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2020-06

Processes



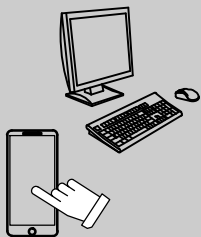
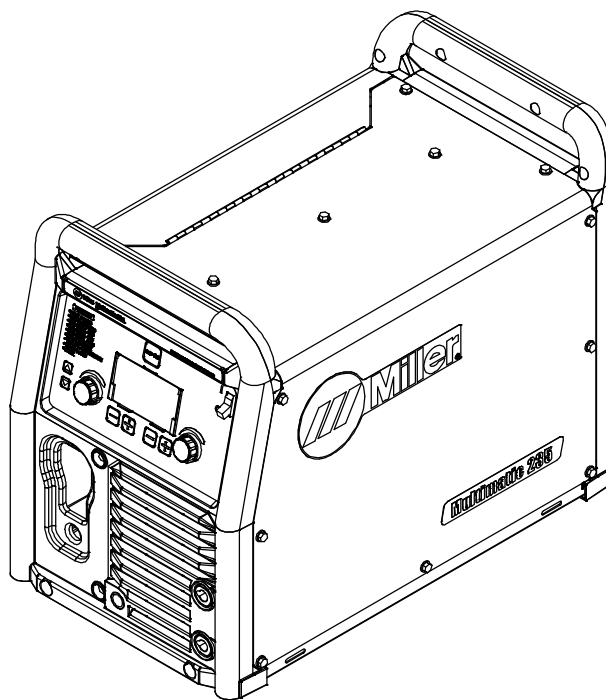
Multiprocess Welding

Description



Arc Welding Power Source
Wire Feeder

Multimatic[®] 235



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 these 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 Principal 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 the 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.

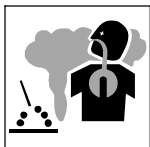
SIGNIFICANT DC VOLTAGE exists in inverter welding power sources AFTER removal of input power.

- 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.

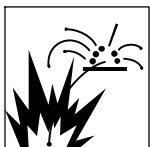
- Keep your head out of the fumes. Do not breathe the fumes.
- Ventilate the work area and/or use local forced ventilation at the arc to remove welding fumes and gases. The recommended way to determine adequate ventilation is to sample for the composition and quantity of fumes and gases to which personnel 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.

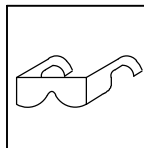


WELDING can cause fire or explosion.

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.



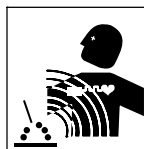
FLYING METAL or DIRT can injure eyes.

- 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.



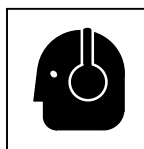
BUILDUP OF GAS can injure or kill.

- 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.

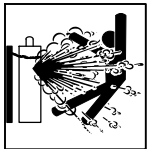
- Wearers of Pacemakers and other Implanted Medical Devices should keep away.
- Implanted Medical Device wearers should consult their doctor and the device manufacturer before going near arc welding, spot welding, gouging, plasma arc cutting, or induction heating operations.



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 Hazards For Installation, Operation, And Maintenance



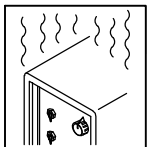
FIRE OR EXPLOSION hazard.

- 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.



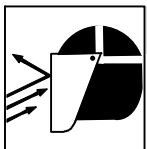
FALLING EQUIPMENT can injure.

- 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.



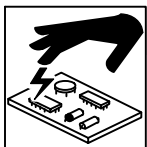
OVERUSE can cause OVERHEATING

- 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.



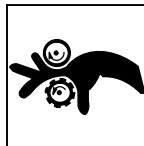
FLYING SPARKS can injure.

- 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.



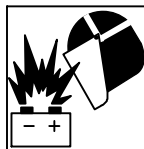
MOVING PARTS can injure.

- 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.



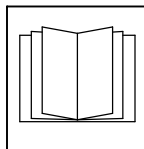
BATTERY EXPLOSION can injure.

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



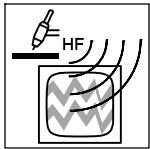
MOVING PARTS can injure.

- 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.



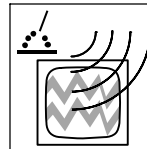
READ INSTRUCTIONS.

- 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, American Welding Society standard ANSI Standard Z49.1. Website: www.aws.org.

Safe Practice For Occupational And Educational Eye And Face Protection, ANSI Standard Z87.1 from American National Standards Institute. Website: www.ansi.org.

Safe Practices for the Preparation of Containers and Piping for Welding and Cutting, American Welding Society Standard AWS F4.1 from Global Engineering Documents. 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. Website: www.global.ihs.com.

National Electrical Code, NFPA Standard 70 from National Fire Protection Association. Website: www.nfpa.org and www.sparky.org.

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1 from Compressed Gas Association. Website: www.cganet.com.

Safety in Welding, Cutting, and Allied Processes, CSA Standard W117.2 from Canadian Standards Association. Website: www.csagroup.org.

Standard for Fire Prevention During Welding, Cutting, and Other Hot Work, NFPA Standard 51B from National Fire Protection Association. 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. Website: www.osha.gov.

OSHA Important Note Regarding the ACGIH TLV, Policy Statement on the Uses of TLVs and BEIs. Website: www.osha.gov.

Applications Manual for the Revised NIOSH Lifting Equation from the National Institute for Occupational Safety and Health (NIOSH). 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.



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.

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 ELECTRIQUE, PIECES EN MOUVEMENT, et PIECES CHAUDES. Reportez-vous aux symboles et aux directives ci-dessous afin de connaître les mesures à prendre pour éviter tout 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 consignes de sécurité présentées ci-après ne font que résumer les informations contenues dans les principales normes de sécurité énumérées à 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 double.
- 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.

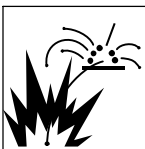
- Eloigner votre tête des fumées. Ne pas respirer les fumées.
- À l'intérieur, ventiler la zone et/ou utiliser une ventilation forcée au niveau de l'arc pour l'évacuation des fumées et des gaz de soudage. Pour déterminer la bonne ventilation, il est recommandé de procéder à un prélèvement pour la composition 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.

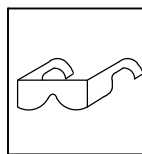


LE SOUDAGE peut provoquer un incendie ou une explosion.

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 homologuées.
- 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 défailir. 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.



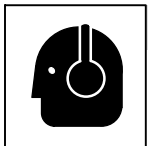
LES ACCUMULATIONS DE GAZ risquent de provoquer des blessures ou même la mort.

- 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.

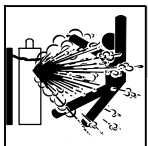
- Les porteurs de stimulateurs cardiaques et autres implants médicaux doivent rester à distance.
- Les porteurs d'implants médicaux doivent consulter leur médecin et le fabricant du dispositif avant de s'approcher de la zone où se déroule du soudage à l'arc, du soudage par points, du gougeage, de la 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. Symboles de dangers supplémentaires en relation avec l'installation, le fonctionnement et la maintenance



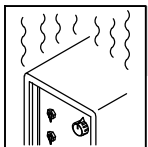
Risque D'INCENDIE OU D'EXPLOSION.

- 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.



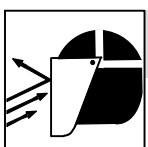
LA CHUTE DE L'ÉQUIPEMENT peut provoquer des blessures.

- 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 manuelle de pièces ou équipements lourds.



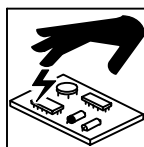
L'EMPLOI EXCESSIF peut SURCHAUFFER L'ÉQUIPEMENT.

- 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.



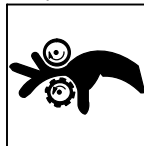
LES ÉTINCELLES PROJÉTÉES peuvent provoquer des blessures.

- 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.



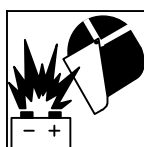
Les PIÈCES MOBILES peuvent causer des blessures.

- 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.



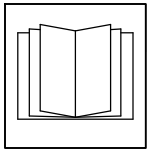
L'EXPLOSION DE LA BATTERIE peut provoquer des blessures.

- 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.

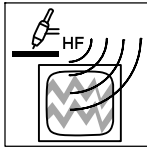
- S'abstenir de toucher des organes mobiles tels que des ventilateurs.
- Maintenir fermés et verrouillés les portes, panneaux, recouvrements et dispositifs de protection.
- Lorsque cela est nécessaire pour des travaux d'entretien et de dépannage, faire retirer les portes, panneaux, recouvrements ou dispositifs 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.

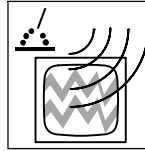
- N'utiliser que les pièces de rechange recommandées par le constructeur.
- Effectuer l'installation, l'entretien et toute intervention selon les manuels d'utilisateurs, les normes nationales, provinciales et de l'industrie, ainsi que les codes municipaux.



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, American Welding Society standard ANSI Standard Z49.1. Website: www.aws.org.

Safe Practice For Occupational And Educational Eye And Face Protection, ANSI Standard Z87.1 from American National Standards Institute. Website: www.ansi.org.

Safe Practices for the Preparation of Containers and Piping for Welding and Cutting, American Welding Society Standard AWS F4.1 from Global Engineering Documents. 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. Website: www.global.ihs.com.

National Electrical Code, NFPA Standard 70 from National Fire Protection Association. Website: www.nfpa.org and www.sparky.org.

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1 from Compressed Gas Association. Website: www.cganet.com.

Safety in Welding, Cutting, and Allied Processes, CSA Standard W117.2 from Canadian Standards Association. Website: www.csagroup.org.

Standard for Fire Prevention During Welding, Cutting, and Other Hot Work, NFPA Standard 51B from National Fire Protection Association. 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. Website: www.osha.gov.

OSHA *Important Note Regarding the ACGIH TLV, Policy Statement on the Uses of TLVs and BEIs*. Website: www.osha.gov.

Applications Manual for the Revised NIOSH Lifting Equation from the National Institute for Occupational Safety and Health (NIOSH). 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.

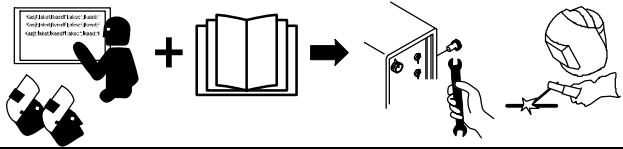
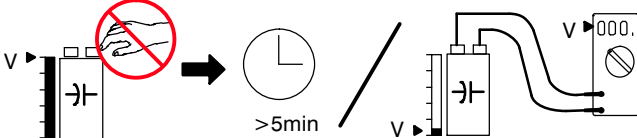
3. Ne pas courber et ne pas entourer les câbles autour de votre corps.
4. Maintenir la tête et le torse aussi loin que possible du matériel du circuit de soudage.
5. Connecter la pince sur la pièce aussi près que possible de la soudure.
6. Ne pas travailler à proximité d'une source de soudage, ni s'asseoir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

	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. Software Licensing Agreement

The End User License Agreement and any third-party notices and terms and conditions pertaining to third-party software can be found at <https://www.millerwelds.com/eula> and are incorporated by reference herein.

4-3. Information About Default Weld Parameters And Settings

NOTICE – Each welding application is unique. Although certain Miller Electric products are designed to determine and default to certain typical welding parameters and settings based upon specific and relatively limited application variables input by the end user, such default settings are for reference purposes only; and final weld results can be affected by other variables and application-specific circumstances. The appropriateness of all parameters and settings should be evaluated and modified by the end user as necessary based upon application-specific requirements. The end user is solely responsible for selection and coordination of appropriate equipment, adoption or adjustment of default weld parameters and settings, and ultimate quality and durability of all resultant welds. Miller Electric expressly disclaims any and all implied warranties including any implied warranty of fitness for a particular purpose.

4-4. Unit Specifications For MIG (GMAW)

Do not use information in unit specifications table to determine electrical service requirements. See Sections 5-2 and 5-3 for information on connecting input power.

This equipment will deliver rated output at an ambient air temperature up to 104 °F (40 °C).

Rated Welding Output	Amperage Range	Maximum Open-Circuit Voltage DC	Amperes Input At Rated Load Output, 50/60 Hz, Single Phase
			240 VAC
235 A, 25.8 volts DC, 20% Duty Cycle	30–235 A	54	31.2
170 A, 22.5 volts DC, 60% Duty Cycle	30–235 A	54	19.9

Wire Type And Diameter			Wire Feed Speed
Solid Steel 0.024 – 0.035	Flux Cored 0.030 – 0.045	Aluminum 0.030 – 3/64	50–600 IPM (1.5–15.2 mpm)

4-5. Unit Specifications For Stick (SMAW)

Do not use information in unit specifications table to determine electrical service requirements. See Sections 5-2 and 5-3 for information on connecting input power.

This equipment will deliver rated output at an ambient air temperature up to 104 °F (40 °C).

Rated Welding Output	Amperage Range	Maximum Open-Circuit Voltage DC	Amperes Input At Rated Load Output, 50/60 Hz, Single Phase
			240 VAC
200 A, 28 volts DC, 30% Duty Cycle	30–200	54	28
150 A, 26 volts DC, 60% Duty Cycle	30–200	54	20.2

4-6. Unit Specifications For TIG (GTAW)

Do not use information in unit specifications table to determine electrical service requirements. See Sections 5-2 and 5-3 for information on connecting input power.

This equipment will deliver rated output at an ambient air temperature up to 104 °F (40 °C).

Rated Welding Output	Amperage Range	Maximum Open-Circuit Voltage DC	Amperes Input At Rated Load Output, 50/60 Hz, Single Phase
			240 VAC
210 A, 18.4 volts DC, 40% Duty Cycle	20–210	54	20.4
180 A, 17.2 volts DC, 60% Duty Cycle	20–210	54	17

4-7. Environmental Specifications

A. IP Rating

IP Rating
IP23 This equipment is designed for outdoor use. IP23 2017-02

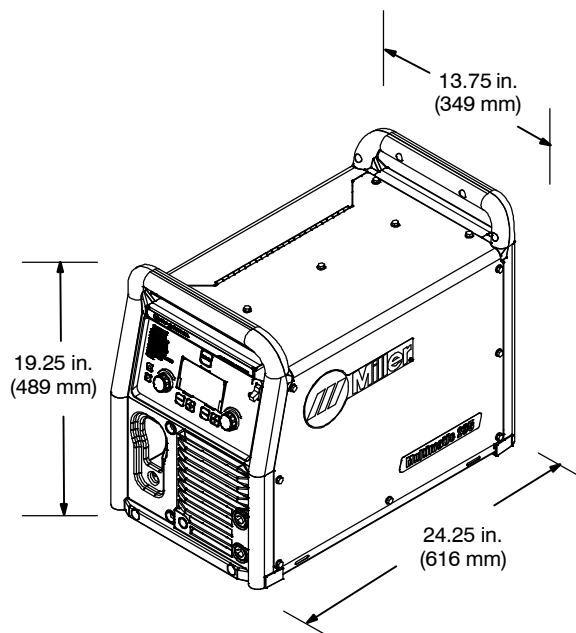
B. Temperature Specifications

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

4-8. Dimensions And Weight

Weight

63 lbs (28.6 kg)



907780

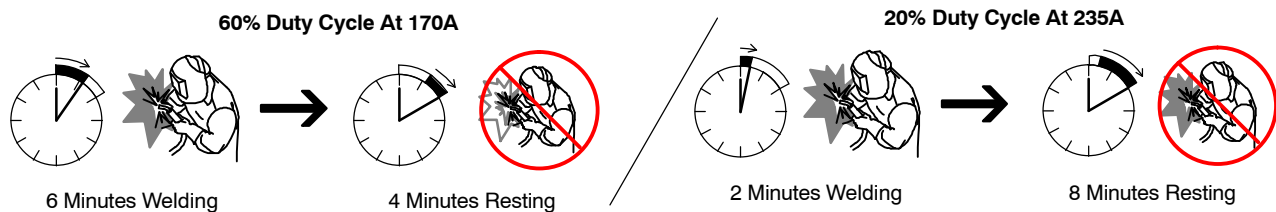
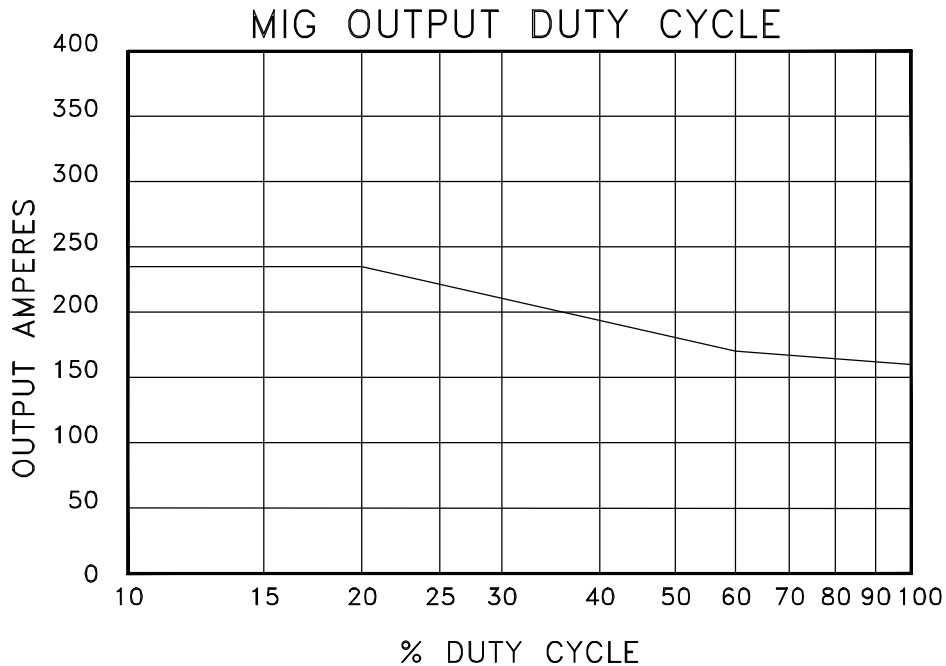
4-9. Duty Cycle And Overheating For MIG (GMAW)



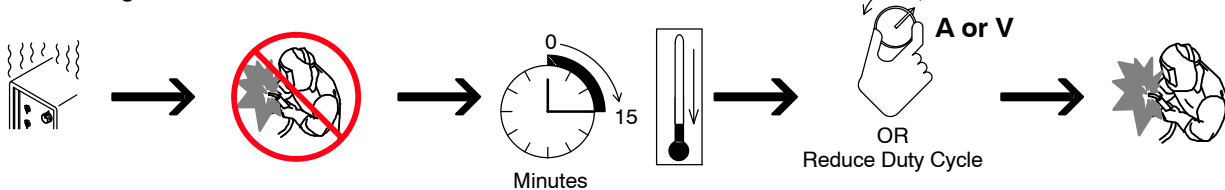
Duty Cycle is percentage of 10 minutes that unit can weld at rated load without overheating.

If unit overheats, output stops. Wait 10 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.



Overheating



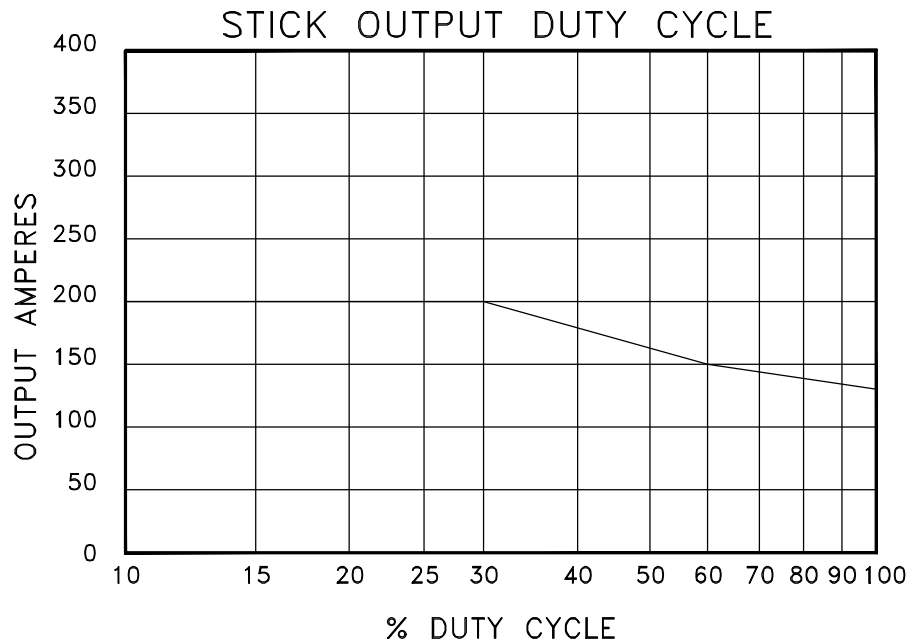
4-10. Duty Cycle And Overheating For Stick (SMAW)



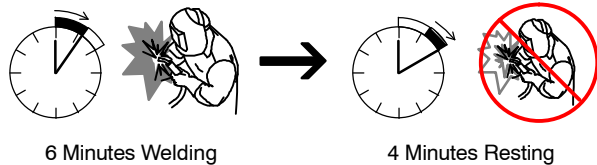
Duty Cycle is percentage of 10 minutes that unit can weld at rated load without overheating.

If unit overheats, output stops. Wait 10 minutes for unit to cool. Reduce amperage or duty cycle before starting to weld again.

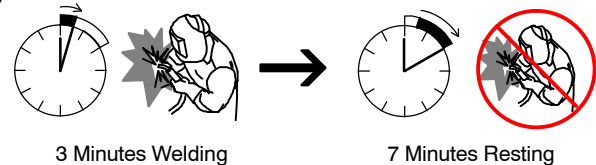
NOTICE – Exceeding duty cycle can damage unit and void warranty.



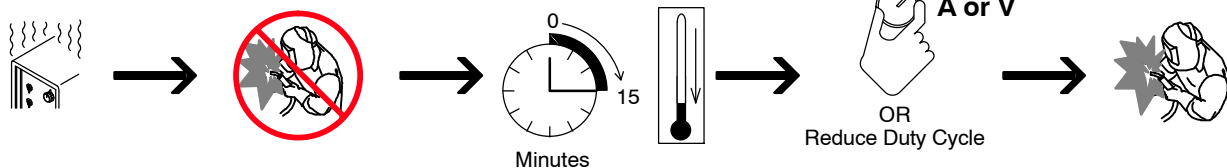
60% Duty Cycle At 150A



30% Duty Cycle At 200A



Overheating



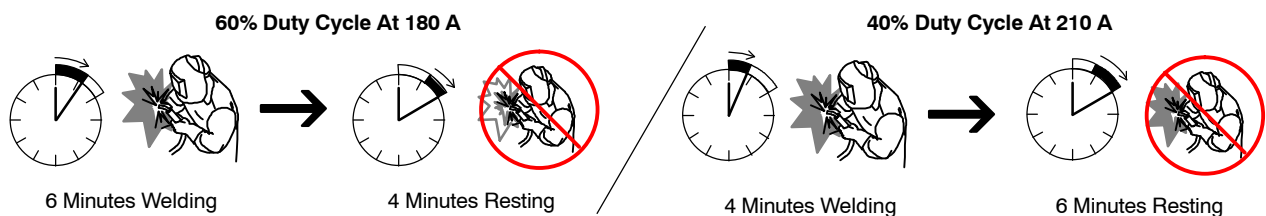
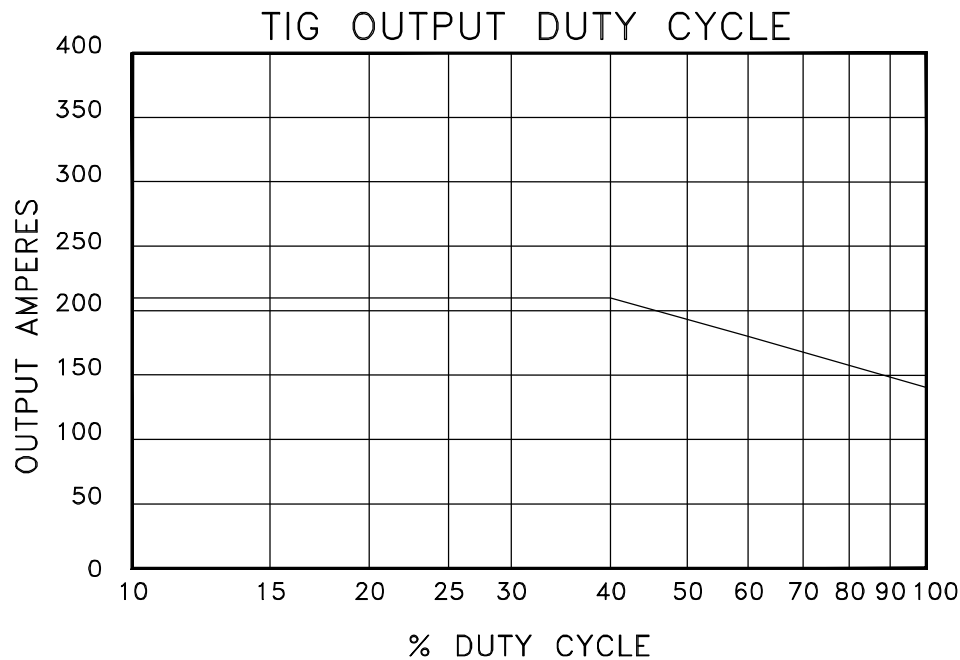
4-11. Duty Cycle And Overheating For TIG (GTAW)



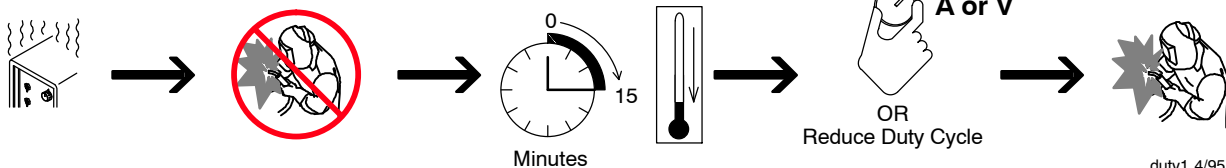
Duty Cycle is percentage of 10 minutes that unit can weld at rated load without overheating.

If unit overheats, output stops. Wait 10 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.



Overheating



duty1 4/95 / 278660

4-12. Static Characteristics

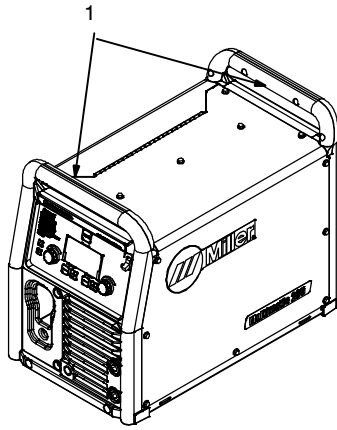
The static (output) characteristics of the welding power source can be described as *flat* during the GMAW process and *drooping* during the SMAW and GTAW processes. Static characteristics are also affected by control settings (including software), electrode, shielding gas, weldment material, and other factors. Contact the factory for specific information on the static characteristics of the welding power source.

SECTION 5 – INSTALLATION

5-1. Selecting A Location



Movement



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



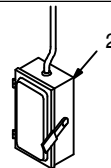
⚠ Do not lift unit by strap threaded through both handles.



⚠ Do not lift unit with cart attached.



Location And Airflow



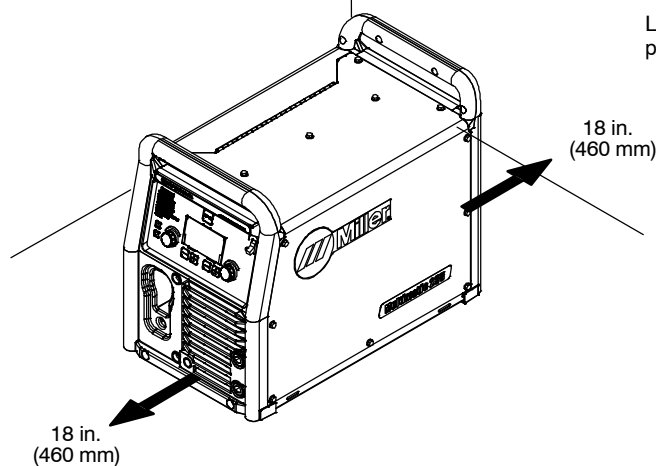
⚠ Special installation may be required where gasoline or volatile liquids are present – see NEC Article 511 or CEC Section 20.

1 Lifting Handles

Use handles to lift unit.

2 Line Disconnect Device

Locate unit near correct input power supply.



loc_smallmig2 2018-09 161-122

Elec Serv 2019-10



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

In individual branch 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
Rated Supply Voltage (V)	240
Rated Maximum Supply Current $I_{1\max}$ (A)	31.2
Maximum Effective Supply Current $I_{1\text{eff}}$ (A)	18.6
Maximum Recommended Standard Fuse Rating In Amperes ¹	
Time-Delay Fuses ²	35
Normal Operating Fuses ³	45
Maximum Recommended Supply Conductor Length In Feet (Meters) ⁴	58 (18)
Raceway Installation	
Minimum Supply Conductor Size In AWG (mm²) ⁵	12 (4)
Minimum Grounding Conductor Size In AWG (mm²) ⁵	12 (4)
Flexible Cord Installation	
Recommended Strain Relief ⁷	See Parts List

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.

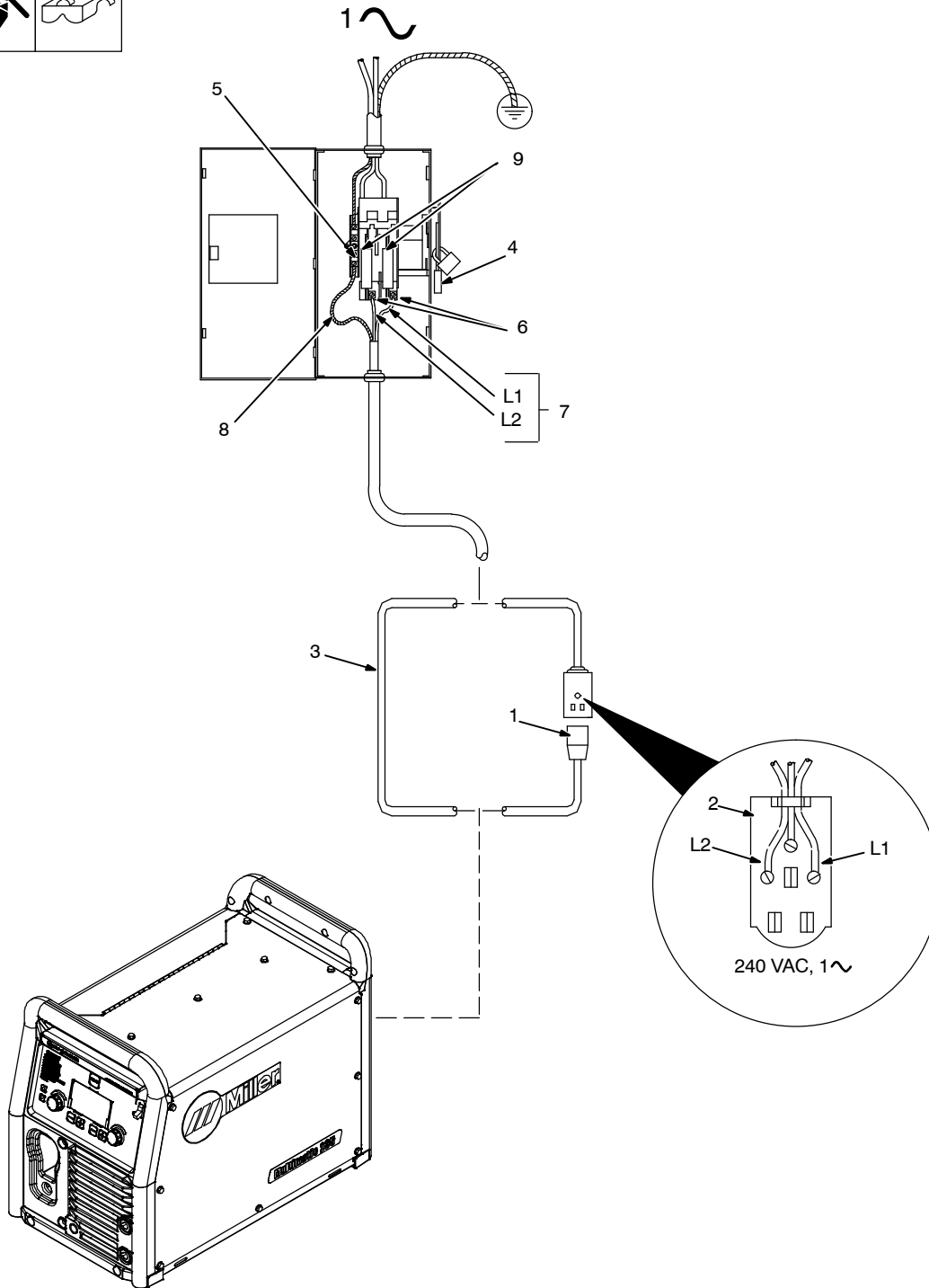
3 "Normal Operating" (general purpose - no intentional delay) fuses are UL class "K5" (up to and including 60 amps), and UL class "H" (65 amps and above).

4 Maximum total length of copper input conductors in entire installation, raceway and/or flexible cord.

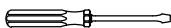
5 Raceway conductor data in this section specifies conductor size (excluding flexible cord or cable) between the panelboard and the equipment per NEC Table 310.15(B)(16) and is based on allowable ampacities of insulated copper conductors having a temperature rating of 75°C (167°F) with not more than three single current-carrying conductors in a raceway.

Notes

5-3. Connecting 1-Phase Input Power For 240 VAC



Tools Needed:





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

1 Plug (NEMA Type 6-50P)

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

Close and secure door on disconnect device. Follow established lockout/tagout procedures to put unit in service.

Ref. Input13 2015-08

Notes

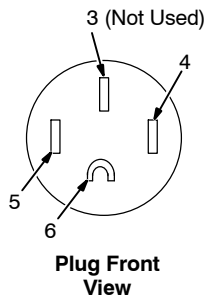
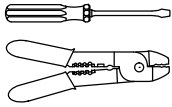


Pros weld and cut safely. Read the safety rules at the beginning of this manual.

5-4. Wiring Optional 240 Volt Plug (119172) For Connection To Miller Welder/Generator With Split-Phase 240 Volt Auxiliary Power

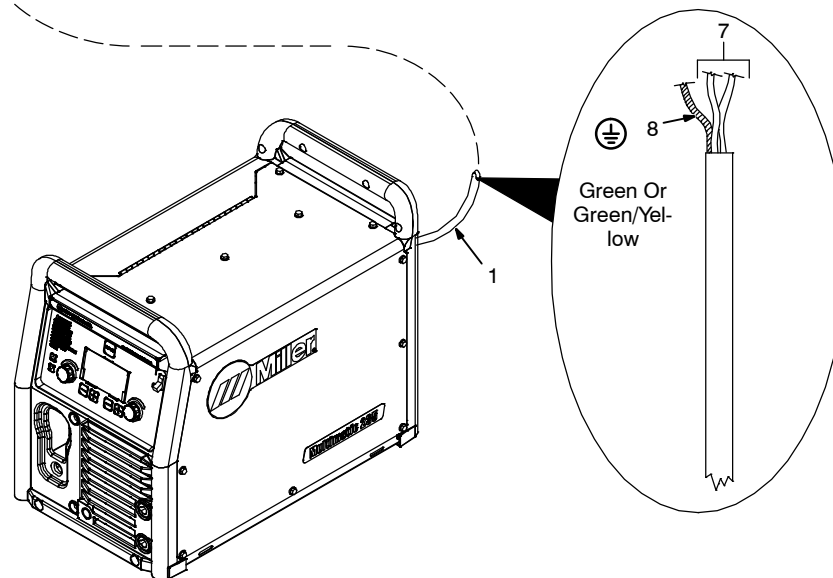
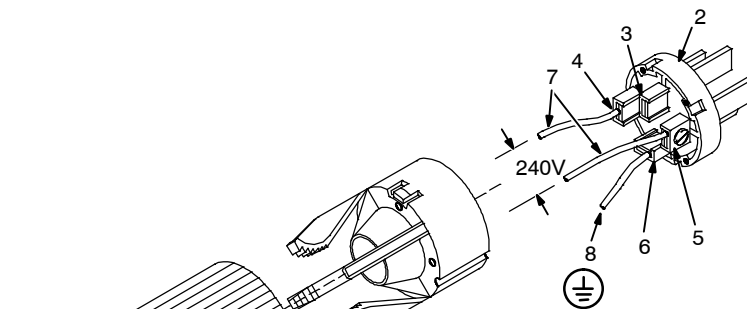


Tools Needed:



- 1 Input And Grounding Conductors
- 2 Plug Wired for 240 V, 2-Wire Load
- 3 Neutral (Brass) Terminal And Prong (**Not Used**)
- 4 Load 1 (Brass) Terminal And Prong
- 5 Load 2 (Brass) Terminal And Prong
- 6 Ground (Brass) Terminal And Prong
- 7 Black And White Input Conductors
- 8 Green Or Green/Yellow Ground Conductor

⚠ Always connect green or green/yellow wire to ground terminal, never to a load terminal. Connect black (L1) and white (L2) wires to load terminals.



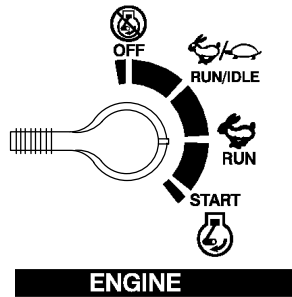
5-5. Generator Or Inverter Requirements



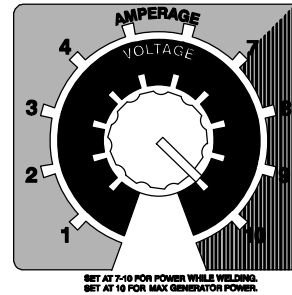
For maximum output Miller recommends 12kW or greater generator.

Generator settings, if applicable.

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



⚠ Set generator Voltage/Amperage Control to 10 (or max) for maximum auxiliary power.



Notes

5-6. Selecting Cable Sizes*

NOTICE – The Total Cable Length in Weld Circuit (see table below) is the combined length of both weld cables. For example, if the power source is 100 ft (30 m) from the workpiece, the total cable length in the weld circuit is 200 ft (2 cables x 100 ft). Use the 200 ft (60 m) column to determine cable size.

Welding Amperes	Weld Cable Size** and Total Cable (Copper) Length in Weld Circuit Not Exceeding***							
	100 ft (30 m) or Less		150 ft (45 m)	200 ft (60 m)	250 ft (70 m)	300 ft (90 m)	350 ft (105 m)	400 ft (120 m)
	10 – 60% Duty Cycle AWG (mm ²)	60 – 100% Duty Cycle AWG (mm ²)	10 – 100% Duty Cycle AWG (mm ²)					
100	4 (20)	4 (20)	4 (20)	3 (30)	2 (35)	1 (50)	1/0 (60)	1/0 (60)
150	3 (30)	3 (30)	2 (35)	1 (50)	1/0 (60)	2/0 (70)	3/0 (95)	3/0 (95)
200	3 (30)	2 (35)	1 (50)	1/0 (60)	2/0 (70)	3/0 (95)	4/0 (120)	4/0 (120)
250	2 (35)	1 (50)	1/0 (60)	2/0 (70)	3/0 (95)	4/0 (120)	2x2/0 (2x70)	2x2/0 (2x70)
300	1 (50)	1/0 (60)	2/0 (70)	3/0 (95)	4/0 (120)	2x2/0 (2x70)	2x3/0 (2x95)	2x3/0 (2x95)
350	1/0 (60)	2/0 (70)	3/0 (95)	4/0 (120)	2x2/0 (2x70)	2x3/0 (2x95)	2x3/0 (2x95)	2x4/0 (2x120)
400	1/0 (60)	2/0 (70)	3/0 (95)	4/0 (120)	2x2/0 (2x70)	2x3/0 (2x95)	2x4/0 (2x120)	2x4/0 (2x120)

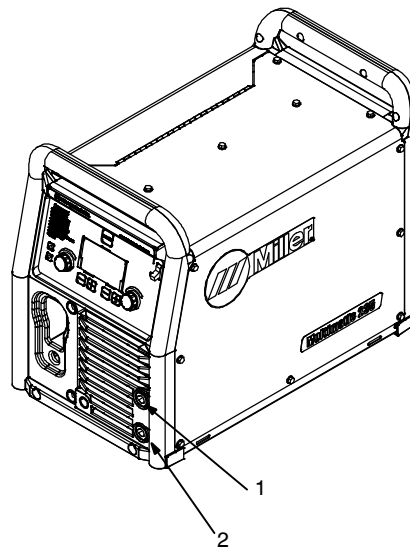
* This chart is a general guideline and may not suit all applications. If cable overheats, use next size larger cable.

**Weld cable size (AWG) is based on either a 4 volts or less drop or a current density of at least 300 circular mils per ampere.
() = mm² for metric use.

***For distances longer than those shown in this guide, see AWS Fact Sheet No. 39, Welding Cables, available from the American Welding Society at <http://www.aws.org>.

Ref. S-0007-M 2017-08

5-7. Weld Output Terminals



⚠ Turn off power before connecting to weld output terminals.

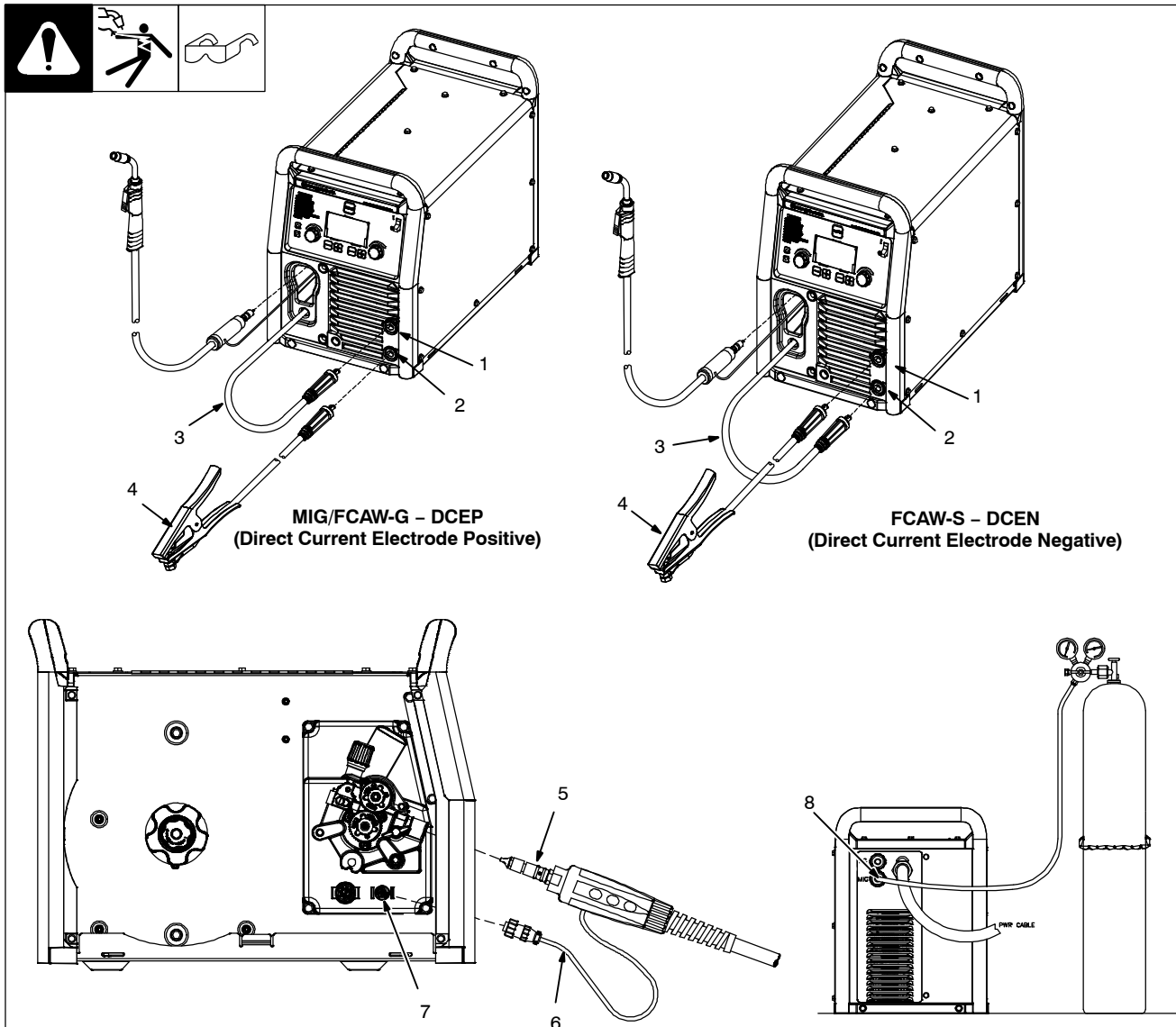
⚠ Do not use worn, damaged, undersized, or repaired cables.

- 1 Positive (+) Weld Output Terminal
- 2 Negative (-) Weld Output Terminal

See Sections 5-8 thru 5-11 for information on connecting to weld output terminals and standard connection diagrams.

output term1 2015-02

5-8. MIG Welding Connections



Ref. 280266B / Ref. 275167A / Ref. 280272C / 907728

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

- 1 Positive Weld Output Receptacle
- 2 Negative Weld Output Receptacle
- 3 Wire Drive Assembly Cable
- 4 Work Clamp And Cable

Ensure all connections are tight.

- 5 Gun End
 - 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

Connect supplied gas hose between regulator/flowmeter gas hose connection and fitting on rear of welding power source.

See Section 10-16 for gas selection.

5-9. Process/Polarity Table

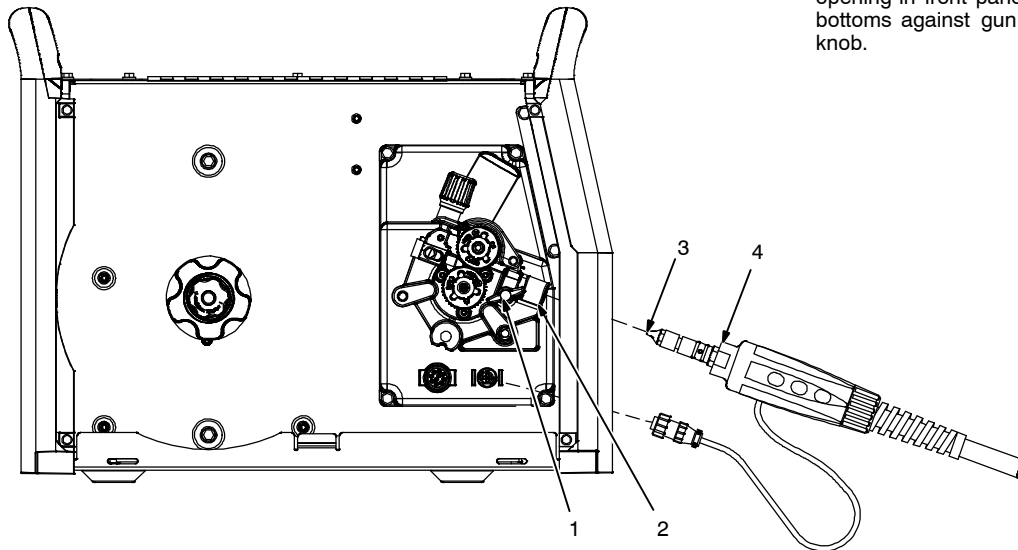
Process	Polarity	Cable Connections	
		Wire Drive Assembly Cable	Work Cable
GMAW – Solid wire with shielding gas	DCEP – Reverse polarity	Connect to positive (+) output receptacle	Connect to negative (–) output receptacle
FCAW-S – Self-shielding wire – no shielding gas	DCEN – Straight Polarity	Connect to negative (–) output receptacle	Connect to positive (+) output receptacle
FCAW-G – Flux-cored wire with shielding gas	DCEP – Reverse Polarity	Connect to positive (+) output receptacle	Connect to negative (–) output receptacle

5-10. MIG Gun Connection Inside Unit

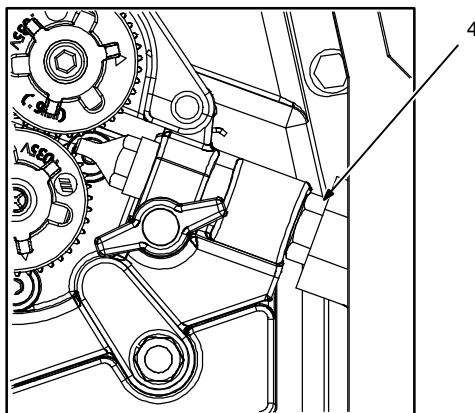


- 1 Gun Securing Knob
- 2 Gun Block
- 3 Gun Outlet Wire Guide
- 4 Gun End

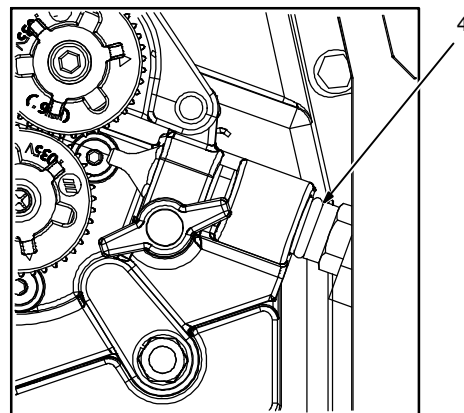
Loosen knob. Insert end of gun through opening in front panel until gun end bottoms against gun block. Tighten knob.



 Be sure that gun end is tight against drive assembly.



Correct



Incorrect

5-11. Stick Welding Connections

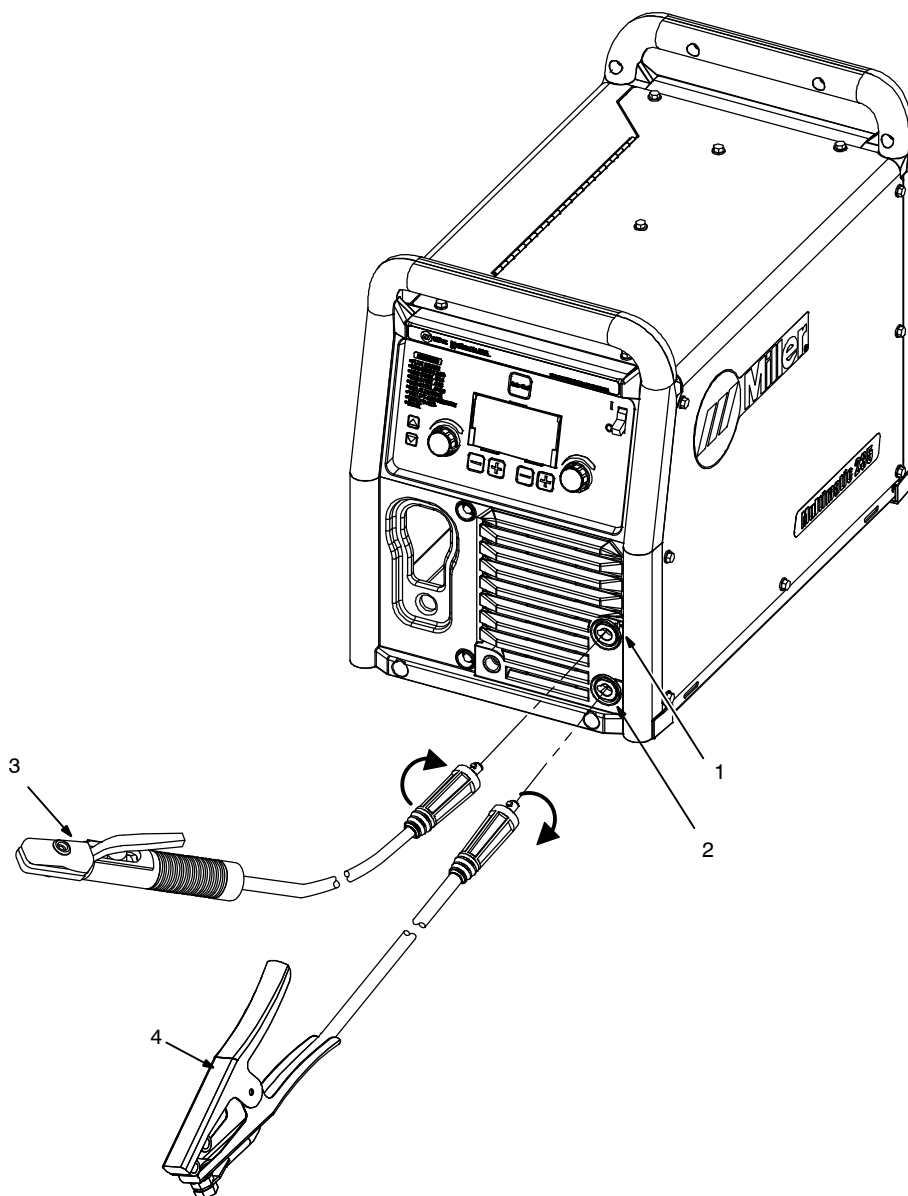


⚠ Turn off unit and disconnect input power before making connections.

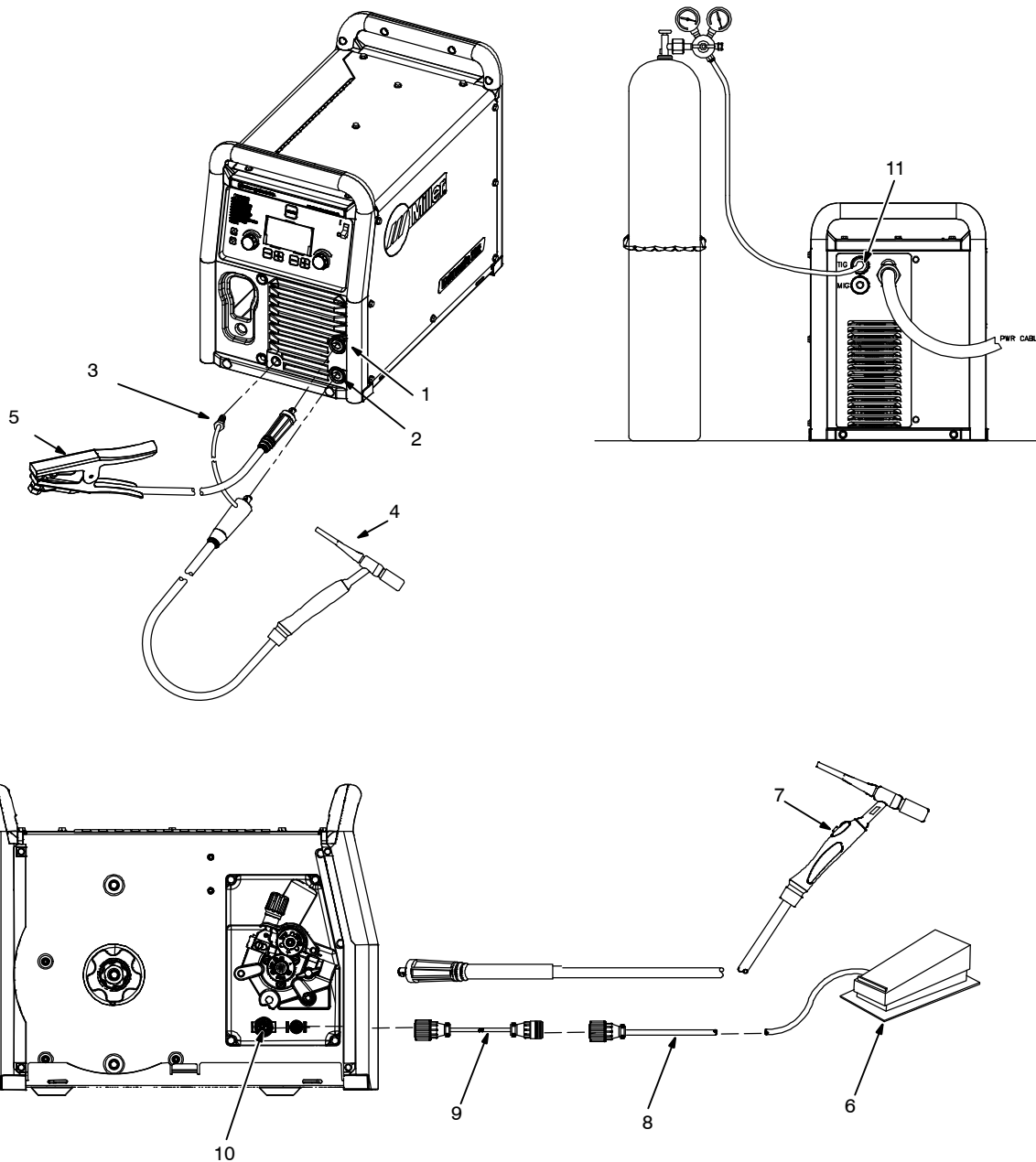
- 1 Positive Weld Output Receptacle
- 2 Negative Weld Output Receptacle
- 3 Stick Electrode Holder And Cable
- 4 Work Clamp And Cable

Connect stick electrode holder cable to the positive weld output receptacle, and connect work clamp to negative weld output receptacle.

Ensure all connections are tight.



5-12. TIG Welding Connections DCEN (Direct Current Electrode Negative)



280265B / Ref. 275167A / Ref. 280272C / 907728 / Ref. 273873

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

For Lift-Arc Operation

- 1 Positive Weld Output Receptacle
- 2 Negative Weld Output Receptacle
- 3 TIG Torch Gas Hose Fitting
- 4 TIG Torch And Cable
- 5 Work Clamp And Cable

Connect TIG torch cable to the negative weld output receptacle. Connect work cable to positive weld output receptacle. Con-

nect TIG torch gas hose to gas hose fitting.

Ensure all connections are tight.

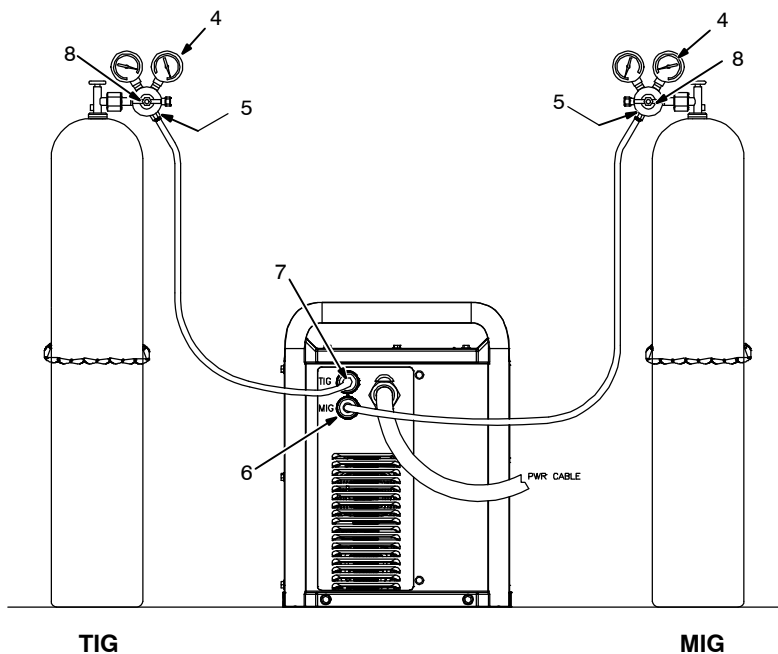
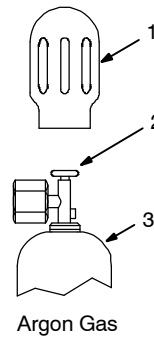
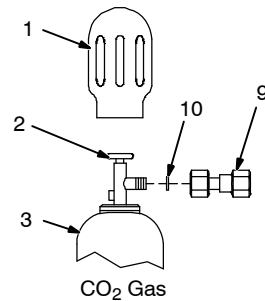
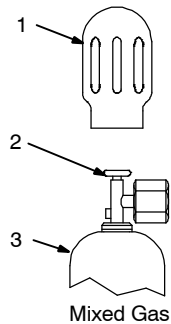
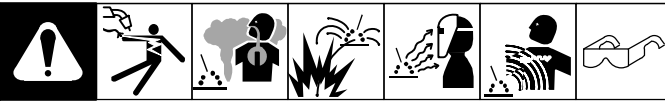
For remote arc starts and control, use optional TIG accessory kit 301518 (contains torch, foot pedal, 10 to 14-pin adapter, regulator, gas hose, and consumables).

Wireless foot control 300429 may also be used with the 10 to 14-pin adapter.

- 6 Foot Control
- 7 Finger Tip Control (Optional)

- 8 Remote Control Cable
 - 9 10-Pin To 14-Pin Cable Adapter (Part No. 301545)
 - 10 Remote Control Receptacle
- Route adapter through MIG gun hole. Connect foot control or finger tip control to adapter. Connect adapter to remote control receptacle.
- 11 TIG Shielding Gas Connection
- Use Argon gas for TIG welding (see Section 5-13).

5-13. 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 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 shielding gas is 20 to 30 CFH (cubic feet per hour). Check wire manufacturer's recommended flow rate.

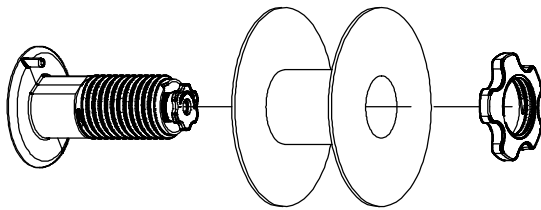
- 9 CO₂ Adapter (Customer Supplied)
- 10 O-Ring (Customer Supplied)

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

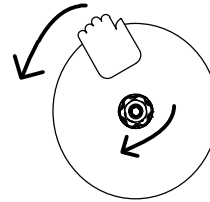
Tools Needed:



5-14. Installing Wire Spool And Adjusting Hub Tension

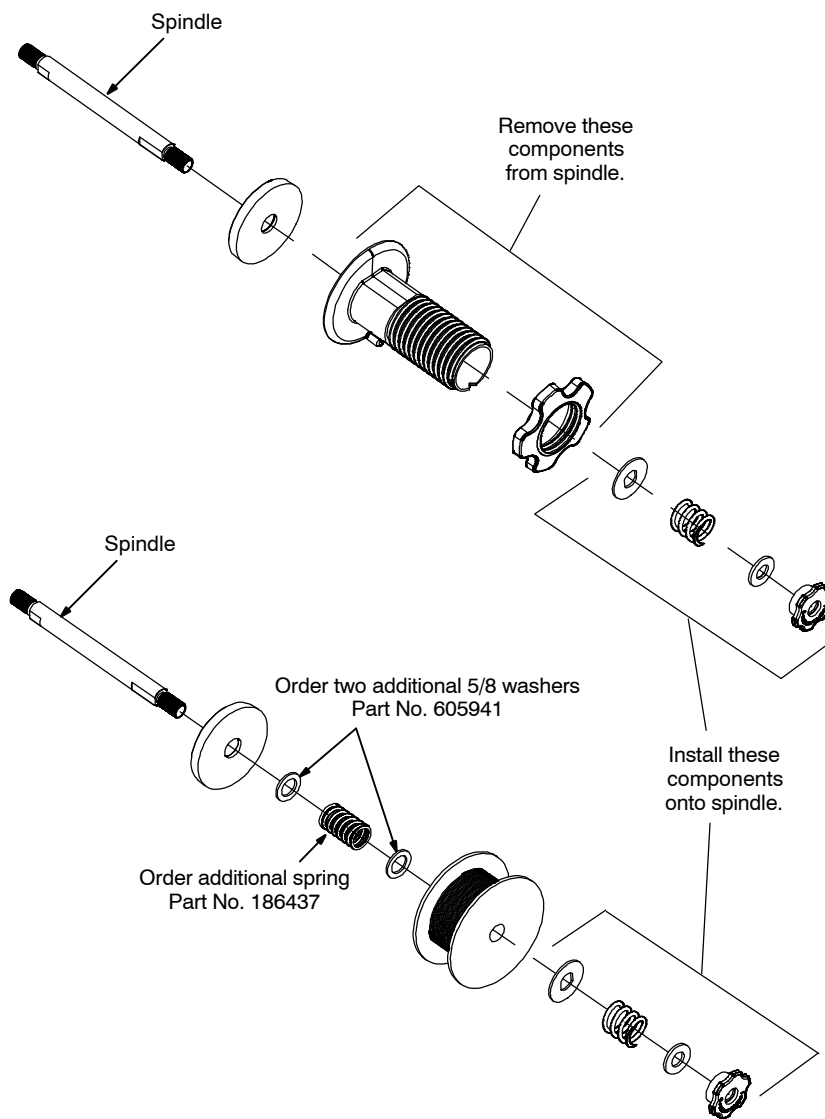


Hand tighten knob clockwise.
When a slight force is needed
to turn spool, tension is set.



Installing 1 Or 2 lb Wire Spool

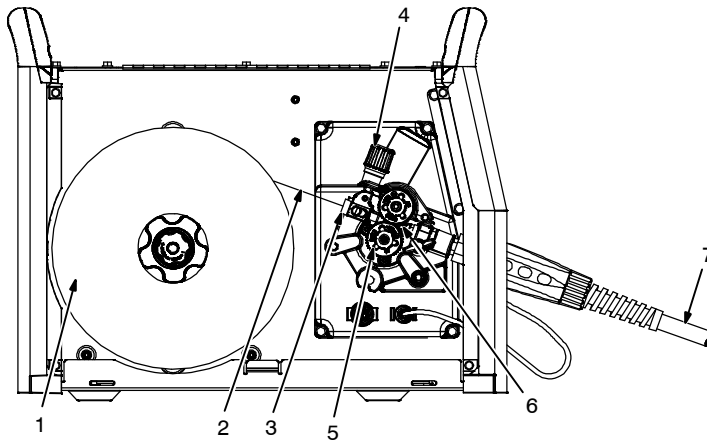
To install either a 1 lb or 2 lb wire spool, follow the procedure as shown in the illustration.



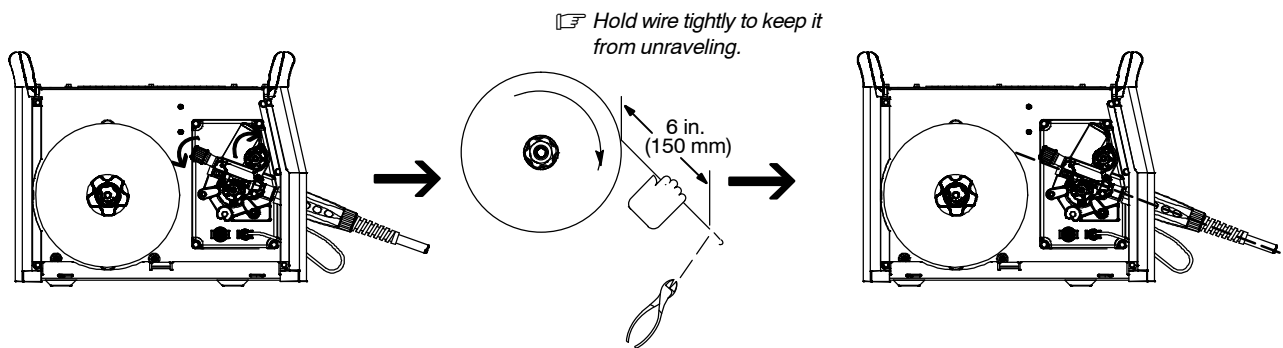
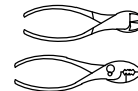
5-15. Threading Welding Wire For MIG Gun



- 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.



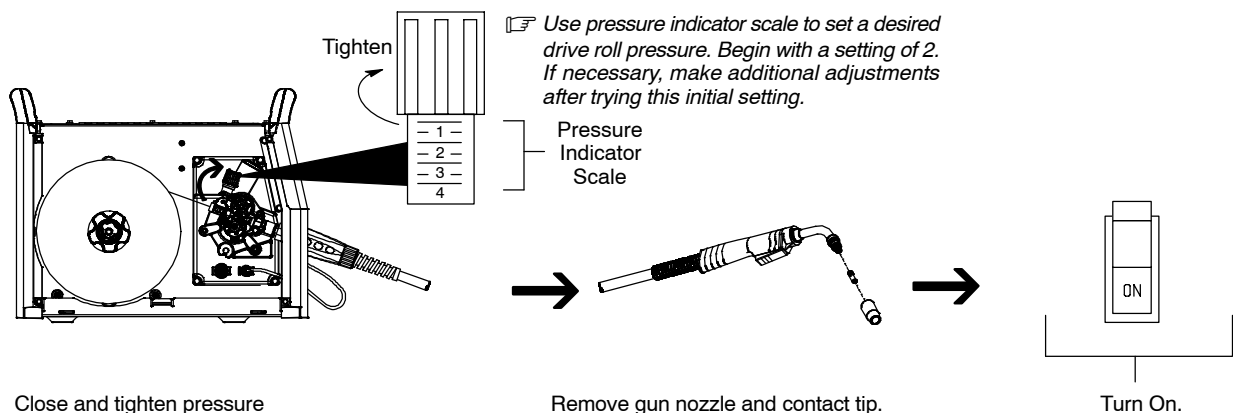
Tools Needed:



Open pressure assembly.

Pull and hold wire; cut off end.

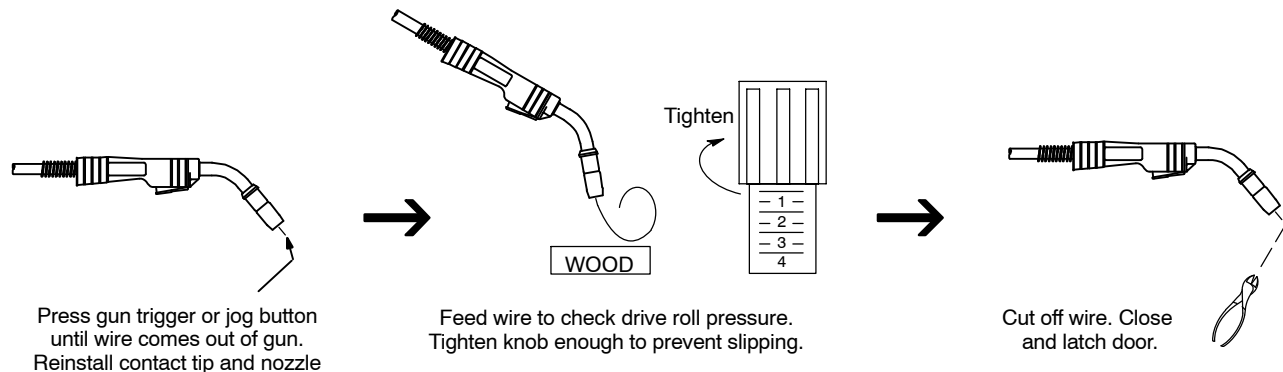
Push wire through guides into gun; continue to hold wire.



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

Remove gun nozzle and contact tip.

Turn On.

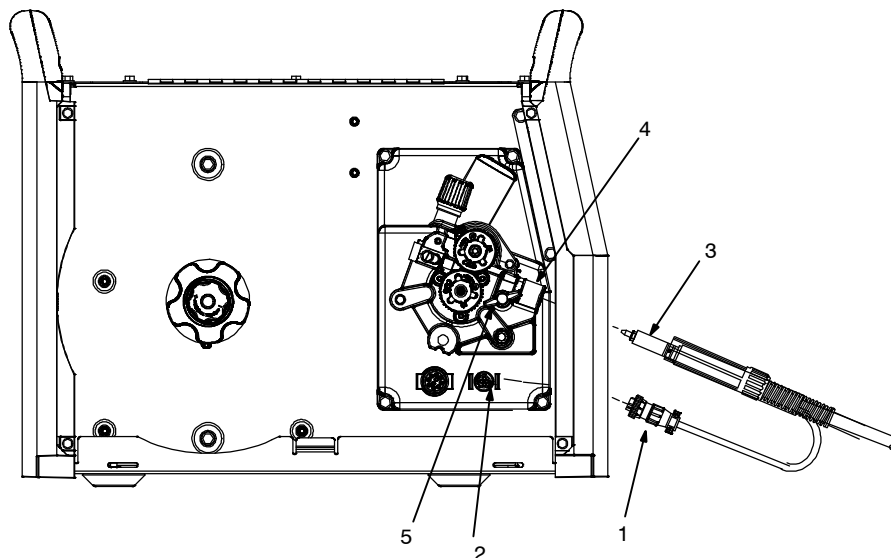


Press gun trigger or jog button until wire comes out of gun. Reinstall contact tip and nozzle

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

Cut off wire. Close and latch door.

5-16. Connecting Spoolmate 100/150 Gun



1 Gun Trigger Plug

Insert plug into receptacle, and tighten threaded collar.

2 Gun Trigger Receptacle

3 Gun End

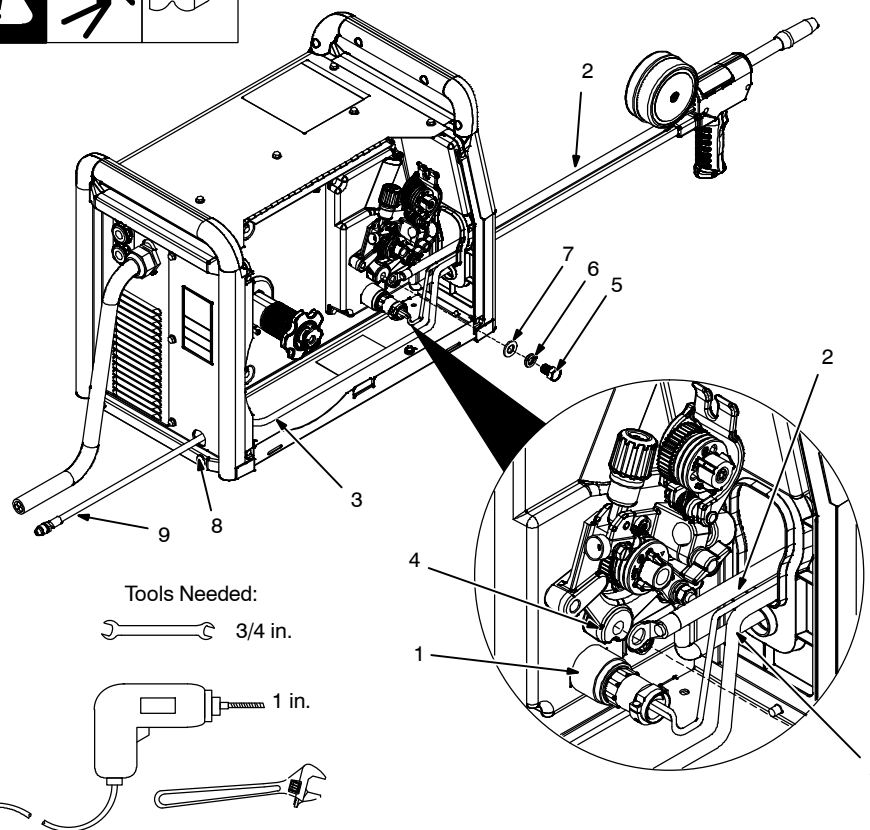
4 Drive Assembly

5 Gun Securing Knob

Loosen gun securing knob. Insert Spoolmate gun end through opening until it is tight against drive assembly. Tighten gun securing knob.

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5-17. Connecting Spoolmatic® 15A Or 30A Or Spoolmate 200 Gun



1 Gun Trigger Plug

Insert plug into receptacle, and tighten threaded collar.

2 Weld Cable

3 Shielding Gas Hose

Route weld cable and gas hose through opening in panel.

4 Drive Casting

Remove the 3/4 in. bolt from the drive casting. Use bolt to connect spoolgun weld cable to drive casting.

5 1/2-13 x 3/4 in. Bolt (282942)

6 Lock Washer (602216)

7 Washer (602247)

8 Gas Hose Routing Hole

To route gas hose through rear panel, drill 1 in. hole through bottom of rear plastic bezel. Align drill with pilot dimple in plastic bezel visible from inside wire drive compartment.

9 Gas Hose Fitting

Route shielding gas hose through wire drive compartment, out opening in rear panel, and up to regulator/flowmeter. Connect gas hose fitting to regulator/flowmeter.

Tools Needed:

3/4 in.

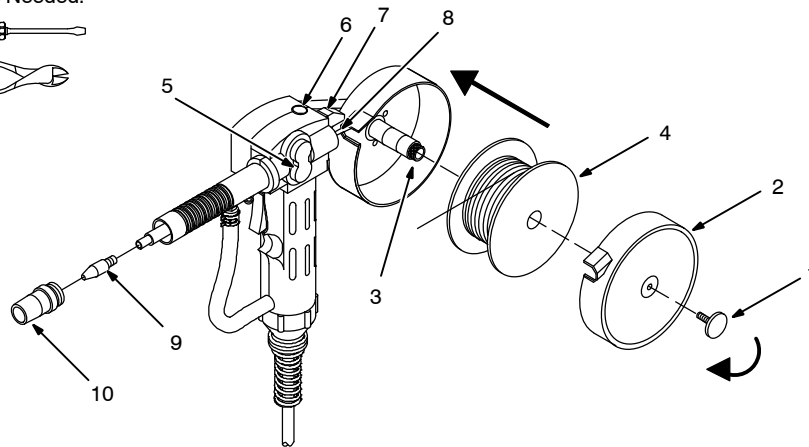
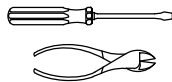
1 in.

282298

5-18. Installing Wire Spool And Threading Welding Wire For Spoolmate 100/150



Tools Needed:



1 Thumb Screw

2 Spool Cover

Remove thumb screw and spool cover.

3 Spool Brake Thumbnut

4 Wire Spool

Install spool so wire feeds from top. Turn spool brake thumbnut just so a slight drag is felt on the wire spool.

5 Push Roll/Lower Drive Roll

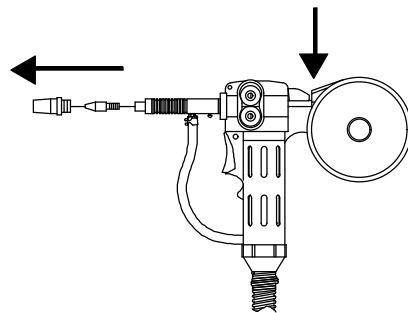
6 Drive Roll Pressure Adjustment Opening

7 Drive Roll Release Lever (Red)

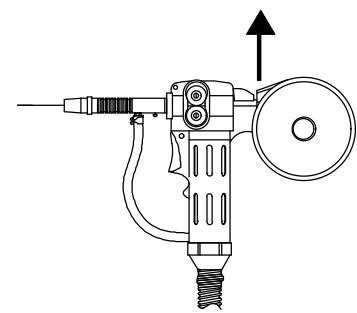
8 Wire Inlet Guide

9 Contact Tip

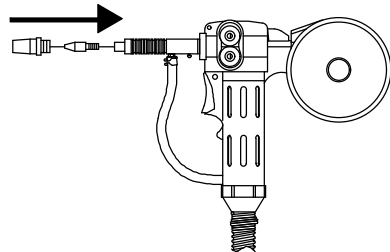
10 Nozzle



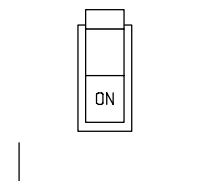
Remove nozzle and contact tip. Push and hold red lever. Thread wire through inlet guide, past push roll/driver roll, and out end of gun 2 inches (50 mm).



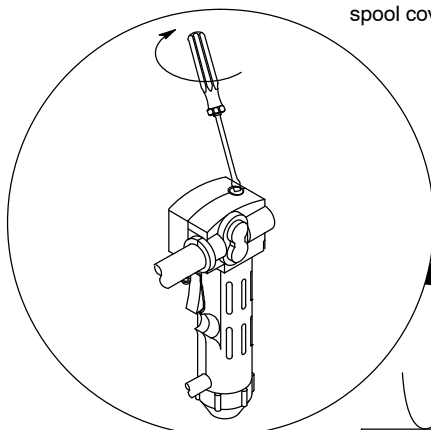
Release red lever.



Install contact tip and nozzle. Reinstall spool cover and thumb screw.



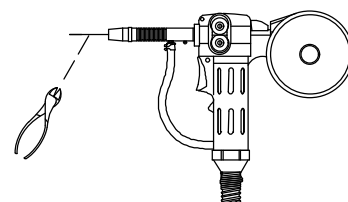
Turn On welding power source power.



Drive roll pressure is preset for .030/.035 aluminum wire. **Rotating screw clockwise decreases drive roll pressure and counterclockwise increases pressure.**

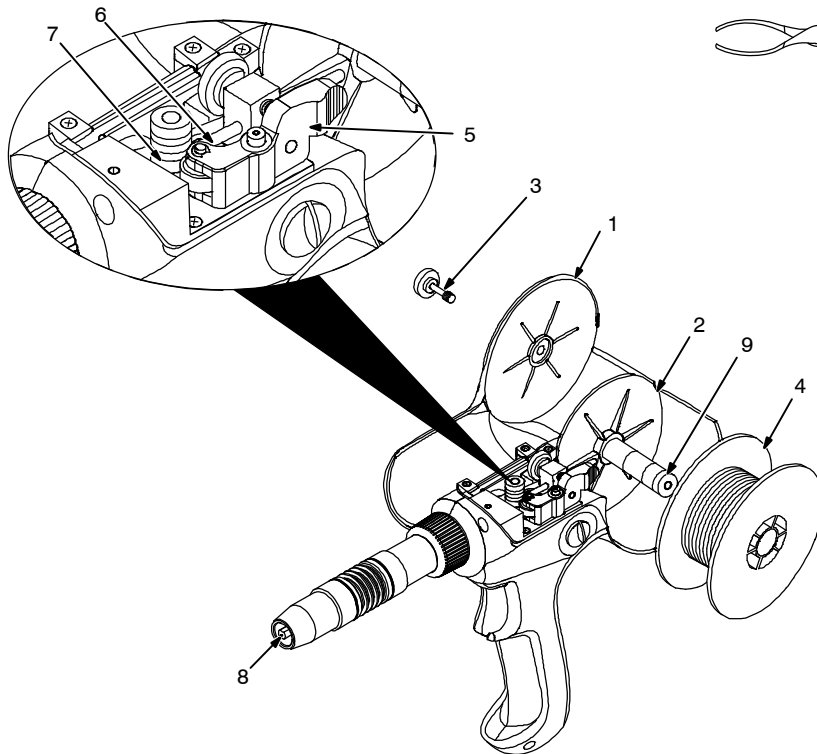
Wood

Press gun trigger to feed wire to check drive roll pressure. Turn screw enough to prevent slipping.



Cut off wire.

5-19. Threading Welding Wire For Spoolmate 200



Tools Needed:



- 1 Cover
- 2 Canister
- 3 Thumbscrew (Cover)

Loosen thumbscrew, and rotate cover open.

- 4 Wire Spool

Loosen wire from spool, cut off bent wire, and pull 6 in (150 mm) of wire off spool.

- 5 Pressure Roll Assembly

Press arm inward to open pressure roll assembly.

- 6 Wire Inlet Guide

- 7 Drive Roll Groove

- 8 Contact Tip

Thread wire through wire inlet guide, along drive roll groove, and out contact tip.

Install spool so wire feeds off top.

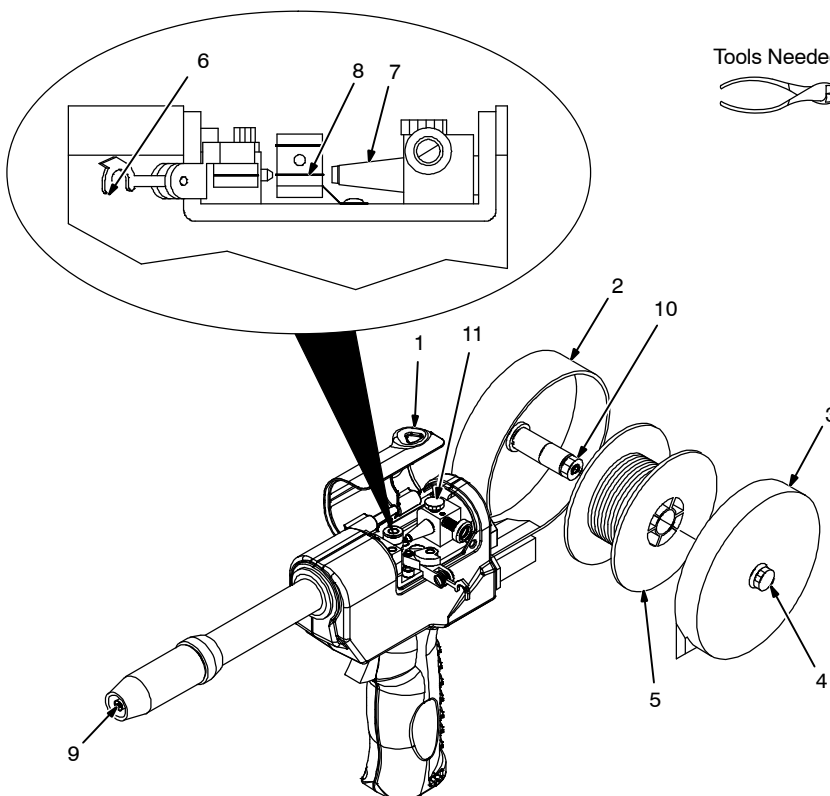
- 9 Spool Brake Thumbnut

If necessary, turn thumbnut counterclockwise slightly to install spool.

Close cover and secure with thumbscrew.

Ref. 243 740-C

5-20. Threading Welding Wire For Spoolmatic 15/30A



Tools Needed:



- 1 Top Cover
- 2 Canister
- 3 Canister Cover
- 4 Thumbscrew (Canister Cover)

Loosen thumbscrew and remove cover.

- 5 Wire Spool

Loosen wire from spool, cut off bent wire, and pull 6 in. (150 mm) of wire off spool.

- 6 Pressure Roll Assembly

Lift arm and open pressure roll assembly.

- 7 Canister Inlet Guide

- 8 Drive Roll Groove

 For wire sizes .035 in. (0.9 mm) and smaller use small groove, and .047 in. (1.2 mm) and 1/16 in (1.6 mm) use large groove.

- 9 Contact Tip

Thread wire through canister inlet guide, along drive roll groove, and out contact tip.

Install spool so wire feeds off bottom.

- 10 Spool Brake Thumbnut

If necessary, turn thumbnut counterclockwise slightly to install spool.

- 11 Thumbscrew (Canister Rotation)

Loosen thumbscrew to rotate canister.

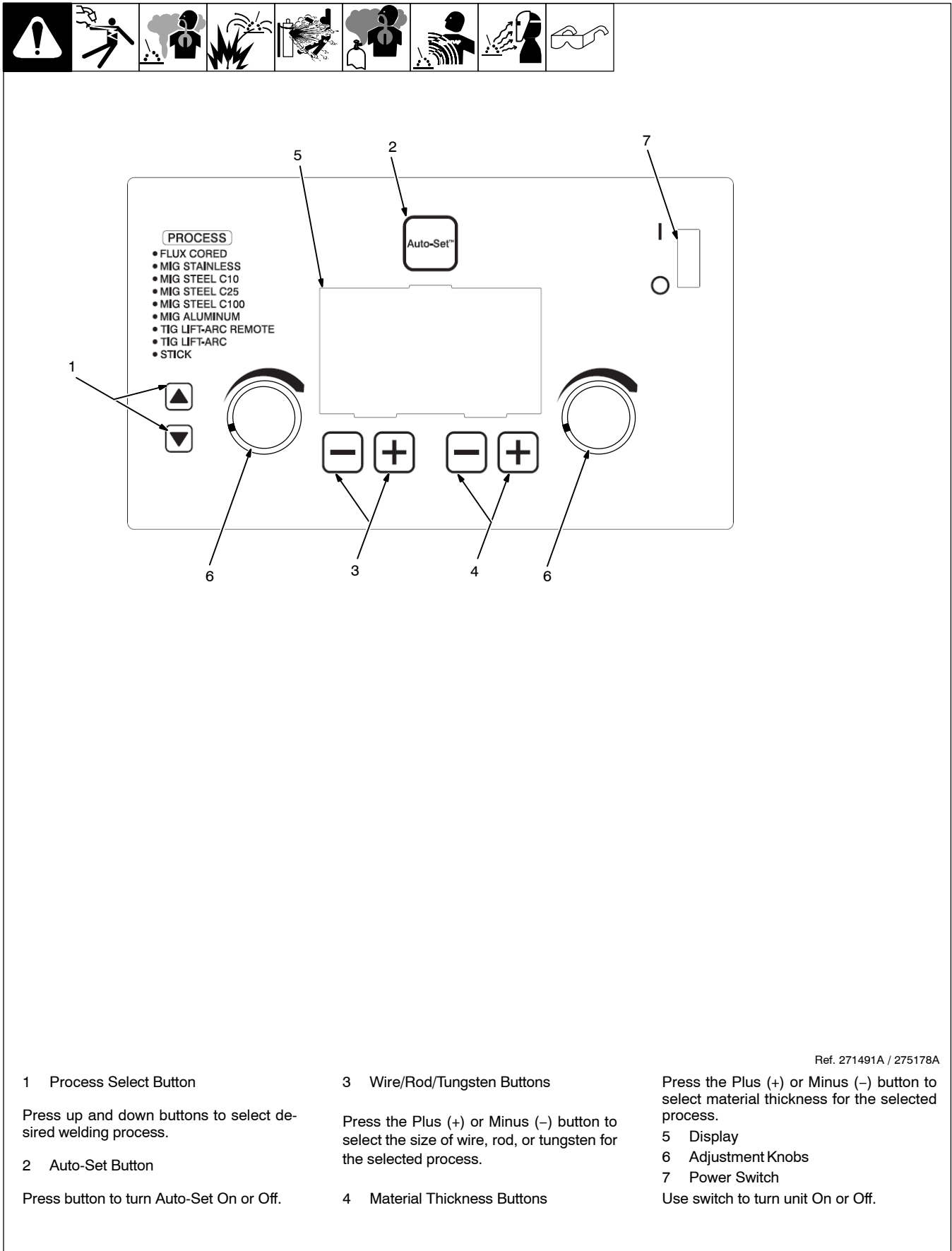
Close and secure pressure roll assembly.

Reinstall top cover and canister cover.

150 436-F

SECTION 6 – OPERATION

6-1. Controls



Ref. 271491A / 275178A

6-2. Special Features

A. MIG Mode

In MIG mode, the left knob is used to adjust welding voltage within a range of 12 to 32 volts. The right knob is used to adjust wire feed speed within a range of 60 to 600 IPM. Refer to weld chart inside the wire drive compartment for proper parameter settings according to wire type, shielding gas, and material type and thickness.

B. Jog Mode

If gun trigger is pressed and held for more than 3 seconds without striking an arc, unit will automatically shut off weld power and shielding gas. After one minute the wire will stop and a trigger error will be displayed. Release trigger.

C. Weld Status

When the arc is extinguished, the last actual amperage and voltage are shown on the display for 5 seconds. If a preset value requires adjustment after the arc is extinguished and during the 5-second display of actual values, turning either knob will cause actual values in the displays to be replaced by preset values for adjustment purposes.

D. MIG Gun-On-Demand

MIG guns and spool guns can be used with this unit. To switch from one gun to another, momentarily press the trigger on the desired unused gun to make it the active gun. Once the trigger is pressed, the unit will recall stored data and both displays will show the last programmed values for that particular gun. If the unit is powered down and back on again, the gun last used will become the current active gun.

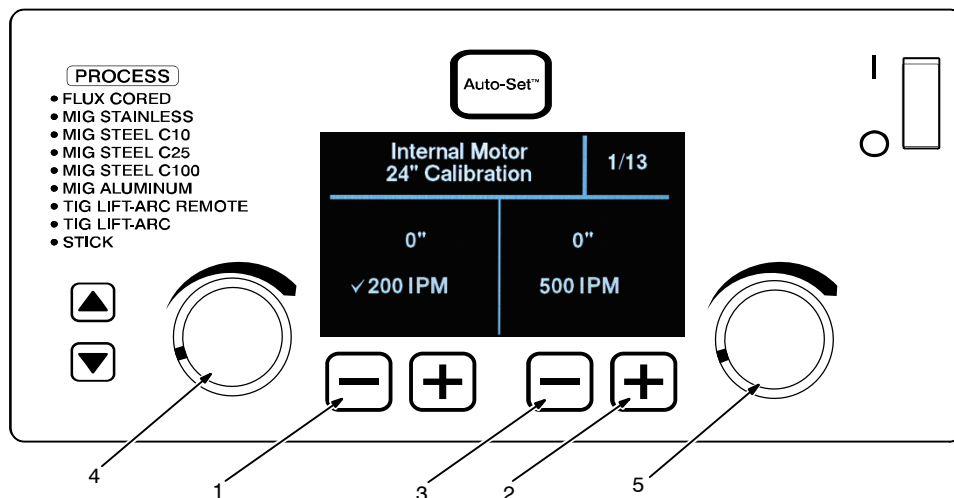
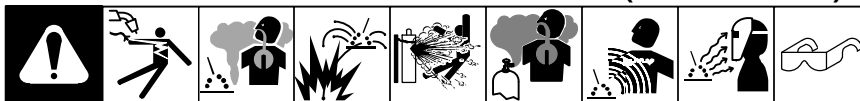
Notes



Work like a Pro!

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

6-4. Internal Motor 24 Inch Calibration (Menu 1 Of 13)



Ref. 281104-C

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

- 1 Lower Left Outside (-) Button
- 2 Lower Right Outside (+) Button
- 3 Lower Right Inside (-) Button
- 4 Left Control Encoder
- 5 Right Control Encoder

Cut wire flush at nozzle.

Follow instructions in Section 6-3 to enter the

setup menu.

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

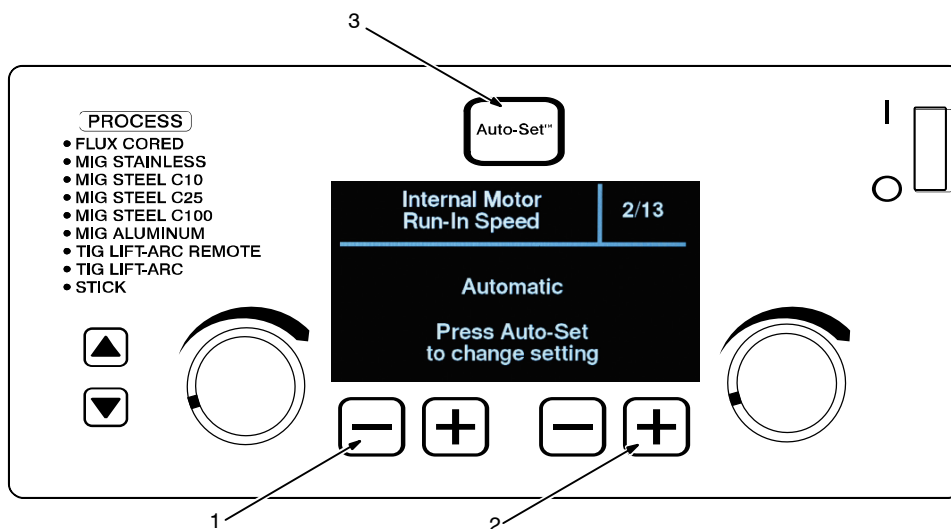
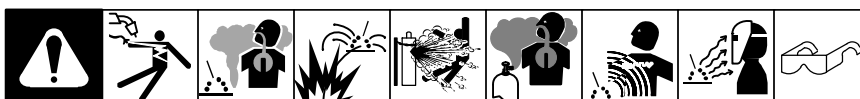
and verify that a check mark appears next to 500 IPM.

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 lower left outside (-) button and lower right outside (+) button, or turn unit off and on.

6-5. Internal Motor Run-In Speed (Menu 2 Of 13)



- 1 Lower Left Outside(-) Button
- 2 Lower Right Outside (+) Button
- 3 Auto-Set Button

Follow instructions in Section 6-3 to enter the setup menu.

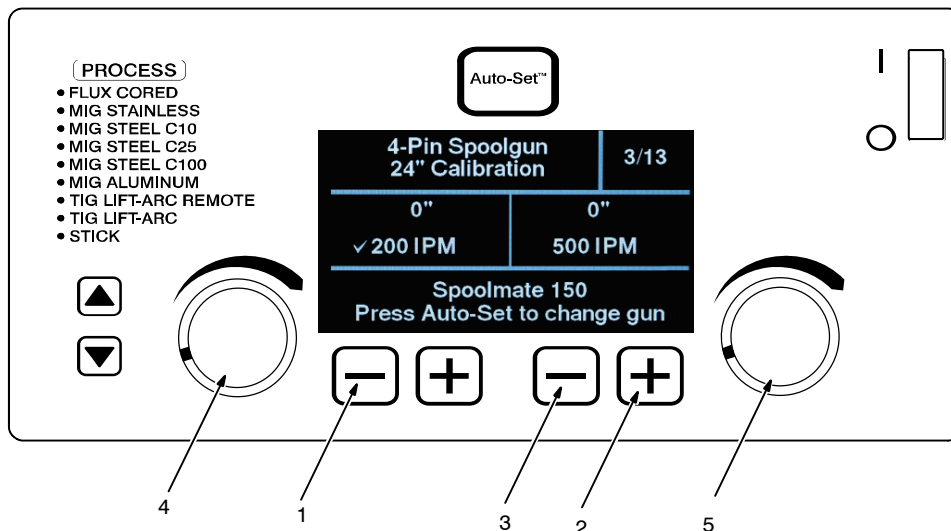
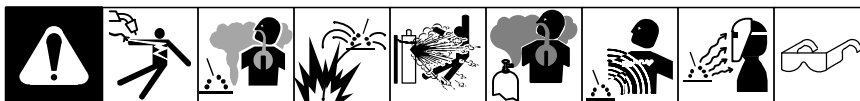
To change the run-in setting, press the Auto-Set button.

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 lower left outside (-) button and lower right outside (+) button, or turn unit off and on.

Ref. 281104-C

6-6. 4 Pin Spoolgun 24 Inch Calibration (Menu 3 Of 13)



- 1 Lower Left Outside (-) Button
- 2 Lower Right Outside (+) Button
- 3 Lower Right Inside (-) Button
- 4 Left Control Encoder
- 5 Right Control Encoder

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 235. Press Auto-Set button to select Spoolmate 100 or 150.

Connect Spoolmate to unit.

Cut wire flush at nozzle.

Follow instructions in Section 6-3 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.

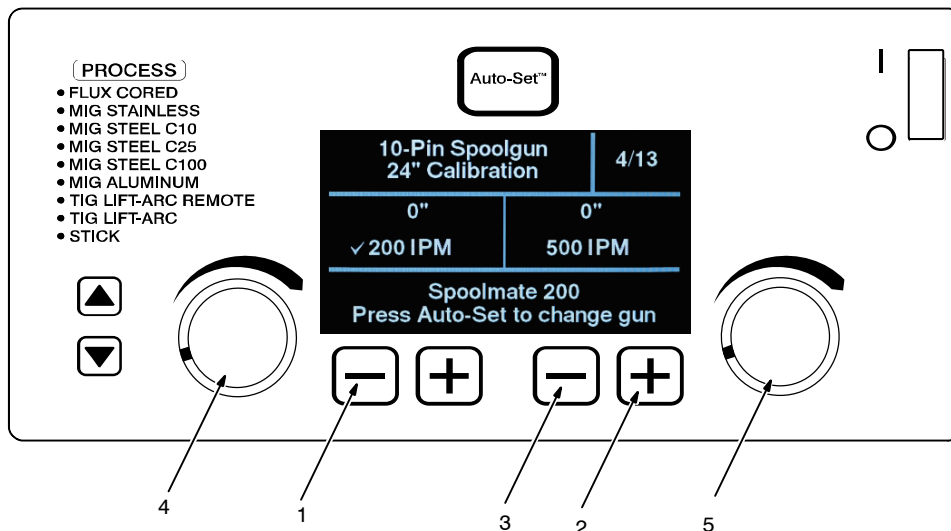
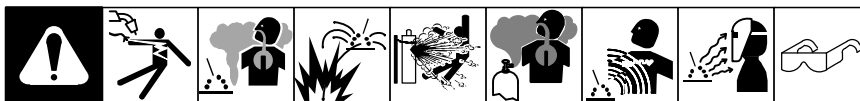
Spoolmate will feed approximately 24 in. of wire through gun.

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 lower left outside (-) button and lower right outside (+) button, or turn unit off and on.

6-7. 10 Pin Spoolgun 24 Inch Calibration (Menu 4 Of 13)



- 1 Lower Left Outside (-) Button
- 2 Lower Right Outside (+) Button
- 3 Lower Right Inside (-) Button
- 4 Left Control Encoder
- 5 Right Control Encoder

Spoolmate 200 and Spoolmatic 15A/30A drive motors are unique to this welding power source. Motor calibration is necessary any time a different Spoolmate 200 or Spoolmatic 15A/30A is connected to the Multimatic 235. Press Auto-Set button to select Spoolmate 200 or Spoolmatic 15A/30A.

Connect Spoolmate to unit.

Cut wire flush at nozzle.

Follow instructions in Section 6-3 to enter the setup menu.

To perform a Spoolgun 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 Spoolgun.

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 Spoolgun 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 Spoolgun.

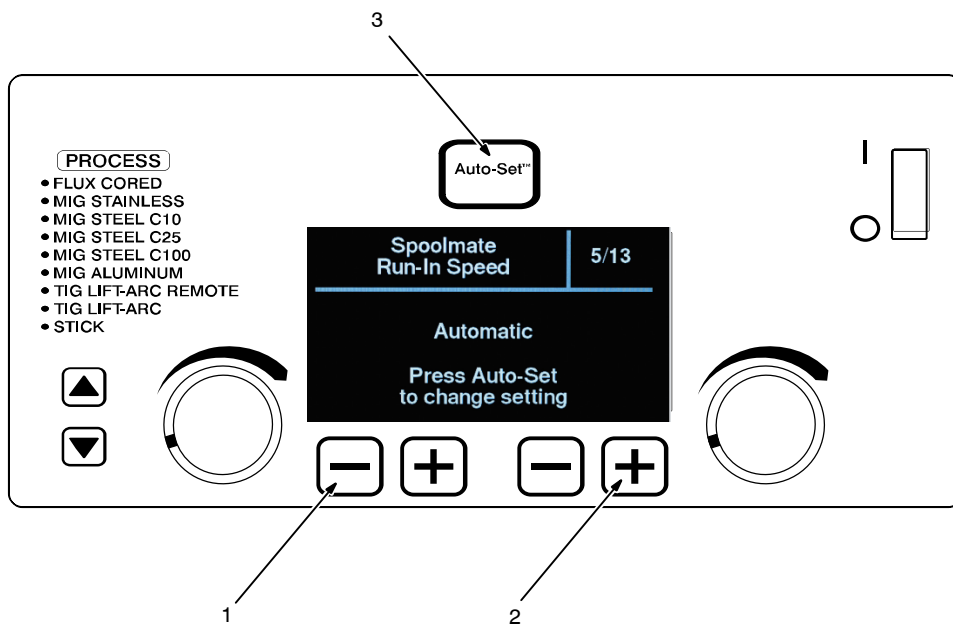
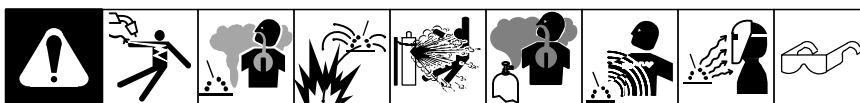
Spoolgun will feed approximately 24 in. of wire through gun.

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 lower left outside (-) button and lower right outside (+) button, or turn unit off and on.

6-8. Spoolmate Run-In Speed (Menu 5 Of 13)



- 1 Lower Left Outside (-) Button
- 2 Lower Right Outside (+) Button
- 3 Auto-Set Button

Follow instructions in Section 6-3 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.

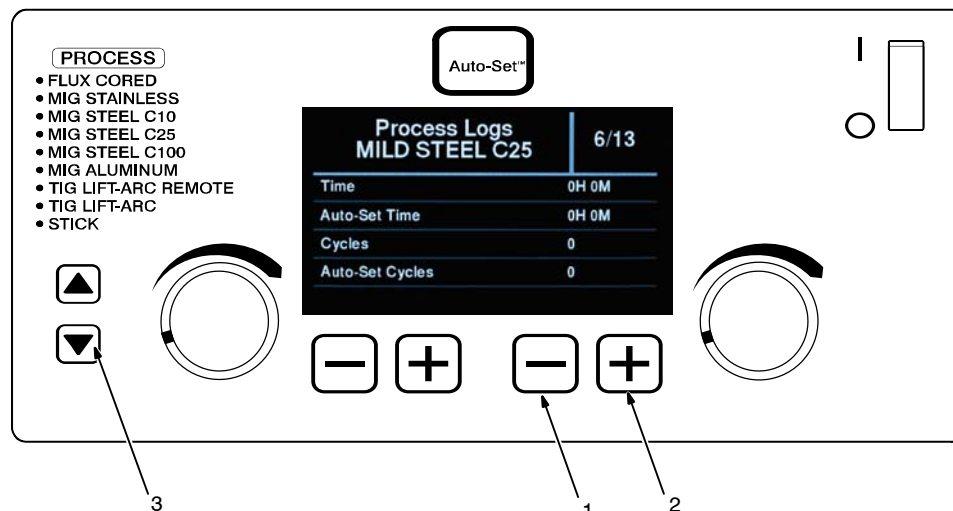
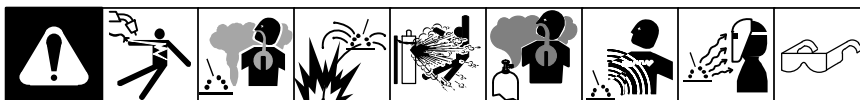
When set to Automatic, the welder determines the optimal run-in speed for each start.

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

To exit menu, simultaneously press and release the lower left outside (-) button and lower right outside (+) button, or turn unit off and on.

Ref. 281104-C

6-9. Process Logs (Menu 6 Of 13)



- 1 Lower Right Inside (-) Button
- 2 Lower Right Outside (+) Button
- 3 Process Select

Follow instructions in Section 6-3 to enter the setup menu.

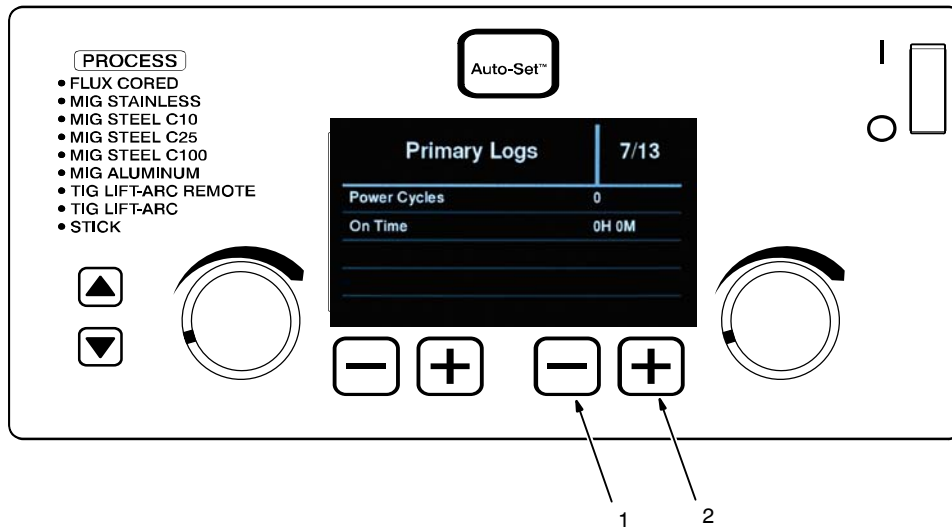
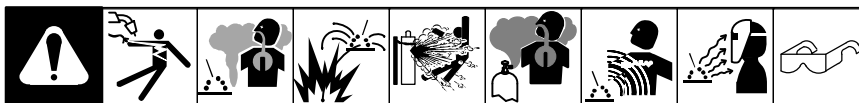
Process Logs menu displays manual time, Auto-Set time, weld cycles, and Auto-Set cycles for the selected process.

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

To exit menu, simultaneously press and release the lower left outside (-) button and lower right outside (+) button, or turn unit off and on.

Ref. 281104-C

6-10. Primary Logs (Menu 7 Of 13)



- 1 Lower Right Inside (-) Button
- 2 Lower Right Outside (+) Button

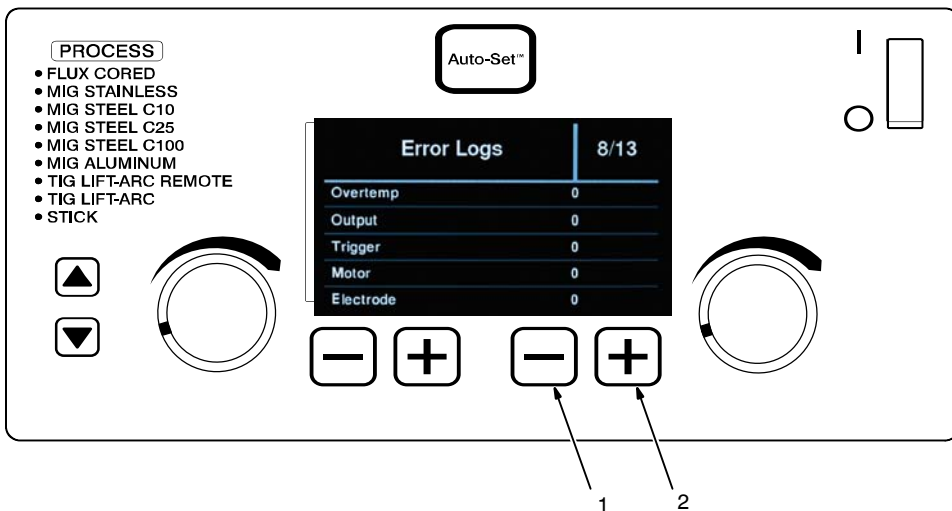
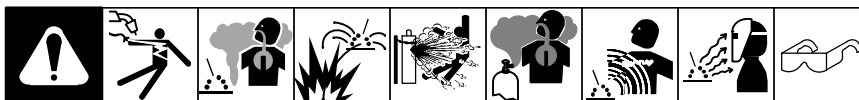
Follow instructions in Section 6-3 to enter the setup menu.

Primary Logs menu displays power cycles.

To exit menu, simultaneously press and release the lower left outside (-) button and lower right outside (+) button, or turn unit off and on.

Ref. 281104-C

6-11. Error Logs (Menu 8 Of 13)



- 1 Lower Right Inside (-) Button
- 2 Lower Right Outside (+) Button

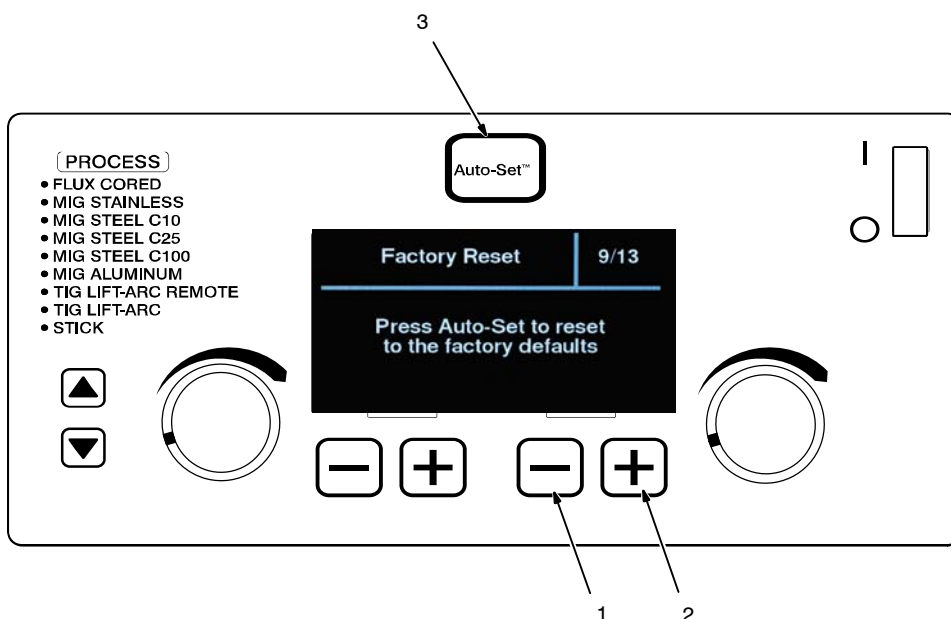
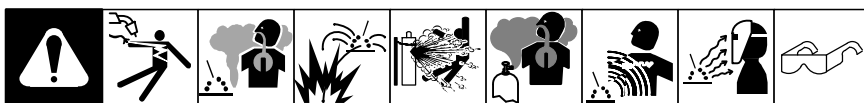
Follow instructions in Section 6-3 to enter the setup menu.

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 lower left outside (-) button and lower right outside (+) button, or turn unit off and on.

Ref. 281104-C

6-12. Factory Reset (Menu 9 Of 13)



- 1 Lower Right Inside (-) Button
- 2 Lower Right Outside (+) 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.

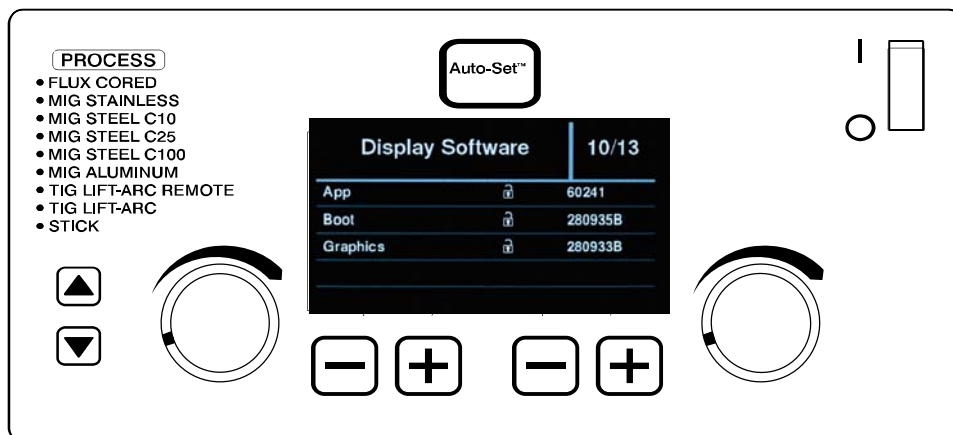
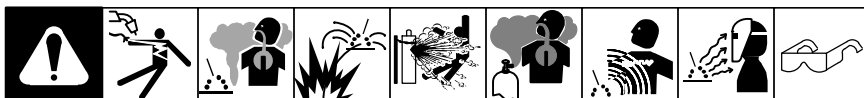
Follow instructions in Section 6-3 to enter the setup menu.

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

To exit menu, simultaneously press and release the lower left outside (-) button and lower right outside (+) button, or turn unit off and on.

Ref. 281104-C

6-13. Display Software (Menu 10 Of 13)



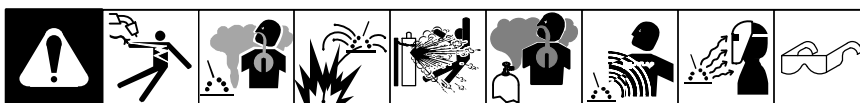
Display Software information is for factory and service use only.

Follow instructions in Section 6-3 to enter the setup menu.

To exit menu, simultaneously press and release the lower left outside (-) button and lower right outside (+) button, or turn unit off and on.

Ref. 281104-C

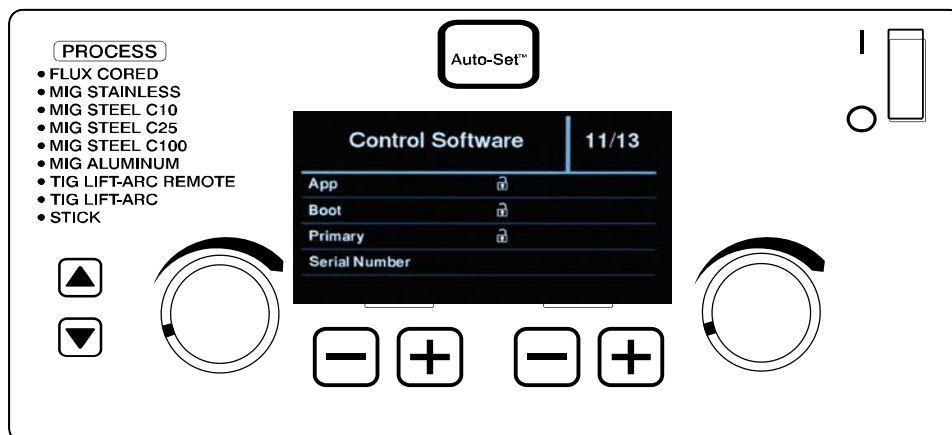
6-14. Control Software (Menu 11 Of 13)



Control Software information is for factory and service use only.

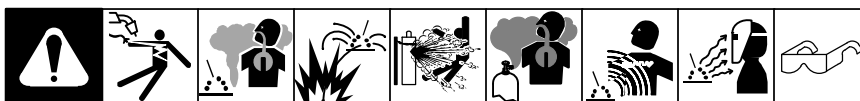
Follow instructions in Section 6-3 to enter the setup menu.

To exit menu, simultaneously press and release the lower left outside (-) button and lower right outside (+) button, or turn unit off and on.



Ref. 281104-C

6-15. Connection Diagram Time (Menu 12 Of 13)

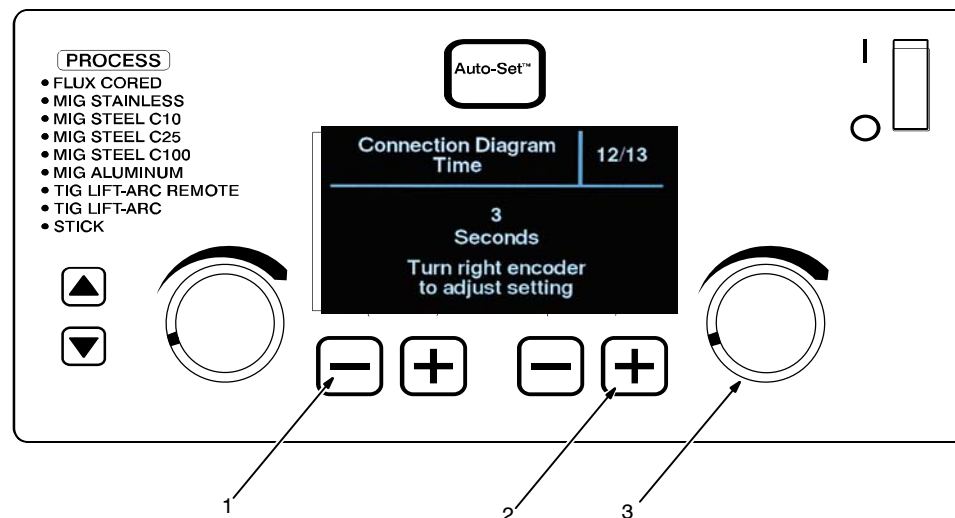


- 1 Lower Left Outside (-) Button
- 2 Lower Right Outside (+) Button
- 3 Right Control Encoder

Follow instructions in Section 6-3 to enter the setup menu.

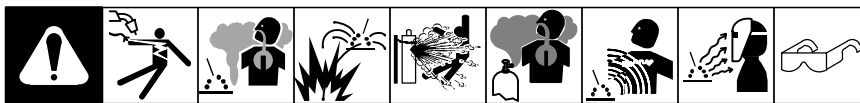
For intuitive connection set up images are displayed to help with proper machine and cable connections when welding processes are changed. This time can be adjusted from Off to 30 seconds. Default time is 3 seconds.

To exit menu, simultaneously press and release the lower left outside (-) button and lower right outside (+) button, or turn unit off and on.



Ref. 281104-C

6-16. TIG Postflow Control (Menu 13 Of 13)



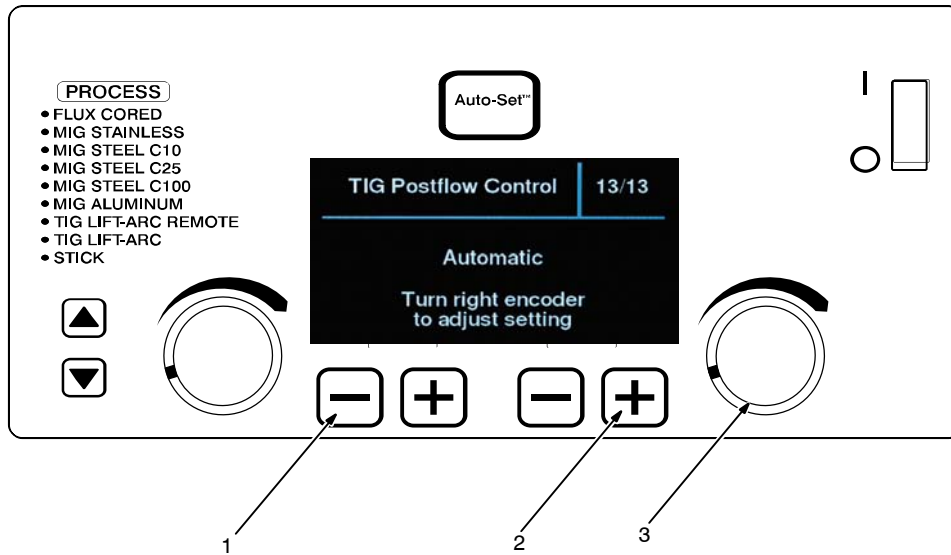
- 1 Lower Left Outside (-) Button
- 2 Lower Right Outside (+) Button
- 3 Right Control Encoder

Follow instructions in Section 6-3 to enter the setup menu.

To adjust TIG post flow time turn right control encoder.

Post flow can be adjusted from auto to 25 seconds.

To exit menu, simultaneously press and release the lower left outside (-) button and lower right outside (+) button, or turn unit off and on.



Ref. 281104-C

Notes

SECTION 7 – WELD PARAMETER CHARTS

7-1. Welding Parameters

Steel WireWelding (MIG/Flux-Cored) Parameters											
Material	Polarity	Shielding Gas*	Wire Type	Wire Size	MIG-GMAW						
					24 ga (V/WFS)	22 ga (V/WFS)	20 ga (V/WFS)	18 ga (V/WFS)	16 ga (V/WFS)	14 ga (V/WFS)	
Steel	DCEP	C25	Solid Wire ER70S-6	0.024"	15.5/174	15.6/201	15.8/211	16.1/272	16.2/330	17.9/409	
				0.030"	14.3/99	14.7/111	15.0/140	15.4/180	15.8/217	16.8/230	
				0.035"	14.3/120	15.0/127	15.0/186	15.8/222	16.7/240		
		C10		0.024"	14.0/157	14.0/191	15.2/211	16.1/271	17.7/322	18.2/400	
				0.030"	13.8/95	14.5/107	14.8/120	15.0/195	15.8/210	16.5/250	
				0.035"		13.9/124	14.6/146	14.7/149	15.3/190	16.3/200	
				C100	0.024"		15.6/160	16.0/180	16.4/210	17.0/270	17.7/306
					0.030"		15.4/105	15.6/112	16.0/170	16.4/190	17.2/225
					0.035"		14.8/87	15.3/92	15.8/163	16.0/200	18.0/221
	DCEN	None	Flux-Cored E71T-11	0.030"				14.4/99	15.2/110	15.4/188	
				0.035"				13.4/73	14.2/82	16.0/126	
				0.045"					14.2/65	15.0/70	
Stainless Steel	DCEP	98/2	Stainless Steel 308L	0.024"		14.8/170	15.4/192	16.4/251	16.8/289	17.8/379	
				0.030"		14.3/154	15.0/176	15.7/195	16.4/225	16.7/241	
				0.035"		13.6/119	14.3/135	14.8/180	15.8/210	16.0/230	
Aluminum WireWelding (MIG) Parameters											
Material	Polarity	Shielding Gas*	Wire Type	Wire Size	MIG-GMAW						
					24 ga (V/WFS)	22 ga (V/WFS)	20 ga (V/WFS)	18 ga (V/WFS)	16 ga (V/WFS)	14 ga (V/WFS)	
Aluminum w/ Spoolmatic 30A	DCEP	Argon	ER4043	0.030"					15.1/310	15.8/386	
				0.035"							
Aluminum w/ Spoolmatic 30A			ER5356	0.030"					13.6/383	15.6/450	
				0.035"							
TIG Welding Parameters											
Material		Polarity	Shielding Gas*	Tungsten Size	TIG-GTAW						
					24 ga (Amps)	22 ga (Amps)	20 ga (Amps)	18 ga (Amps)	16 ga (Amps)	14 ga (Amps)	
Steel, Stainless Steel		DCEN	Argon	1/16"	27	35	40	45	55	70	
				3/32"	27	35	40	45	55	70	
				1/8"							
Stick Welding Parameters											
Material	Polarity	Electrode Type			Stick-SMAW						
					24 ga (Amps)	22 ga (Amps)	20 ga (Amps)	18 ga (Amps)	16 ga (Amps)	14 ga (Amps)	
Steel	DCEP	6011		3/32"					50	50	
				1/8"							
				5/32"							
		6013		3/32"					50	55	
				1/8"							
				5/32"							
		7018		3/32"						70	
				1/8"							
				5/32"							

Steel Wire Welding (MIG/Flux-Cored) Parameters

Material	Polarity	Shielding Gas*	Wire Type	Wire Size	MIG-GMAW				
					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 ER70S-6	0.024"	19.4/545	19.6/600			
				0.030"	18.0/285	19.3/382	20.4/440	21.2/460	21.5/480
				0.035"	18.7/256	19.5/306	20.5/330	21.2/365	22.3/395
		C10		0.024"	19.0/533	20.3/600			
				0.030"	18.0/290	18.5/336	26.1/470	26.5/480	26.8/505
				0.035"	17.7/209	18.8/340	26.1/420	26.5/435	26.8/453
		C100		0.024"	21.4/400	22.1/440			
				0.030"	18.2/240	21.0/290	23.0/430	23.6/450	24.0/460
				0.035"	19.1/260	21.7/290	22.3/342	23.5/360	24.0/365
	DCEN	None	Flux-Cored E71T-11	0.030"	19.7/350	21.6/371	22.5/413		
				0.035"	19.9/283	21.8/310	22.3/345	23.6/360	24.1/377
				0.045"	19.0/131	19.9/175	20.5/200	20.7/210	21.0/221
Stainless Steel	DCEP	98/2	Stainless Steel 308L	0.024"	20.0/500	22.0/600			
				0.030"	17.7/295	18.0/347	25.6/567	25.8/571	26.7/600
				0.035"	17.8/286	18.4/315	25.2/440	26.1/460	26.8/475

Aluminum Wire Welding (MIG) Parameters

Material	Polarity	Shielding Gas*	Wire Type	Wire Size	MIG-GMAW				
					1/8" (V/WFS)	3/16" (V/WFS)	1/4" (V/WFS)	5/16" (V/WFS)	3/8" (V/WFS)
Aluminum w/ Spoolmatic 30A	DCEP	Argon	ER4043	0.030"	21.7/400	23.2/425	25.0/500	25.3/525	26.0/590
				0.035"	19.5/250	22.5/280	24.5/325	25.0/380	25.5/420
Aluminum w/ Spoolmatic 30A			ER5356	0.030"	21.6/530	23.1/700	24.7/800		
				0.035"	19.5/300	21.5/380	24.5/465		

TIG Welding Parameters

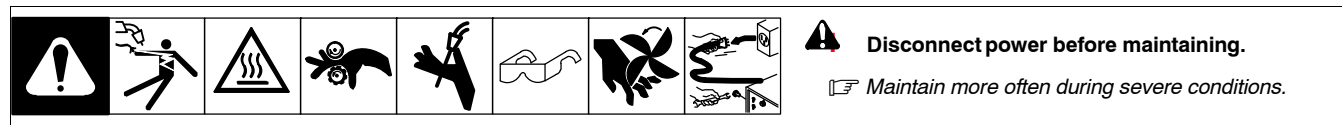
Material		Polarity	Shielding Gas*	Tungsten Size	TIG-GTAW				
					1/8" (Amps)	3/16" (Amps)	1/4" (Amps)	5/16" (Amps)	3/8" (Amps)
Steel, Stainless Steel		DCEN	Argon	1/16"	120	137			
				3/32"	120	137	190		
				1/8"					

Stick Welding Parameters

Material	Polarity	Electrode Type		Stick-SMAW				
				1/8" (Amps)	3/16" (Amps)	1/4" (Amps)	5/16" (Amps)	3/8" (Amps)
Steel	DCEP	6011	3/32"	60	90			
			1/8"	80	90	100	110	
			5/32"	130	140	150	160	160
		6013	3/32"	70	90			
			1/8"	80	95	115	130	
			5/32"	120	140	155	165	165
		7018	3/32"	95	100			
			1/8"	120	120	125	130	140
			5/32"	125	145	170	180	190

SECTION 8 – MAINTENANCE & TROUBLESHOOTING

8-1. Routine Maintenance



	✓ = Check * To be done by Factory Authorized Service Agent	◇ = Change	● = Clean	☆ = Replace
Every 3 Months	 ☆ Damaged Or Unreadable Labels	 ☆ Repair Or Replace Cracked Weld Cable	 ● Clean And Tighten Weld Terminals	 ✓ Check Gun Cable
Every 6 Months	 ● Inside Unit	 ● Clean Drive Rolls	 ✓ Apply Light Coat Of Oil Or Grease To Drive Motor Shaft	

8-2. Changing Drive Roll and Wire Inlet Guide

Tools Needed:
 7/16 in.

1 Securing Screw
2 Inlet Wire Guide
 Loosen screw. Slide tip as close to drive rolls as possible without touching. Tighten screw.
3 Drive Roll
 The drive roll consists of two different sized grooves. The stamped markings on the end surface of the drive roll refers to the groove on the opposite side of the drive roll. The groove closest to the motor shaft is the proper groove to thread (see Section 5-15).
4 Drive Roll Securing Nut
 Turn nut one click to secure drive roll.

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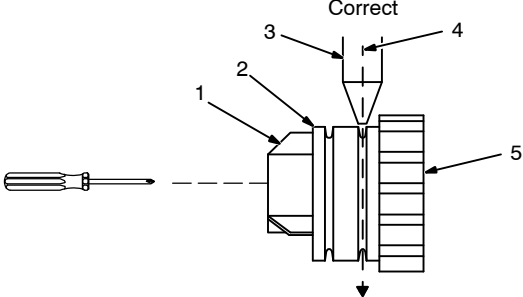
8-3. Overheating

Thermistors RT1 and RT2 protect the unit from damage due to overheating. If the output diode heat sink or transformer get too hot, they command the weld controller to disable the output. The fan keeps running to cool the unit. Wait several minutes before trying to weld.

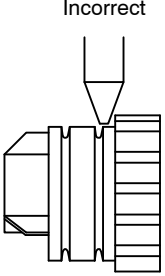
8-4. Aligning Drive Rolls and Wire Guide



Correct



Incorrect



⚠ Turn Off power.

View is from top of drive rolls looking down with pressure assembly open.

- 1 Drive Roll Securing Nut
- 2 Drive Roll
- 3 Wire Guide
- 4 Welding Wire
- 5 Drive Gear

Insert screwdriver, and turn screw in or out until drive roll groove lines up with wire guide.

Close pressure roll assembly.

Tools Needed:



Ref. 800 412-A

8-5. 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 authorized Miller service center.		
Trigger Error 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 or spool gun trigger is engaged while another process is selected.			
Trigger Error Release 10-pin trigger to clear error		The 10-pin trigger is engaged on power up.	Release 10-pin trigger to clear error.		
		The spool gun trigger is held during jog for more than 10 seconds.			
Foot Pedal Error Release TIG Foot Pedal		The TIG trigger is engaged on power up.	Release the TIG trigger to clear error.		
		The TIG trigger is engaged while the process is changed to TIG Lift-Arc Remote.			

Message	Error	Remedy
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 authorized Miller service center.
	Control board is damaged.	
Motor Error The 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 control board is damaged.	Contact authorized Miller service center.
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 authorized Miller service center.
	The fan is damaged.	
	The control board is damaged.	
Thermal Error Primary thermistor range error	The primary circuit thermistor is unplugged.	Reconnect the primary circuit thermistor.
	The primary circuit thermistor is reading too high or too low for a valid temperature.	Contact authorized Miller service center.
	The control board is damaged.	
Thermal Error Secondary thermistor range error	The secondary circuit thermistor is unplugged.	Reconnect the secondary circuit thermistor.
	The secondary circuit thermistor is reading too high or too low for a valid temperature.	Contact authorized Miller service center.
	The 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 error persists after a power cycle, contact authorized Miller service center.
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 150 volts.	Increase primary voltage above 150 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 authorized Miller service center.
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 authorized Miller service center.
	The control board is damaged.	
	The interface board is damaged.	
Stuck Electrode Free electrode to clear error	Stick/tungsten welding electrode has become stuck in weld puddle and turned output off.	Remove Stick/tungsten welding electrode from workpiece and output will turn back on after about one second.

Message	Error	Remedy
Cable Error Connect wire feed housing cable to clear error	A process that requires a welding gun to be attached to the internal motor is selected, but the wire feed housing cable is not attached to either the positive stud or negative stud of the power source.	Connect wire drive assembly cable to either the positive or negative stud, or select a different process.
	The control board is damaged.	Contact authorized Miller service center.
Cable Error Wire feed housing cable is touching electrode or work	A process that does not require a welding gun to be attached to the internal motor is selected, but the wire feed housing cable is attached to either the positive stud or negative stud of the power source.	Remove wire drive assembly cable from either the positive or negative stud, or select a different process.
	The control board is damaged.	Contact authorized Miller service center.
Remote Error Connect the TIG remote/foot pedal to clear error	A process that requires a remote or foot pedal is selected, but no remote is detected.	Connect a TIG remote or foot pedal, or select a different process.
Spoolgun Fault Remove and service gun. Cycle power to clear error	The spool gun motor lead is shorted to the electrode.	Fix or replace damaged spool gun.

8-6. 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.

SECTION 9 – ELECTRICAL DIAGRAM

	WARNING Do not touch live electrical parts. Disconnect input power or stop engine before servicing. Do not operate with covers removed. Have only qualified persons install, use, or service this unit.
	ELECTRIC SHOCK HAZARD

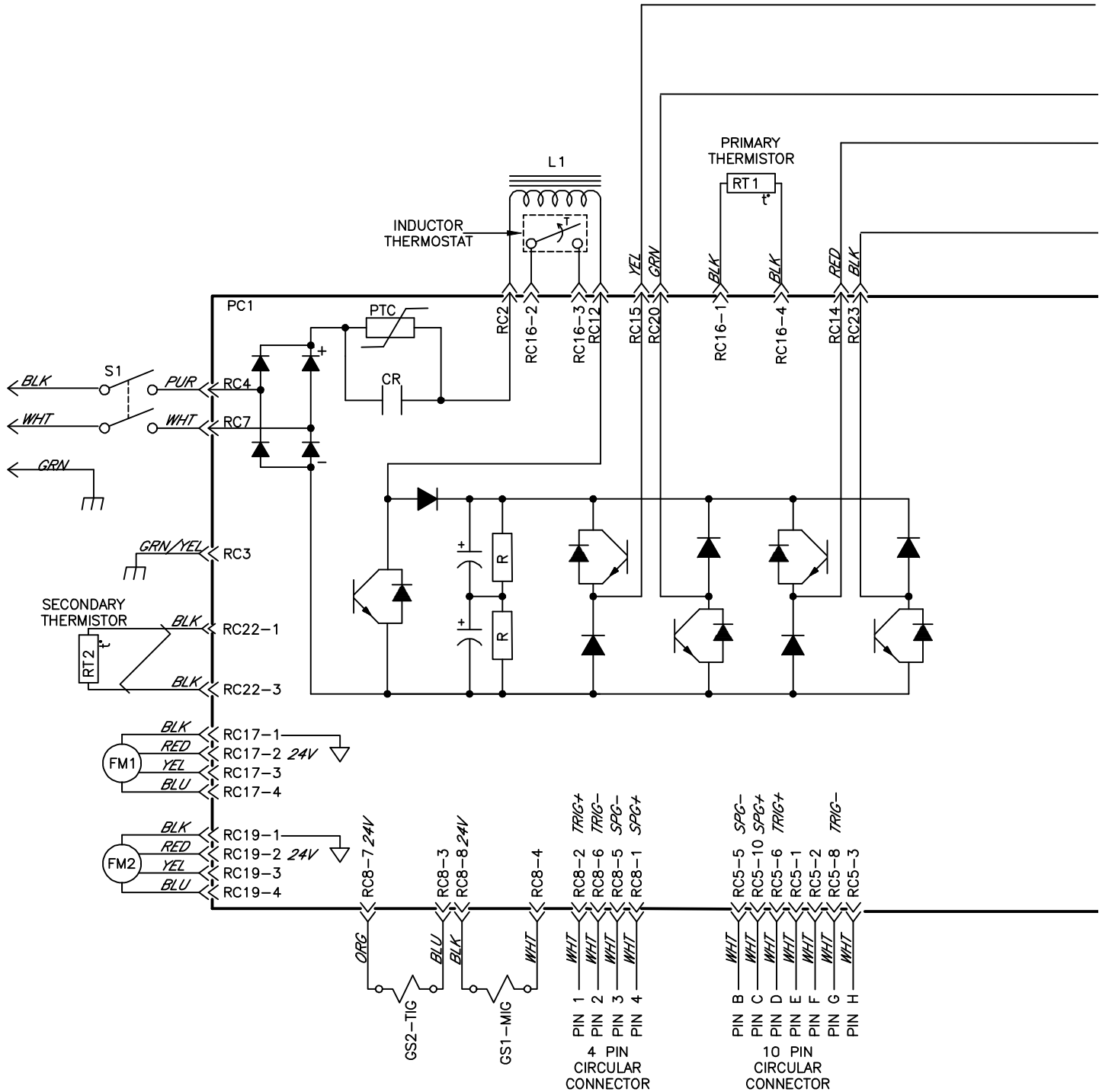
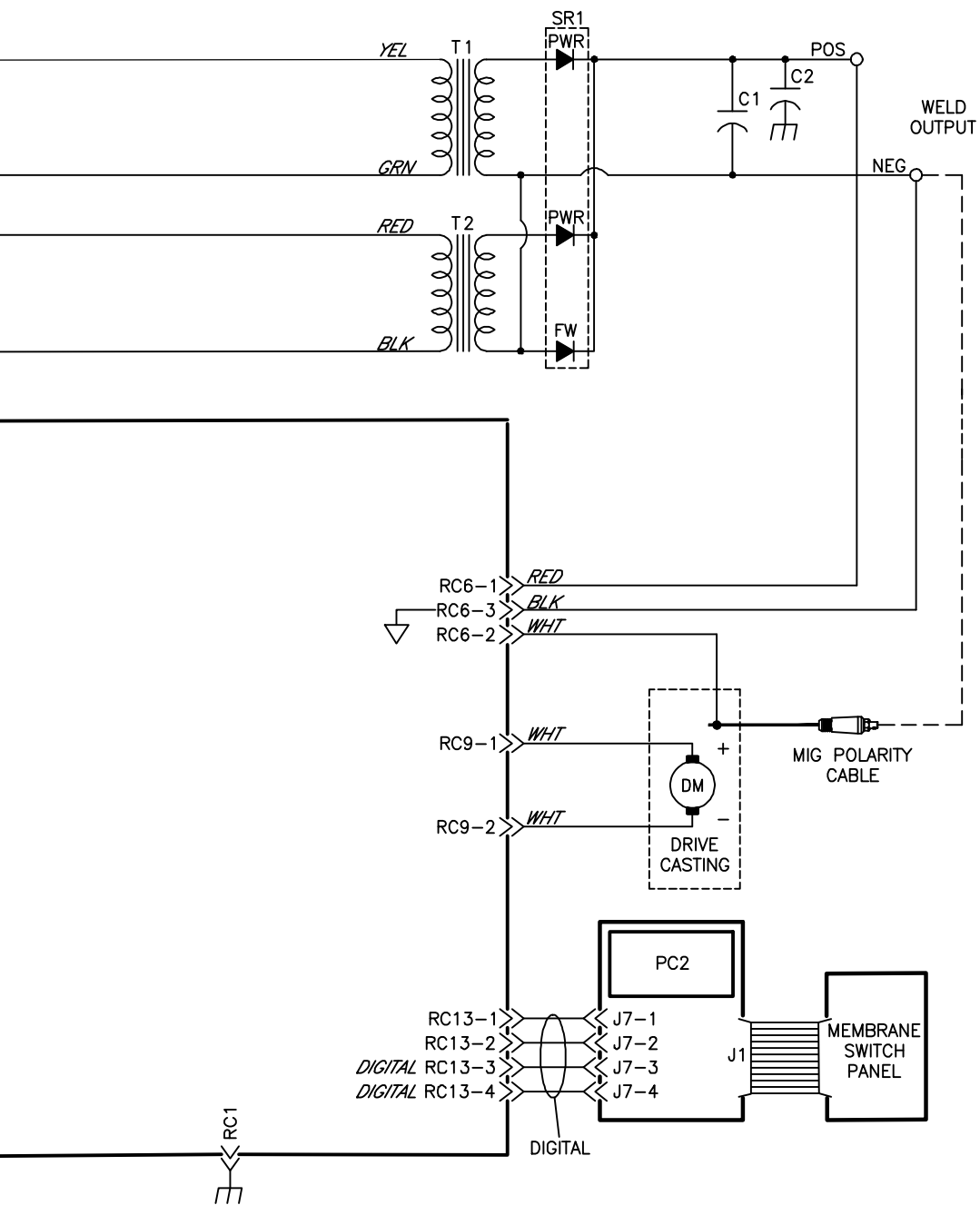
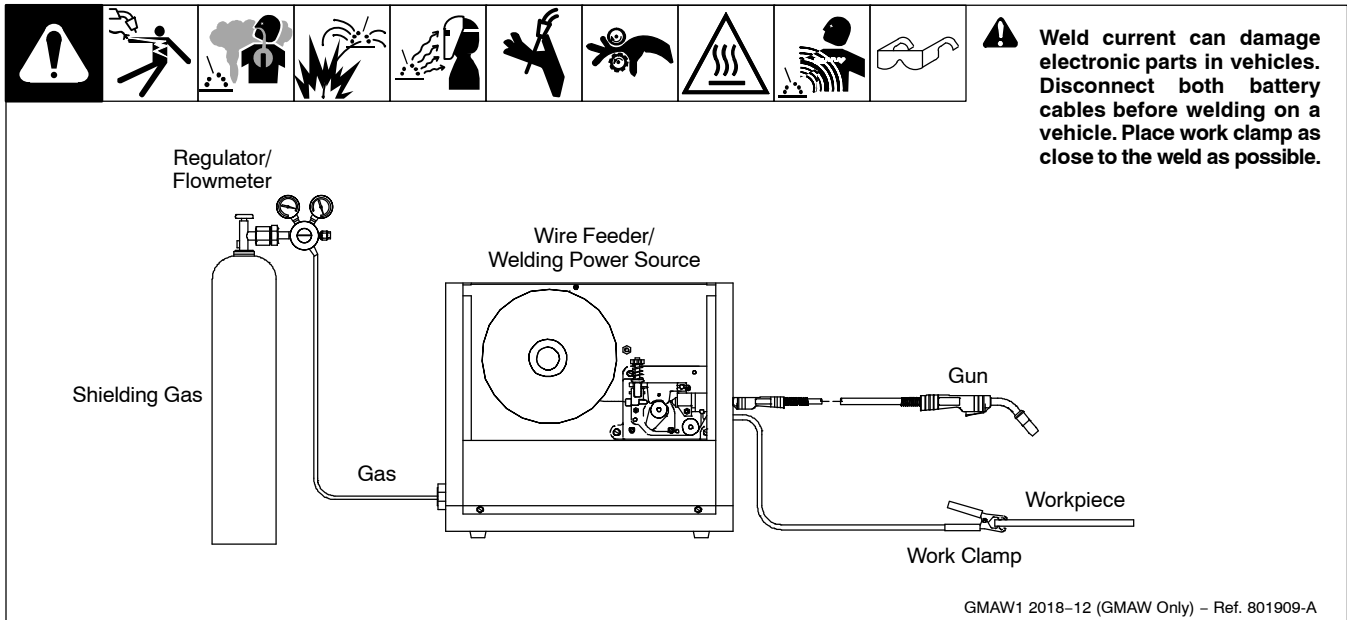


Figure 9-1. Circuit Diagram

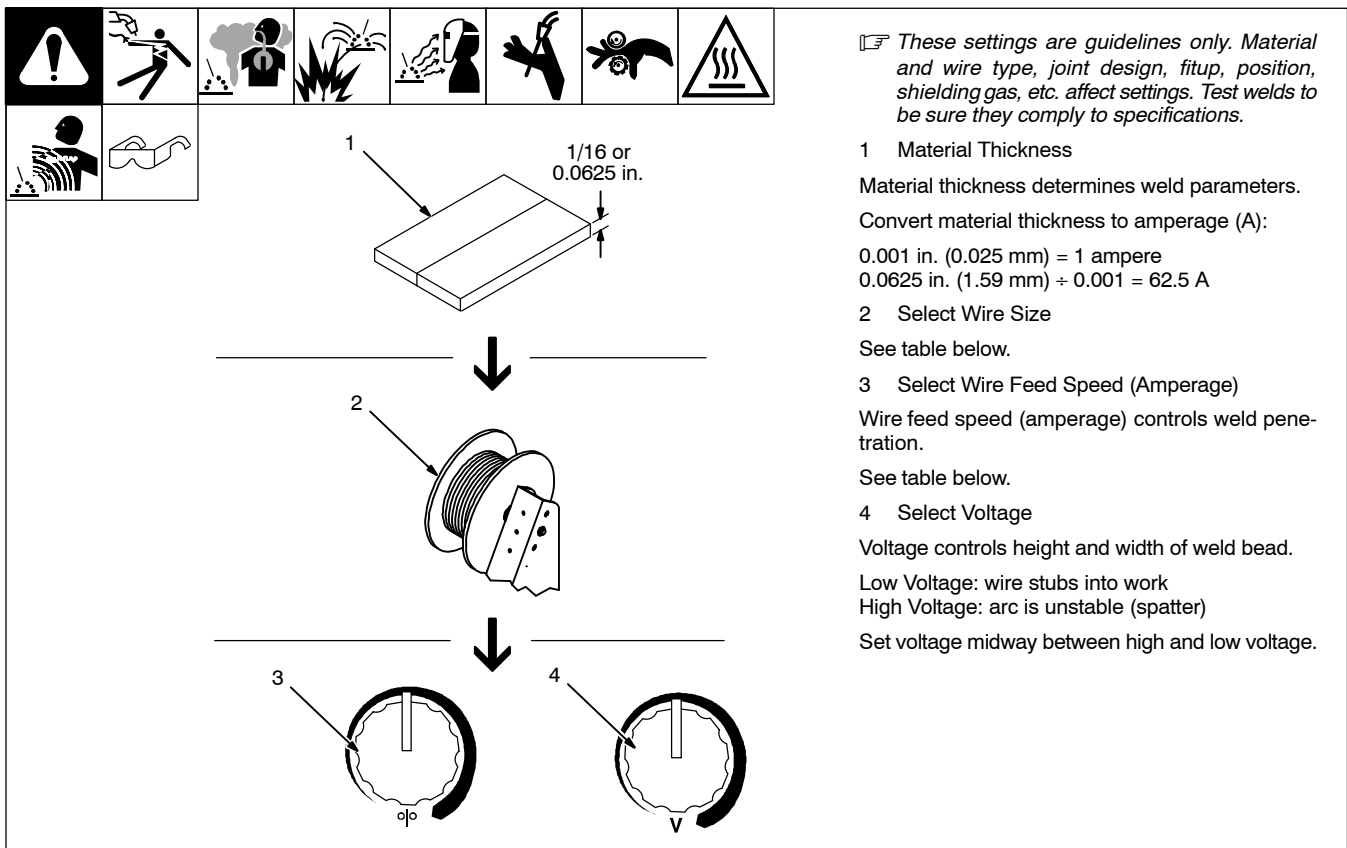


SECTION 10 – GMAW WELDING (MIG) GUIDELINES

10-1. Typical GMAW (MIG) Process Connections



10-2. Typical GMAW (MIG) Process Control Settings

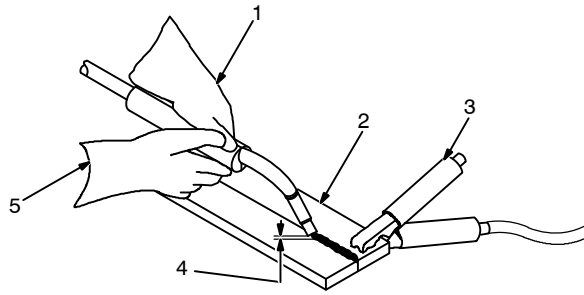


Wire Size	Amperage Range	Recommended Wire Feed Speed	Wire Feed Speed*
0.023 in. (0.58 mm)	30–90 A	3.5 in. (89 mm) per amp	3.5 x 62.5 A = 219 ipm (5.56 mpm)
0.030 in. (0.76 mm)	40–145 A	2 in. (51 mm) per amp	2 x 62.5 A = 125 ipm (3.19 mpm)
0.035 in. (0.89 mm)	50–180 A	1.6 in. (41 mm) per amp	1.6 x 62.5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

*62.5 A based on 1/16 in. (1.6 mm) material thickness.

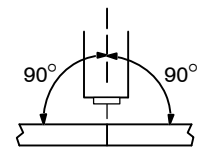
ipm = inches per minute; mpm = meters per minute

10-3. Holding And Positioning Welding Gun

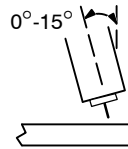


Welding wire is energized when gun trigger is pressed. Before lowering helmet and pressing trigger, be sure wire is no more than 1/2 in. (13 mm) past end of nozzle, and tip of wire is positioned correctly on seam.

- 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

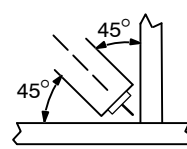


End View of Work Angle

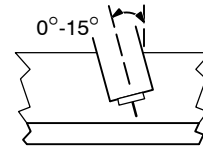


Side View of Gun Angle

Groove Welds



End View of Work Angle



Side View of Gun Angle

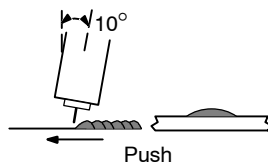
Fillet Welds

S-0421-A

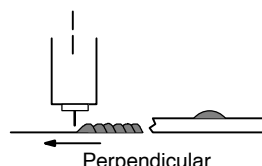
10-4. Conditions That Affect Weld Bead Shape



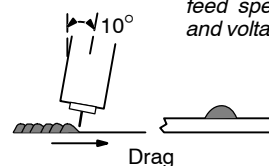
Weld bead shape depends on gun angle, direction of travel, electrode extension (stickout), travel speed, thickness of base metal, wire feed speed (weld current), and voltage.



Push

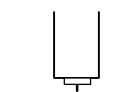


Perpendicular

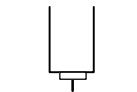


Drag

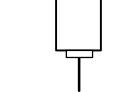
Gun Angles And Weld Bead Profiles



Short

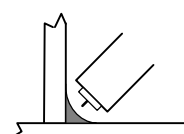


Normal

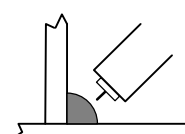


Long

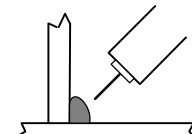
Electrode Extensions (Stickout)



Short



Normal



Long

Fillet Weld Electrode Extensions (Stickout)



Slow



Normal

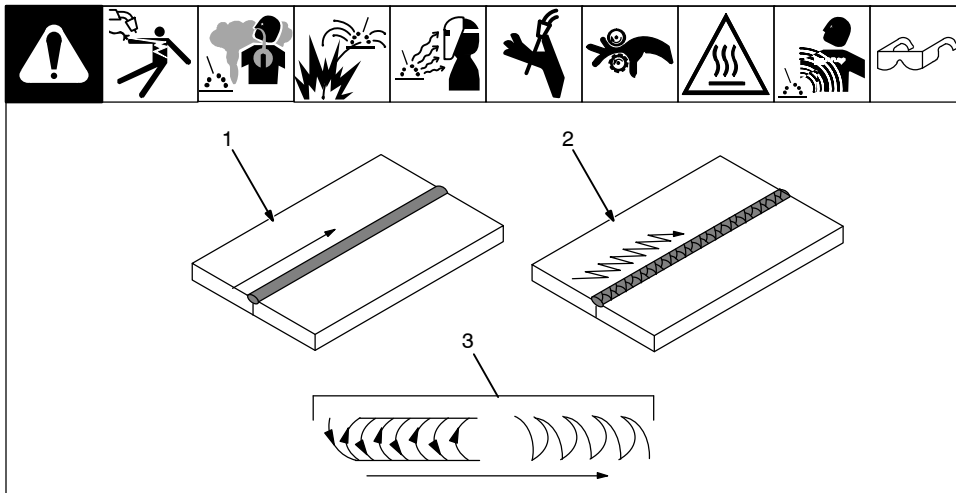


Fast

Gun Travel Speed

S-0634

10-5. Gun Movement During Welding



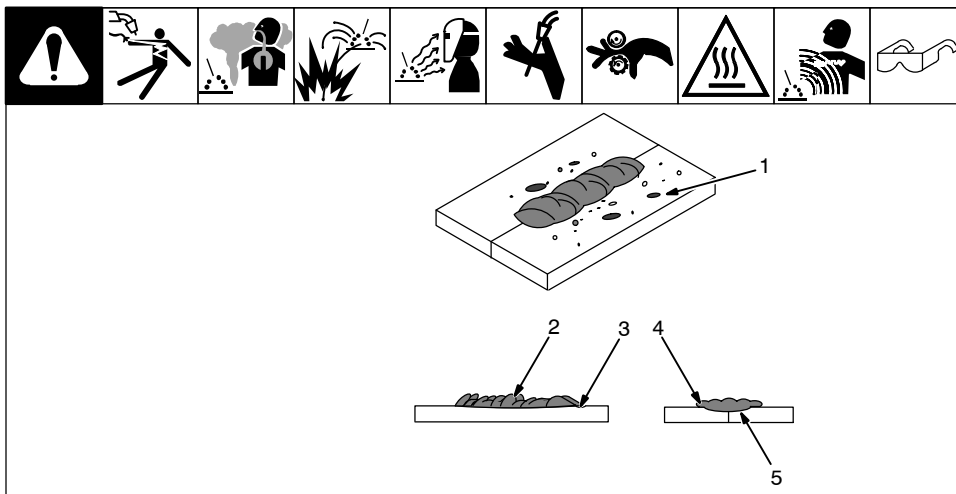
Normally, a single stringer bead is satisfactory for most narrow groove weld joints; however, for wide groove weld joints or bridging across gaps, a weave bead or multiple stringer beads works better.

- 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

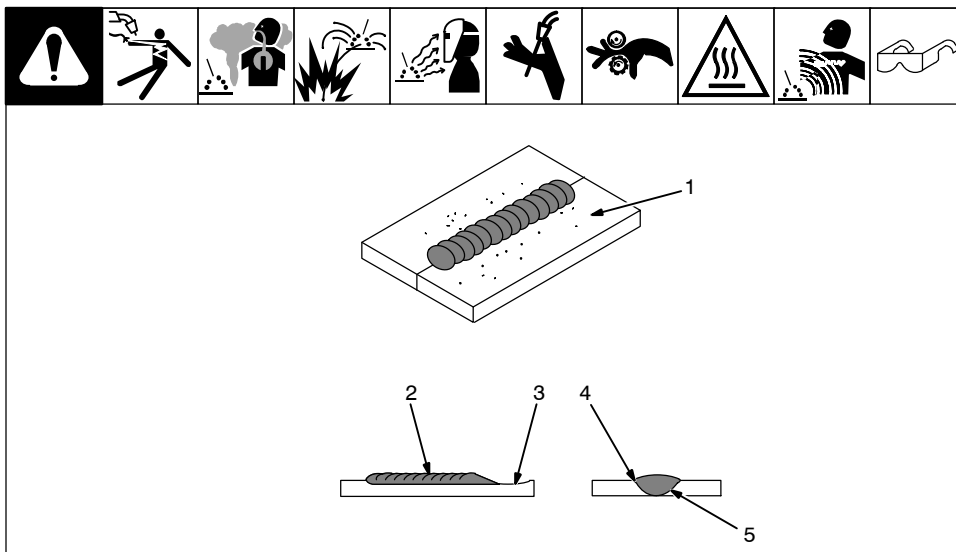
10-6. Poor Weld Bead Characteristics



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

S-0053-A

10-7. Good Weld Bead Characteristics



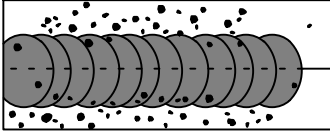
- 1 Fine Spatter
- 2 Uniform Bead
- 3 Moderate Crater During Welding

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

10-8. Troubleshooting – Excessive Spatter

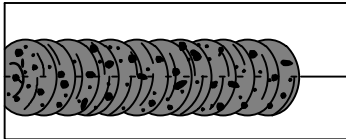


Excessive Spatter – scattering of molten metal particles that cool to solid form near weld bead.

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.

10-9. Troubleshooting – Porosity

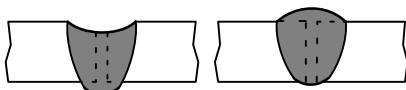


Porosity – small cavities or holes resulting from gas pockets in weld metal.

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.

10-10. Troubleshooting – Excessive Penetration



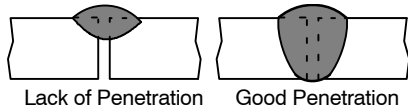
Excessive Penetration Good Penetration

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.

10-11. Troubleshooting – Lack Of Penetration

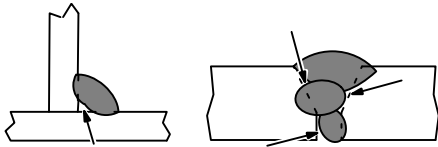


Lack Of Penetration – shallow fusion between weld metal and base metal.

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.

10-12. Troubleshooting – Incomplete Fusion

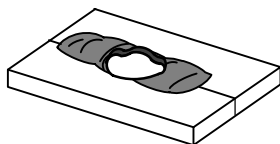


Incomplete Fusion – failure of weld metal to fuse completely with base metal or a preceding weld bead.

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.

10-13. Troubleshooting – Burn-Through

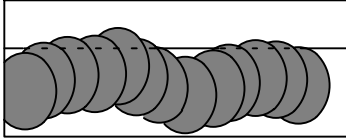


Burn-Through – weld metal melting completely through base metal resulting in holes where no metal remains.

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.

10-14. Troubleshooting – Waviness Of Bead

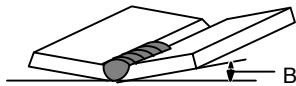


Waviness Of Bead – weld metal that is not parallel and does not cover joint formed by base metal.

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.

10-15. 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

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

10-16. 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			

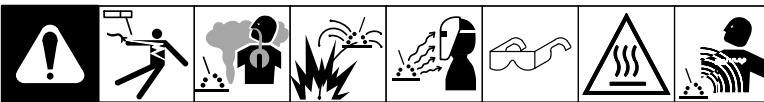
¹ Heavy Thicknesses

10-17. Troubleshooting Guide For Semiautomatic Welding Equipment

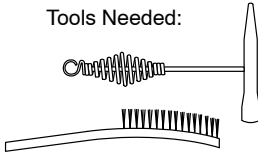
Problem	Probable Cause	Remedy
Wire feed motor operates, but wire does not feed.	Too little pressure on wire feed rolls.	Increase pressure setting on wire feed rolls.
	Incorrect wire feed rolls.	Check size stamped on wire feed rolls, replace to match wire size and type if necessary.
	Wire spool brake 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 11 – STICK WELDING (SMAW) GUIDELINES

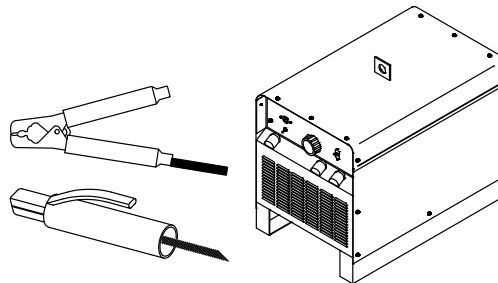
11-1. Stick Welding Procedure



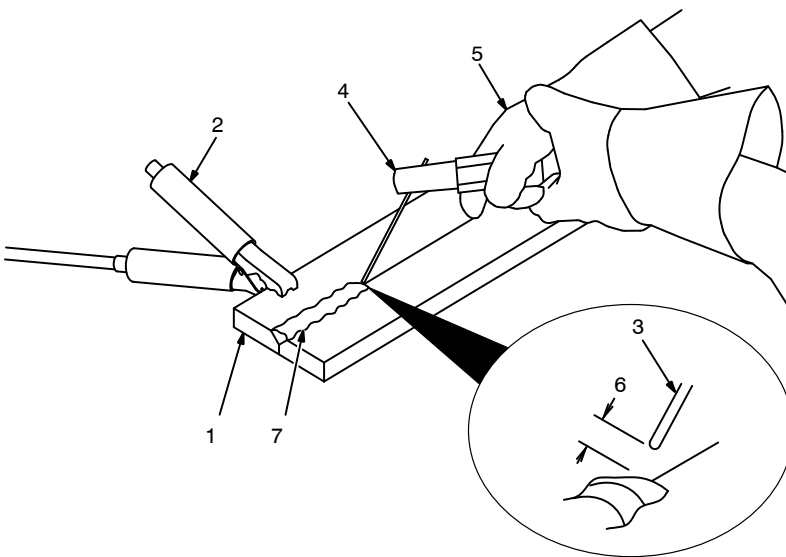
Tools Needed:



Equipment Needed:



Constant Current
Welding Power Source



⚠ Weld current starts when electrode touches workpiece.

⚠ 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 11-2).

4 Insulated Electrode Holder

5 Electrode Holder Position

6 Arc Length

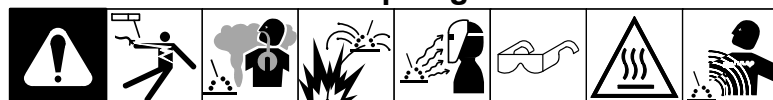
Arc length is the distance from the electrode to the workpiece. A short arc with correct amperage will give a sharp, crackling sound. Correct arc length is related to electrode diameter. Examine the weld bead to determine if the arc length is correct.

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.

11-2. Electrode And Amperage Selection Chart



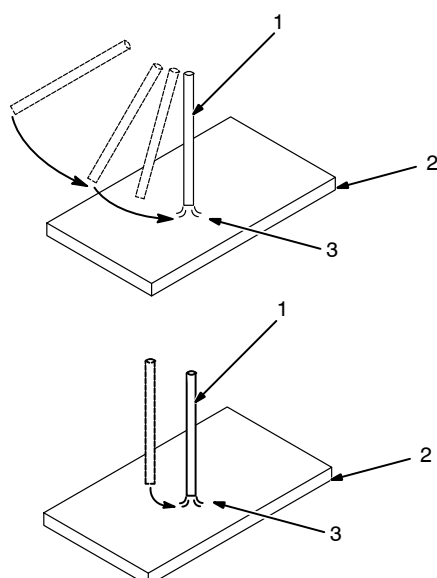
ELECTRODE	DIAMETER	AMPERAGE RANGE								
		50	100	150	200	250	300	350	400	450
6010 & 6011	3/32									
	1/8									
	5/32									
	3/16									
	7/32									
6013	1/4									
	1/16									
	5/64									
	3/32									
	1/8									
7014	5/32									
	3/16									
	7/32									
	1/4						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

11-3. Striking An Arc



⚠ Weld current starts when electrode touches workpiece.

- 1 Electrode
- 2 Workpiece
- 3 Arc

Scratch Technique

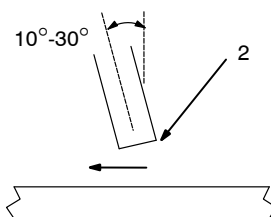
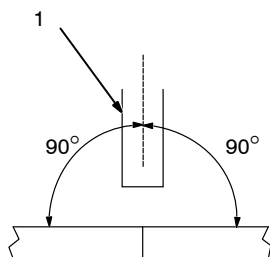
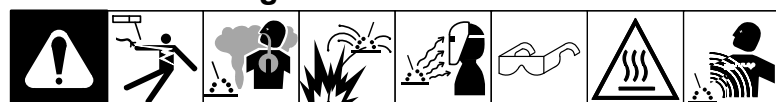
Drag electrode across workpiece like striking a match; lift electrode slightly after touching work. If arc goes out, electrode was lifted too high. If electrode sticks to workpiece, use a quick twist to free it.

Tapping Technique

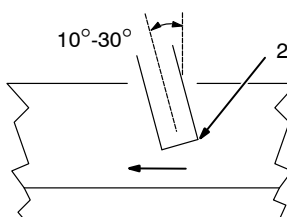
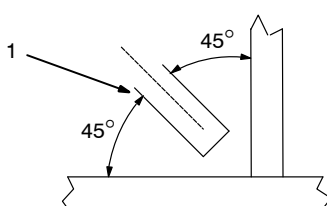
Bring electrode straight down to workpiece; then lift slightly to start arc. If arc goes out, electrode was lifted too high. If electrode sticks to workpiece, use a quick twist to free it.

S-0049 / S-0050

11-4. Positioning Electrode Holder



Groove Welds



Fillet Welds

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

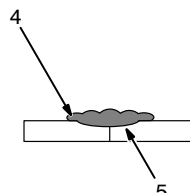
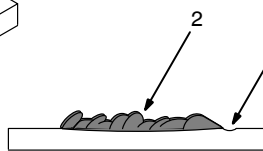
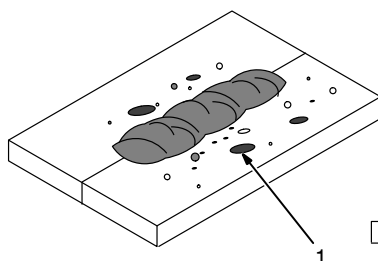
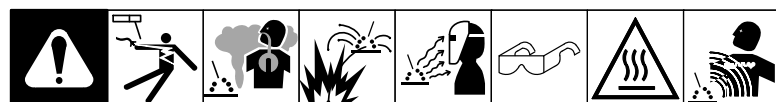
After learning to start and hold an arc, practice running beads of weld metal on flat plates using a full electrode.

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

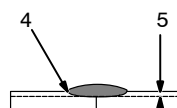
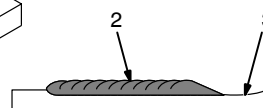
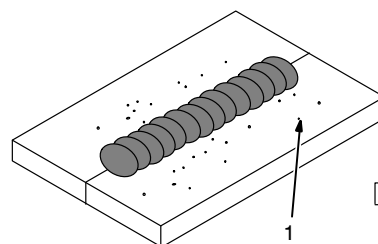
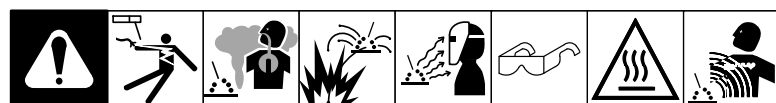
11-5. Poor Weld Bead Characteristics



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

S-0053-A

11-6. Good Weld Bead Characteristics



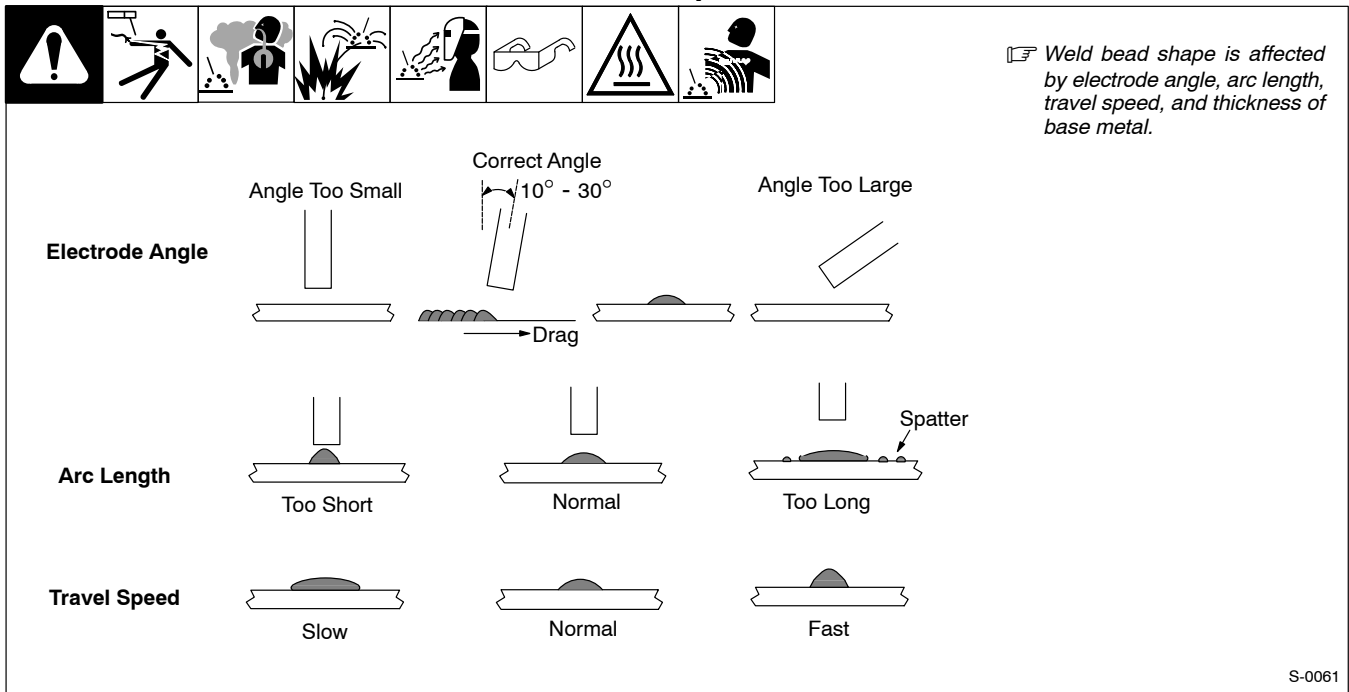
- 1 Fine Spatter
- 2 Uniform Bead
- 3 Moderate Crater During Welding

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

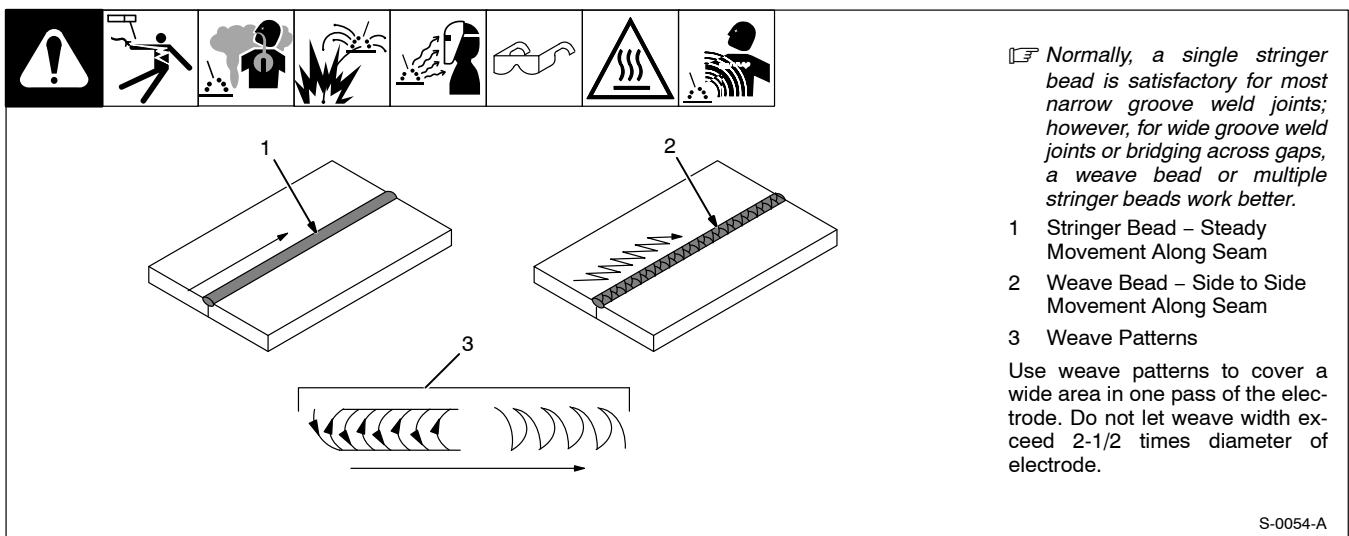
- 4 No Overlap
- 5 Good Penetration into Base Metal

S-0052-B

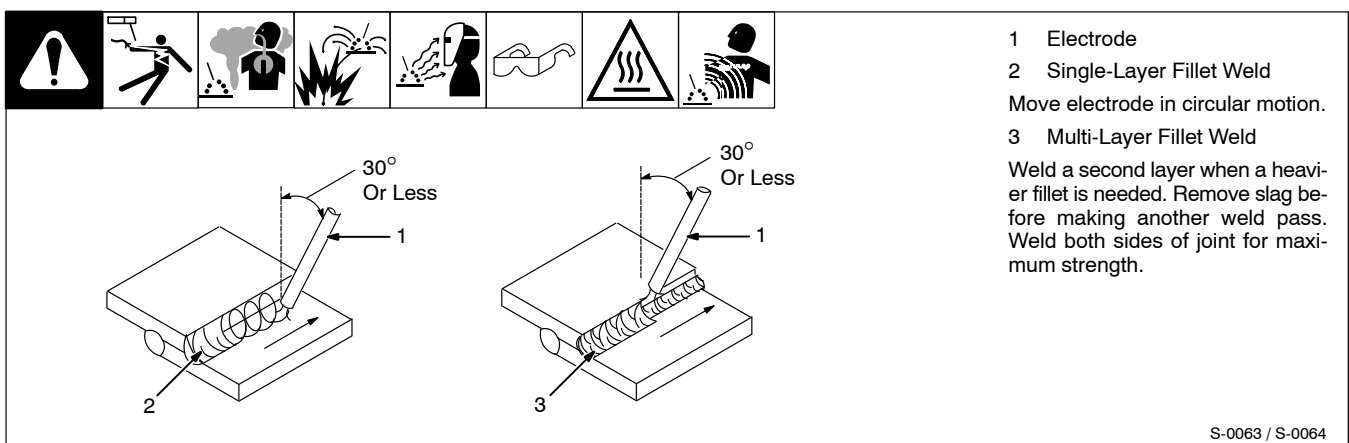
11-7. Conditions That Affect Weld Bead Shape



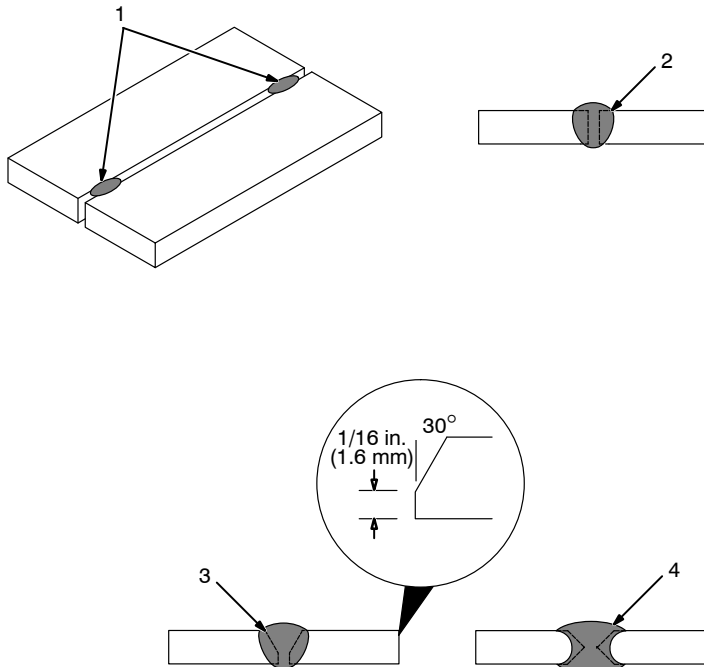
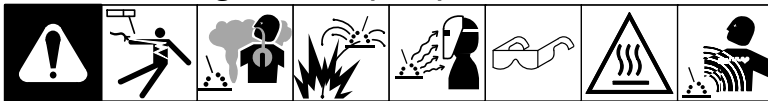
11-8. Electrode Movement During Welding



11-9. Welding Lap Joints



11-10. 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

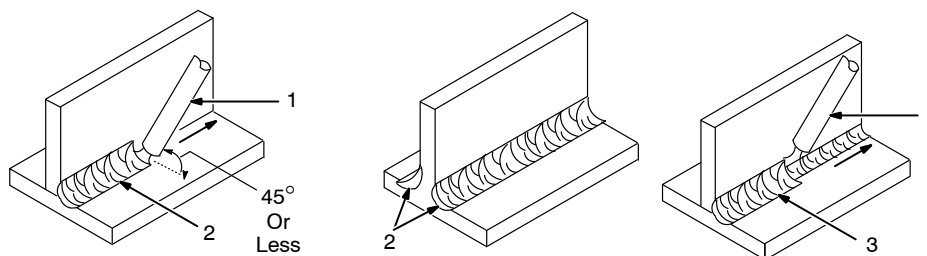
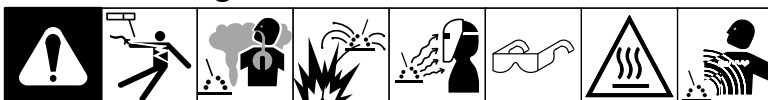
4 Double V-Groove Weld

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

11-11. 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.

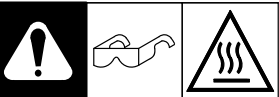
For maximum strength weld both sides of upright section.

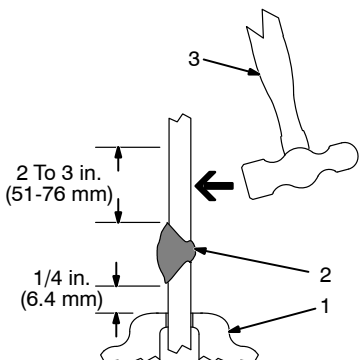
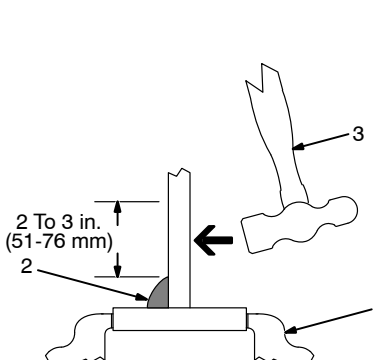
3 Multi-Layer Deposits

Weld a second layer when a heavier fillet is needed. Use any of the weaving patterns shown in Section 11-8. Remove slag before making another weld pass.

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

11-12. 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.

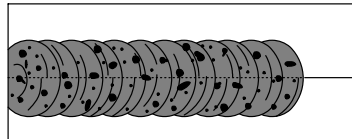
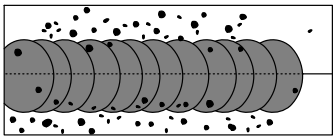
If the weld is porous (many holes), the arc length was probably too long.

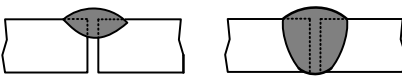
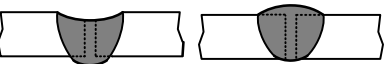
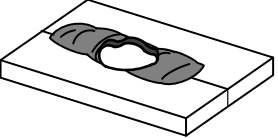
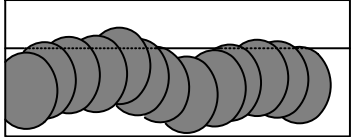
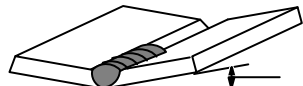
If the weld contains bits of slag, the arc may have been too long or the electrode was moved incorrectly which allowed molten slag to be trapped in the weld. This may happen on a V-groove joint made in several layers and calls for additional cleaning between layers.

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

11-13. Troubleshooting

	Porosity – small cavities or holes resulting from gas pockets in weld metal.
Possible Causes	Corrective Actions
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	Corrective Actions
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 preceeding weld bead.
Possible Causes	Corrective Actions
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	Corrective Actions
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	Corrective Actions
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	Corrective Actions
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	Corrective Actions
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	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 amperage for electrode.
	Increase travel speed.
	Weld in small segments and allow cooling between welds.

SECTION 12 – 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.

12-1. 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).

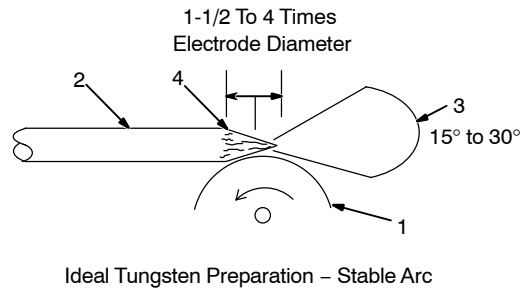
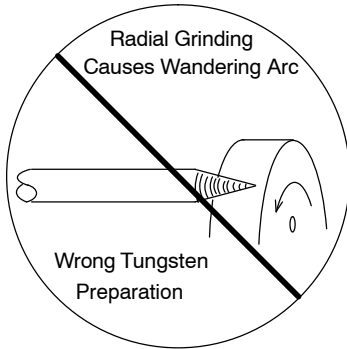
B. Electrode Composition.

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.	

12-2. 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 thoria. 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 13 – PARTS LIST

13-1. Drive Roll And Wire Guide Kits

 Base selection of drive rolls upon the following recommended usages:

- 1 V-Grooved rolls for hard wire.
- 2 U-Grooved rolls for soft and soft shelled cored wires.
- 3 U-Cogged rolls for extremely soft shelled wires (usually hard surfacing types).
- 4 V-Knurlled rolls for hard shelled cored wires.
- 5 Drive roll types may be mixed to suit particular requirements (example: V-Knurlled roll in combination with U-Grooved).

Wire Diameter			Kit No.	Drive Roll		Inlet Wire Guide
Fraction	Decimal	Metric		Part No.	Type	
.023/.025 in.	.023/.025 in.	0.6 mm	087 131	087 130	V-Grooved	056 192
.030/.035 in.	.030/.035 in.	0.8/0.9 mm	204 579	203 526	V-Grooved	056 192
.030 in.	.030 in.	0.8 mm	079 594	053 695	V-Grooved	056 192
.035 in.	.035 in.	0.9 mm	079 595	053 700	V-Grooved	056 192
.045 in.	.045 in.	1.2 mm	079 596	053 697	V-Grooved	056 193

Ref. S-0026-B/7-91

13-2. MDX Welding Gun Consumables

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

A complete Parts List is available on-line at www.MillerWelds.com

Notes

TRUE BLUE[®]

WARRANTY

Effective January 1, 2020

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

This limited warranty supersedes all previous Miller warranties and is exclusive with no other guarantees or warranties expressed or implied.

Warranty Questions?

Call
1-800-4-A-MILLER
for your local
Miller distributor.

Your distributor also gives
you ...

Service

You always get the fast,
reliable response you
need. Most replacement
parts can be in your
hands in 24 hours.

Support

Need fast answers to the
tough welding questions?
Contact your distributor.
The expertise of the
distributor and Miller is
there to help you, every
step of the way.

LIMITED WARRANTY – Subject to the terms and conditions below, Miller Electric Mfg. LLC, Appleton, Wisconsin, warrants to authorized distributors that new Miller equipment sold after the effective date of this limited warranty is free of defects in material and workmanship at the time it is shipped by Miller. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS.

Within the warranty periods listed below, Miller will repair or replace any warranted parts or components that fail due to such defects in material or workmanship. Miller must be notified in writing within thirty (30) days of such defect or failure, at which time Miller will provide instructions on the warranty claim procedures to be followed. Notifications submitted as online warranty claims must provide detailed descriptions of the fault and troubleshooting steps taken to diagnose failed parts. Warranty claims that lack the required information as defined in the Miller Service Operation Guide (SOG) may be denied by Miller.

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 (Except External Sensors)
 - * 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, Filtair 400 and Industrial Collector Series
4. 1 Year — Parts and Labor Unless Specified
 - * ArcReach Heater
 - * AugmentedArc and LiveArc Welding Systems
 - * Automatic Motion Devices
 - * Bernard BTB Air-Cooled MIG Guns (No Labor)
 - * CoolBelt (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 – Filtair 130, MWX and SWX Series, ZoneFlow Extraction Arms and Motor Control Box
 - * 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
 - * Subarc Wire Drive Assemblies

- * Supplied Air Respirator (SAR) Boxes and Panels
 - * 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)
 - * ArcReach Heater Quick Wrap and Air Cooled Cables
 - * Canvas Covers
 - * Induction Heating Coils and Blankets, Cables, and Non-Electronic Controls
 - * MDX Series MIG Guns
 - * 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

Register your product at www.millerwelds.com/support/product-registration

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 Protective Equipment (PPE)

Service and Repair

Replacement Parts

Training (Schools, Videos, Books)

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.

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For International Locations Visit

www.MillerWelds.com

