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2023-02

Processes



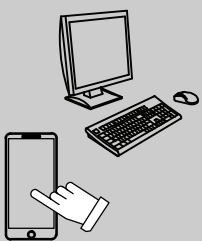
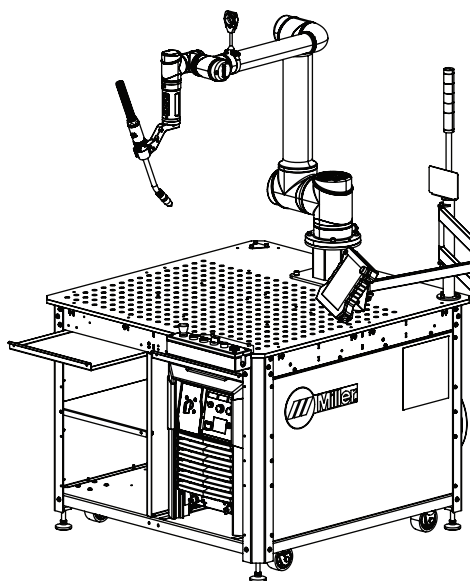
MIG (GMAW) Welding
Pulsed MIG (GMAW-P) Welding

Description



Collaborative Robotic Welding System

Copilot™ Collaborative Welding System



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

www.MillerWelds.com

OWNER'S MANUAL

Introduction

Miller Copilot is a portable Collaborative Arc Welding System. The system is designed to meet applicable North American safety standards listed in the specifications section of this manual. The system includes a Miller Cobot, controller, welding power source and welding torch all integrated onto a unified cart, ready for you to connect power, gas, and wire.

Intended Use Of Miller Copilot

Miller collaborative arc welding systems have been designed for safe operation in a collaborative production environment. This **Collaborative Robot (Cobot)** has been designed to provide you the repetitive precision and endurance of robots, while working in the same workspace, side by side with the individual skills and ability of people. To achieve this capability, the safety related control system is designed to control key parameters such as speed and force to ensure safe operation in the shared workspace.

The system has a single, fixed cobot workspace shared with and contained within a larger, single operator workspace.

The cobot performs weld process production tasks on the materials that are loaded and unloaded by an operator.

During normal production tasks, there is the potential for direct interaction between the cobot and the operator, however, unintentional direct interaction is possible due to a lack of a physical barrier separating the cobot workspace from that of the production personnel. As such, the cobot can only operate under power and force limited control at slower speeds in accordance with ISO/TS 15066:2016 thereby reducing risk of unintended contact between the cobot and production personnel.

Miller collaborative arc welding systems are manufactured and shipped as unapplied welding systems. These systems are designed for welding related applications. Miller Welding Automation (MWA) has made an assessment to identify the tasks associated with these applications. These tasks are considered in this risk assessment at the end of this manual.

Important: Tooling, fixtures, and other equipment added to the robotic cell after delivery may change the type and number of hazards present in and around the cobot system. A review of the safety and another risk assessment must be made after installation of any additional equipment to the robotic cell.



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

 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. 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

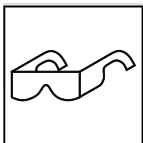
(stick) welder, or 3) an AC welder with reduced open-circuit voltage. In most situations, use of a DC, constant voltage wire welder is recommended. And, do not work alone!

- 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.
- Use only well-maintained equipment. Repair or replace damaged parts at once. Maintain unit according to manual.
- Do not touch electrode holders connected to two welding machines at the same time since double open-circuit voltage will be present.
- 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.



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.



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.



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.



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.



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.

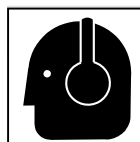
- Wear an approved welding helmet fitted with a proper shade of filter lenses to protect your face and eyes from arc rays and sparks when welding or watching (see ANSI Z49.1 and Z87.1 listed in Safety Standards).
- Wear approved safety glasses with side shields under your helmet.
- Use protective screens or barriers to protect others from flash, glare, and sparks; warn others not to watch the arc.
- Wear body protection made from leather or flame-resistant clothing (FRC). 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 (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 leather or flame-resistant clothing (FRC). 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.



NOISE can damage hearing.

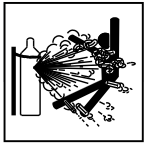
Noise from some processes or equipment can damage hearing.

- Wear approved ear protection if noise level is high.



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.



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



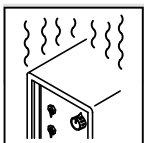
FIRE OR EXPLOSION hazard.

- 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.



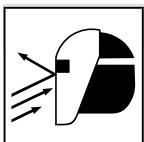
FALLING EQUIPMENT can injure.

- 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.



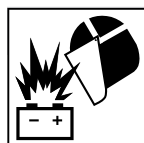
MOVING PARTS can injure.

- 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.



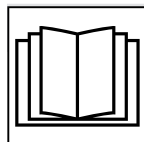
BATTERY EXPLOSION can injure.

- 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 microprocessors, 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. Maintenance and Repair



MAINTENANCE and REPAIR WORK must follow all safety instructions in this manual.

Maintenance, calibration, and repair work must be performed in accordance with the latest versions of

Service Manuals.

Follow all regional and national safety requirements and always test whether all safety functions work properly.

Prior to operating the Cobot manipulator or control box, please follow the procedures and warnings below:

- Before performing maintenance, follow lockout/tag out procedures.
- Remove the main input power cable from the control box to ensure the power is off.
- Check the grounding connection before switching on the power of the Cobot system.

- Observe ESD (Electro-Static Discharge) procedures when parts of the Cobot manipulator or control box are disassembled.
- There are no serviceable parts in the controller. If service is required, please contact Miller Electric.
- Avoid disassembling the power supply connections located inside the controller. High voltages can be present at the power supply connections for several hours after the control box has been switched off.
- Prevent water and dust from entering the Cobot manipulator or controller.
- Changing torch weight can affect force limits, which can cause injury. Contact Miller Welding Automation Service to determine safety settings before changing torch weight.
- Reactivate any deactivated safety measures immediately after maintenance work is completed.
- Document all maintenance operations completed and save for future reference.

1-5. 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.

1-6. Principal Safety Standards

Safety in Welding, Cutting, and Allied Processes, American Welding Society standard ANSI Standard Z49.1. Website: <http://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. Website: <http://www.aws.org>.

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

American National Standard for Industrial Robots and Robot Systems – Safety Requirements, ANSI/RIA R15.06-2012, Robotic Industries Association. Website: www.robotics.org.

Robotic Industries Association Technical Report – supplement to ANSI/RIA R15.06-2012, RIA TR 15.406-2014, Robotic Industries Association. Website: www.robotics.org.

Technical Report for Industrial Robots and Robot Systems – Safety Requirements, Task-based Risk Assessment Methodology, RIA TR R15.306-2014. Website: www.robotics.org.

Electrical Standard for Industrial Machinery, NFPA Standard 79, from National Fire Protection Association. Website: www.nfpa.org.

Safety Standard for Robots and Robotic Equipment, UL 1740. Website: www.ulstandards.ul.com.

Industrial robots and robot systems, CAN/CSA-Z434, Canadian Standards Association (CSA). Website: www.csa.ca.

Technical Specification Robots and Robotic Devices- Collaborative Robots, ISO/TS 15066:2016.

Safety of Machinery – General Principles for Design – Risk Assessment and Risk Reduction, ISO 12100:2010.

Robots and Robotic Devices – Safety Requirements– Part 2: Industrial Robot Systems and Integration, ISO 10218-2:2011.

Safety of Machinery; General Requirements & Risk Assessment, ANSI B11.0-2010.

Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function, IEC 60947-5-5.

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1-7. 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

 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 ce symbole, prendre garde et suivre les instructions afférentes pour éviter tout risque. Les consignes de sécurité présentées ci-après ne font que résumer l'information contenue dans les Normes de sécurité principales. Lire et suivre 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.

 Au cours de l'utilisation, tenir toute personne à l'écart et plus particulièrement les enfants.



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 !

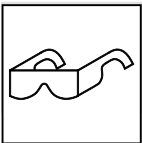
- Couper l'alimentation ou arrêter le moteur avant de procéder à l'installation, à la réparation ou à l'entretien de l'appareil. Déverrouiller l'alimentation selon la norme OSHA 29 CFR 1910.147 (voir normes de sécurité).
- Brancher correctement la mise à la terre et utiliser cet appareil conformément à son manuel d'utilisateur et aux codes nationaux, provinciaux et municipaux.
- Toujours vérifier la mise à la terre — vérifier et assurez-vous que le conducteur de mise à la terre du cordon d'alimentation est bien raccordé à la borne de mise à la terre dans le boîtier de déconnexion ou que la fiche du cordon est raccordée à une prise correctement mise à la terre.
- En effectuant les raccordements d'entrée, fixer d'abord le conducteur de mise à la terre approprié et contre-vérifier les connexions.
- Les câbles doivent être exempts d'humidité, d'huile et de graisse ; protégez-les contre les étincelles et les pièces métalliques chaudes.
- Vérifier fréquemment le cordon d'alimentation et le conducteur de mise à la terre afin de s'assurer qu'il n'est pas altéré ou dénudé -, le remplacer immédiatement s'il l'est -. Un fil dénudé peut entraîner la mort.
- L'équipement doit être hors tension lorsqu'il n'est pas utilisé.
- Ne pas utiliser des câbles usés, endommagés, de grosseur insuffisante ou mal épissés.
- Ne pas enrouler les câbles autour du corps.
- Si la pièce soudée doit être mise à la terre, le faire directement avec un câble distinct.
- Ne pas toucher l'électrode quand on est en contact avec la pièce, la terre ou une électrode provenant d'une autre machine.
- Ne pas toucher des porte électrodes connectés à deux machines en même temps à cause de la présence d'une tension à vide doublée.
- N'utiliser qu'un matériel en bon état. Réparer ou remplacer sur-le-champ les pièces endommagées. Entretenir l'appareil conformément à ce manuel.
- Porter un harnais de sécurité si l'on doit travailler au-dessus du sol.

- S'assurer que tous les panneaux et couvercles sont correctement en place.
- Fixer le câble de retour de façon à obtenir un bon contact métal-métal avec la pièce à souder ou la table de travail, le plus près possible de la soudure.
- Isoler la pince de masse quand pas mis à la pièce pour éviter le contact avec tout objet métallique.
- Ne pas raccorder plus d'une électrode ou plus d'un câble de masse à une même borne de sortie de soudage. Débrancher le câble pour le procédé non utilisé.
- Utiliser une protection différentielle lors de l'utilisation d'un équipement auxiliaire dans des endroits humides ou mouillés.



LES PIÈCES CHAUDES peuvent provoquer des brûlures.

- Ne pas toucher des parties chaudes à mains nues.
- 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.



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 FUMÉES ET LES GAZ peuvent être dangereux.

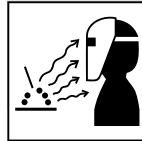
Le soudage génère des fumées et des gaz. Leur inhalation peut être dangereuse pour votre santé.

- 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 dégraisage, 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 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 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 pendant le soudage (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 une protection corporelle en cuir ou des vêtements ignifuges (FRC). La protection du corps comporte des vêtements sans huile, comme des gants de cuir, une chemise solide, des pantalons sans revers, des chaussures hautes et une casquette.

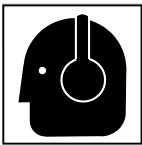


LE SOUDAGE peut provoquer un incendie ou une explosion.

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 défaillir. Voir OSHA 29 CFR 1910.177 énuméré dans les normes de sécurité.
- Ne pas effectuer le soudage sur des conteneurs fermés tels que des réservoirs, tambours, ou conduites, à moins qu'ils n'aient été préparés correctement conformément à AWS F4.1 (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 le 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 dégeler 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 une protection corporelle en cuir ou des vêtements ignifuges (FRC). La protection du corps comporte des vêtements sans huile, comme 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.



Le BRUIT peut endommager l'ouïe.

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

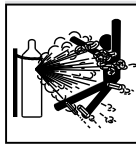
- Porter des protections approuvées pour les oreilles si le niveau sonore est trop élevé.



Les 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 le soudage à l'arc, du soudage par points, du gougeage, de la découpe plasma ou une opération de chauffage par induction.



Si des BOUTEILLES sont endommagées, elles pourront exploser.

Des bouteilles de gaz comprimé protecteur 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.
- Maintenir le chapeau de protection sur la soupape, sauf en cas d'utilisation ou de branchement de la bouteille.
- 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.

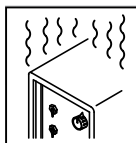
- Ne pas placer l'appareil sur, au-dessus ou à proximité de surfaces inflammables.
- Ne pas installer l'appareil à proximité de produits inflammables
- Ne pas surcharger l'installation électrique – s'assurer que l'alimentation est correctement dimensionnée et protégée avant de mettre l'appareil en service.



LA CHUTE DE L'ÉQUIPEMENT peut provoquer des blessures.

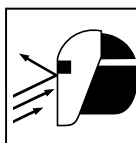
- Utiliser l'anneau de levage uniquement pour soulever l'appareil, NON PAS les organes de roulement, les bouteilles de gaz ou tout autre accessoire.
- Utilisez les procédures correctes et des équipements d'une capacité appropriée pour soulever et supporter l'appareil.
- En utilisant des fourches de levage pour déplacer l'unité, s'assurer que les fourches sont suffisamment longues pour dépasser du côté opposé de l'appareil.

- Tenir l'équipement (câbles et cordons) à distance des véhicules mobiles lors de toute opération en hauteur.
- Suivre les consignes du Manuel des applications pour l'équation de levage NIOSH révisée (Publication N°94-110) lors du levage manuel de pièces ou équipements lourds.



L'EMPLOI EXCESSIF peut SURCHAUFFER L'ÉQUIPEMENT.

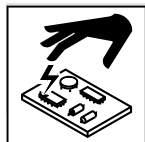
- Laisser l'équipement refroidir ; respecter le facteur de marche nominal.
- Réduire le courant ou le cycle opératoire avant de recommencer le soudage.
- Ne pas obstruer les passages d'air du poste.



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.



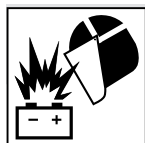
Les PIÈCES MOBILES peuvent causer des blessures.

- 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 gachette 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.

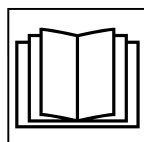
- Ne pas utiliser l'appareil de soudage pour charger des batteries ou faire démarrer des véhicules à l'aide de câbles de démarrage, sauf si l'appareil

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 des pièces de remplacement provenant du fabricant.
- 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. Maintenance et réparation



Les TRAVAUX DE MAINTENANCE et de RÉPARATION doivent respecter toutes les consignes de sécurité indiquées dans ce manuel.

Les travaux de maintenance, d'étalonnage et de réparation doivent être effectués conformément aux indications contenues dans les dernières versions des manuels d'entretien.

Appliquer toutes les exigences en matière de sécurité régionales et nationales et toujours vérifier que toutes les fonctions de sécurité sont en bon état de marche.

Avant d'utiliser le manipulateur Cobot ou le boîtier de commande, suivre les procédures et les avertissements ci-dessous :

- Avant d'effectuer des opérations de maintenance, suivre les procédures de verrouillage/indications de mise hors service.
- Retirer le câble d'alimentation de l'entrée principale du boîtier de commande pour vous assurer que l'alimentation est coupée.
- Vérifier la connexion à la terre avant de mettre le système Cobot sous tension.
- Respecter les procédures ESD (Electro-Static Discharge) lorsque des pièces du manipulateur Cobot ou du boîtier de commande sont démontées.
- Les pièces situées dans le contrôleur ne sont pas réparables. Si une réparation est nécessaire, contacter Miller Electric.

- Éviter de démonter les connexions d'alimentation électrique situées à l'intérieur du contrôleur. Des tensions élevées peuvent être présentes au niveau des connexions d'alimentation pendant plusieurs heures après avoir éteint le boîtier de commande.
- Empêcher l'eau et la poussière de pénétrer dans le manipulateur Cobot ou le contrôleur.

- La modification du poids de la torche peut affecter les limites de force, ce qui peut provoquer des blessures. Contacter Miller Welding Automation Service pour déterminer les paramètres de sécurité avant de changer le poids de la torche.
- Rallumer toutes les mesures de sécurité désactivées immédiatement après la fin des travaux de maintenance.
- Consigner toutes les opérations de maintenance effectuées et les conserver pour consultation ultérieure.

2-5. 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.

2-6. Principales normes de sécurité

Safety in Welding, Cutting, and Allied Processes, American Welding Society standard ANSI Standard Z49.1. Website: <http://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. Website: <http://www.aws.org>.

National Electrical Code, NFPA Standard 70 from National Fire Protection Association. Website: www.nfpa.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.csa-group.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.

American National Standard for Industrial Robots and Robot Systems – Safety Requirements, ANSI/RIA R15.06-2012, Robotic Industries Association. Website: www.robotics.org.

Robotic Industries Association Technical Report – supplement to ANSI/RIA R15.06-2012, RIA TR 15.406-2014, Robotic Industries Association. Website: www.robotics.org.

Technical Report for Industrial Robots and Robot Systems – Safety Requirements, Task-based Risk Assessment Methodology, RIA TR R15.306-2014. Website: www.robotics.org.

Electrical Standard for Industrial Machinery, NFPA Standard 79, from National Fire Protection Association. Website: www.nfpa.org.

Safety Standard for Robots and Robotic Equipment, UL 1740. Website: www.ulstandards.ul.com.

Industrial robots and robot systems, CAN/CSA-Z434, Canadian Standards Association (CSA). Website: www.csa.ca.

Technical Specification Robots and Robotic Devices- Collaborative Robots, ISO/TS 15066:2016.

Safety of Machinery – General Principles for Design – Risk Assessment and Risk Reduction, ISO 12100:2010.

Robots and Robotic Devices – Safety Requirements– Part 2: Industrial Robot Systems and Integration, ISO 10218-2:2011.

Safety of Machinery; General Requirements & Risk Assessment, ANSI B11.0-2010.

Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function, IEC 60947-5-5.

Cobot System_cfr 2023–02

2-7. 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: par exemple, des restrictions d'accès pour les passants ou une évaluation individuelle des risques 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 découpage 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 Symbol Definitions

	Warning! Watch Out! There are possible hazards as shown by the symbols.
	Do not remove or paint over (cover) the label.
	Hazardous voltage; electric shock can kill.
	Hazardous voltage; electric shock can kill.
	Moving parts can injure. Keep away from positioning arm when it is being moved.

3-2. Miscellaneous Symbols

A	Amperage
V	Voltage
Hz	Hertz
1~	Single Phase
3~	Three Phase
U₁	Rated Supply Voltage

I₁	Rated Supply Current
I_{1max}	Rated Maximum Supply Current
I_{1eff}	Maximum Effective Supply Current
	Ground
I	On

	Off
	Power On/Off
	Lockout
	Pushbutton In
	Pushbutton Out
	Isolating Switch Disconnect

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 the work table, above the input power connections. Use rating label to determine input power requirements and/or rated output. For future reference, write serial number in space provided on 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

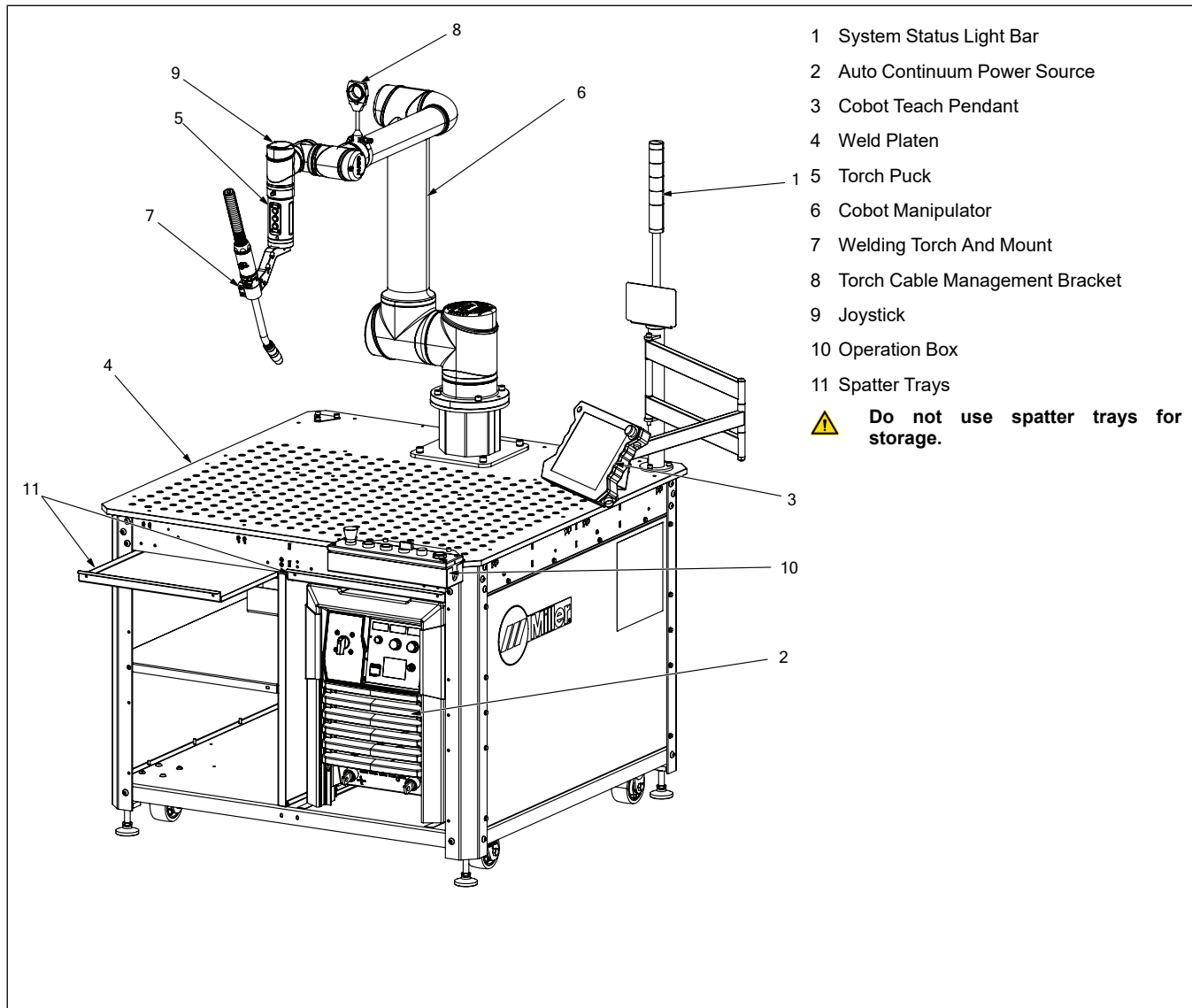
NOTICE – Each welding application is unique. Although certain Miller Electric products are designed to determine and default to certain typical welding parameters and settings based upon specific and relatively limited application variables input by the end user, such default settings are for reference 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. Cobot System Specifications

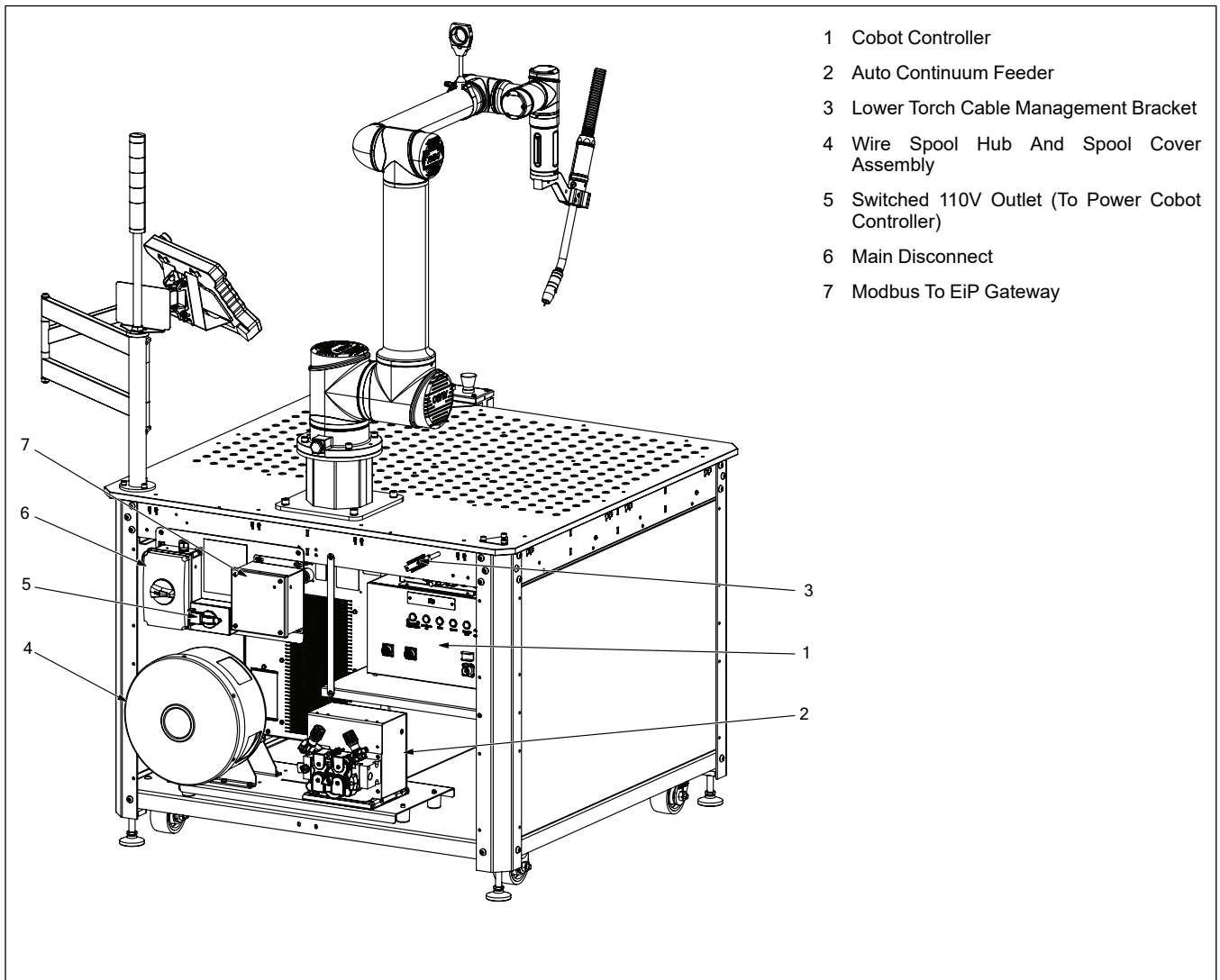
Input Power	3-phase 240-575 VAC Cobot requires separate 110 VAC input
Welder Specifications	Auto Continuum 350 350A at 31.5 VDC at 100% duty cycle
System Dimensions (HxWxD)	84 in. x 48 in. x 52 in. (2134 mm x 1219 mm x 1321 mm)
Payload capacity with feet	1500 lb (680 kg) (Assuming evenly spread across table)
Payload capacity with casters	750 lb (340 kg) (Assuming evenly spread across table)
Load Height	37 in. (940 mm)
System Weight	1700 lb (771 kg)
Torch Specifications	Tregaskiss CA3 Torch 350A Air Cooled
Table Specifications	5/8 in. diameter holes on 2 in. grid spacing 48 x 48 in (1219 x 1219 mm). Table is nitride hardened and reversible

4-5. System Component Identification

A. Front Of System

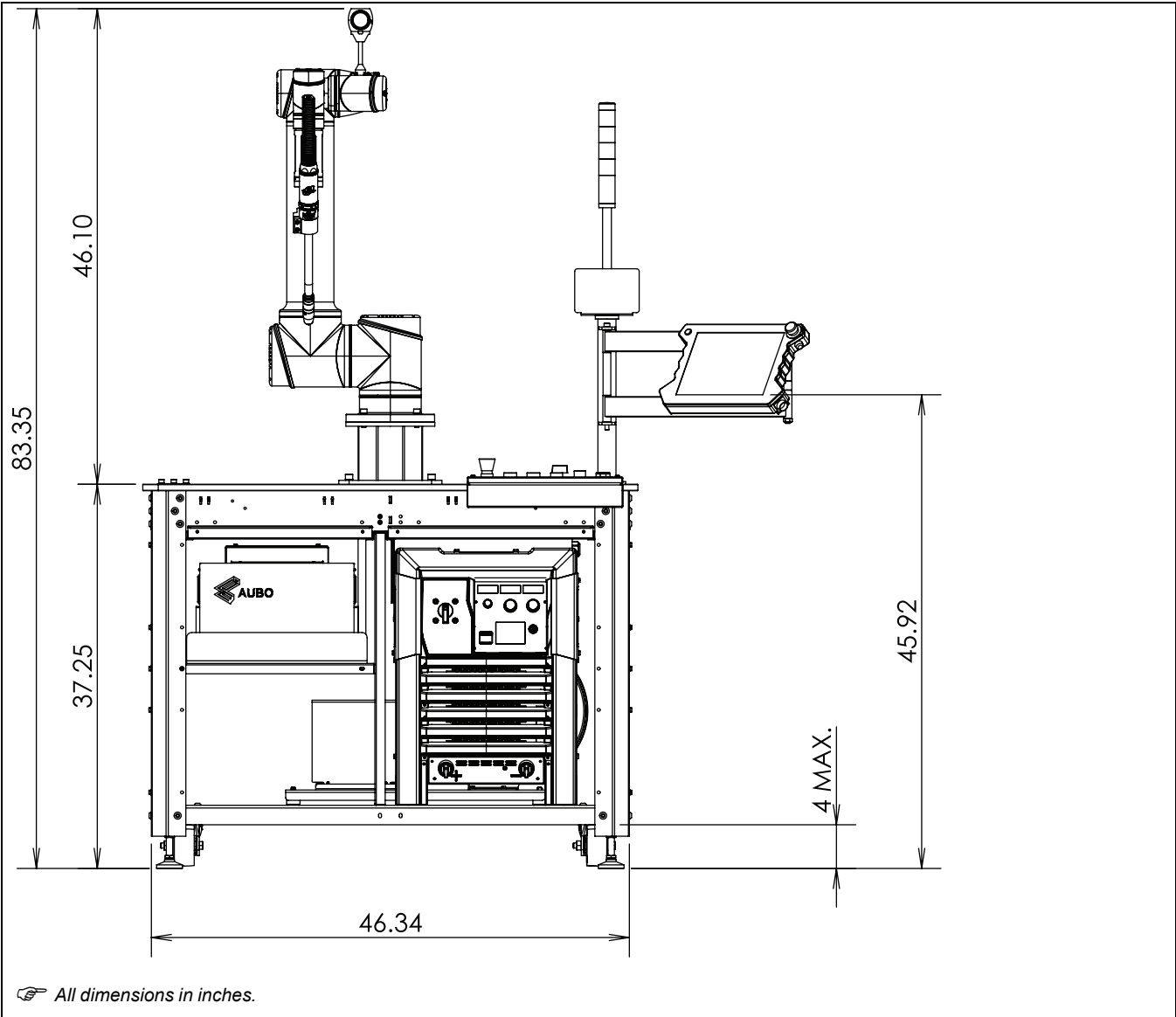


B. Rear Of System

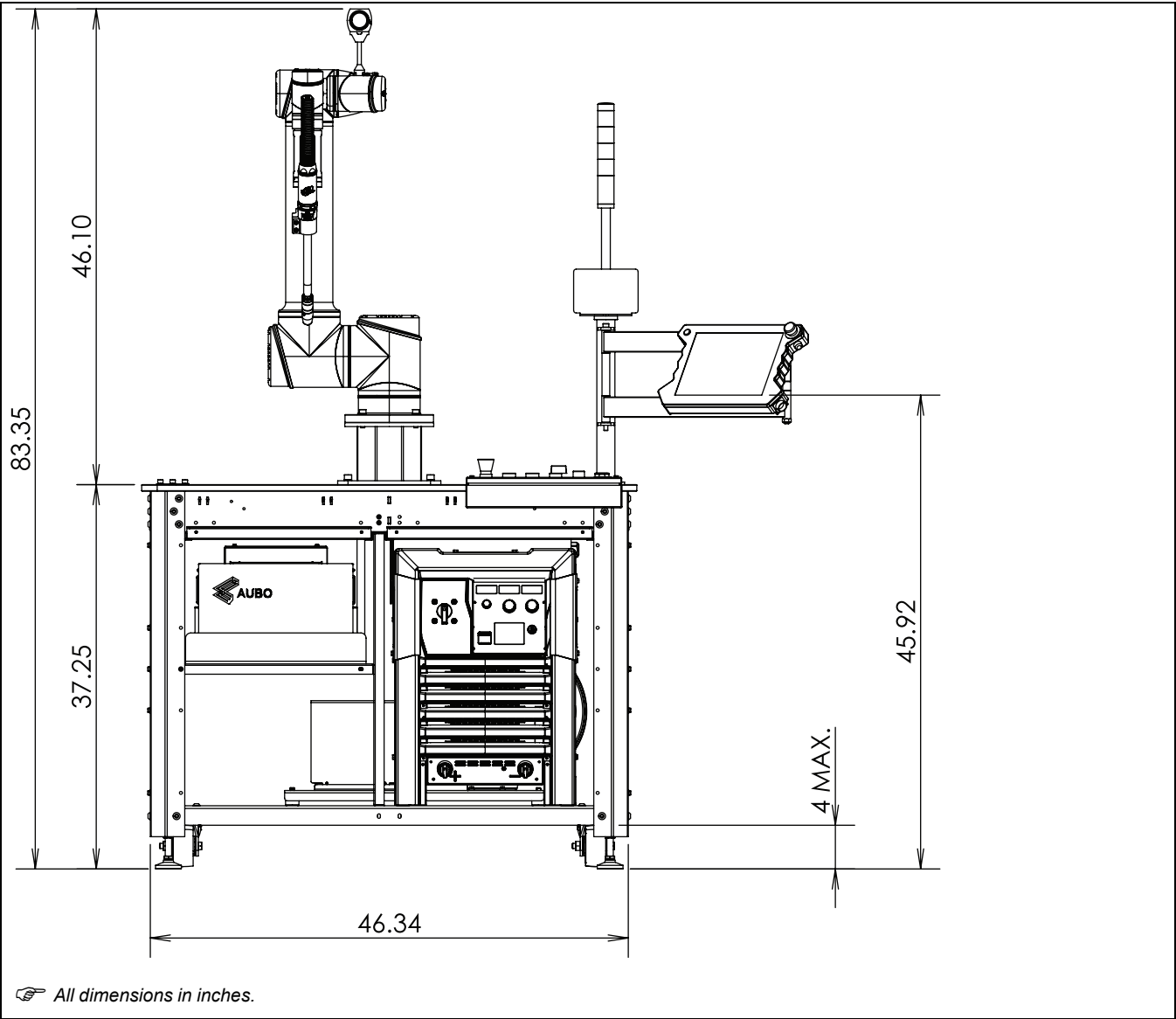


4-6. Dimensions

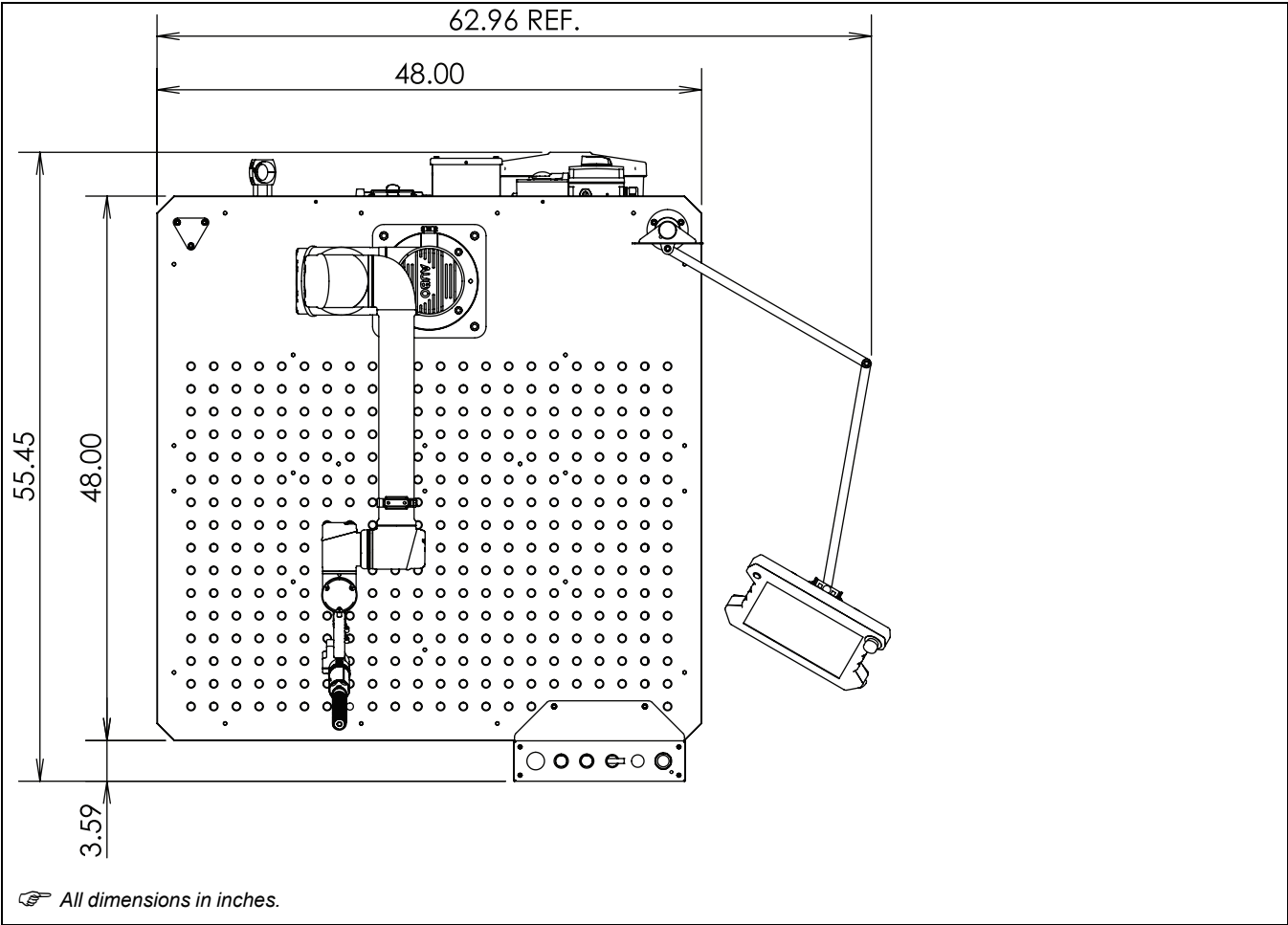
A. Front View



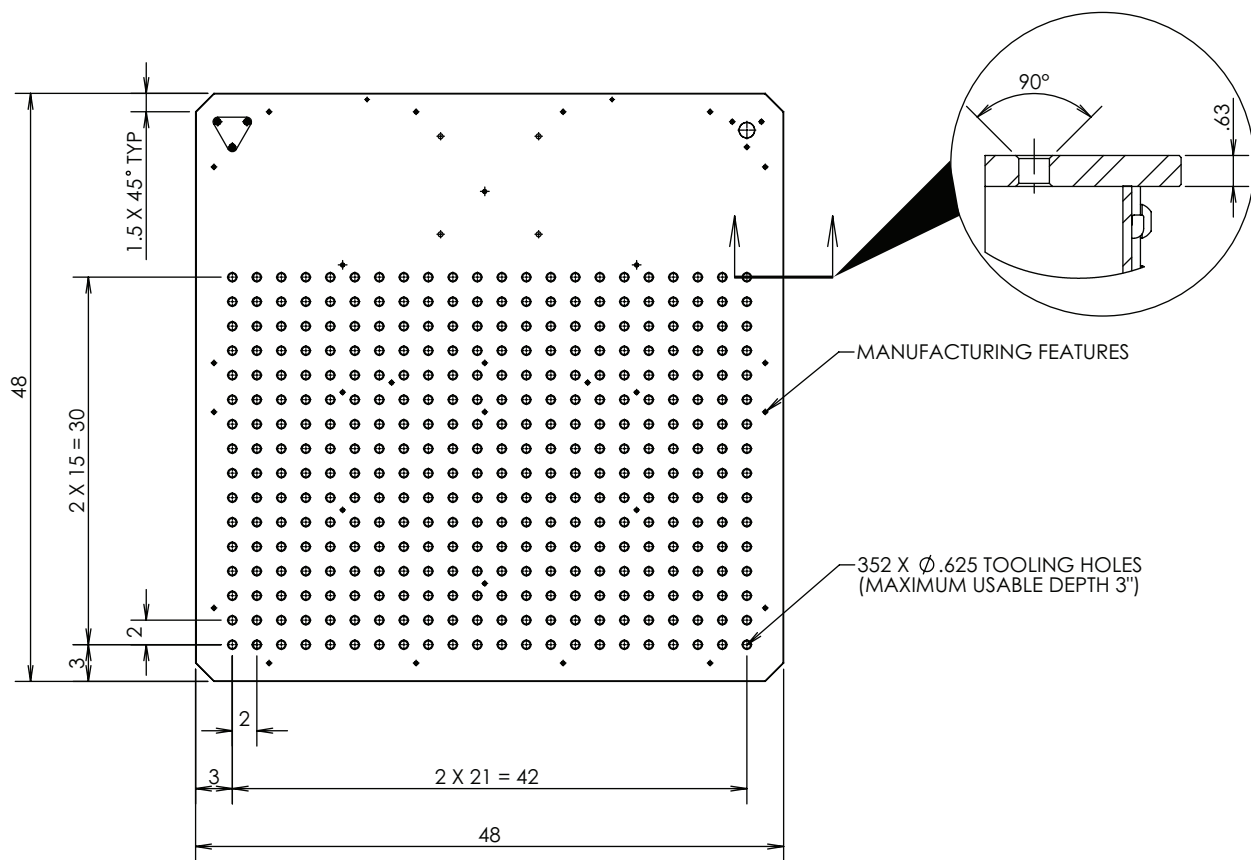
B. Side View



C. Top View



4-7. Table Platen



Tooling holes are 2 in. apart.

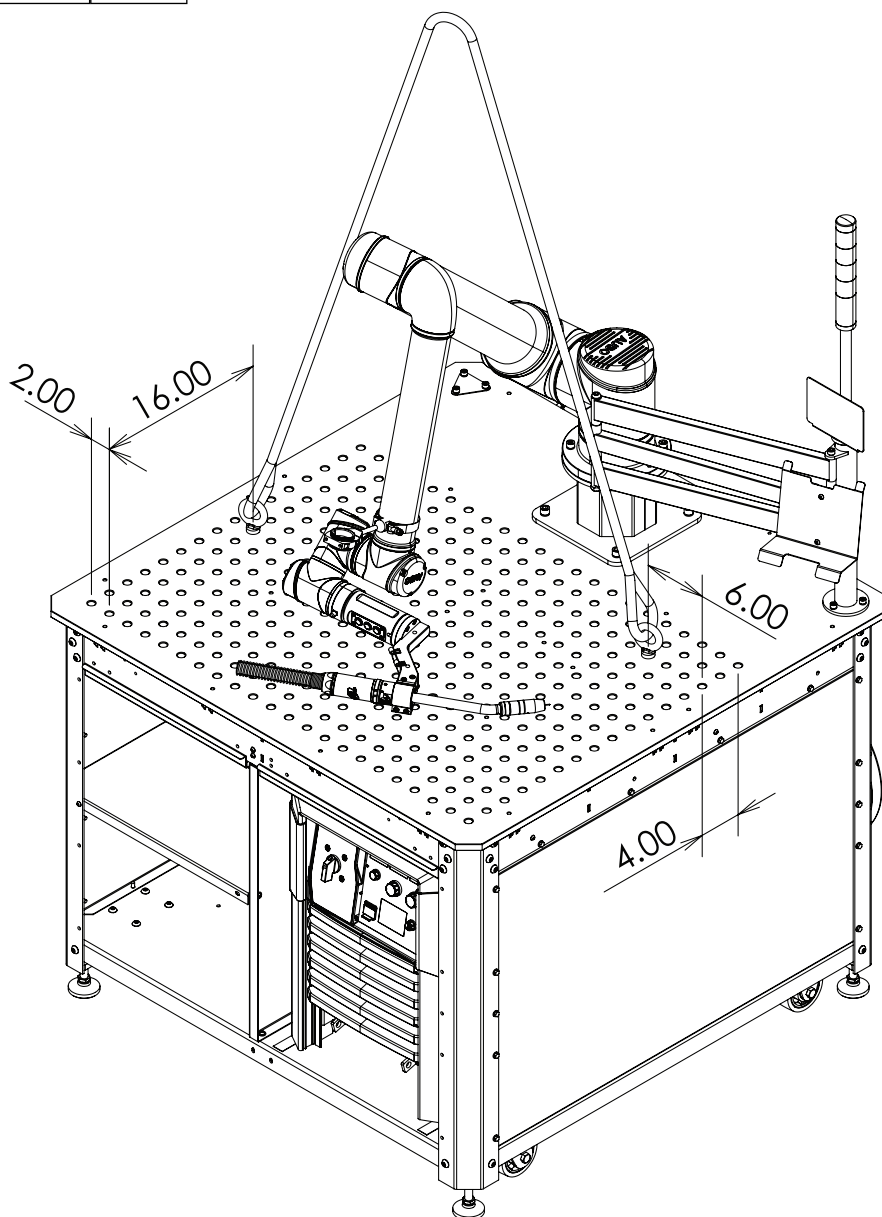
There are 3 inches between edge of table and first tooling holes.

There are 15 rows of holes front to back and 21 rows of holes left to right, for a total of 325 holes.

The holes have diameter 0.625 in and maximum usable depth of 3 in.

SECTION 5 – INSTALLATION

5-1. Moving The System



- ⚠ 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.
- ⚠ Use lifting eye to lift unit only, NOT running gear, gas cylinders, or any other accessories.

Miller Copilot is shipped in a crate capable of being moved as a single unit. This not only makes moving the system easy; it also means a quick startup time once the machine is placed. Power, welding wire, and welding gas are generally all that are required to have the system ready to program and run production.

The cobot system and shipping crate weigh less than 4500 pounds (1818 kg). An 8000 pound (3636 kg) capacity fork truck is recommended for safely moving and lifting the system.

Uncrating The System

Tools needed: ladder, crowbar, dead blow hammer

Reference video at MillerWelds.com/copilotsupport.

- Step 1.** Start uncrating from top of the crate. Remove the clips with crowbar.
- Step 2.** Remove support beams under top of crate.
- Step 3.** Remove front clips and front panel.
- Step 4.** Remove rear clips and rear panel.
- Step 5.** Remove bottom side clips and side panels (one side at a time).
- Step 6.** Follow procedure for lifting table using lifting straps.

Lifting Table

- ⚠ Use only eye bolts with shoulders to lift the cobot system.

NOTICE – The Cobot system is not designed to be lifted from underneath. Lifting from the bottom may result in damage to the system.

Remove spatter trays.

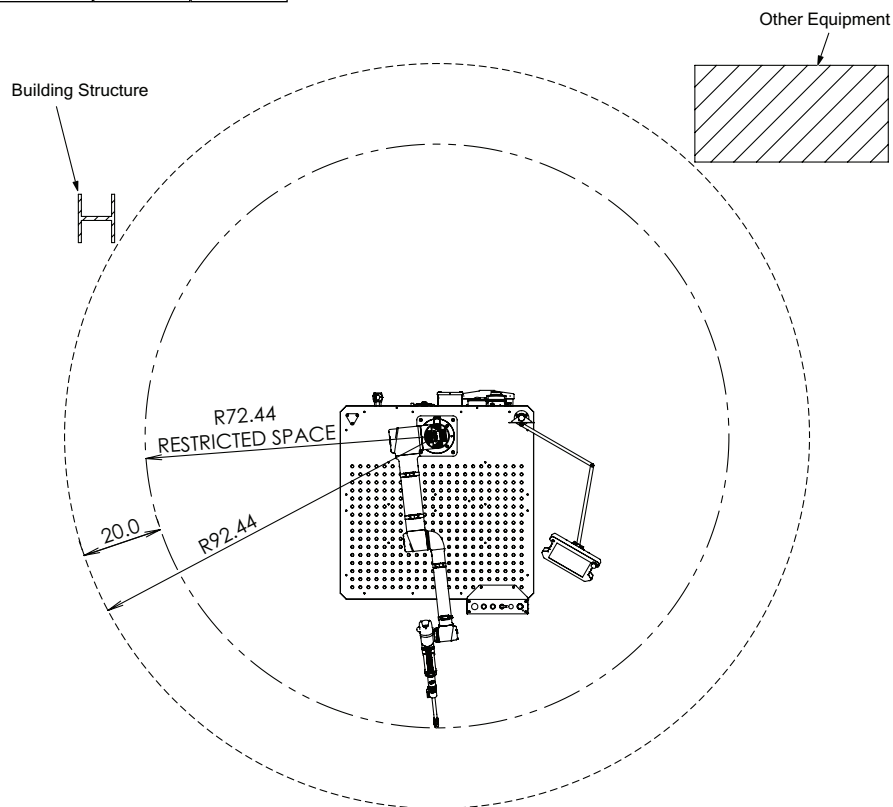
Install eye bolts with shoulders through tooling holes as shown.

Attach nuts to eye bolts from underside of table. Hand tighten eye bolts.

Use correct procedures and equipment of adequate capacity to lift and support the unit.

- ⚠ Do not move or operate unit where it could tip.
- ⚠ Special installation may be required where gasoline or volatile liquids are present - see NEC Article 511 or CEC Section 20.

5-2. Cobot Installation Site Requirements



Do not move or operate unit where it could tip.



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

A risk assessment of the specific installation location shall be performed to determine possible trapping or pinch points within the cobot restricted space.

A minimum of 20 in. (508 mm) of clearance beyond the restricted space (72.44 in. from the base of the cobot arm) shall be maintained. This includes perimeter barriers, arc screens, buildings, structures, utilities, other machines, and equipment not specifically supporting the cobot function.

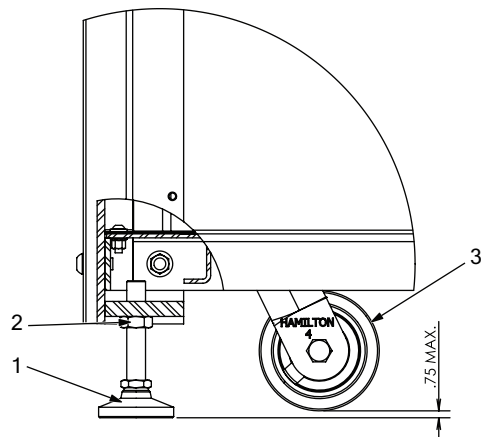


Failure to maintain the required clearance can result in entrapment.

5-3. Leveling The System



Raising Leveling Mounts



- 1 Leveling Mount
- 2 5/8 in. (16 mm) Jam Nut
- 3 Wheel

Leveling the system is recommended.

Lowering Leveling Mounts For Welding Operation

Spin leveling mount down until it contacts the floor.

Using wrench, continue to spin the leveling mount until cart is raised off the wheels. Do not raise wheels by more than 0.75 in. (19 mm).

Repeat on all four corners. Check the table level and adjust as required to level table.

Use wrench to secure 5/8 in. jam nuts.

NOTICE – Cart must be supported by leveling mounts to support rated load of 1500 lb (680 kg).

Raising Leveling Mounts For Transit

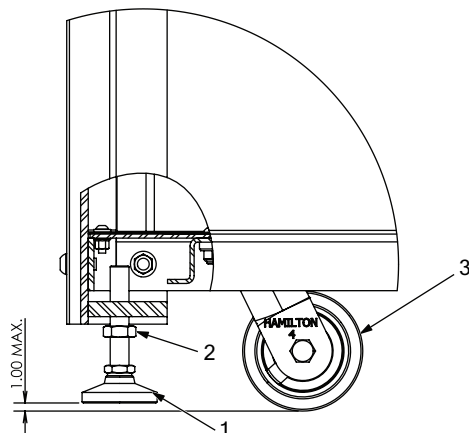
Remove tooling from cart before transit. Maximum transit load is 750 lb (340 kg).

Loosen 5/8 in. jam nut enough to allow raising of leveling mount.

Spin leveling mount to raise it off the floor by at least 1/4 in. (6 mm). Do not raise mounts past 1 inch (25 mm).

Repeat on all four corners.

Lowering Leveling Mounts



5-4. Electrical Service Guide

 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.

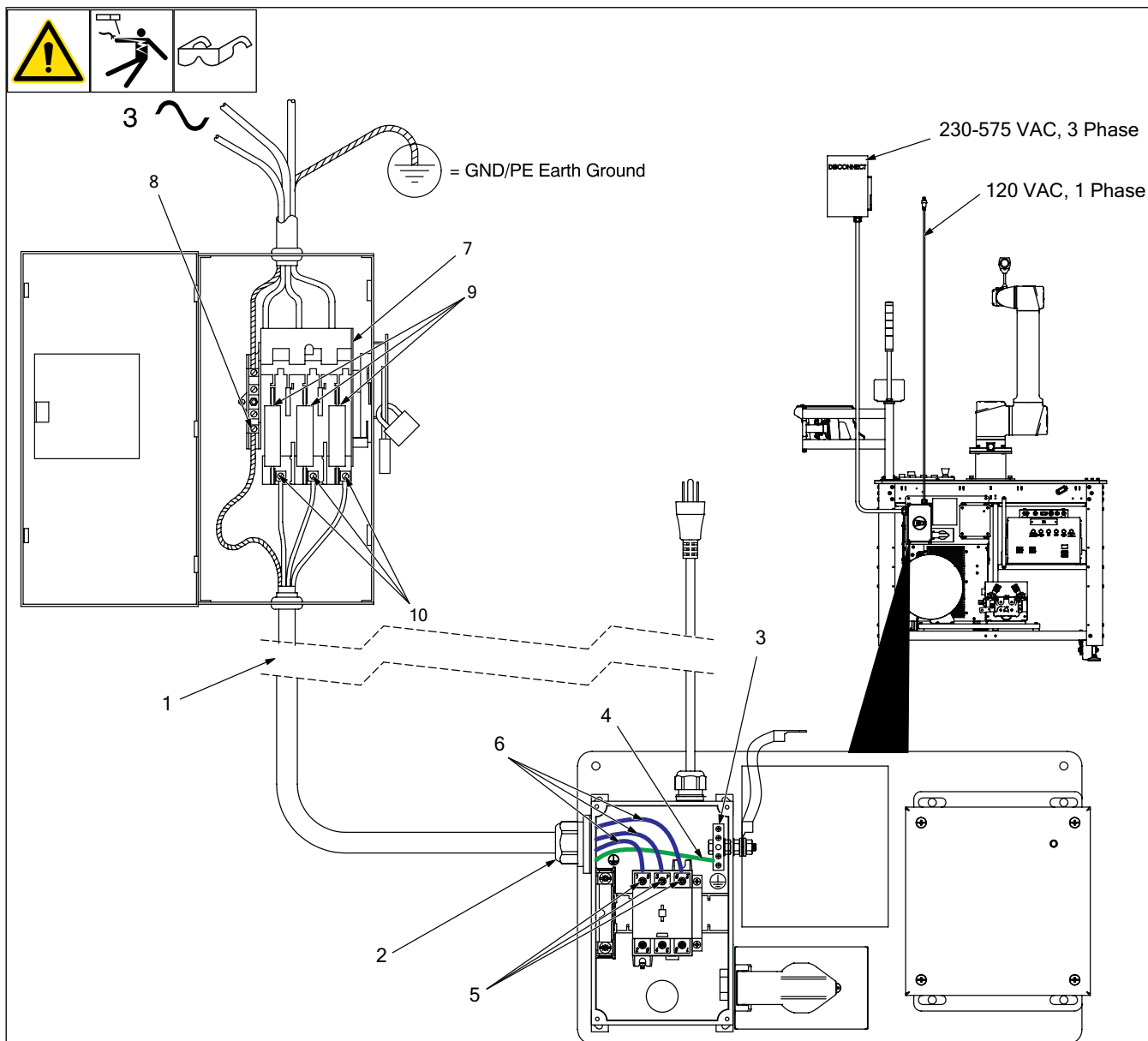
NOTICE – **INCORRECT INPUT POWER** can damage this welding power source. This welding power source requires a **CONTINUOUS** supply of input power at rated frequency $\pm 10\%$ and voltage $\pm 10\%$. Phase to ground voltage shall not exceed $+10\%$ of rated input voltage. Do not use a generator with automatic idle device (that idles engine when no load is sensed) to supply input power to this welding power source.

NOTICE – Actual input voltage should not be 10% less than minimum and/or 10% more than maximum input voltages listed in table. If actual input voltage is outside this range, output may not be available.

350 Amp Model	60 Hz 3-Phase				
Rated Supply Voltage (V)	230	380	400	460	575
Rated Maximum Supply Current $I_{1\max}$ (A)	43.7	26.2	24.6	21.4	17.1
Rated Effective Supply Current $I_{1\text{eff}}$ (A)	36.7	21.8	28.8	18.8	14.6
Maximum Recommended Standard Fuse Rating In Amperes ¹					
Time Delay Fuses ²	50	30	30	25	20
Normal Operating Fuses ³	60	35	35	30	25
Maximum Recommended Supply Conductor Length In Feet (Meters) ⁴	119 (36)	215 (66)	241 (74)	193 (59)	196 (60)
Raceway Installation					
Minimum Supply Conductor Size In AWG (mm ²) ⁵	8 (10)	10 (6)	10 (6)	12 (4)	14 (2.5)
Minimum Grounding Conductor Size In AWG (mm ²) ⁵	8 (10)	10 (6)	10 (6)	12 (4)	14 (2.5)

Reference: 2020 National Electrical Code (NEC) (including article 630)

5-5. Connecting 3-Phase Input Power



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

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

⚠ Make input power connections to the cobot system first.

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

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

1 Input Power Conductors (Customer Supplied Cord)

Select size and length of conductors using Electrical Service Guide. Conductors must

comply with national, state, and local electrical codes.

Cobot System Input Power Connections

2 Strain Relief Installed On Disconnect OR Strain Relief (Customer Supplied)

Install strain relief of proper size for unit and conductors. Route conductors (cord) through strain relief. Tighten strain relief.

3 Cobot System Grounding Terminal

4 Green Or Green/Yellow Grounding Conductor

Connect green or green/yellow grounding conductor to machine grounding terminal first.

5 Cobot System Line Terminals

6 Input Conductors (L1, L2, And L3)

Connect input conductors L1, L2, and L3 to cobot system line terminals.

Disconnect Device Input Power Connections

7 Disconnect Device (switch shown in the OFF position)

8 Disconnect Device Grounding Terminal

9 Disconnect Device Line Terminals

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

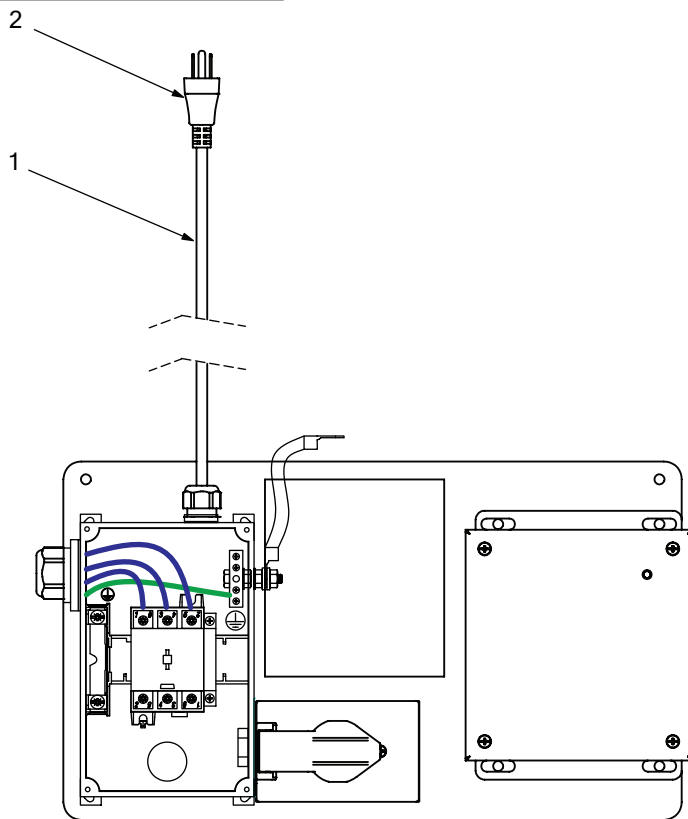
Connect input conductors L1, L2, and L3 to disconnect device line terminals.

10 Over-Current Protection

Select type and size of over-current protection using Electrical Service Guide (fused disconnect switch shown).

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

5-6. Connecting 120 VAC Input Power



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

NOTICE – Do not modify the power cord. The power cord plugs will work with standard NEMA receptacles. Use only the power cords supplied with this unit. Modifying the power cord(s) and/or plugs, or using cords not intended for use with this product will void warranty.

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

1 Power Cord, 120 VAC

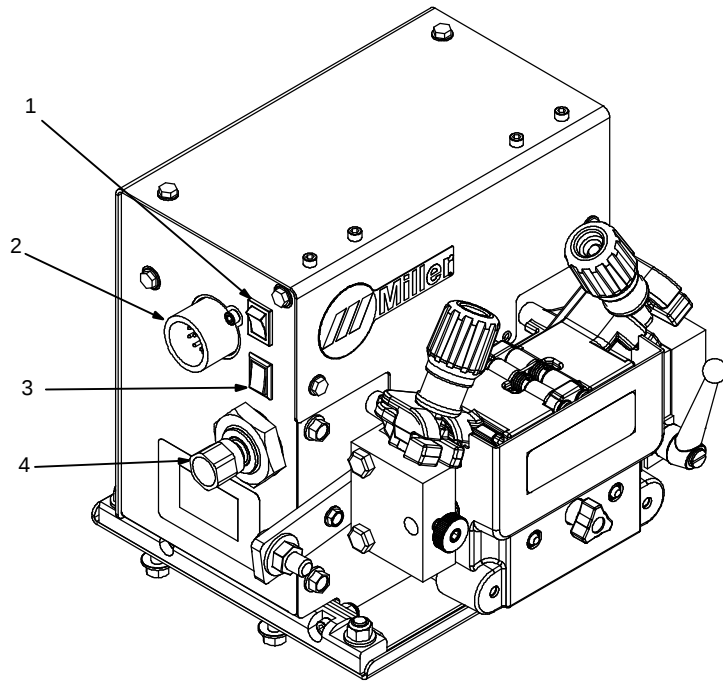
120 VAC cord with NEMA type 5-15P plug and SDG plug.

2 Plug - NEMA Type 5-15P

3 Receptacle - NEMA Type 5-15R (Not Shown)

Connect plug to receptacle.

5-7. Shielding Gas And Cooler Connections (CE Model)



 **Turn off power before making connections.**

- 1 Jog/Retract Switch
- 2 10 Socket Control Receptacle RC3
- 3 Gas Purge Switch

Connect control cable from rear of welding power source to wire drive assembly.

To make connections, align keyway, insert plug, and tighten threaded collar.

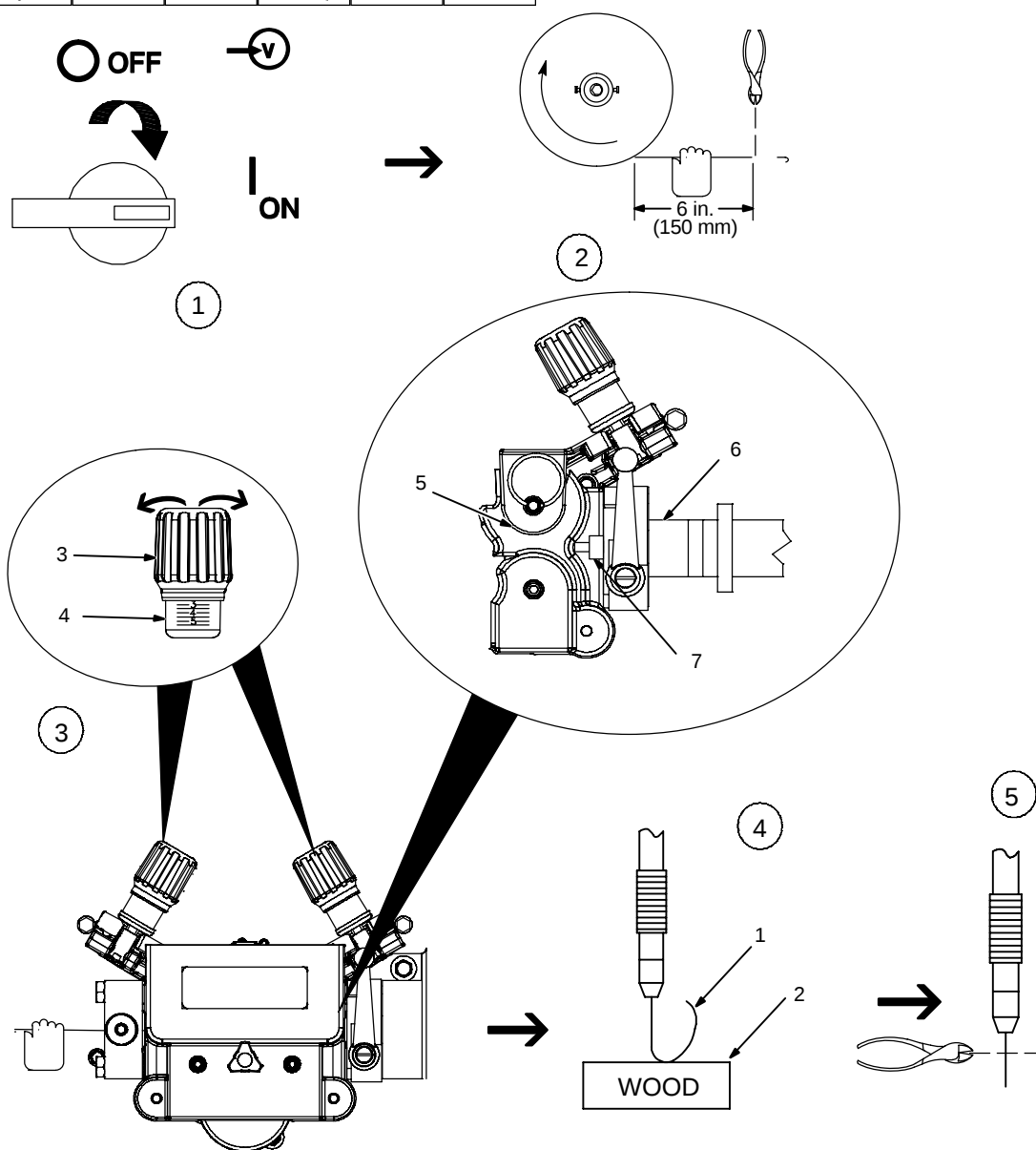
- 4 Shielding Gas Valve Fitting

Requires hose fitting with 5/8–18 right-hand threads.

For guns requiring external gas connections, remove hose from barbed fitting near gun/feeder opening and connect to gun.

 *Shielding gas pressure not to exceed 100 psi (689 kPa).*

5-8. Installing And Threading Welding Wire



☞ Verify correct drive rolls are installed.

- 1 Example Of No Wire Slippage
- 2 Nonconducting Surface
- 3 Pressure Adjust Knob
- 4 Pressure Indicator Scale
- 5 Drive Rolls
- 6 Back Of Gun
- 7 End Of Liner

Step 1. Turn power switch to "ON" position, located on front of power source.

Step 2. Pull and hold wire. Cut off end of wire.

☞ Hold wire tightly to keep it from unraveling.

Step 3. Push wire through guides up to drive rolls; continue to hold wire.

Install gun. Lay gun cable out straight. Cut off end of wire. Push wire through guides up to drive rolls; continue to hold wire. Press Jog button to feed wire out gun.

☞ For best wire feeding performance, be sure that the outlet cable has the proper size liner for the welding wire size being used. Also, when the gun is installed, the liner extending from the back of the gun should be as close to the drive rolls as possible, without touching.

Step 4. To adjust drive roll pressure, begin by holding nozzle about 2 in. (51 mm) from

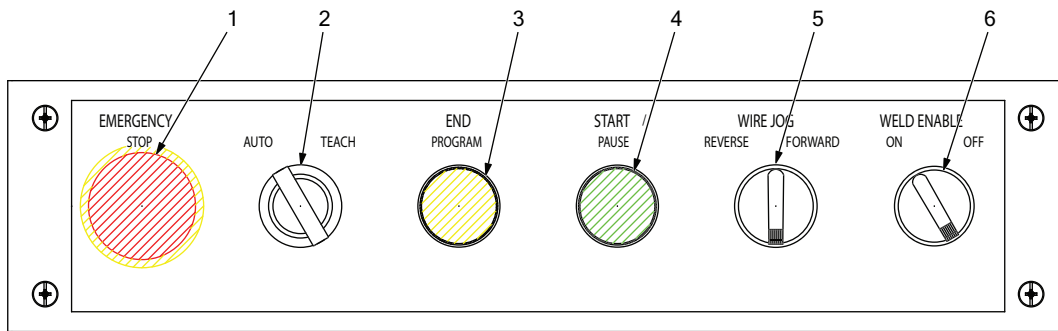
nonconducting surface and pressing gun trigger to feed wire against surface.

Step 5. Cut wire off.

☞ For soft wire or small diameter stainless steel wire, reduce drive roll pressure on the rear roll to half that of the front rolls.

SECTION 6 – CONTROLS

6-1. Operation Box



293166-A

1 Emergency Stop Button

Press this button to stop cobot and welding and to remove drive power from cobot.

2 Auto/Teach Key Switch

Auto Mode allows playback of active program. Teach Modes allow creation and editing of programs.

3 End Program Button

Press this button to stop the cobot and force an end to program in auto mode.

4 Start/Pause Button

Pressing this button in Auto Mode will start the active program in auto mode.

Pressing this button while cobot is running a program will cause cobot to pause.

Pressing this button while cobot is paused will cause the cobot to resume from paused position.

5 Wire Jog Forward/Reverse Switch

Rotate switch counterclockwise to retract the weld wire.

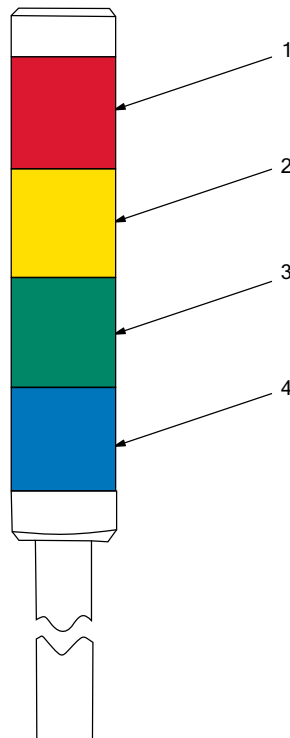
Rotate switch clockwise to jog the weld wire forward.

6 Weld Enable Switch

Rotate switch counterclockwise to enable welding arc.

Rotate switch clockwise to disable welding arc.

6-2. Signal Light Tower



1 Red Light

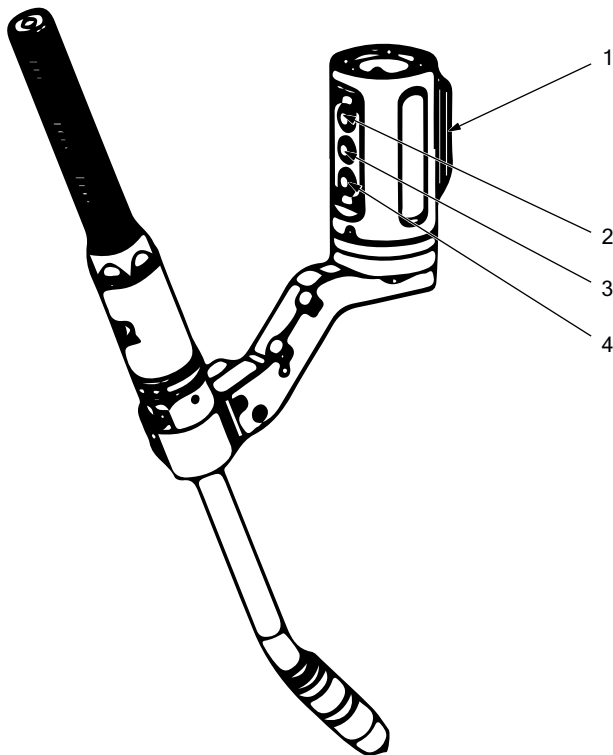
2 Amber Light

3 Green Light

4 Blue Light

Light	Definition
Red — Steady State	Emergency Stop condition
Red — Flashing	Grip Error or Cobot Error
Amber — Steady State	Cobot is moving
Amber — Flashing	Cobot is welding
Green — Steady State	Cobot is in collaborative mode
Blue — Steady State	Cobot is in Auto mode

6-3. Puck Buttons



1 Free Drive Enable 3-Position Switch

The switch enables the programmer to move the robot to a position by dragging the robot while this switch is in the ON (Middle) position.

In the normal (not depressed) state, the switch is typically used to prevent the cobot from operating. In the middle position, the switch allows the operator to manually drive the cobot arm into position. When the switch is fully depressed, it locks the arm in place.

2 Air Point Store

Pressing this button stores a non-weld position point and a weld end point.

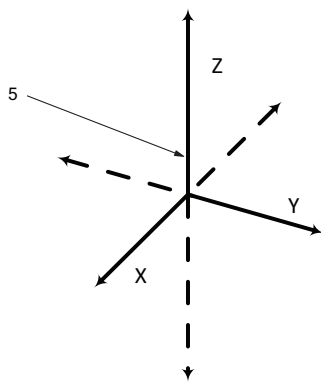
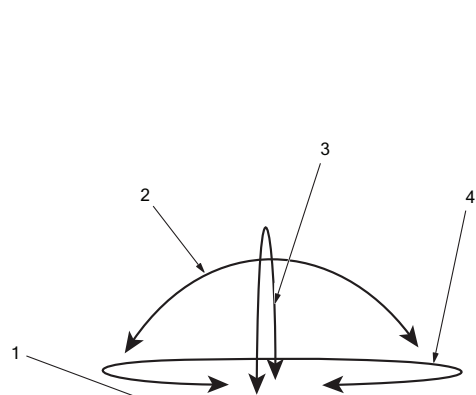
3 Weld Point Store

Pressing this button stores a weld position point.

4 Linear/Circular

Press this button to toggle between a linear weld point and a circular weld point.

6-4. Moving The Cobot With The Joystick



- 1 Joystick
- 2 Roll
- 3 Pitch
- 4 Yaw
- 5 World Frame

Grasp the joystick with fingers

Moving the joystick up/down, left/right, or forward/backward will cause the manipulator to move in that direction in the world frame.

Rotate or twist the joystick in pitch/yaw/roll directions about the world frame.



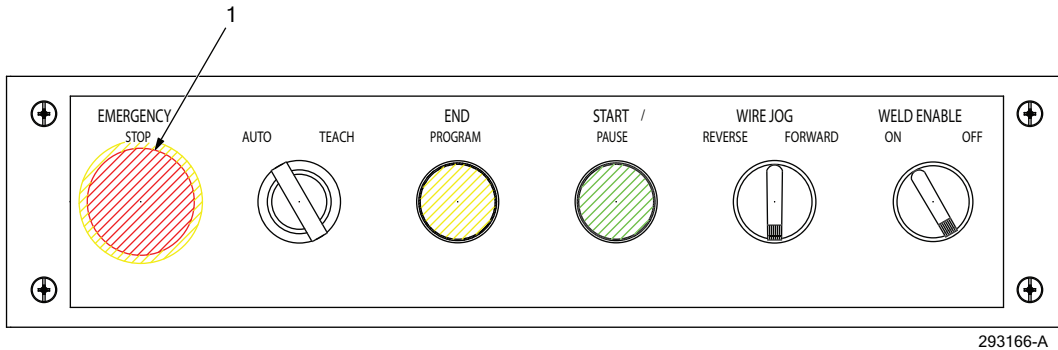
 Cobot motion controlled by the joystick is slow and precise. Joystick adjustments are generally used for fine tuning the cobot position and orientation.

SECTION 7 – SAFETY DEVICES

⚠ The cobot system is equipped with several safety devices that protect both personnel working around the system and the equipment in the system. Personnel working with the cobot system must check for proper operation of the safety devices on a regular basis.

Two emergency stop (E-stop) buttons are provided on the cobot welding system. These are latching type switches that stay in the pressed position until the button is twisted to release the latch.

7-1. Operator Station Emergency Stop



1 Operator Station Emergency Stop

The E-stop located on the operator station is a large mushroom type button.

- Press the E-stop button in to stop all cobot functions and turn off cobot servo power.
- Twist the red portion of the button clockwise to release the emergency stop

condition and allow servo power to be turned back on. The button pops out when turned.

7-2. Teach Pendant Emergency Stop



The cobot teach pendant has an E-stop push button in the upper right corner of the pendant.

- Press the E-stop button in to stop all cobot functions and turn off cobot servo power.
- Twist the red portion of the button clockwise to release the emergency stop condition and allow servo power to be turned back on. The button pops out when turned.

7-3. Lockout/Tagout Point



⚠ DANGER! – Disconnect input power or stop engine before installing or servicing this equipment. Lockout/tagout input power according to safety standards (see Section 1-2).

1 Lockout Tab

The disconnect switch provides a lockout tab with hole to insert a padlock.

Turn switch to Off.

Pull out lockout tab.

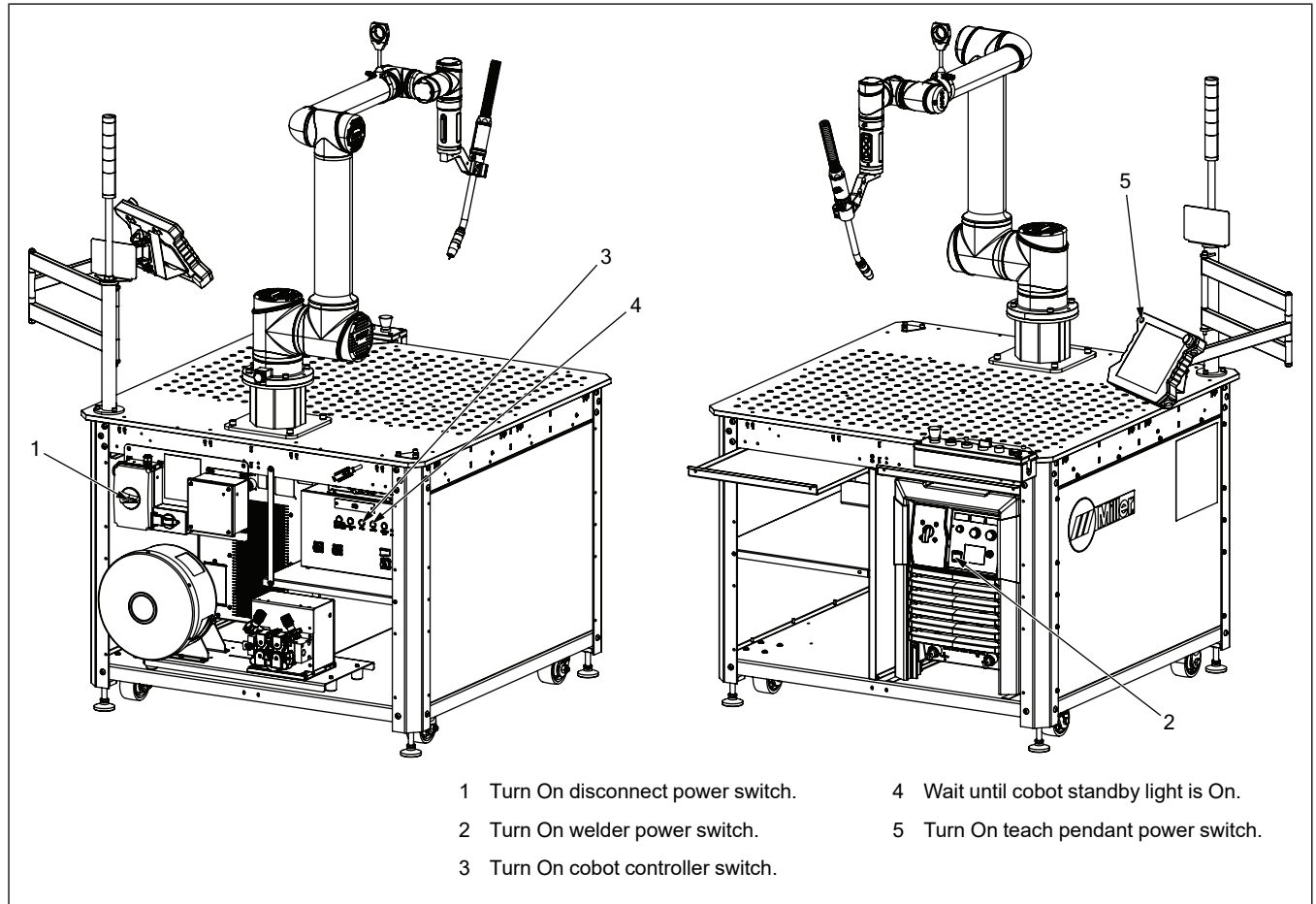
Insert padlock.

SECTION 8 – OPERATION

The cobot system is operated from the front of the system using the operator station push buttons. In most cases welding operation only requires the operator to load a part to be welded, press the “start” push button.

⚠ All personnel that will be operating the system must be familiar with the safety features of the system and know how to stop the cobot in the case of an emergency.

8-1. Powering Up The System



8-2. Logging In To The System

When you power up the system, you automatically be logged in as an Operator. The Operator level does not require a password. If you need to change default settings, log in as an Administrator. See the Manipulator Owner's Manual.

8-3. System Settings

A cobot system has many settings that are configured when the system is assembled. Most are one-time settings that will never need to be changed for the life of the system. This section introduces a few key concepts for basic setup and operation. This is not a comprehensive list of all the settings that each system has. Refer to the Manipulator Owner's Manual for more detailed information.

You can view these settings when you are logged in as an Operator.

You can change some settings not related to safety if you are logged in as an Administrator.

A. Home Position

POSITION			
HOME		TCP CHECK	
X -120.12	RX -120.12	X -120.12	RX -120.12
Y -430.12	RY -430.12	Y -430.12	RY -430.12
Z -550.12	RZ -550.12	Z -550.12	RZ -550.12
MOVE TO POSITION SAVE		MOVE TO POSITION SAVE	

- 1 Move to Position Button
- 2 Save Button

Press and holding the Move to Position button to move the cobot to the defined Home position.

The Home position is automatically inserted as the first line of any new program.

The Home position can be updated by moving the cobot to a new Home position and pressing the Save button.

It is a good practice when creating programs to start and end programs at the Home position so operators can understand when the cobot has completed a task.

B. Tool Center Point (TCP) Check

The TCP definition tells the cobot where the end of the torch is—the point where welding occurs (at least under ideal conditions). It is a reference point that is used to control the motion of the cobot and to define the location of the wire tip in relation to the cobot's base or other reference frame.

A pointer is mounted inside the system to be used as a quick reference to verify the torch and/or arm alignment. This can be a valuable tool to determine if the welding torch is no longer in alignment because of a “crash” (when the torch or arm collides with something solid in the system such as the tool, the part being welded, or the system frame).

To check the TCP using the reference pointer:

Step 1. Check the contact tip and replace it.

Step 2. Check the welding wire stick-out length (typically 12-15 mm) and straightness of the wire. Consistency is more important than how straight the wire is; if the wire has a natural “cast” or bend, that is acceptable as long as the bend is consistent.

Step 3. Press the Move to Position button.

Step 4. Be prepared to stop the movement if the torch looks like it is going to crash with the TCP pointer.

Step 5. Move forward to the TCP Checkpoint.

Step 6. If the wire aligns with the pointer, TCP is confirmed and the system is ready for operation.

Step 7. If the wire does not align with the pointer, the torch may need straightening or adjustment, or it is possible that the cobot origin position is no longer correct.

Step 8. If the wire aligns with the pointer but the part program is still not tracing or running correctly, the tool or parts to be welded may not be repeating correctly.

The position can be updated by moving the cobot to a new TCP position and pressing the Save button.

Be careful updating this position after you have created programs. Programs created before the revised TCP Check position may be shifted based on an incorrect/damaged TCP point.

8-4. Inputs And Outputs

Cobot inputs and outputs are used to operate the system and understanding where to view these and what they mean can make running and troubleshooting the system much easier.

To view the inputs and outputs go to Settings/IO Tab.

A. Cobot Inputs

Input signals from the different buttons and safety devices let the cobot know what operation to perform, and when it is safe for the cobot to start moving. The following list covers the basic inputs to the cobot.

Input #	Name	Description
DI00	Auto	Auto Mode Input. Changes operational mode to Auto
DI01	Teach	Teach Mode Input. Changes operational mode to Teach
DI02	Start/Pause	When cobot is in Auto Mode, Start/Pause Inputs Starts and Pauses Active Program
DI03	End Program	When cobot is in Auto Mode End Program Stops cobot at current position and ends Active program
DI04	Position Store	When cobot is in teach Mode, Puck mounted Position Store Button adds non-weld position points.
DI05	Weld Store	When cobot is in teach Mode, Puck mounted Weld Store Button adds weld position points.
DI06	Linear/Circular	When cobot is in teach Mode, Puck mounted Linear/Circular Button toggles weld position points between linear and circular.
DI07	Weld Enable/Disable	When Weld Enable/Disable Switch is set to Enable, Welding commands are valid. When Switch is set to disable, welding commands are invalid.
DI10	Wire Jog Fwd	When wire jog fwd input is valid weld wire is feed forward. If input is held valid for 3 sec wire will jog forward at high speed.
DI11	Wire Jog Rev	When the wire jog rev input is valid weld wire will retract. If input is held valid for 3 sec wire will retract at high speed.
SI00	Emergency Stop input CH1	External Emergency Stop Input (At Operator Station) CH1
SI01	Emergency Stop input CH2	External Emergency Stop Input (At Operator Station) CH2
SI06	Force Enable CH1	Lead Through Teach Enable Switch (Located at torch puck) CH1
SI16	Force Enable CH2	Lead Through Teach Enable Switch (Located at torch puck) CH2

B. Cobot Outputs

Cobot outputs tell the cobot when to run a tip change and let the system know when the cobot is clear of the work and at the home position.

Output #	Name	Description
DO00	Cobot Moving/Welding	Output is valid without flashing when cobot is moving. Output is valid and flashing when the cobot is welding (Amber)
DO01	Auto Mode	Output is valid when cobot is in auto mode (Blue)
DO02	E-Stop/Error State	Output is valid without flashing when cobot is in e-stop. Output is flashing when cobot is in error state
DO03	Collaborative Mode	Output is valid when cobot is in collaborative mode

8-5. Auto Mode Start-Up

Once the weld programs have been created, follow the steps below to run the cobot automatically.

Option 1: Running the program Active in Teach

Step 1. Turn the operation box Auto/Teach key switch to *Auto*.

Step 2. Load and secure the part for welding.

Step 3. If cobot is not at first point in active program, Press and hold start button until cobot is at first point. Releasing button prior to reaching first point will stop cobot.

Step 4. In case something is in the way of the cobot while moving to first position of program, switch Auto/Teach switch to teach and hand guide cobot around obstacle and then switch back to Auto.

Step 5. Once cobot has reached first point in program. Press the *START/PAUSE* push button once. This will start the program.

Step 6. Pressing the start/pause button while the cobot is running the active program will cause the cobot to pause.

Step 7. Pressing the Start/Pause after the cobot has paused will resume the active program at the point it paused.

Step 8. Pressing the end program button while the cobot is running the active program will cause the cobot to stop and end the active program

Step 9. Pressing e-stop (or if the cobot generates an error while running the active program) will cause the cobot to stop and end the active program.

SECTION 9 – TEACHING

Cobot systems are shipped with all the necessary system configuration installed so end users only need to program the welding that they want the cobot to perform. This section makes recommendations and outlines the programming structure; this manual is not intended to instruct users on the operation of the cobot teach pendant and explain the commands used in cobot programs. Please refer to the cobot operations manual for specific information on using the teach pendant.

 **It is strongly recommended that new cobot users go through our basic operations training class before attempting to create or modify programs on the cobot system. The cobot can potentially injure personnel or damage itself if not programmed properly.**

9-1. Teach Mode

To teach new programs the cobot must be in Teach Mode. This means the key switch located on the operation box must be set to Teach.

Do not switch the Auto/Teach key switch while the cobot is actively running a program. If you wish to interrupt auto mode operation, press the Start/Pause button first, then turn the key switch to Teach.

9-2. Pre-Teaching Checks

Any time an operator or programmer has an opportunity to inspect the system is a good time to look for normal wear that may need to be addressed. This is even more critical when a programmer is in the process of correcting a weld or creating a new program. Failure to check the cobot hardware before touching up points could result in lost time.

- Cobot torch alignment—crashes happen and many times no adjustment is needed but it is good programming practice to check the cobot torch position against a fixed reference point to see if anything has moved since the last time the cobot was programmed. If it has, correcting the hardware misalignment may solve any welding problems.
- Cables—the torch cable (whip), power cables, and liners sometimes get caught up on equipment. Twisted cables cause short circuits or broken wires. Welding wire liners forced to bend in a very small radius can keep wire from passing freely through the liner. Replace or service any cable or liner that is visibly damaged or has reached the end of its useful service life.

SECTION 10 – TROUBLESHOOTING

This troubleshooting list addresses only potential system problems and does not cover the cobot error and alarm codes. For a comprehensive list of cobot errors see the cobot operations manual.

Problem	Probable Cause	Remedy
No drive power . Emergency Stop Error displayed on pendant. Solid red light.	Operation ESTOP, Pendant Estop was activated.	Check both E-Stop switches for activation.
		Check Teach Pendant cable.
		Check Operation Box cable.
Red light flashing.	Free Drive Grip Error or Cobot internal error.	Release free-drive enable switch and wait for flashing red light to turn off.
		Clear error on pendant. If error does not pop back up, then wait for red light to turn off for about one minute.
		If error does not clear, cycle power on the cobot.
Cobot does not turn on.	120V cord not plugged into wall outlet or wall outlet has no power.	Check to see if 120V cord coming from cobot system main disconnect is plugged into wall outlet receptacle.
		Have qualified personnel check to see if 120 VAC is available at wall outlet.
Cobot does not weld.	Weld Enable switch on Operation Box is set to Off.	Set Weld Enable switch to On.
Welder does not turn on.	Customer supplied disconnect is switched to off or fuses are blown.	Check to see if customer supplied disconnect is in ON position.
		Have qualified personnel check to see if customer supplied disconnect has blown fuses.
Cobot displays welder communication error or can't feed wire or purge gas from teach pendant.	Communication error between cobot and welder.	Cycle system power at disconnect located on back side of system (see Section 8-1).

SECTION 11 – RISK ASSESSMENT

Operator Task	Hazard	Severity (S1, S2, S3)	Exposure (E1, E2)	Avoidance (A1, A2, A3)	Risk Category	Risk Reduction Recommendations	Safeguards Used	Exposure (E1, E2)	Avoidance (A1, A2, A3)	Severity (S1, S2, S3)	Risk Category	Residual Risk Level
Process Hazard All Users	Arc welding (Radiation hazard -Eye arc flash)	S2	E2	A2	Medium	Barriers and Arc Screens	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S2	Low	Low risk of arc flash
Process Hazard All Users	Arc welding (Radiation hazard -Skin arc flash)	S2	E2	A2	Medium	Barriers and Arc Screens	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S2	Low	Low risk of arc flash
Process Hazard All Users	Welding fumes/ smoke	S2	E1	A1	Medium	Local Exhaust Ventilation (LEV)	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S1	Negligible	
Process Hazard All Users	Arc welding (thermal hazard)	S2	E1	A1	Medium	Barriers and Arc Screens	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S2	Low	Low Risk of Burn
Process Hazard All Users	Weld Spatter and Sparks	S2	E2	A1	Medium	Barriers and Arc Screens	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S2	Low	
Mechanical Hazard – Crush/Pinch All Users	Robot motion	S2	E2	A1	Medium	Elimination, Safeguarding, Visual Warning and Awareness Means, Administrative Controls	Robot Safety Software, Safety Precautions, Personal Protective Equipment, Operator Training. Reference Manipulator Owner's Manual.	E2	A1	S1	Negligible	
Mechanical Hazard -Entanglement All Users	Moving Elements	S2	E2	A1	Medium	Elimination, Safeguarding, Visual Warning and Awareness Means, Administrative Controls	Robot Safety Software, Safety Precautions, Personal Protective Equipment, Operator Training. Reference Manipulator Owner's Manual.	E2	A1	S1	Negligible	
Mechanical Hazard – Puncture/ Stabbing All Users	Welding Wire/Torch	S2	E2	A1	Medium	Elimination, Safeguarding, Visual Warning and Awareness Means, Administrative Controls	Robot Safety Software, Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E2	A1	S1	Low	Low Risk of Puncture/ Stabbing
Workpiece Loading/ Unloading Operator/ Programmer	Hot parts (thermal hazard)	S1	E2	A2	Low	Barriers and Arc Screens	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E2	A1	S1	Low	Low

Operator Task	Hazard	Severity (S1, S2, S3)	Exposure (E1, E2)	Avoidance (A1, A2, A3)	Risk Category	Risk Reduction Recommendations	Safeguards Used	Exposure (E1, E2)	Avoidance (A1, A2, A3)	Severity (S1, S2, S3)	Risk Category	Residual Risk Level
Programming and verification Operator/ Programmer	Robot motion (mechanical hazard - pinching, impact)	S2	E1	A1	Medium	Elimination, Safeguarding, Visual Warning and Awareness Means, Administrative Controls	Robot Safety Software, Safety Precautions, Personal Protective Equipment, Operator Training. Reference Manipulator Owner's Manual.	E2	A1	S1	Low	Low
Programming and verification Operator/ Programmer	Arc welding (thermal hazard)	S2	E1	A1	Low	Barriers and Arc Screens	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S2	Low	Low
Programming and verification Operator/ Programmer	Arc welding (radiation hazard - arc flash)	S2	E1	A2	High	Barriers and Arc Screens	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E2	A2	S1	Low	Low risk to a programmer, while welding in test mode around the robot and work-piece.
Programming and verification Operator/ Programmer	Welding wire/Torch (mechanical - puncture/ stabbing)	S1	E1	A1	Low	Elimination, Safeguarding, Visual Warning and Awareness Means, Administrative Controls	Robot Safety Software, Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S1	Negligible	Negligible
Programming and verification Operator/ Programmer	Tripping hazard	S1	E1	A1	Negligible			E1	A1	S1	Negligible	Negligible
Brief operator intervention not requiring disassembly	Welding wire/Torch (mechanical - puncture/ stabbing)	S1	E1	A1	Low	Elimination, Safeguarding, Visual Warning and Awareness Means, Administrative Controls	Robot Safety Software, Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S1	Negligible	Negligible
Tip change Operator/ Programmer	Welding wire/Torch (mechanical - puncture/ stabbing)	S1	E2	A1	Low	Elimination, Safeguarding, Visual Warning and Awareness Means, Administrative Controls	Robot Safety Software, Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S1	Negligible	Negligible

Operator Task	Hazard	Severity (S1, S2, S3)	Exposure (E1, E2)	Avoidance (A1, A2, A3)	Risk Category	Risk Reduction Recommendations	Safeguards Used	Exposure (E1, E2)	Avoidance (A1, A2, A3)	Severity (S1, S2, S3)	Risk Category	Residual Risk Level
Tip change Operator/ Programmer	Welding wire/Torch (thermal hazard - hot nozzle/tip)	S1	E2	A1	Low	Administrative Control, Visual Warning and Awareness Means.	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S1	Negligible	Negligible
Tip change Operator/ Programmer	Thermal hazard - hot torch	S1	E2	A1	Low	Administrative Control, Visual Warning and Awareness Means.	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S1	Negligible	Negligible
Nozzle cleaning Operator/ Programmer	Welding wire/Torch (mechanical - puncture/stabbing)	S1	E2	A1	Low	Elimination, Safeguarding, Visual Warning and Awareness Means, Administrative Controls	Robot Safety Software, Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S1	Negligible	Negligible
Nozzle cleaning Operator/ Programmer	Welding wire/Torch (thermal hazard - hot nozzle/tip)	S1	E2	A1	Low	Administrative Control, Visual Warning and Awareness Means.	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S1	Negligible	Negligible
Wire change Operator/ Programmer	Welding wire/Torch (mechanical - puncture/stabbing)	S1	E2	A1	Low	Elimination, Safeguarding, Visual Warning and Awareness Means, Administrative Controls	Robot Safety Software, Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S1	Negligible	Negligible
Trouble-shooting Programmer/ Maintenance	Electrical hazard (shock, electrocution, burn)	S3	E1	A1	High	Safeguarding, Administrative Controls, and Warning and Awareness Means.	Safety Precautions, Troubleshooting to be performed only by trained personnel, and Lockout/Tagout Procedures Reference Section 1-2.	E1	A1	S1	Negligible	Negligible
Trouble-shooting Programmer/ Maintenance	Unexpected robot motion (mechanical hazard - crush, impact, stabbing)	S3	E1	A1	High	Elimination, Safeguarding, Visual Warning and Awareness Means, Administrative Controls	Robot Safety Software, Troubleshooting to be performed only by trained personnel, Lockout/Tagout Procedures, and Safety Precautions. Reference Manipulator Owner's Manual.	E1	A1	S1	Negligible	Negligible
Trouble-shooting	Mechanical hazard (tripping)	S1	E1	A1	Negligible			E1	A1	S1	Negligible	Negligible
Equipment jams	Mechanical (stored energy)	S2	E1	A1	Medium	Safeguarding, Administrative Controls, and Warning and	Robot Safety Software, Safety Precautions, Troubleshooting to be performed only by trained personnel, and	E1	A1	S1	Negligible	Negligible

Operator Task	Hazard	Severity (S1, S2, S3)	Exposure (E1, E2)	Avoidance (A1, A2, A3)	Risk Category	Risk Reduction Recommendations	Safeguards Used	Exposure (E1, E2)	Avoidance (A1, A2, A3)	Severity (S1, S2, S3)	Risk Category	Residual Risk Level
						Awareness Means.	Lockout/Tagout Procedures Reference Manipulator Owner's Manual.					
Dropped parts (unapplied system)	Mechanical (impact, cutting)	S2	E1	A1	Low	Personal Protective Equipment, Administrative Controls	Personal protection equipment - Operator training.	E1	A1	S1	Negligible	Unapplied systems - no tooling supplied by MWA
Event recovery (wire stick, no arc, etc.)	Mechanical (crushing, stabbing, cutting)	S2	E2	A2	High	Safeguarding, Administrative Controls, and Warning and Awareness Means.	Robot Safety Software, Safety Precautions, Personal Protective Equipment, Operator Training. Reference Manipulator Owner's Manual.	E1	A1	S1	Negligible	Negligible
Event recovery (wire stick, no arc, etc.)	Thermal hazard (burn)	S1	E2		Low	Administrative Control, Visual Warning and Awareness Means.	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S1	Negligible	Negligible
Abnormal condition (process issues - part burn thru)	Thermal hazard (burn)	S1	E1	A2	Low	Administrative Control, Visual Warning and Awareness Means.	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S1	Negligible	Negligible
Control of hazardous energy (including fixtures, clamps, and other equipment)	Stored energy	S3	E2	A2	High	Safeguarding, Administrative Controls, Personal Protective Equipment	Robot Safety Software, Safety Precautions, Personal Protective Equipment, Operator Training. Reference Manipulator Owner's Manual.	E1	A1	S1	Negligible	Negligible
Changing torch weight or cobot payload Maintenance and repair	Robot motion (mechanical hazard -impact force)	S2	E2	A1	Medium	Elimination, Safeguarding, Visual Warning and Awareness Means, Administrative Controls	Contact Miller Welding Automation Service to determine safety settings before changing torch weight, Personal Protective Equipment, Operator Training.	E2	A1	S1	Low	Low
Maintenance and repair	Mechanical hazard (tripping)	S1	E1	A1	Negligible			E1	A1	S1	Negligible	Negligible
Maintenance and repair	Ergonomic hazards (difficult access)	S1	E1	A1	Negligible			E1	A1	S1	Negligible	Negligible
Equipment cleaning	Mechanical hazard (tripping)	S1	E1	A1	Negligible			E1	A1	S1	Negligible	Negligible
Equipment cleaning	Ergonomic hazards (difficult access)	S1	E1	A1	Negligible			E1	A1	S1	Negligible	Negligible

Operator Task	Hazard	Severity (S1, S2, S3)	Exposure (E1, E2)	Avoidance (A1, A2, A3)	Risk Category	Risk Reduction Recommendations	Safeguards Used	Exposure (E1, E2)	Avoidance (A1, A2, A3)	Severity (S1, S2, S3)	Risk Category	Residual Risk Level
Equipment cleaning	Environmental hazards (dirt, oil)	S1	E1	A1	Negligible			E1	A1	S1	Negligible	Negligible
Passing by System	Arc welding (Radiation hazard - arc flash)	S2	E2	A2	Medium	Barriers and Arc Screens	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S2	Low	
Passing by System	Weld Spatter and Sparks	S2	E2	A2	Medium	Barriers and Arc Screens	Safety Precautions, Personal Protective Equipment, Operator Training. Reference Section 1-2.	E1	A1	S2	Low	
Load/Unload Parts Operator	Electrical hazard (shock, electrocution, burn)	S1	E1	A1	Negligible			E1	A1	S1	Negligible	Negligible
Placement of the equipment	Robot motion (mechanical hazard - pinching, impact)	S1	E1	A1	Low	Administrative Control, Visual Warning and Awareness Means.	Safety Precautions, Personal Protective Equipment. Reference Manipulator Owner's Manual.	S1	E1	A1	Low	

SECTION 12 – WARRANTY

Miller Welding Automation Cobot Welding System Warranty Information

Warranty Table

This table consists of the warranty coverage periods for a variety of MWA supplied components.

Please consult this table prior to calling the service department or your integration partner with a warranty claim.

Warranty Coverage Periods (Effective 1/1/2023)	90 Days	1 Year	3 Years
Mig Inverter Welding Power Supplies			X
Mig Conventional Welding Power Supplies			X
Tig Welding Power Supplies			X
Robotic Wire Feeder		X	
Robotic Torches	X		
Wire Feeder Extension Cable	X		
Cobots and Teaching Pendant		X	
Systems Components — Non-Miller		X	
Systems Components — Customer Supplied	N/A		
*Systems warranty coverage begins from ship date to the MWA customer.	Warranty Registration Effective from 01/01/2023 Revised 12/15/2022		
*Robot warranty coverage begins from the ship date to the MWA customer.			

NOTE: Warranty terms and conditions are subject to change without notice.

Notes

Owner's Record

Please complete and retain with your personal records.

Model Name	Serial/Style Number
Purchase Date	(Date which equipment was delivered to original customer.)
Distributor	
Address	
City	
State	Zip

For Service

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

Always provide Model Name and Serial/Style Number.

Contact your Distributor for:	Welding Supplies and Consumables Options and Accessories Personal 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
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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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