lines

S-0694



- Ground the track.

SECTION 10 – SELECTING AND PREPARING A TUNGSTEN FOR DC OR AC WELDING WITH INVERTER MACHINES

gtaw_Inverter_2018-01

Whenever possible and practical, use DC weld output instead of AC weld output.

10-1. Selecting Tungsten Electrode (Wear Clean Gloves To Prevent Contamination Of Tungsten)

A. Select Tungsten Electrode.

Not all tungsten electrode manufacturers use the same colors to identify tungsten type. Contact the tungsten electrode manufacturer or reference the product packaging to identify the tungsten you are using.

Electrode Diameter	Amperage Range - Gas Type♦ - Polarity	
	(DCEN) – Argon Direct Current Electrode Negative (For Use With Mild Or Stainless Steel)	AC – Argon Unbalanced Wave (For Use With Aluminum)
2% Ceriated, 1.5% Lanthanum, Or 2% Thorium Alloy Tungstens		
.010 in. (.25 mm)	Up to 15	Up to 15
.020 in. (.50 mm)	5-20	5-20
.040 in. (1 mm)	15-80	15-80
1/16 in. (1.6 mm)	70-150	70-150
3/32 in. (2.4 mm)	150-250	140-235
1/8 in. (3.2 mm)	250-400	225-325
5/32 in. (4.0 mm)	400-500	300-400
3/16 in (4.8 mm)	500-750	400-500
1/4 in. (6.4 mm)	750-1000	500-630

♦ Typical argon shielding gas flow rates are 10 to 25 CFH (cubic feet per hour).

Figures listed are a guide and are a composite of recommendations from American Welding Society (AWS).

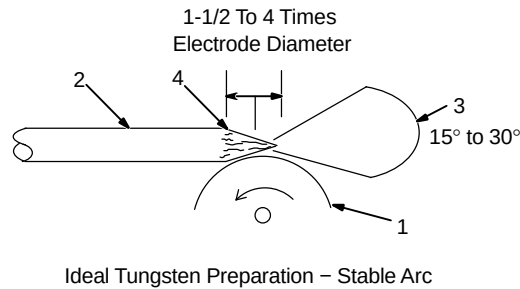
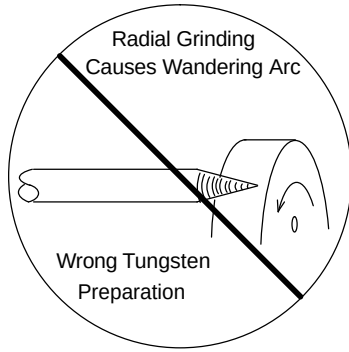
B. Electrode Composition.

Tungsten Type	Application Notes
2% Cerium (Grey*)	Good all-around tungsten for both AC and DC welding.
1.5–2% Lanthanum (Yellow/Blue)	Excellent low amp starts for AC and DC welding.
2% Thorium (Red)	Commonly used for DC welding, not ideal for AC.
Pure Tungsten (Green)	Not Recommended for inverters! For best results in most applications use a sharpened cerium or lanthanum electrode for AC and DC welding.
* Color may vary depending on manufacturer, please refer to manufacturer's guide for color designation.	

10-2. Preparing Tungsten Electrode For DC Electrode Negative (DCEN) Welding Or AC Welding With Inverter Machines



 **Grinding the tungsten electrode produces dust and flying sparks which can cause injury and start fires. Use local exhaust (forced ventilation) at the grinder or wear an approved respirator. Read MSDS for safety information. Consider using tungsten containing ceria, lanthana, or yttria instead of thorium. Grinding dust from thoriated electrodes contains low-level radioactive material. Properly dispose of grinder dust in an environmentally safe way. Wear proper face, hand, and body protection. Keep flammables away.**



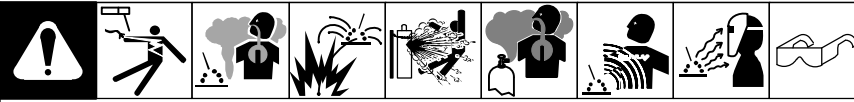
- Grind lengthwise, **not radial**.

Notes

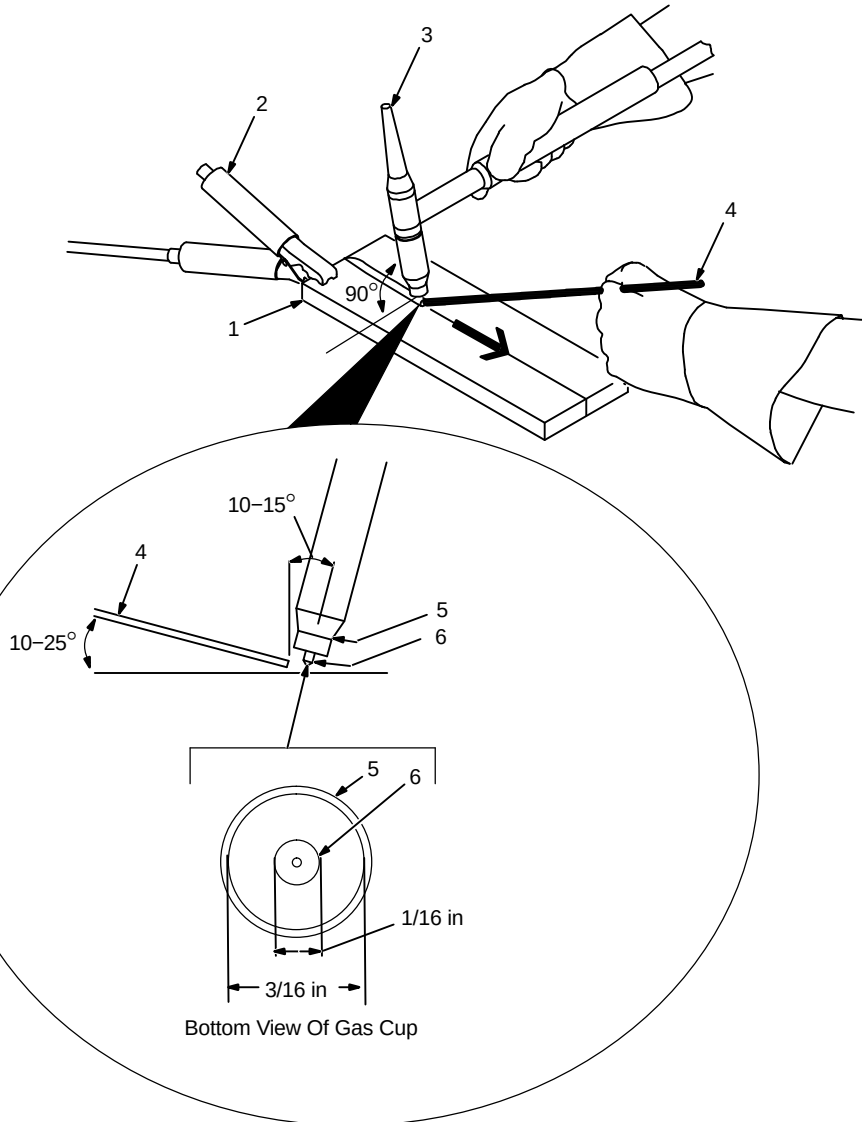
SECTION 11 – GUIDELINES FOR TIG WELDING (GTAW)

Ref. gtaw_Phase_2018-01

11-1. Positioning The Torch



⚠ Grinding the tungsten electrode produces dust and flying sparks which can cause injury and start fires. Use local exhaust (forced ventilation) at the grinder or wear an approved respirator. Read MSDS for safety information. Consider using cerium or lanthanum based tungsten instead of thoriated. Thorium dust contains low-level radioactive material. Properly dispose of grinder dust in an environmentally safe way. Wear proper face, hand, and body protection. Keep flammables away.



1 Workpiece

Make sure workpiece is clean before welding.

2 Work Clamp

Place as close to the weld as possible.

3 Torch

4 Filler Rod (If Applicable)

5 Gas Cup

6 Tungsten Electrode

Select and prepare tungsten according to Section 10-2.

Guidelines:

The inside diameter of the gas cup should be at least three times the tungsten diameter to provide adequate shielding gas coverage. (For example, if tungsten is 1/16 in diameter, gas cup should be a minimum of 3/16 in diameter.

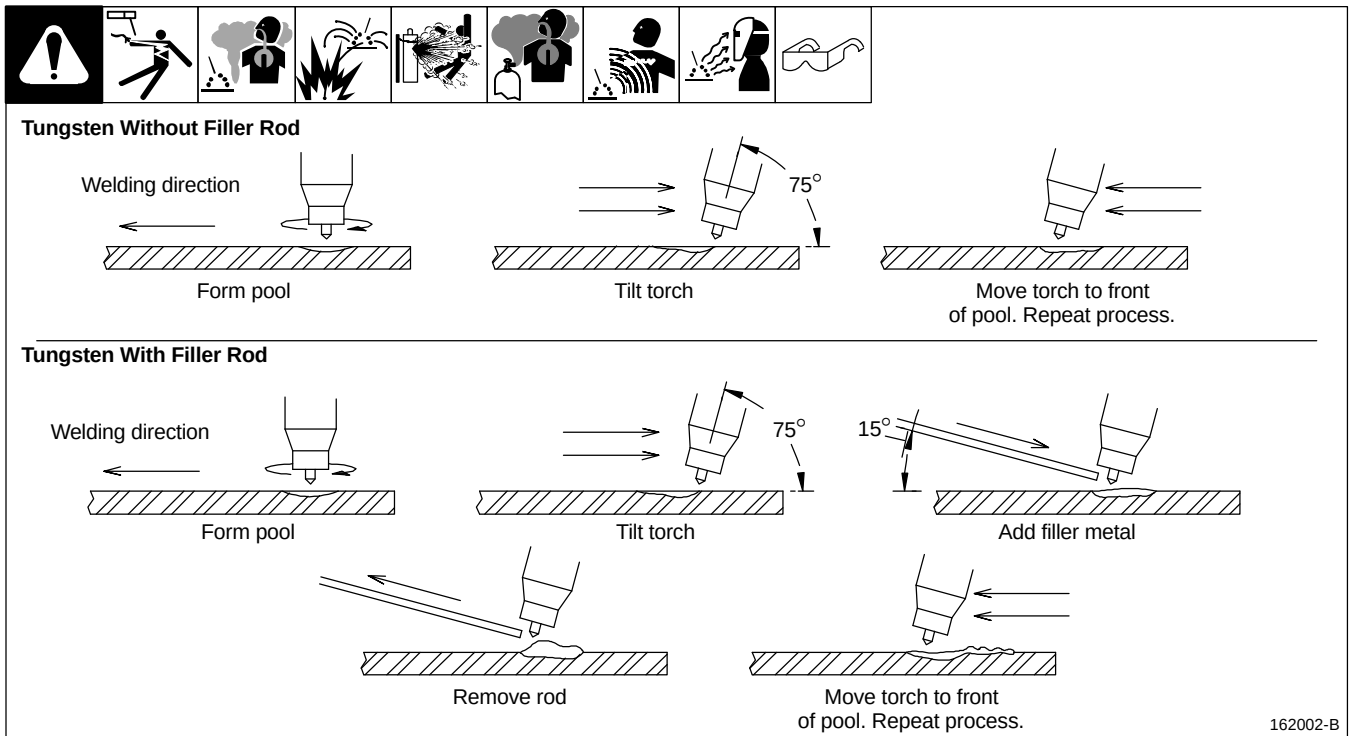
Tungsten extension is the distance the tungsten extends out gas cup of torch.

The tungsten extension should be no greater than the inside diameter of the gas cup.

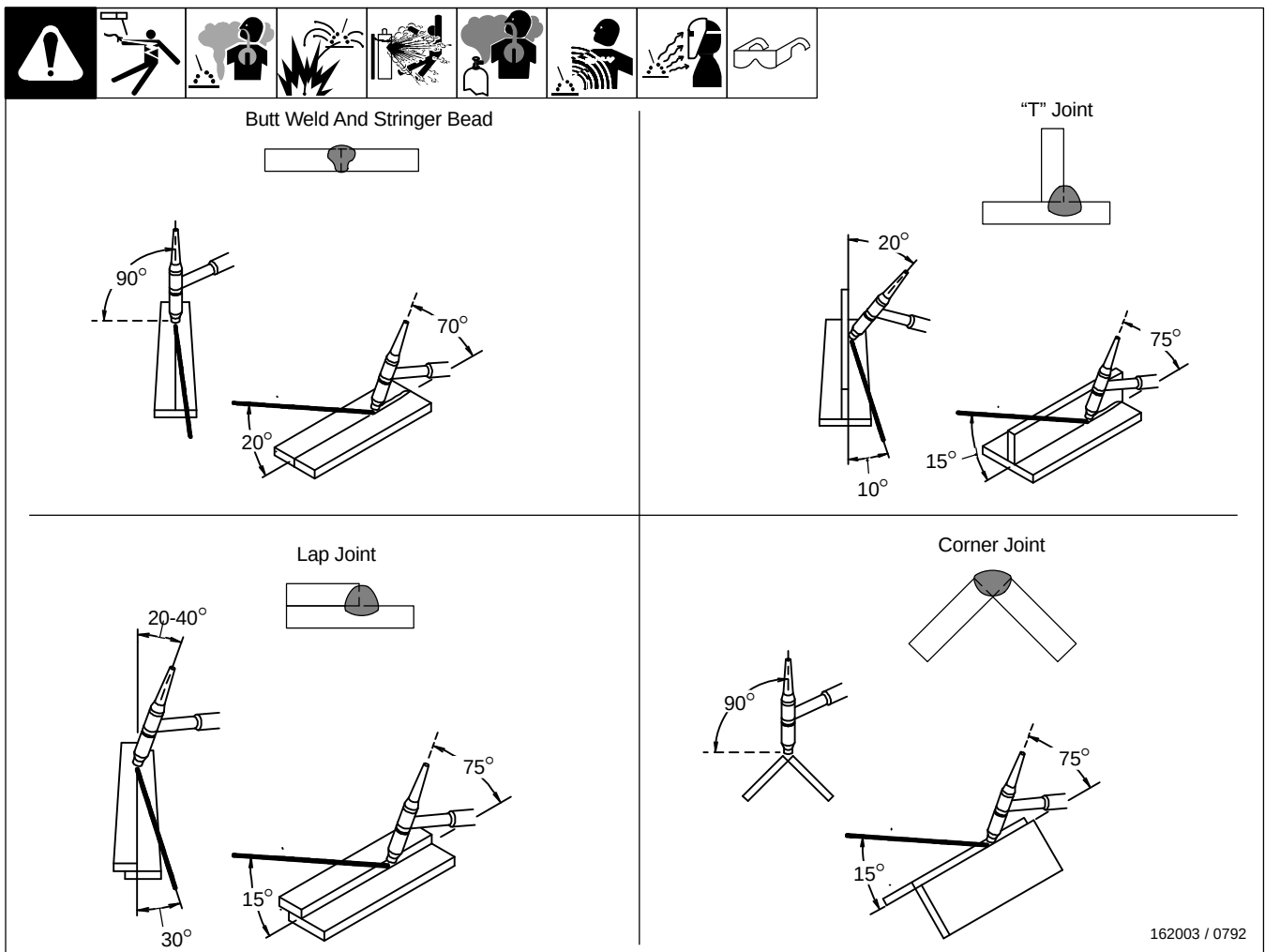
Arc length is the distance from the tungsten to the workpiece.

Ref.161892

11-2. Torch Movement During Welding

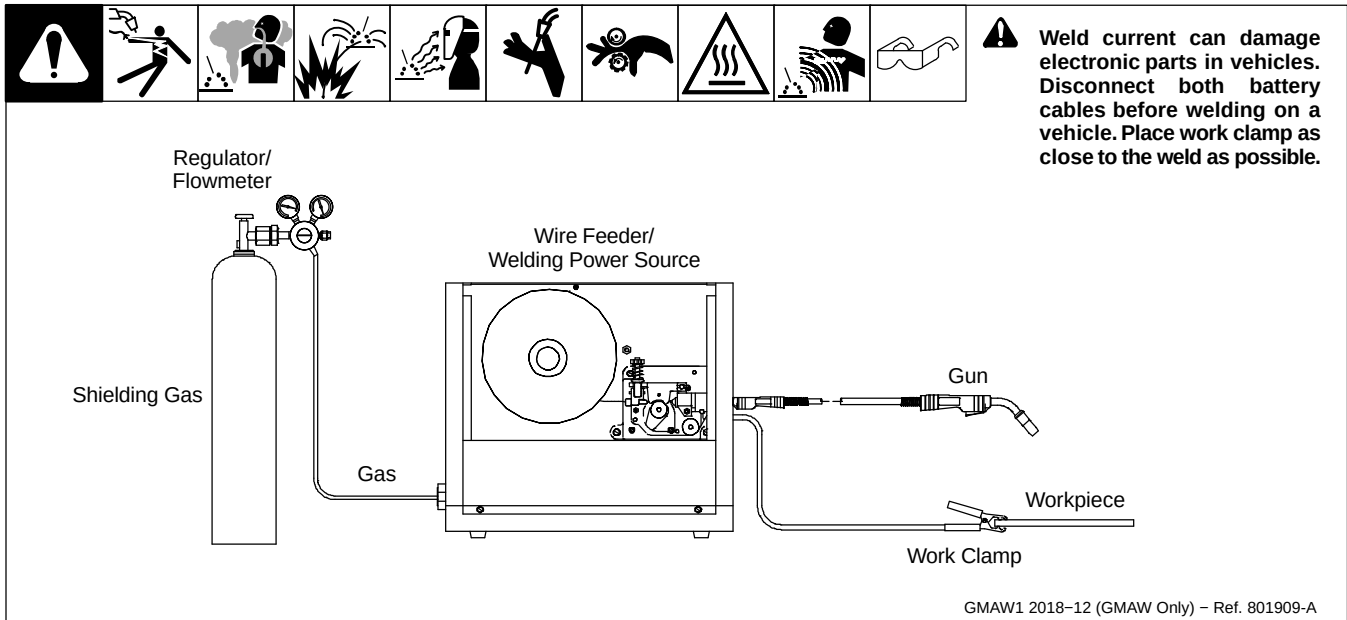


11-3. Positioning Torch Tungsten For Various Weld Joints

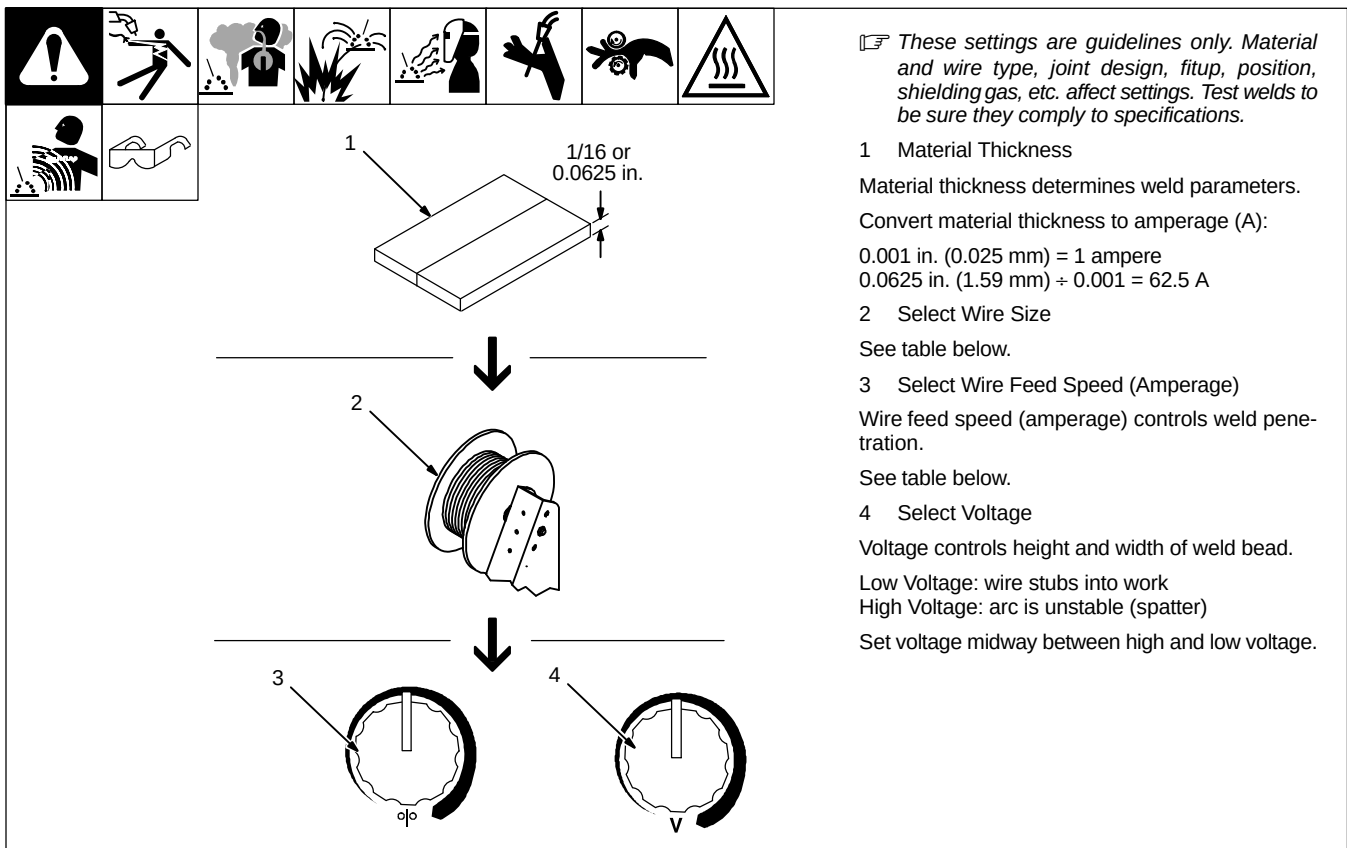


SECTION 12 – GMAW WELDING (MIG) GUIDELINES

12-1. Typical GMAW (MIG) Process Connections



12-2. Typical GMAW (MIG) Process Control Settings



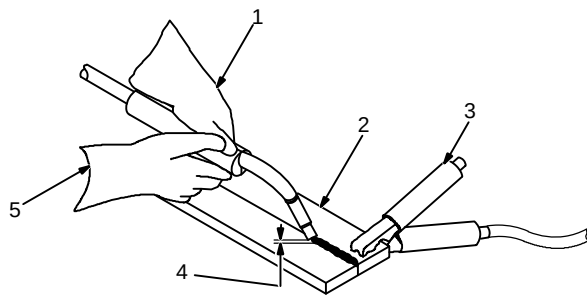
Wire Size	Amperage Range	Recommended Wire Feed Speed	Wire Feed Speed*
0.023 in. (0.58 mm)	30–90 A	3.5 in. (89 mm) per amp	3.5 x 62.5 A = 219 ipm (5.56 mpm)
0.030 in. (0.76 mm)	40–145 A	2 in. (51 mm) per amp	2 x 62.5 A = 125 ipm (3.19 mpm)
0.035 in. (0.89 mm)	50–180 A	1.6 in. (41 mm) per amp	1.6 x 62.5 A = 100 ipm (2.56 mpm)

*62.5 A based on 1/16 in. (1.6 mm) material thickness. ipm = inches per minute; mpm = meters per minute

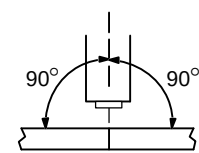
12-3. Holding And Positioning Welding Gun



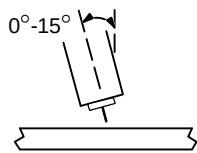
☞ Welding wire is energized when gun trigger is pressed. Before lowering helmet and pressing trigger, be sure wire is no more than 1/2 in. (13 mm) past end of nozzle, and tip of wire is positioned correctly on seam.



- 1 Hold Gun and Control Gun Trigger
- 2 Workpiece
- 3 Work Clamp
- 4 Electrode Extension (Stickout)
Solid Wire – 3/8 to 1/2 in.
(9 to 13 mm)
- 5 Cradle Gun and Rest Hand on Workpiece

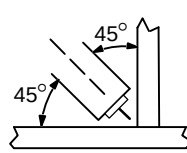


End View of Work Angle

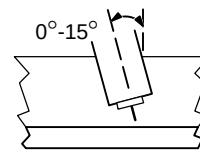


Side View of Gun Angle

Groove Welds



End View of Work Angle

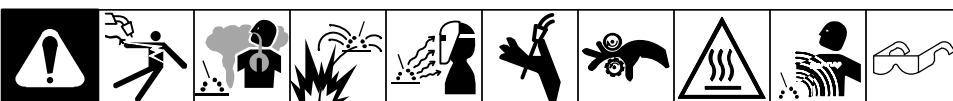


Side View of Gun Angle

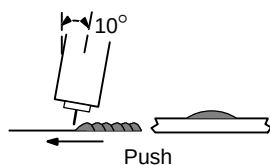
Fillet Welds

S-0421-A

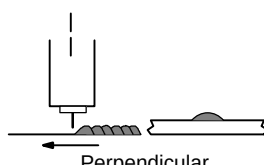
12-4. Conditions That Affect Weld Bead Shape



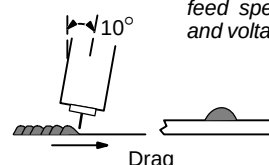
☞ Weld bead shape depends on gun angle, direction of travel, electrode extension (stickout), travel speed, thickness of base metal, wire feed speed (weld current), and voltage.



Push

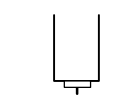


Perpendicular

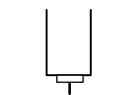


Drag

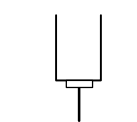
Gun Angles And Weld Bead Profiles



Short

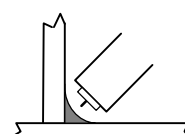


Normal

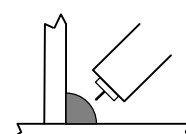


Long

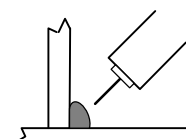
Electrode Extensions (Stickout)



Short



Normal



Long

Fillet Weld Electrode Extensions (Stickout)



Slow



Normal

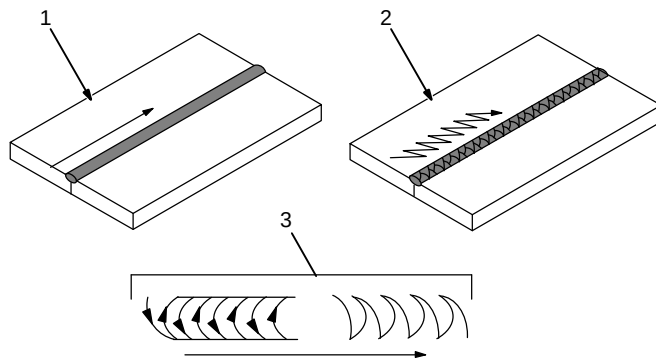
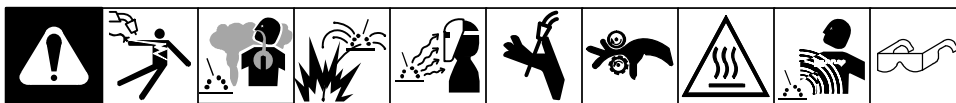


Fast

Gun Travel Speed

S-0634

12-5. Gun Movement During Welding



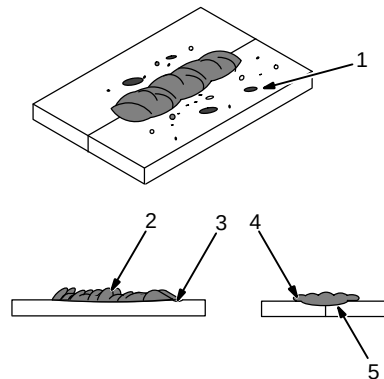
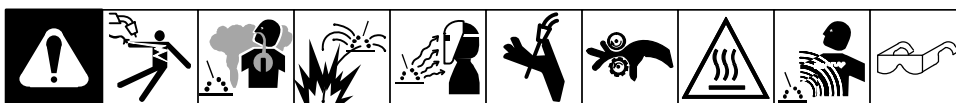
Normally, a single stringer bead is satisfactory for most narrow groove weld joints; however, for wide groove weld joints or bridging across gaps, a weave bead or multiple stringer beads works better.

- 1 Stringer Bead – Steady Movement Along Seam
- 2 Weave Bead – Side To Side Movement Along Seam
- 3 Weave Patterns

Use weave patterns to cover a wide area in one pass of the electrode.

S-0054-A

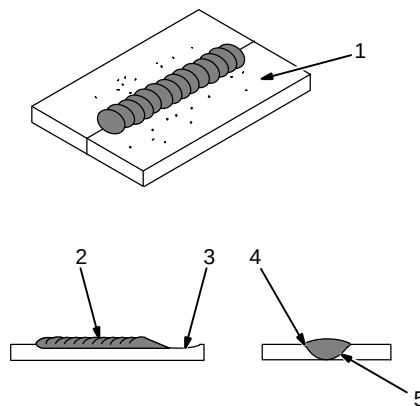
12-6. Poor Weld Bead Characteristics



- 1 Large Spatter Deposits
- 2 Rough, Uneven Bead
- 3 Slight Crater During Welding
- 4 Bad Overlap
- 5 Poor Penetration

S-0053-A

12-7. Good Weld Bead Characteristics



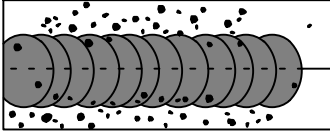
- 1 Fine Spatter
- 2 Uniform Bead
- 3 Moderate Crater During Welding

Weld a new bead or layer for each 1/8 in. (3.2 mm) thickness in metals being welded.

- 4 No Overlap
- 5 Good Penetration into Base Metal

S-0052-B

12-8. Troubleshooting – Excessive Spatter

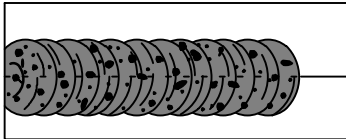


Excessive Spatter – scattering of molten metal particles that cool to solid form near weld bead.

S-0636

Possible Causes	Corrective Actions
Wire feed speed too high.	Select lower wire feed speed.
Voltage too high.	Select lower voltage range.
Electrode extension (stickout) too long.	Use shorter electrode extension (stickout).
Workpiece dirty.	Remove all grease, oil, moisture, rust, paint, undercoating, and dirt from work surface before welding.
Insufficient shielding gas at welding arc.	Increase flow of shielding gas at regulator/flowmeter and/or prevent drafts near welding arc.
Dirty welding wire.	Use clean, dry welding wire.
	Eliminate pickup of oil or lubricant on welding wire from feeder or liner.
Incorrect polarity.	Check polarity required by welding wire, and change to correct polarity at welding power source.

12-9. Troubleshooting – Porosity

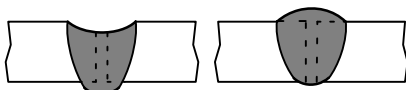


Porosity – small cavities or holes resulting from gas pockets in weld metal.

S-0635

Possible Causes	Corrective Actions
Insufficient shielding gas at welding arc.	Increase flow of shielding gas at regulator/flowmeter and/or prevent drafts near welding arc.
	Remove spatter from gun nozzle.
	Check gas hoses for leaks.
	Place nozzle 1/4 to 1/2 in. (6-13 mm) from workpiece.
	Hold gun near bead at end of weld until molten metal solidifies.
Wrong gas.	Use welding grade shielding gas; change to different gas.
Dirty welding wire.	Use clean, dry welding wire.
	Eliminate pick up of oil or lubricant on welding wire from feeder or liner.
Workpiece dirty.	Remove all grease, oil, moisture, rust, paint, coatings, and dirt from work surface before welding.
	Use a more highly deoxidizing welding wire (contact supplier).
Welding wire extends too far out of nozzle.	Be sure welding wire extends not more than 1/2 in. (13 mm) beyond nozzle.

12-10. Troubleshooting – Excessive Penetration



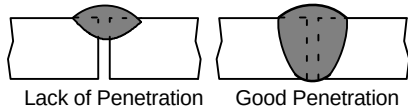
Excessive Penetration Good Penetration

Excessive Penetration – weld metal melting through base metal and hanging underneath weld.

S-0639

Possible Causes	Corrective Actions
Excessive heat input.	Select lower voltage range and reduce wire feed speed.
	Increase travel speed.

12-11. Troubleshooting – Lack Of Penetration

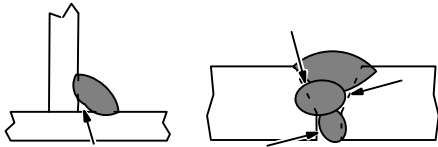


Lack Of Penetration – shallow fusion between weld metal and base metal.

S-0638

Possible Causes	Corrective Actions
Improper joint preparation.	Material too thick. Joint preparation and design must provide access to bottom of groove while maintaining proper welding wire extension and arc characteristics.
Improper weld technique.	Maintain normal gun angle of 0 to 15 degrees to achieve maximum penetration.
	Keep arc on leading edge of weld puddle.
	Be sure welding wire extends not more than 1/2 in. (13 mm) beyond nozzle.
Insufficient heat input.	Select higher wire feed speed and/or select higher voltage range.
	Reduce travel speed.
Incorrect polarity.	Check polarity required by welding wire, and change to correct polarity at welding power source.

12-12. Troubleshooting – Incomplete Fusion

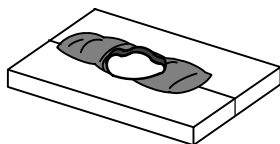


Incomplete Fusion – failure of weld metal to fuse completely with base metal or a preceding weld bead.

S-0637

Possible Causes	Corrective Actions
Workpiece dirty.	Remove all grease, oil, moisture, rust, paint, undercoating, and dirt from work surface before welding.
Insufficient heat input.	Select higher voltage range and/or adjust wire feed speed.
Improper welding technique.	Place stringer bead in proper location(s) at joint during welding.
	Adjust work angle or widen groove to access bottom during welding.
	Momentarily hold arc on groove side walls when using weaving technique.
	Keep arc on leading edge of weld puddle.
	Use correct gun angle of 0 to 15 degrees.

12-13. Troubleshooting – Burn-Through

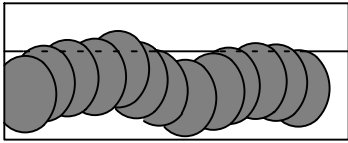


Burn-Through – weld metal melting completely through base metal resulting in holes where no metal remains.

S-0640

Possible Causes	Corrective Actions
Excessive heat input.	Select lower voltage range and reduce wire feed speed.
	Increase and/or maintain steady travel speed.

12-14. Troubleshooting – Waviness Of Bead

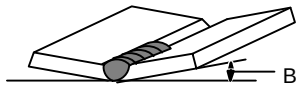


Waviness Of Bead – weld metal that is not parallel and does not cover joint formed by base metal.

S-0641

Possible Causes	Corrective Actions
Welding wire extends too far out of nozzle.	Be sure welding wire extends not more than 1/2 in. (13 mm) beyond nozzle.
Unsteady hand.	Support hand on solid surface or use two hands.

12-15. Troubleshooting – Distortion



- Base metal moves in the direction of the weld bead.

Distortion – contraction of weld metal during welding that forces base metal to move.

S-0642

Possible Causes	Corrective Actions
Excessive heat input.	Use restraint (clamp) to hold base metal in position.
	Make tack welds along joint before starting welding operation.
	Select lower voltage range and/or reduce wire feed speed.
	Increase travel speed.
	Weld in small segments and allow cooling between welds.

Notes

[illegible]

12-16. Common GMAW (MIG) Shielding Gases

This is a general chart for common gases and where they are used. Many different combinations (mixtures) of shielding gases have been developed over the years. The most commonly used shielding gases are listed in the following table.

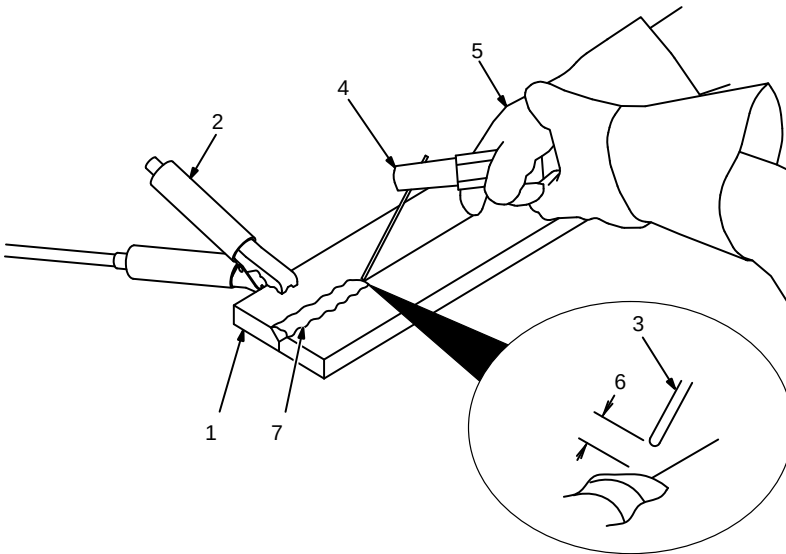
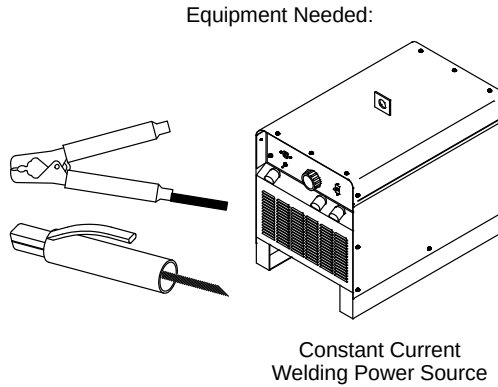
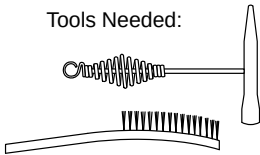
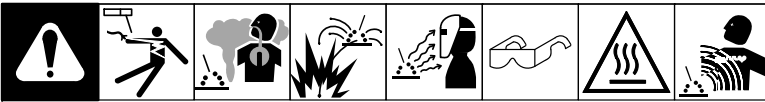
Gas	Application								
	Spray Arc Steel	Short Circuiting Steel	GMAW-P Steel	Spray Arc Stainless Steel	Short Circuiting Stainless Steel	GMAW-P Stainless Steel	Spray Arc Aluminum	Short Circuiting Aluminum	GMAW-P Aluminum
Argon			All Positions				All Positions	All Positions	All Positions
Argon + 1% O ₂	Flat & Horizontal Fillet		All Positions	Flat & Horizontal Fillet					
Argon + 2% O ₂	Flat & Horizontal Fillet		All Positions	Flat & Horizontal Fillet					
Argon + 5% CO ₂	Flat & Horizontal Fillet		All Positions						
Argon + 10% CO ₂	Flat & Horizontal Fillet	All Positions	All Positions						
Argon + 25% CO ₂		All Positions							
Argon + 50% CO ₂		All Positions							
CO ₂		All Positions							
Helium							All Positions ¹		
Argon + Helium							All Positions ¹		
90% HE + 7-1/2% AR + 2-1/2% CO ₂					All Positions				
65% AR + 33% HE + 2% CO ₂						All Positions			

1 Heavy Thicknesses

Problem	Probable Cause	Remedy
Wire feed motor operates, but wire does not feed.	Too little pressure on wire feed rolls.	Increase pressure setting on wire feed rolls.
	Incorrect wire feed rolls.	Check size stamped on wire feed rolls, replace to match wire size and type if necessary.
	Wire spool brake pressure too high.	Decrease brake pressure on wire spool.
	Restriction in the gun and/or assembly.	Check and replace cable, gun, and contact tip if damaged. Check size of contact tip and cable liner, replace if necessary.
Wire curling up in front of the wire feed rolls (bird nesting).	Too much pressure on wire feed rolls.	Decrease pressure setting on wire feed rolls.
	Incorrect cable liner or gun contact tip size.	Check size of contact tip and check cable liner length and diameter, replace if necessary.
	Gun end not inserted into drive housing properly.	Loosen gun securing bolt in drive housing and push gun end into housing just enough so it does not touch wire feed rolls.
	Dirty or damaged (kinked) liner.	Replace liner.
Wire feeds, but no gas flows.	Gas cylinder empty.	Replace empty gas cylinder.
	Gas nozzle plugged.	Clean or replace gas nozzle.
	Gas cylinder valve not open or flowmeter not adjusted.	Open gas valve at cylinder and adjust flow rate.
	Restriction in gas line.	Check gas hose between flowmeter and wire feeder, and gas hose in gun and cable assembly.
	Loose or broken wires to gas solenoid.	Have Factory Authorized Service Agent repair wiring.
	Gas solenoid valve not operating.	Have Factory Authorized Service Agent replace gas solenoid valve.
	Incorrect primary voltage connected to welding power source.	Check primary voltage and relink welding power source for correct voltage.
Welding arc not stable.	Wire slipping in drive rolls.	Adjust pressure setting on wire feed rolls. Replace worn drive rolls if necessary.
	Wrong size gun liner or contact tip.	Match liner and contact tip to wire size and type.
	Incorrect voltage setting for selected wire feed speed on welding power source.	Readjust welding parameters.
	Loose connections at the gun weld cable or work cable.	Check and tighten all connections.
	Gun in poor shape or loose connection inside gun.	Repair or replace gun as necessary.

SECTION 13 – GUIDELINES FOR STICK WELDING (SMAW)

13-1. Stick Welding Procedure



⚠ Weld current starts when electrode touches work-piece.

⚠ Weld current can damage electronic parts in vehicles. Disconnect both battery cables before welding on a vehicle. Place work clamp as close to the weld as possible.

Always wear appropriate personal protective clothing.

1 Workpiece

Make sure workpiece is clean before welding.

2 Work Clamp

Place as close to the weld as possible.

3 Electrode

Before striking an arc, insert an electrode in the electrode holder. A small diameter electrode requires less current than a large one. Follow recommendations of the electrode manufacturer when setting weld amperage (see Section 13-2).

4 Insulated Electrode Holder

5 Electrode Holder Position

6 Arc Length

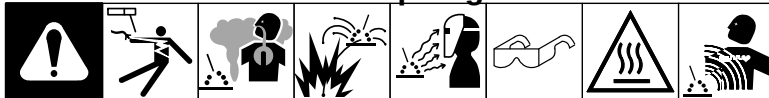
Arc length is the distance from the electrode to the workpiece. A short arc with correct amperage will give a sharp, crackling sound. Correct arc length is related to electrode diameter. Examine the weld bead to determine if the arc length is correct.

Arc length for 1/16 and 3/32 in. diameter electrodes should be about 1/16 in. (1.6 mm); arc length for 1/8 and 5/32 in. electrodes should be about 1/8 in. (3 mm).

7 Slag

Use a chipping hammer and wire brush to remove slag. Remove slag and check weld bead before making another weld pass.

13-2. Electrode And Amperage Selection Chart



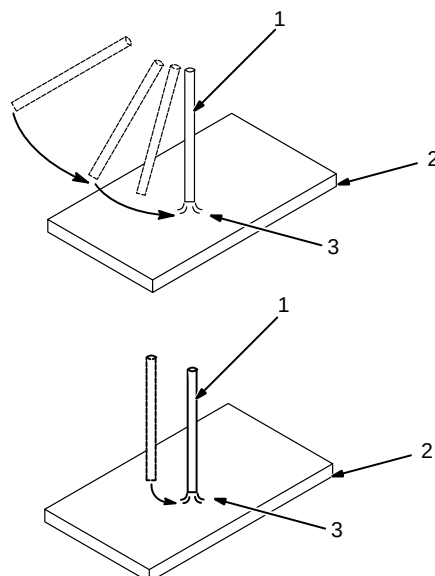
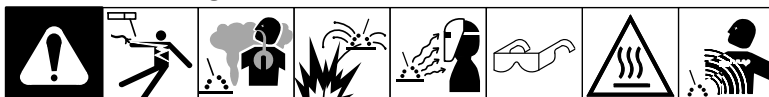
ELECTRODE	DIAMETER	AMPERAGE RANGE									
		50	100	150	200	250	300	350	400	450	
6010 & 6011	3/32										
	1/8										
	5/32										
	3/16										
	7/32										
6013	1/4										
	1/16										
	5/64										
	3/32										
	1/8										
	5/32										
	3/16										
	7/32										
7014	1/4										
	3/32										
	1/8										
	5/32										
	3/16										
7018	7/32										
	1/4										
	3/32										
	1/8										
7024	5/32										
	3/16										
	7/32										
	1/4										
	3/32										
Ni-CI	1/8										
	5/32										
	3/16										
	7/32										
308L	1/4										
	3/32										
	5/32										

ELECTRODE	DC*	AC	POSITION	PENETRATION	USAGE
6010	EP		ALL	DEEP	MIN. PREP. ROUGH HIGH SPATTER
6011	EP	✓	ALL	DEEP	
6013	EP,EN	✓	ALL	LOW	GENERAL
7014	EP,EN	✓	ALL	MED	SMOOTH, EASY, FAST
7018	EP	✓	ALL	MED	LOW HYDROGEN, STRONG
7024	EP,EN	✓	FLAT HORIZ*	LOW	SMOOTH, EASY, FASTER
NI-CL	EP	✓	ALL	LOW	CAST IRON
308L	EP	✓	ALL	LOW	STAINLESS

*EP = ELECTRODE POSITIVE (REVERSE POLARITY)
EN = ELECTRODE NEGATIVE (STRAIGHT POLARITY)

Ref. S-087 985-A

13-3. Striking An Arc



⚠ Weld current starts when electrode touches workpiece.

- 1 Electrode
- 2 Workpiece
- 3 Arc

Scratch Technique

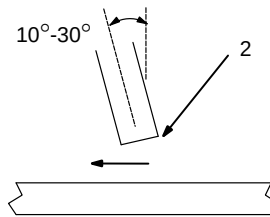
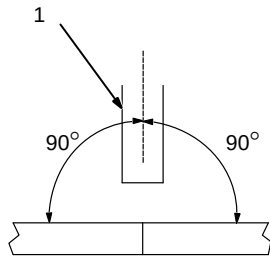
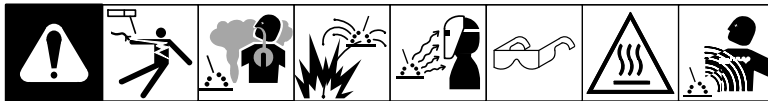
Drag electrode across workpiece like striking a match; lift electrode slightly after touching work. If arc goes out, electrode was lifted too high. If electrode sticks to workpiece, use a quick twist to free it.

Tapping Technique

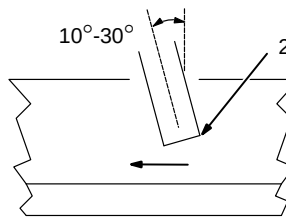
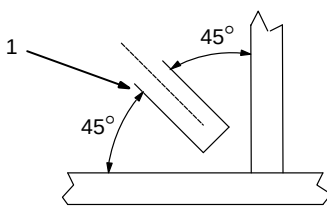
Bring electrode straight down to workpiece; then lift slightly to start arc. If arc goes out, electrode was lifted too high. If electrode sticks to workpiece, use a quick twist to free it.

S-0049 / S-0050

13-4. Positioning Electrode Holder



Groove Welds



Fillet Welds

- 1 End View Of Work Angle
- 2 Side View Of Electrode Angle

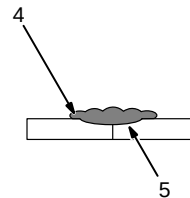
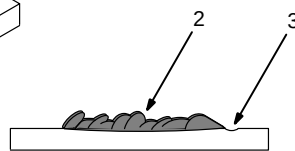
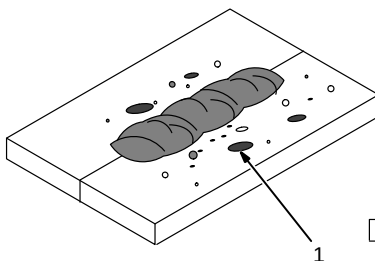
After learning to start and hold an arc, practice running beads of weld metal on flat plates using a full electrode.

Hold the electrode nearly perpendicular to the work, although tilting it ahead (in the direction of travel) will be helpful.

To produce the best results, hold a short arc, travel at a uniform speed, and feed the electrode downward at a constant rate as it melts.

S-0060

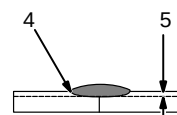
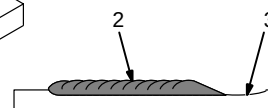
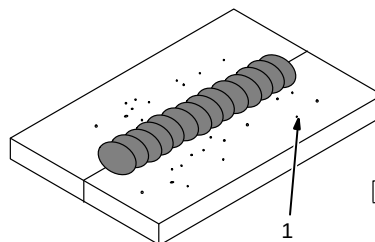
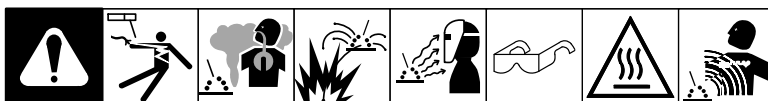
13-5. Poor Weld Bead Characteristics



- 1 Large Spatter Deposits
- 2 Rough, Uneven Bead
- 3 Slight Crater During Welding
- 4 Bad Overlap
- 5 Poor Penetration

S-0053-A

13-6. Good Weld Bead Characteristics



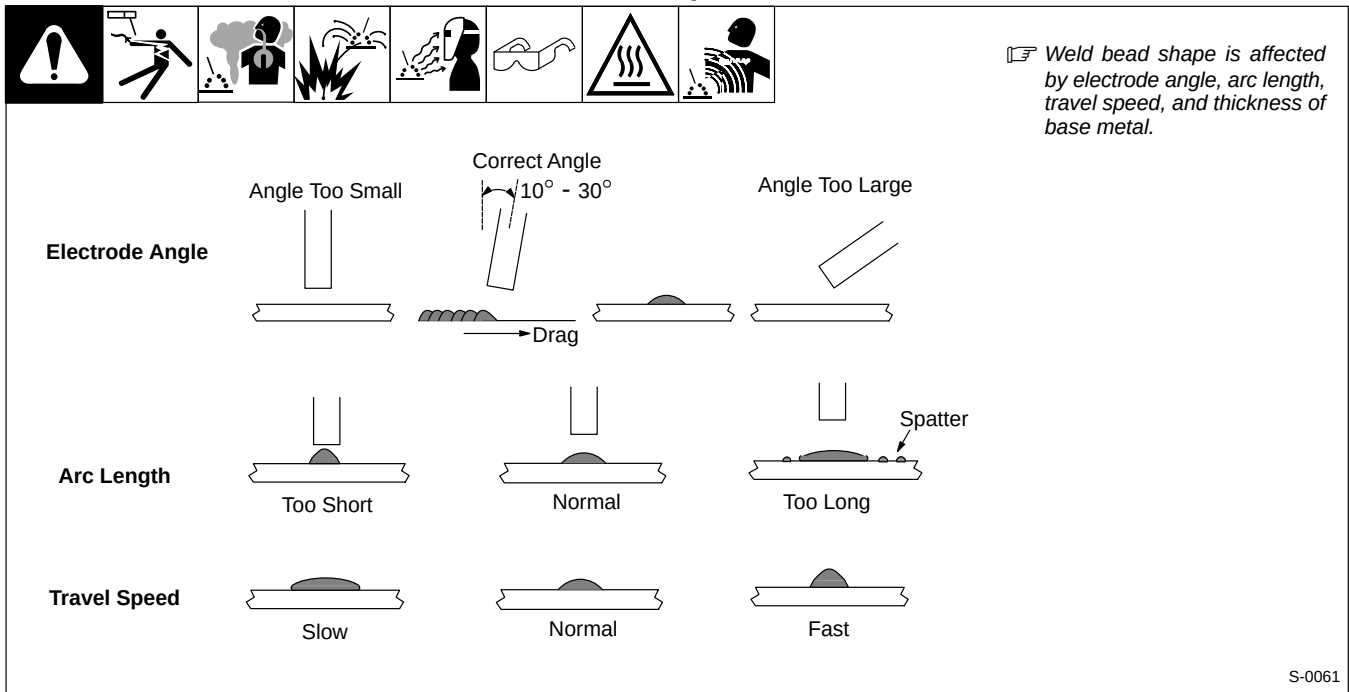
- 1 Fine Spatter
- 2 Uniform Bead
- 3 Moderate Crater During Welding
- 4 No Overlap
- 5 Good Penetration into Base Metal

Weld a new bead or layer for each 1/8 in. (3.2 mm) thickness in metals being welded.

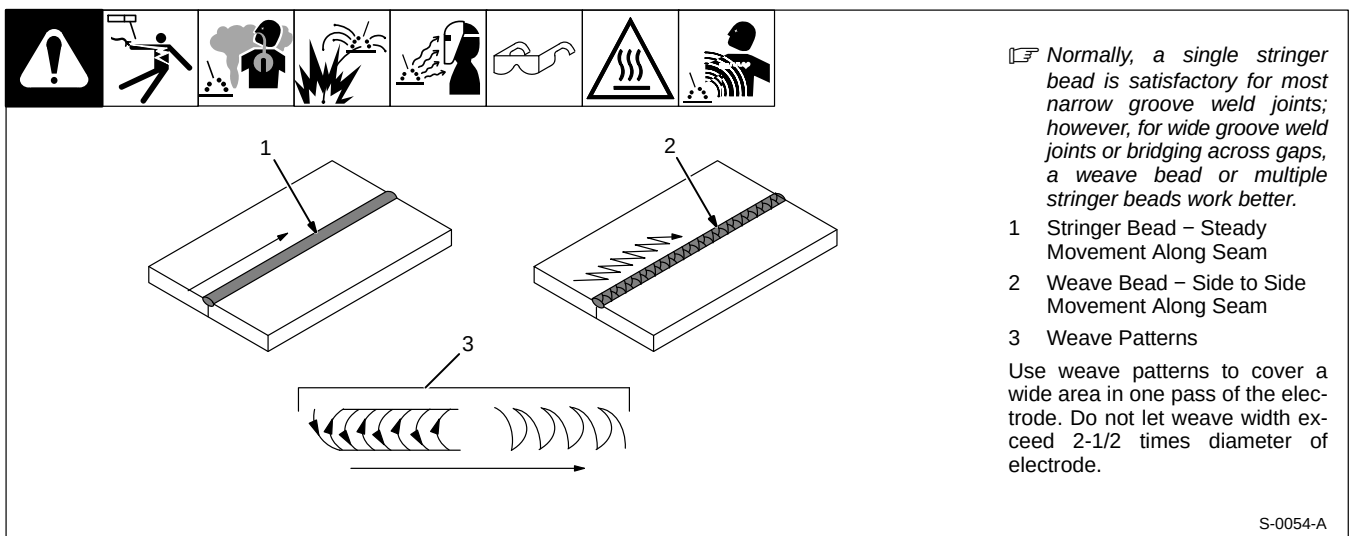
- 4 No Overlap
- 5 Good Penetration into Base Metal

S-0052-B

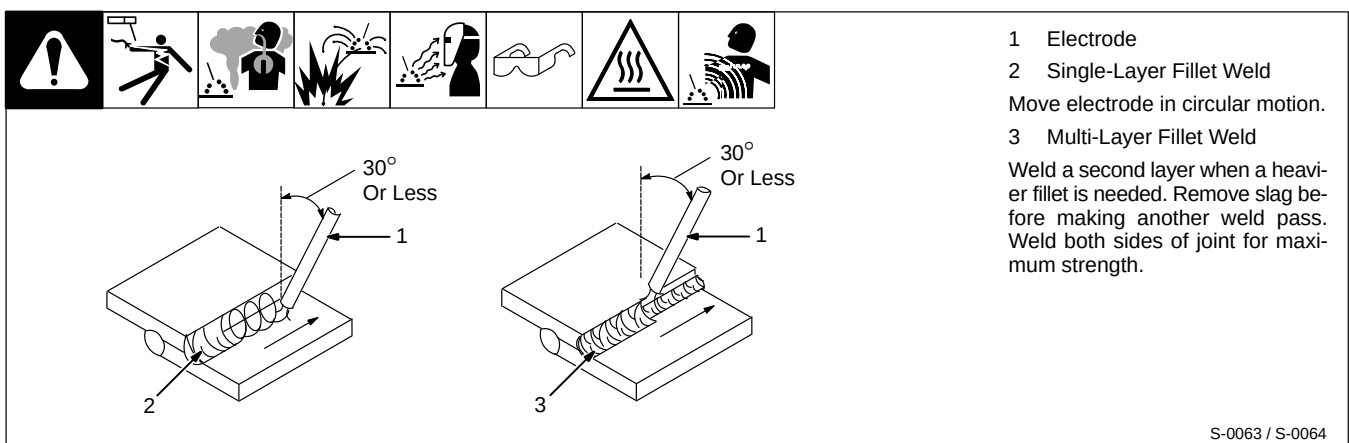
13-7. Conditions That Affect Weld Bead Shape



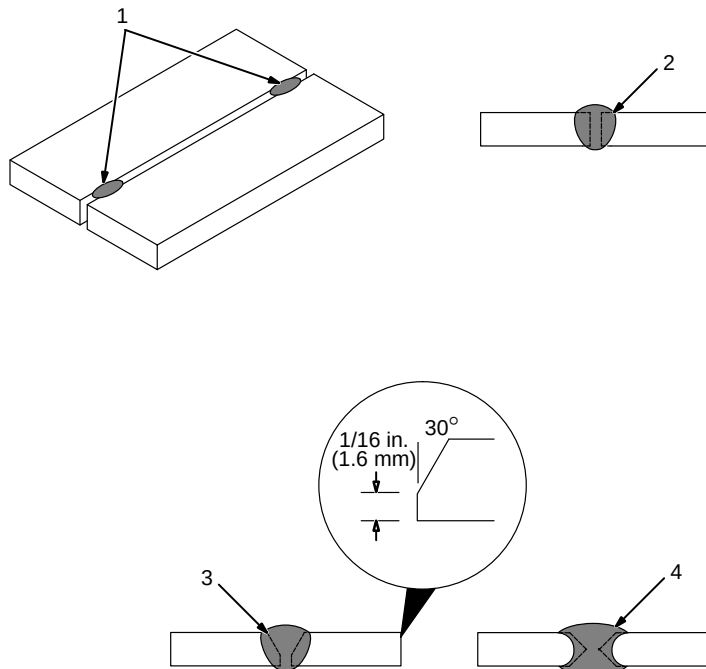
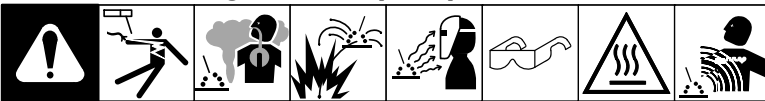
13-8. Electrode Movement During Welding



13-9. Welding Lap Joints



13-10. Welding Groove (Butt) Joints



1 Tack Welds

Prevent butt joint distortion by tack welding the materials in position before final weld.

Workpiece distortion occurs when heat is applied locally to a joint. One side of a metal plate will curl up toward the weld. Distortion will also cause the edges of a butt joint to pull together ahead of the electrode as the weld cools.

2 Square Groove Weld

3 Single V-Groove Weld

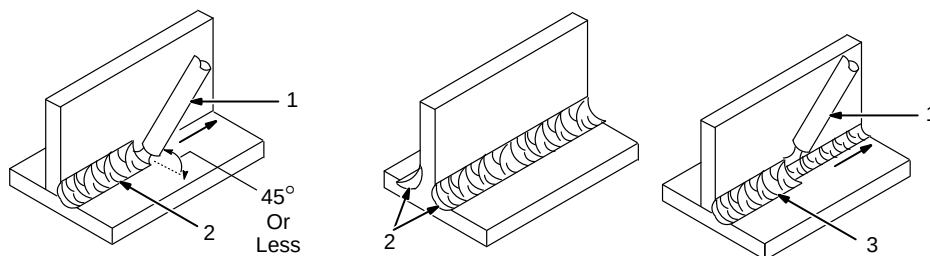
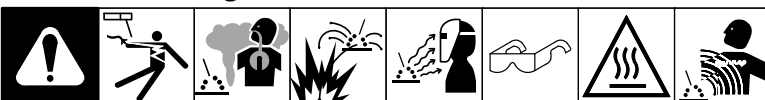
4 Double V-Groove Weld

Materials up to 3/16 in. (5 mm) thick can often be welded without special preparation using the square groove weld. However, when welding thicker materials it may be necessary to prepare the edges (V-groove) of butt joints to ensure good welds.

The single or double V-groove weld is good for materials 3/16 – 3/4 in. (5-19 mm) thick. Generally, the single V-groove is used on materials up to 3/4 in. (19 mm) thick and when, regardless of thickness, you can weld from one side only. Create a 30 degree bevel with oxy-acetylene or plasma cutting equipment. Remove scale from material after cutting. A grinder can also be used to prepare bevels.

S-0062

13-11. Welding T-Joints



1 Electrode

2 Fillet Weld

Keep arc short and move at definite rate of speed. Hold electrode as shown to provide fusion into the corner. Square edge of the weld surface.

For maximum strength weld both sides of upright section.

3 Multi-Layer Deposits

Weld a second layer when a heavier fillet is needed. Use any of the weaving patterns shown in Section 13-8. Remove slag before making another weld pass.

S-0060 / S-0058-A / S-0061

13-12. Weld Test

- 1 Vise
- 2 Weld Joint
- 3 Hammer

Strike the weld joint in the direction shown. A good weld bends over but does not break.

If the weld breaks, examine it to determine the cause.

If the weld is porous (many holes), the arc length was probably too long.

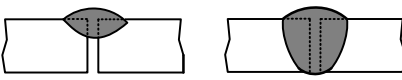
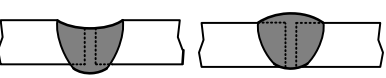
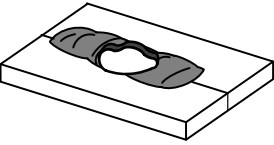
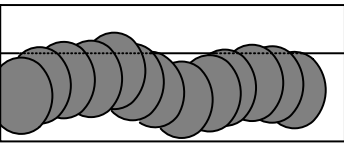
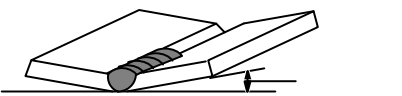
If the weld contains bits of slag, the arc may have been too long or the electrode was moved incorrectly which allowed molten slag to be trapped in the weld. This may happen on a V-groove joint made in several layers and calls for additional cleaning between layers.

If the original beveled surface is visible the material was not fully melted which is often caused by insufficient heat or too fast a travel speed.

S-0057-B

13-13. Troubleshooting

	Porosity – small cavities or holes resulting from gas pockets in weld metal.
Possible Causes	Remedy
Arc length too long.	Reduce arc length.
Damp electrode.	Use dry electrode.
Workpiece dirty.	Remove all grease, oil, moisture, rust, paint, coatings, slag, and dirt from work surface before welding.
	Excessive Spatter – scattering of molten metal particles that cool to solid form near weld bead.
Possible Causes	Remedy
Amperage too high for electrode.	Decrease amperage or select larger electrode.
Arc length too long or voltage too high.	Reduce arc length or voltage.
	Incomplete Fusion – failure of weld metal to fuse completely with base metal or a preceding weld bead.
Possible Causes	Remedy
Insufficient heat input.	Increase amperage. Select larger electrode and increase amperage.
Improper welding technique.	Place stringer bead in proper location(s) at joint during welding.
	Adjust work angle or widen groove to access bottom during welding.
	Momentarily hold arc on groove side walls when using weaving technique.
	Keep arc on leading edge of weld puddle.
Workpiece dirty.	Remove all grease, oil, moisture, rust, paint, coatings, slag, and dirt from work surface before welding.

 Lack of Penetration Good Penetration	Lack Of Penetration – shallow fusion between weld metal and base metal.
Possible Causes	Remedy
Improper joint preparation.	Material too thick. Joint preparation and design must provide access to bottom of groove.
Improper weld technique.	Keep arc on leading edge of weld puddle.
Insufficient heat input.	Increase amperage. Select larger electrode and increase amperage.
	Reduce travel speed.
 Excessive Penetration Good Penetration	Excessive Penetration – weld metal melting through base metal and hanging underneath weld.
Possible Causes	Remedy
Excessive heat input.	Select lower amperage. Use smaller electrode.
	Increase and/or maintain steady travel speed.
	Burn-Through – weld metal melting completely through base metal resulting in holes where no metal remains.
Possible Causes	Remedy
Excessive heat input.	Select lower amperage. Use smaller electrode.
	Increase and/or maintain steady travel speed.
	Waviness Of Bead – weld metal that is not parallel and does not cover joint formed by base metal.
Possible Causes	Remedy
Unsteady hand.	Use two hands. Practice technique.
 Base metal moves in the direction of the weld bead.	Distortion – contraction of weld metal during welding that forces base metal to move.
Possible Causes	Remedy
Excessive heat input.	Use restraint (clamp) to hold base metal in position.
	Make tack welds along joint before starting welding operation.
	Select lower amperage for electrode.
	Increase travel speed.
	Weld in small segments and allow cooling between welds.

SECTION 14 – PARTS LIST

14-1. Recommended MIG Spare Parts

Part No.	Description	Quantity
..... 261157	Roll, Drive .024, .030-.035V Wire, .035VK Wire	1
..... ♦ 202926	Roll, Drive VK .030-.035/.045 Wire	1
..... 271493	Lens Cover, Replaceable	1
♦ OPTIONAL		

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

☞ See OM-282976 (shipped with this product) for replacement consumables for MDX welding gun.

14-2. Recommended TIG Spare Parts

Part No.	Description	Quantity
..... WP1712RDI25	Tig Torch, A-150 12.5FT	1
..... 194744	Foot Control, RFCS-14HD	1
..... AK2C	Accessory Kit, Ceriated	1
..... AK-150MFC	Accessory Kit, FX	1

☞ A complete Parts List is available online at www.MillerWelds.com

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Effective January 1, 2019

(Equipment with a serial number preface of MK or newer)

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Miller shall honor warranty claims on warranted equipment listed below in the event of a defect within the warranty coverage time periods listed below. Warranty time periods start on the delivery date of the equipment to the end-user purchaser, or 12 months after the equipment is shipped to a North American distributor, or 18 months after the equipment is shipped to an international distributor, whichever occurs first.

1. 5 Years Parts — 3 Years Labor
 - * Original Main Power Rectifiers Only to Include SCRs, Diodes, and Discrete Rectifier Modules
2. 3 Years — Parts and Labor Unless Specified
 - * Auto-Darkening Helmet Lenses (No Labor) (See Classic Series Exception Below)
 - * Engine Driven Welder/Generators
(NOTE: Engines are Warranted Separately by the Engine Manufacturer.)
 - * Insight Welding Intelligence Products
 - * Inverter Power Sources
 - * Plasma Arc Cutting Power Sources
 - * Process Controllers
 - * Semi-Automatic and Automatic Wire Feeders
 - * Transformer/Rectifier Power Sources
3. 2 Years — Parts and Labor
 - * Auto-Darkening Helmet Lenses – Classic Series Only (No Labor)
 - * Auto-Darkening Weld Masks (No Labor)
 - * Fume Extractors – Capture 5, Filtrair 400 and Industrial Collector Series
4. 1 Year — Parts and Labor Unless Specified
 - * AugmentedArc and LiveArc Welding Systems
 - * Automatic Motion Devices
 - * Bernard BTB Air-Cooled MIG Guns (No Labor)
 - * CoolBelt and CoolBand Blower Unit (No Labor)
 - * Desiccant Air Dryer System
 - * Field Options
(NOTE: Field options are covered for the remaining warranty period of the product they are installed in, or for a minimum of one year — whichever is greater.)
 - * RFCS Foot Controls (Except RFCS-RJ45)
 - * Fume Extractors – Filtrair 130, MWX and SWX Series HF Units
 - * ICE/XT Plasma Cutting Torches (No Labor)
 - * Induction Heating Power Sources, Coolers
(NOTE: Digital Recorders are Warranted Separately by the Manufacturer.)
 - * Load Banks
 - * Motor-Driven Guns (except Spoolmate Spoolguns)
 - * PAPR Blower Unit (No Labor)
 - * Positioners and Controllers
 - * Racks (For Housing Multiple Power Sources)
 - * Running Gear/Trailers
 - * Spot Welders

- * Subarc Wire Drive Assemblies
 - * TIG Torches (No Labor)
 - * Tregaskiss Guns (No Labor)
 - * Water Cooling Systems
 - * Wireless Remote Foot/Hand Controls and Receivers
 - * Work Stations/Weld Tables (No Labor)
5. 6 Months — Parts
 - * Batteries
 6. 90 Days — Parts
 - * Accessories (Kits)
 - * Canvas Covers
 - * Induction Heating Coils and Blankets, Cables, and Non-Electronic Controls
 - * M-Guns
 - * MIG Guns, Subarc (SAW) Torches, and External Cladding Heads
 - * Remote Controls and RFCS-RJ45
 - * Replacement Parts (No labor)
 - * Spoolmate Spoolguns

Miller's True Blue[®] Limited Warranty shall not apply to:

1. **Consumable components; such as contact tips, cutting nozzles, contactors, brushes, relays, work station table tops and welding curtains, or parts that fail due to normal wear. (Exception: brushes and relays are covered on all engine-driven products.)**
2. Items furnished by Miller, but manufactured by others, such as engines or trade accessories. These items are covered by the manufacturer's warranty, if any.
3. Equipment that has been modified by any party other than Miller, or equipment that has been improperly installed, improperly operated or misused based upon industry standards, or equipment which has not had reasonable and necessary maintenance, or equipment which has been used for operation outside of the specifications for the equipment.
4. Defects caused by accident, unauthorized repair, or improper testing.

MILLER PRODUCTS ARE INTENDED FOR COMMERCIAL AND INDUSTRIAL USERS TRAINED AND EXPERIENCED IN THE USE AND MAINTENANCE OF WELDING EQUIPMENT.

The exclusive remedies for warranty claims are, at Miller's option, either: (1) repair; or (2) replacement; or, if approved in writing by Miller, (3) the pre-approved cost of repair or replacement at an authorized Miller service station; or (4) payment of or credit for the purchase price (less reasonable depreciation based upon use). Products may not be returned without Miller's written approval. Return shipment shall be at customer's risk and expense.

The above remedies are F.O.B. Appleton, WI, or Miller's authorized service facility. Transportation and freight are the customer's responsibility. TO THE EXTENT PERMITTED BY LAW, THE REMEDIES HEREIN ARE THE SOLE AND EXCLUSIVE REMEDIES REGARDLESS OF THE LEGAL THEORY. IN NO EVENT SHALL MILLER BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING LOSS OF PROFIT) REGARDLESS OF THE LEGAL THEORY. ANY WARRANTY NOT PROVIDED HEREIN AND ANY IMPLIED WARRANTY, GUARANTY, OR REPRESENTATION, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE, ARE EXCLUDED AND DISCLAIMED BY MILLER.

Some US states do not allow limiting the duration of an implied warranty or the exclusion of certain damages, so the above limitations may not apply to you. This warranty provides specific legal rights, and other rights may be available depending on your state. In Canada, some provinces provide additional warranties or remedies, and to the extent the law prohibits their waiver, the limitations set out above may not apply. This Limited Warranty provides specific legal rights, and other rights may be available, but may vary by province.





Owner's Record

Please complete and retain with your personal records.

Model Name

Serial/Style Number

Purchase Date

(Date which equipment was delivered to original customer.)

Distributor

Address

City

State

Zip



For Service

Contact a *DISTRIBUTOR* or *SERVICE AGENCY* near you.

Always provide Model Name and Serial/Style Number.

Contact your Distributor for:

Welding Supplies and Consumables

Options and Accessories

Personal Safety Equipment

Service and Repair

Replacement Parts

Training (Schools, Videos, Books)

Technical Manuals (Servicing Information and Parts)

Circuit Diagrams

Welding Process Handbooks

To locate a Distributor or Service Agency visit www.millerwelds.com or call 1-800-4-A-Miller

Contact the Delivering Carrier to:

File a claim for loss or damage during shipment.

For assistance in filing or settling claims, contact your distributor and/or equipment manufacturer's Transportation Department.

Miller Electric Mfg. LLC

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International Headquarters—USA

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For International Locations Visit
www.MillerWelds.com

