




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. Collaborative Robot 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.



COLLABORATIVE ROBOTS (Cobot) can kill.

- Make sure to read and understand all the requirements in this manual before installing or using the Cobot.
- Do not use the Cobot when damage is present.
- Do not modify the Cobot.
- Install the Cobot and all electrical equipment according to the requirements and specifications listed in this manual and according to Local and National codes.
- Verify the manipulator joints and tooling are installed safely.
- Inspect the Cobot and all safety functions before placing the Cobot into production.
- Check the system and equipment for operational safety and any physical damage that can be detected before starting the system and equipment for the first time. Confirm that the system conforms to all applicable codes and regulations.
- When the Cobot is installed, the end user must perform a comprehensive risk assessment.
- Only qualified persons should set and modify the Safety Parameters. These parameters are password protected to prevent unauthorized personnel from setting and modifying Safety Parameters. After a safety parameter is modified, the related safety functions must be analyzed.
- When the Cobot is combined with or working with machines capable of damaging the Cobot, test all the interfacing of the Cobot and other machinery separately from the Cobot motion program.
- Read and understand the Owner's Manual for ALL devices used in the installation.
- Use the correct Tool Center Point (TCP) settings, including the mass TCP offset setting and collision sensitivity setting.
- Do not connect any safety-related devices to general purpose inputs and outputs. Use safety-related interfaces only.



ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Disconnect the input power or stop all equipment before installing or servicing this equipment. Use lockout/tagout procedures for input power according to OSHA 29 CFR 1910.147. (See Safety Standards).
- When making input connections, attach the proper grounding conductor first and double-check all other connections.
- Keep all input 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.
- Switch off all equipment when not in use.
- Use only well-maintained equipment. Repair or replace damaged parts at once. Maintain all devices according to the appropriate manual.
- All panels and covers must be securely in place at all times.



FALLING EQUIPMENT can injure.

- Check wire insulation and protection guards before transporting the robot.
- When transporting the Cobot, follow the requirements specified in the transportation section.
- Use the correct procedures and equipment to lift and support the Cobot unit.
- Follow the guidelines in the Applications Manual for the Revised NIOSH Lifting Equation (Publication No. 94-110) when manually lifting heavy parts or equipment.



MOVING PARTS can injure.

- Make sure the Cobot manipulator is placed with enough space to move freely.
- Tooling and barriers should be free of sharp edges and pinch points. Keep clear of the Cobot work space when main power is on.
- Stay alert when working near the Cobot.
- Understand the Emergency Stop feature.
- Understand and be familiar with the Cobot robotic movements. Each joint module of the manipulator



has a brake.

- Never stand with your back toward the Cobot.
- Never place yourself between multiple Cobot workstation areas when more than one workstation is used.
- Train all personnel on the operation and safety features of the Cobot.
- Never wear loose clothing or jewelry when working with the Cobot. Make sure long hair is tied back when working with the Cobot.
- Always wear head and safety personal protective equipment (PPE). Always stand outside the reach of the Cobot.
- Be aware of the manipulator's movement when using the teach pendant.
- When the Cobot or other devices are switched on, especially when the Cobot seems to be stopped, it is possible that the Cobot is waiting for a signal. Always assume the Cobot is in action when switched on.
- Draw a line around the Cobot to mark the range of motion of the Cobot, including attached tools.
- Safety precautions to include, but not limited to: placement of protective arc screens, rails, guards, or other security measures near the operating area of the Cobot to protect the operator and surrounding bystanders. Use lockout/tagout procedures to prevent use of Cobot by unauthorized operators.
- Tools and barriers should not have sharp edges or pinch points.
- After using the operation panel or the teach pendant, make sure to put gloves back on. Prevent operational errors; remove gloves when using the operation panel or the teach pendant.



HOT PARTS can burn.

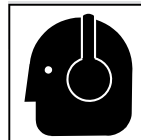
- The manipulator and control box generate heat during operation. Do not touch the manipulator while the Cobot is in motion or immediately after motion stops.
- To cool the Cobot, switch off power to Cobot and wait for 1 hour.
- Never place fingers behind the internal cover of the control box.



Emergency Pinning Recovery Procedure

- If an operator is pinned by a function being performed by the Cobot, press any of the system emergency stop buttons to ensure drive power is removed. Then manually move the manipulator arm out of the way.
- Only in an emergency can the Cobot arm be moved manually without electric drive assist.

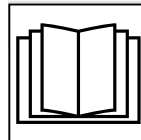
NOTICE – Manually forcing the Cobot manipulator arm to move can damage the manipulator joints.



NOISE can damage hearing.

Noise from some processes or equipment can damage hearing.

- Wear approved ear protection if noise level is high.



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 Manual, industry standards, and national, state, and local codes.

1-3. Arc Welding Hazards



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.
- Do not store or use equipment in standing water.
- 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!

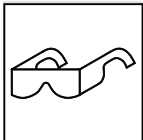
- Disconnect input power or stop engine before installing or servicing this equipment. Lockout/tagout input power according to OSHA 29 CFR 1910.147 (see Safety Standards).
- Properly install, ground, and operate this equipment according to its Owner's Manual and national, state, and local codes.
- Always 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.

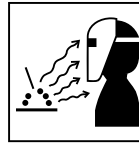
Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health.

- 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.

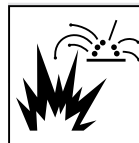
- Shut off compressed gas supply when not in use.
- Always ventilate confined spaces or use approved air-supplied respirator.



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.

1-4. Risk Assessment Requirements

The Cobot can be integrated with other equipment to form a system or be used as a single, stand alone unit. The information in this manual does not cover how to design, install, and operate a complete Cobot system, nor does it cover all peripheral equipment that can influence the safety of the complete system.

A risk assessment is one of the most important requirements when installing and operating a Cobot system. The risk assessment should follow the process defined in the standards listed below based on location of the equipment.

- ISO 12100:2010 Safety of Machinery – General Principles for Design – Risk assessment and Risk reduction.
- ISO 10218-2:2011 Robots and Robotic Devices – Safety Requirements – Part 2: Industrial Robot Systems and Integration.
- RIA TR R15.306-2014 Technical Report for Industrial Robots and Robot Systems – Safety Requirements, Task-based Risk Assessment Methodology.

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

When installing, operating, or maintaining a Cobot system, the following process must be met:

- Complete risk assessment of the Cobot system.
- Inspect the system design and make sure installation is correct.
- Provide training to personnel.
- Create operational procedures for the Cobot and the Cobot system.
- Establish appropriate safety requirements and procedures.
- Eliminate or minimize all hazards upon installation.
- Provide technical information associated with the Cobot or tech pendant operation and maintenance.

1-5. Intended Use

Robot controllers and robots can only be used in non-hazardous industrial applications.

Any use or application deviating from the intended use is deemed to be impermissible misuse. This includes, but is not limited to:

- Use in potentially flammable and explosive environments.

- Used to move or carry people or animals.
- Used for or part of a medical device.
- Use in a nonindustrial application.
- Use in moving environment-like vehicle or ship.
- Use as a climbing tool.

1-6. Emergency Stop Device

Pressing the emergency stop button immediately stops all of the Cobot motions and removes hazardous energy. The emergency stop function is only to be used as a safety device. When multiple emergency stop buttons are connected, additional buttons will require documentation by safety personnel.

Emergency stop button must comply with IEC 60947-5-5.

The emergency stop button is located on the Teach Pendant of the Cobot. The stop button shall be pressed when a hazardous situation or emergency occurs. The location of the pendant emergency stop button is shown in the following figure:

⚠ DANGER! – Press the Emergency Stop button to stop Cobot movement, if an accident or abnormal operation occurs.

- The Cobot will maintain its position when emergency stop button is pressed and power is removed.
- Do not turn the power on and off repeatedly. Wait at least 10 seconds between each power cycle.



⚠ Any equipment or tools that are integrated to the Cobot and/or system may cause a hazard. Ensure that any additional safety devices are integrated to the emergency stop circuit and/or safety inputs within the Cobot system. Failure to follow this can result in death, serious injury, or substantial property damage.

Resetting the Emergency Stop Device

The emergency stop device has a "lock" function. This "lock" must be opened to end the emergency stop state.

Rotating the emergency stop button can open the "lock".

⚠ Resetting the emergency stop device is a simple but very important step. Only operate after making sure that the Cobot system is completely safe to operate.

1-7. Moving The Cobot Arm Without Drive Power

In certain cases, such as an emergency stop or power failure situation, it may be required to move one or more Cobot joints without drive power. In order to move the Cobot without drive power use the following procedure:

Force a joint to move by pulling hard, at least 157 lbf (700 N) on the Cobot arm, in the direction you need to remove the hazard.

⚠ Do not move the Cobot joints or arms manually unless it is an emergency situation. Such movement can damage the joints.

Excessive Force Protection

The manipulator is equipped with excessive force protection. The excessive force protection is activated when an impact force exceeds the safety threshold. When this occurs, the manipulator will follow the direction of impact force passively. This function can reduce the damage when objects collide with the manipulator.

1-8. Transportation Precautions

When lifting the Cobot, any moving parts must be secured to avoid damage during lifting and transportation.

When transporting, the Cobot must remain in the shipping position.

Lift the controller using the handle. When placing the manipulator in the installation position, hold the Cobot in place until all mounting bolts are safely tightened at the base of the Cobot.

Turn the Cobot on after installing it. Manually adjust the Cobot orientation to a proper position.

Save the original packaging after transportation. Store the packaging material in a dry place for future repackaging and transporting the Cobot.

⚠ Do not overload the manipulator body with external equipment during transportation and lifting.

⚠ Follow all national, state, and local codes.

⚠ Follow the instructions in this manual when moving and installing the Cobot.

1-9. 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.

1-10. 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.

1-11. Principal Safety Standards

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

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

Safe Practices for the Preparation of Containers and Piping for Welding and Cutting, American Welding Society Standard AWS F4.1. Website: 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, Robotic Industries Association. Website: www.robotics.org.

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

Safety of Machinery – General Principles for Design – Risk Assessment and Risk Reduction, ISO 12100. Website: www.iso.org.

Robots and Robotic Devices – Safety Requirements– Part 2: Industrial Robot Systems and Integration, ISO 10218-2. Website: www.iso.org.

Safety of Machinery; General Requirements & Risk Assessment, ANSI B11.0. Website: www.ansi.org.

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. Website: www.iec.ch.

Cobot System 2024–01