Motoman ERC Controller

Robotic Arc Welding Manual

Part Number: 479950-6
Revision 2

MOTOMAN
a YASKAWA company

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1.0 INTRODUCTION

1.1 DESCRIPTION OF SYSTEM

This Robotic Arc Welding Manual provides specific information about the Gas Metal Arc Welding (GMAW) welding system. It is designed to help personnel install, operate, maintain, and troubleshoot each of the components in the GMAW welding system. This manual also contains information about tool center point definition, ERC setting of absolute welding values, and arc retry.

The main components of a GMAW welding system are:

- Motoman K6SB1 or K10S robot with ERC controller
- Startup Kit
- KVA step-down isolation transformer kit
- Excel-Arc 6045 welding power source
- Motoman air-cooled torch or water-cooled torch
- Motoman PWF4-600 wire feeder
- Universal Welding Interface (UWI)
- Side-mount process package with Motoman RAM torch breakaway

Options for a GMAW welding system include:

- Torch tender
- Wire cutter
- Com-Arc II

1.2 REFERENCE TO OTHER DOCUMENTATION

For additional information, refer to the following:

- Motoman K6SB Robot Manipulator Manual (Part Number 479951-2)
- Motoman K10S Robot Manipulator Manual (Part Number 479951-4)
- Motoman K6SB1 Robot Manipulator Manual (Part Number 479951-14)
- Motoman ERC Programming Manual (Part Number 479950-3)
- Motoman ERC OP2 Key Function Manual (Part Number 479950-4)

1.3 CUSTOMER SERVICE INFORMATION

If you are in need of technical assistance, contact the Motoman service staff at (513) 847-3200. Have the following information ready before you call:

- Robot Type (K3, K6, K10, etc.)
- System Number (located on the cover page of this manual)
- Robot Serial Number (located on the back side of the robot arm)
- Application Type (palletizing, welding, handling, etc.)

2.0 SAFETY

It is the purchaser's responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06. The address is as follows:

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: 313/994-6088
FAX: 313/994-3338

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. **The robot must not be operated by personnel who have not been trained!**

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.

This safety section addresses the following:

- Standard Conventions (see Section 2.1)
- General Cautions and Warnings (see Section 2.2)
- Mechanical Safety Devices (see Section 2.3)
- Installation Safety (see Section 2.4)
- Programming Safety (see Section 2.5)
- Operation Safety (see Section 2.6)
- Maintenance Safety (see Section 2.7)

2.1 STANDARD CONVENTIONS

This manual includes information essential to the safety of personnel and equipment. As you read through this manual, be alert to the four signal words:

- DANGER
- WARNING
- CAUTION
- NOTE

Pay particular attention to the information provided under these headings which are defined below (in descending order of severity).

➪ *DANGER!*

Information appearing under the DANGER caption concerns the protection of personnel from the immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.

➪ *WARNING!*

Information appearing under the WARNING caption concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.

➪ *CAUTION!*

Information appearing under the CAUTION caption concerns the protection of equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

NOTE: Information appearing in a NOTE caption provides additional information which is helpful in understanding the item being explained.

2.2 GENERAL SAFEGUARDING TIPS

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can damage the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.

- Do not enter the robot cell while it is in operation. Place the robot in Emergency Stop (E-Stop) mode and ensure that all motion has stopped before entering the cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.

2.3 MECHANICAL SAFETY DEVICES

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, RIA safety recommendations, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety measures are available:

- Safety fences and barriers
- Light curtains
- Door interlocks
- Safety mats
- Floor markings
- Warning lights

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.

2.4 INSTALLATION SAFETY

Safe installation is essential for protection of people and equipment. The user must be aware of the various national codes, RIA safety recommendations, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations.

- Ensure that only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories are permitted to operate this robot system.
- Identify the work envelope of each robot with floor markings, signs, and barriers.
- Position all controllers outside the robot work envelope.

- Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
- Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
- Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

2.5 PROGRAMMING SAFETY

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Any modifications to NODE 2 (for ERC controllers) or PART 1 (for MRC controllers) of the controller PLC can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to NODE 2 or PART 1. Making any changes without the written permission of Motoman will **VOID YOUR WARRANTY!**
- Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. **YOUR WARRANTY WILL BE VOID** if you use these special passwords.
- Back up all programs and jobs onto a floppy disk whenever program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
- The concurrent I/O (Input and Output) function allows the customer to modify the internal ladder inputs and outputs for maximum robot performance. Great care must be taken when making these modifications. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations that may damage the robot or other parts of the system.
- Improper operation can damage the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Inspect the robot and work envelope to ensure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Ensure that all safeguards are in place.
- Check the E-STOP button on the teach pendant for proper operation before programming.
- Keep the teach pendant with you when you enter the workcell.
- Ensure that only the person holding the teach pendant enters the workcell.
- Test any new or modified program at low speed for at least one full cycle.

2.6 OPERATION SAFETY

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Inspect the robot and work envelope to ensure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Ensure that all safeguards are in place.
- Improper operation can damage the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Do not enter the robot cell while it is in operation. Place the robot in Emergency Stop (E-Stop) mode and ensure that all motion has stopped before entering the cell.
- The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. On ERC controllers this includes controller parameters; ladder nodes 1, 2, or 3; and I/O (Input and Output) modifications. On MRC controllers this includes controller parameters, ladder parts 1 and 2, and I/O (Input and Output) modifications. Check and test all changes at slow speed.

2.7 MAINTENANCE SAFETY

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.

- Improper operation can damage the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Back up all your programs and jobs onto a floppy disk whenever program changes are made. A backup must always be made before any servicing or changes are made to options, accessories, or equipment to avoid loss of information, programs, or jobs.
- Do not enter the robot cell while it is in operation. Place the robot in Emergency Stop (E-Stop) mode and ensure that all motion has stopped before entering the cell.
- The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- Ensure all safeguards are in place.
- Use proper replacement parts.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. On ERC controllers this includes controller parameters; ladder nodes 1, 2, or 3; and I/O (Input and Output) modifications. On MRC controllers this includes controller parameters, ladder parts 1 and 2, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).

3.0 GENERAL INSTALLATION INFORMATION

This section covers general installation information including the proper location for the system, floor preparation, electrical requirements, and Earth grounds. Please read this section before installing your Motoman Robotic Arc Welding Unit.

3.1 LOCATION OF SYSTEM

For best operating characteristics and longest unit life, take care in selecting an installation site. When installing the equipment, avoid locations that are exposed to high humidity, dust, high ambient temperature, or corrosive fumes. Temperature must be 0 to 45° C. Relative humidity must be 20-80% non-condensing. Moisture condenses on machine parts and electrical controls; this causes corrosion that can seriously affect operation and efficiency. Dust and dirt cause extra wear on all moving parts. Locate the equipment so that excess moisture, dust, and corrosive fumes will not be drawn into the controller.

Adequate air circulation is needed at all times in order to ensure proper operation. A minimum of 12" (305 mm) of free air space at the front, sides, and rear of the controller must be provided. The ventilator openings must not be obstructed. Air enters through the front and side panels, and exits through the rear of the machine.

3.2 FLOOR PREPARATION

The floor should be flat, level, smooth concrete with a minimum thickness of 3" to support the system without movement.

3.3 ELECTRICAL REQUIREMENTS

➪ *DANGER!*

Bare conductors, bare terminals in the output circuit, and ungrounded, electrically live equipment can fatally shock a person. To protect against shock, have a competent electrician verify that the equipment is adequately grounded. Do not make contact with terminals or parts that are electrically HOT.

➪ *DANGER!*

The body's electrical resistance is decreased when wet; this permits dangerous currents to flow through the body. Do not work in damp area without being extremely careful. Stand on dry rubber mat or dry wood, and use insulating gloves when dampness or sweat cannot be avoided. Keep clothing dry.

➪ *CAUTION!*

Transformers reduce the voltage from 480 volts to the required voltage of the welding power source and the ERC. <u>Do NOT apply high voltage directly to the ERC or to the welding power source.</u>

Each welding power source has specific electrical requirements. Refer to the applicable Welding Power Source Operator's Manual for specific electrical requirements.

3.4 EARTH GROUNDS

➪ WARNING!

Do not place the GMAW system within 50 feet of other sources of noise (i.e., GTAW arc starters, plasma cutters, induction furnaces, high-power-resistance spot welders, dielectric heaters, etc.). Equipment that generates impulse or high-frequency noise can cause unexpected equipment operation and failure, which can result in serious injury or death.

➪ WARNING!

If proper Earth grounds cannot be provided, do not use the equipment!

➪ CAUTION!

Failure to provide proper Earth grounding can cause ERC shutdown and/or system lockup.

The grounding of a GMAW system is very important to the system operation and reliability. Failure to provide proper Earth grounds can cause high-frequency noise to shut down the robot system, interfere with peripheral equipment, or cause noise to be radiated into other manufacturing computer controllers or electronic equipment. Motoman has taken steps to reduce the noise generated and conducted to other circuits within the robot system. Filter circuits depend on proper conduction of noise to an Earth ground.

An "Earth ground" means that equipment is connected to a ground stake driven into the earth. The ground stake must be driven a minimum of eight feet into the earth, and the earth must be treated with environmentally acceptable chemicals in order to reduce resistance to the ground stake (refer to local and national electrical codes for proper ground treatment requirements). Deeper ground stakes may be required depending on area soil conditions. A minimum of 100 ohms ground resistance is recommended.

The Earth ground is a different ground than the normal one used by the power company. The welding equipment and the robot require that the power line grounds be connected; however, if the power grounds are longer than 25 feet from

the main power ground location, they are not effective in reducing the high-frequency noise that may be radiated or conducted from the welding equipment.

The Earth ground provides a short path for noise to be directed from the equipment. When the welding power source is mounted on the same pallet or base as the ERC, you must provide an ERC base ground and a robot and positioner ground.

The following actions must be taken in order to minimize the effects of high-frequency impulse noise:

- The ERC controller or common base must be grounded within 3 feet of the controller, using an 8-foot long (minimum) ground stake (Blackburn 5008 1/2 x 8' or equivalent) and a ground clamp (Blackburn GG12H or equivalent). When the welding power source is mounted on the same common base as the ERC controller, it is necessary to provide a separate "dirty ground" for the robot and the positioner.
- Flat-plated copper ground braid must be used on all Earth grounds. The ground braid must be #6 AWG or larger (3M Scotch #25 electrical ground braid).

4.0 INSTALLING SYSTEM COMPONENTS

4.1 INSTALLING THE ROBOT

For detailed installation information, refer to the Motoman K6SB1 Robot Manipulator Manual (Part Number 479951-14) or the Motoman K10S Robot Manipulator Manual (Part Number 479951-4).

The robot and the ERC controller are shipped in a wooden crate. To install the robot, follow these steps:

1. Open the shipping crate containing the robot and the ERC controller
2. Carefully remove the protective plastic wrapping from around the robot.
3. Inspect the robot for any damage.

NOTE: If damage is found, contact the shipper.

4. Unbolt the robot from the base of the crate.
5. Attach a chain hook to each of the eyebolts on the robot body.

➪ CAUTION!

Be sure to use a spreader bar to keep the dual chains from pulling against the robot assembly and damaging it.

6. Attach the chains to a forklift or overhead crane.
7. Using the forklift or overhead crane, carefully lift the robot and move it to the riser.
8. Align the holes on the robot with the holes on the riser.
9. Using the hardware supplied, bolt the robot securely to the riser.
10. Using 1/2-inch-diameter (minimum) lag bolts, lag the riser to the floor.

NOTE: Motoman recommends the use of epoxy grout anchor hardware.

4.1.1 Removing the Shipping Brackets

CAUTION!

Failure to remove shipping brackets from robot before operating the system may result in damage to the robot drive mechanisms.

Two bright yellow brackets (see Figure 4-1) keep the robot from moving during shipping. The larger bracket secures the lower arm assembly to the S-axis housing. The smaller bracket on the side of the robot keeps the S-axis housing from pivoting.

After the robot is in place, remove the shipping brackets from the robot.

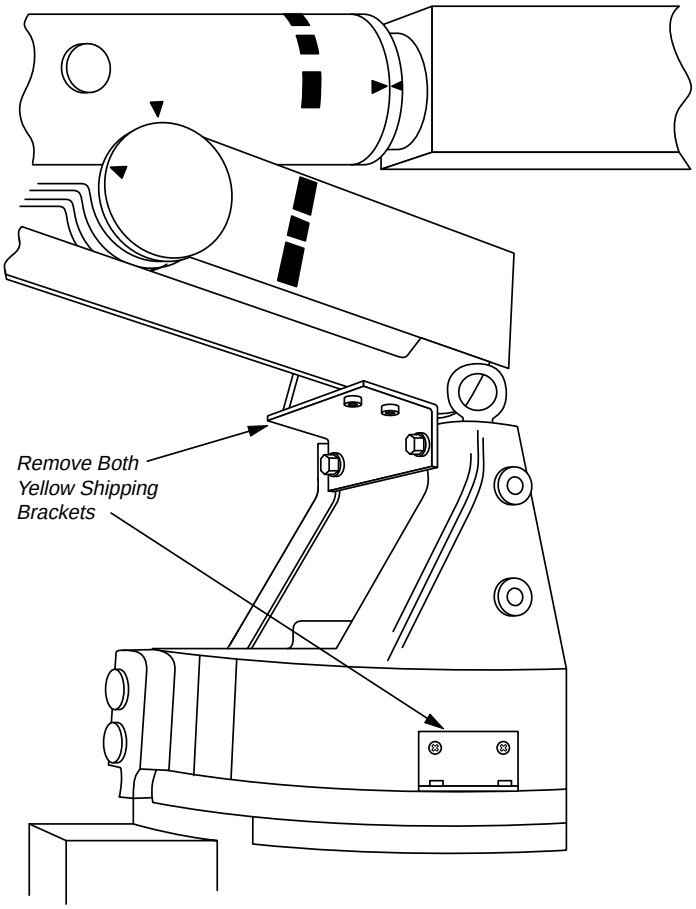

Figure 4-1 Location of Shipping Brackets

4.1.2 Installing the Wire Feeder

The PWF-4 wire feeder is already installed on the robot; however, it is necessary to install the wire guide cable. The wire guide is shipped in an accessories box.

NOTE: Although the GMAW system arrives with the wire feeder already installed, there may be circumstances in which the wire feeder needs to be replaced.

To install the wire guide, follow these steps:

1. Remove the wire guide from the accessories box.
2. Screw the connector end of the wire guide into the wire feeder housing (see Figure 4-2) by turning connector clockwise until it is hand-tight.
3. Put the other end of the wire guide into the side mount and tighten the thumbscrew.

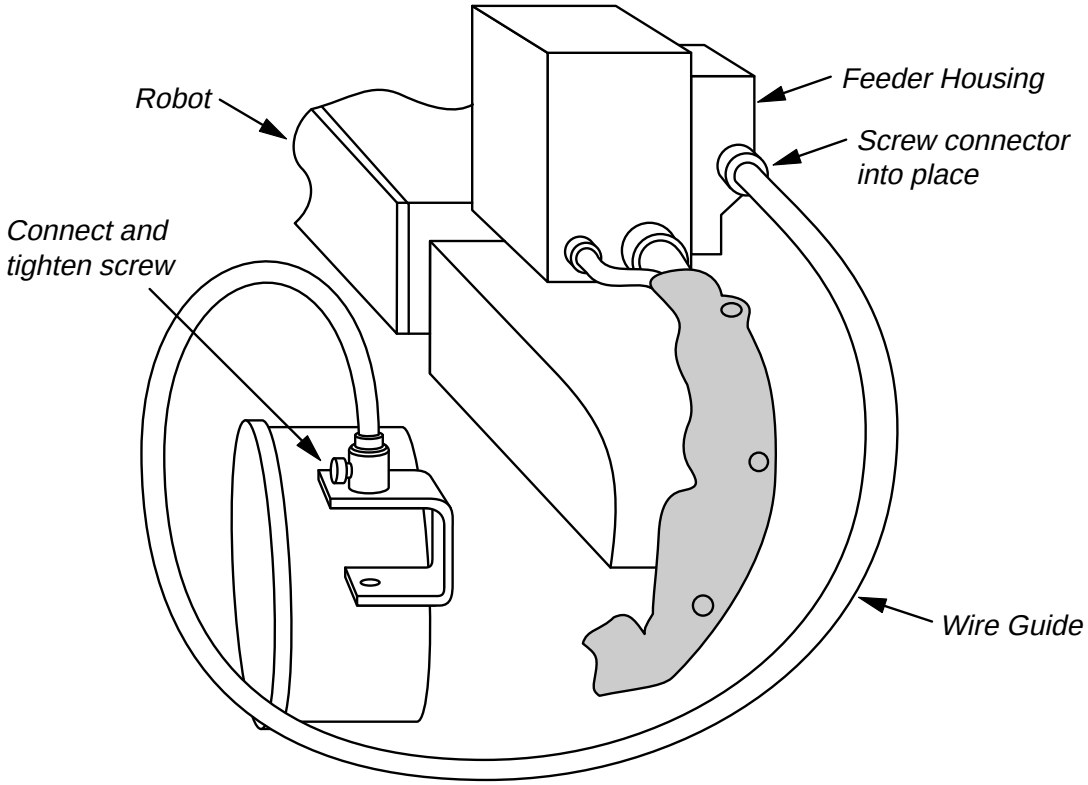

Figure 4-2 Installing the Wire Guide

4.1.3 Installing the Ram Torch Breakaway

Although the GMAW welding system arrives with the RAM torch breakaway already installed, there may be circumstances in which the RAM torch breakaway needs to be replaced. For information on replacing the RAM torch breakaway, see Section 10.0 of this manual.

4.1.4 Installing the Torch

The GMAW Welding System may include either a Hobart TA-4 air-cooled torch or a Hobart TW-5 water-cooled torch. The water-cooled torch will already be connected to the robot. The air-cooled torch will be shipped in an accessories box. For detailed installation and operating information, refer to the applicable Hobart Torch Owner's Manual.

To install the water-cooled torch, follow these steps:

1. Untape the torch from the top of the robot.
2. Snap the torch onto the breakaway.
3. Attach the green restraining wire, using the screw provided.

To install the air-cooled torch, follow these steps:

1. Remove the accessories box from the welding power source.
2. Remove the air-cooled torch from the accessories box.
3. Plug the small plastic end of the retractile cord (see Figure 4-3) into the breakaway and the other end into the wire feeder housing.
4. Plug the end of the air-cooled torch into the feeder housing.
5. Tighten the black knob on the feeder housing to secure the connection.
6. Snap the torch onto the breakaway. The white T-mark on the torch assembly should be aligned with the white T-mark on the breakaway.
7. Attach the green restraining wire, using the screw provided.

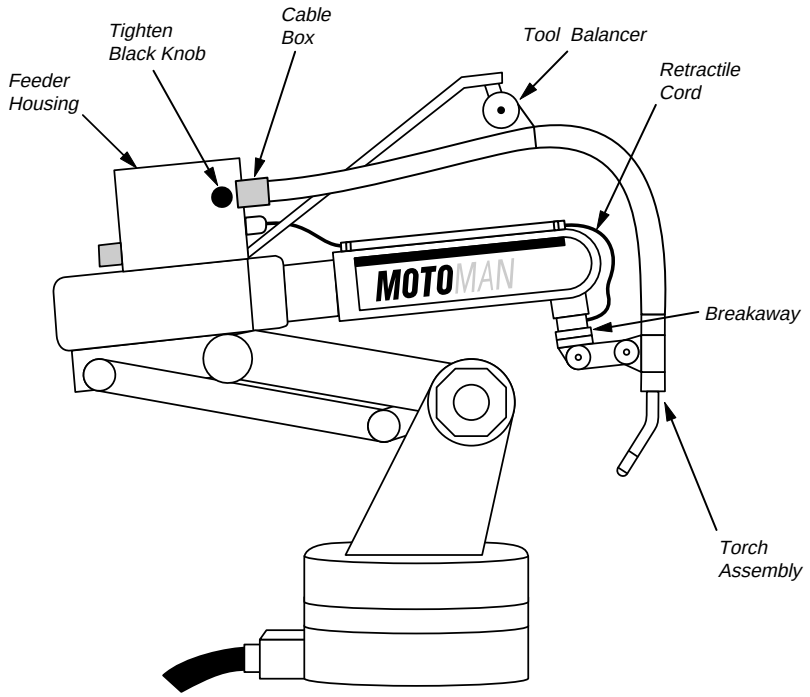

Figure 4-3 Installing the Torch

4.1.5 Installing the Water Circulator

Systems using a water-cooled torch will have a water circulator. The water circulator is shipped either in the crate with the robot and controller or on a separate wooden shipping skid.

To install the water circulator, follow these steps:

1. Remove the water circulator from the wooden shipping crate or skid.
2. Carefully remove the protective plastic wrapping from around the water circulator.

NOTE: If damage is found, contact the shipper.

3. Set the water circulator into place.
4. Plug the water circulator into the welding power source.

➪ *CAUTION!*

Use only the antifreeze provided by Motoman. Automotive antifreeze contains stop-leak addditives that will clog the small torch water-cooling ports and damage the gaskets in the pump.

➪ *CAUTION!*

Do not fill water circulator past fill line. Damage to water circulator could occur.

5. Fill the water circulator tank with the antifreeze coolant provided (Part Number 131224-1).

4.1.6 Connecting the Robot

The wire feeder on the robot contains five cables and hoses that must be connected to various components (see Figure 4-4). These cables and hoses are enclosed in a leather casing.

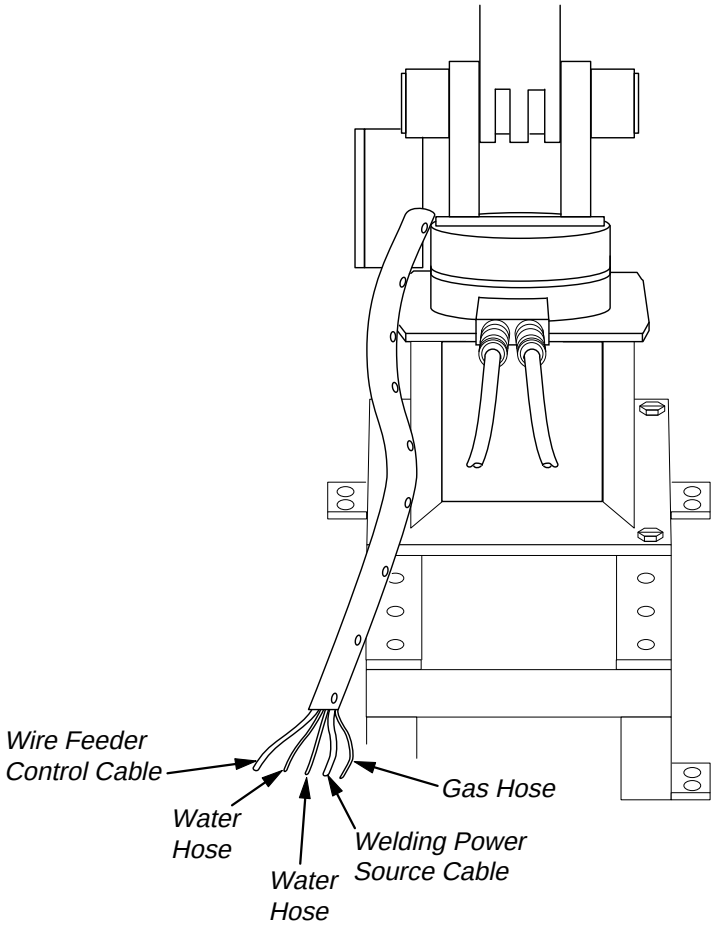

Figure 4-4 Robot Cables and Hoses Enclosed in Leather Casing

To connect the five cables and hoses, follow these steps:

1. Connect the wire feeder control cable to the FEEDHEAD connection on the side of the ERC (see Figure 4-5).
2. Connect the two water hoses to the connections on the water circulator that are marked WATER-IN and WATER-OUT.

NOTE: It does not matter which water hose goes in WATER-IN and which one goes in WATER-OUT.

3. Connect the gas hose to the gas supply.

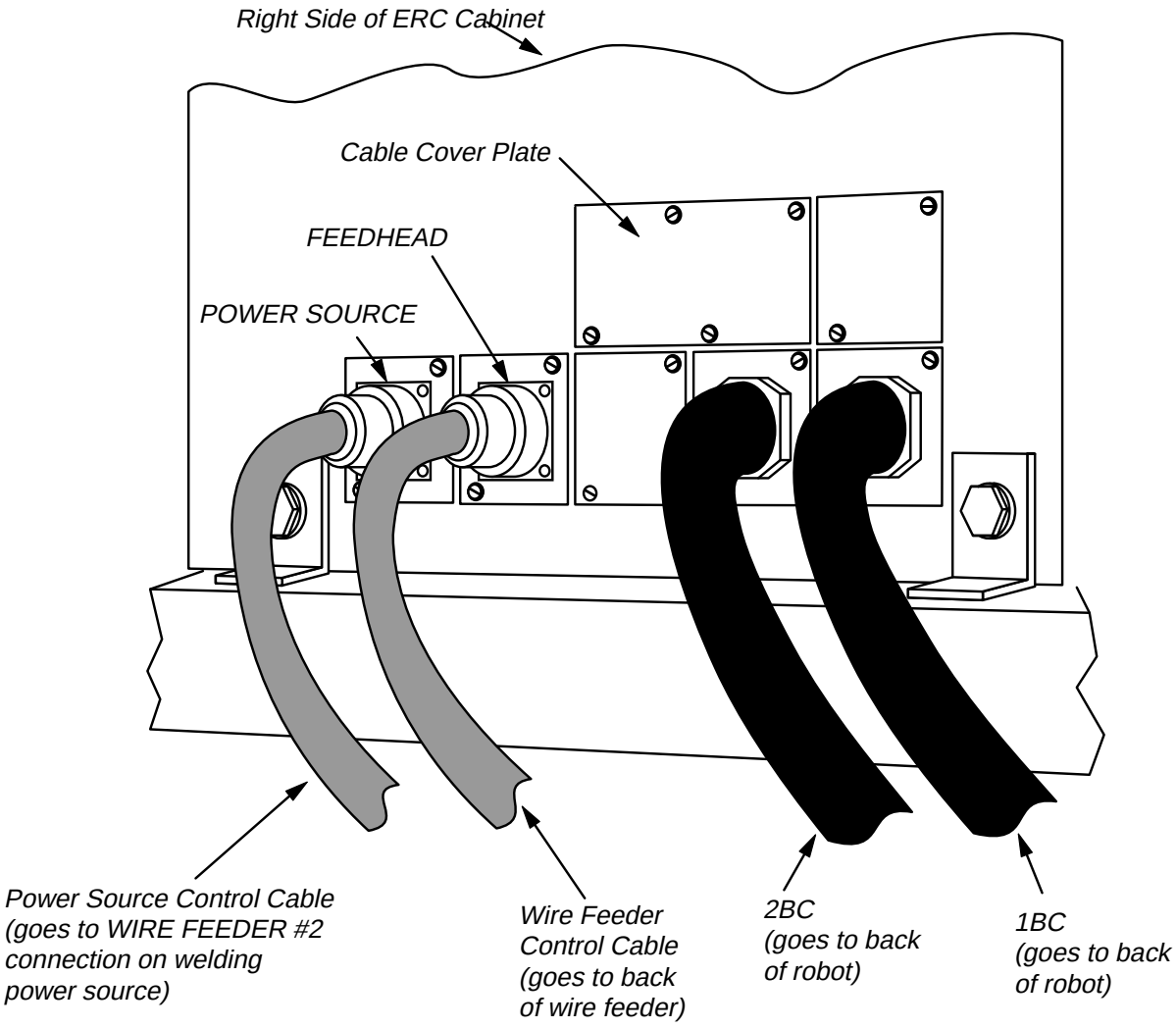

Figure 4-5 Power Source Control Cable, Wire Feeder Control Cable, and 1BC and 2BC Cable Connections on ERC

4.2 INSTALLING THE ERC CONTROLLER

For detailed installation information, refer to the Motoman K6SB1 Robot Manipulator Manual (Part Number 479951-14) or the Motoman K10S Robot Manipulator Manual (Part Number 479951-4).

1. Carefully remove the protective plastic wrapping from around the controller.
2. Inspect the controller for any damage.

NOTE: If damage is found, contact the shipper.

3. Unbolt the controller from the base of the crate.
4. Attach a chain hook to each of the eyebolts on the controller.

➪ CAUTION!

Be sure to use a spreader bar to keep the dual chains from pulling against the ERC and damaging it.

5. Attach the chains to a forklift or overhead crane.
6. Using the forklift or overhead crane, carefully lift the controller and set it into place.
7. Using lag bolts, lag the controller to the floor.

4.2.1 Connecting the ERC

To connect the ERC, follow these steps:

1. Connect the two large black cables on the ERC to the back of the robot (see Figure 4-6). The smaller of the two cables should be on the left and the larger on the right.
2. Remove the power source control cable from the accessories box.
3. Connect the power source control cable to the ERC connection (see Figure 4-5).
4. Connect the other end of the power source control cable to the WIRE FEED #2 connection on the welding power source.

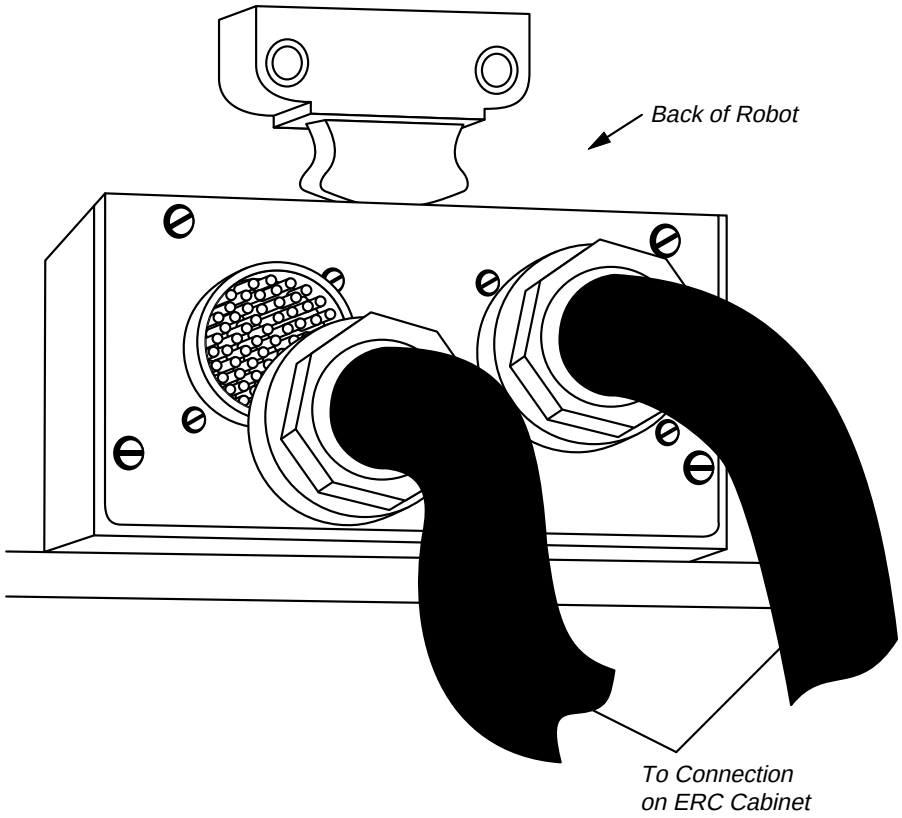

Figure 4-6 Connecting the ERC to the Robot

4.3 INSTALLING THE WELDING POWER SOURCE

The welding power source is shipped on a wooden shipping skid. To install the welding power source, follow these steps:

1. Remove the welding power source from the wooden shipping skid.
2. Carefully remove the protective plastic wrapping from around the welding power source.
3. Inspect the welding power source for any damage.

NOTE: If damage is found, contact the shipper.

4. Attach a chain hook to the eyebolt on the welding power source.
5. Attach the chain to a forklift or overhead crane.
6. Using the forklift or overhead crane, carefully lift the welding power source and set it into place.
7. Using lag bolts, lag the welding power source to the floor.

NOTE: Motoman recommends the use of epoxy grout anchor hardware.

4.3.1 Connecting the Welding Power Source

To connect the welding power source, follow these steps:

1. Install primary power service according to the Owner's Manual and to local and national electrical codes.
2. Connect the welding power source cable to the positive (+) terminal on the welding power source (see Figure 4-7).
3. Connect one end of the ground welding cable to the grounding block.
4. Connect the other end of the ground welding cable to the negative (-) terminal on the welding power source (see Figure 4-7).

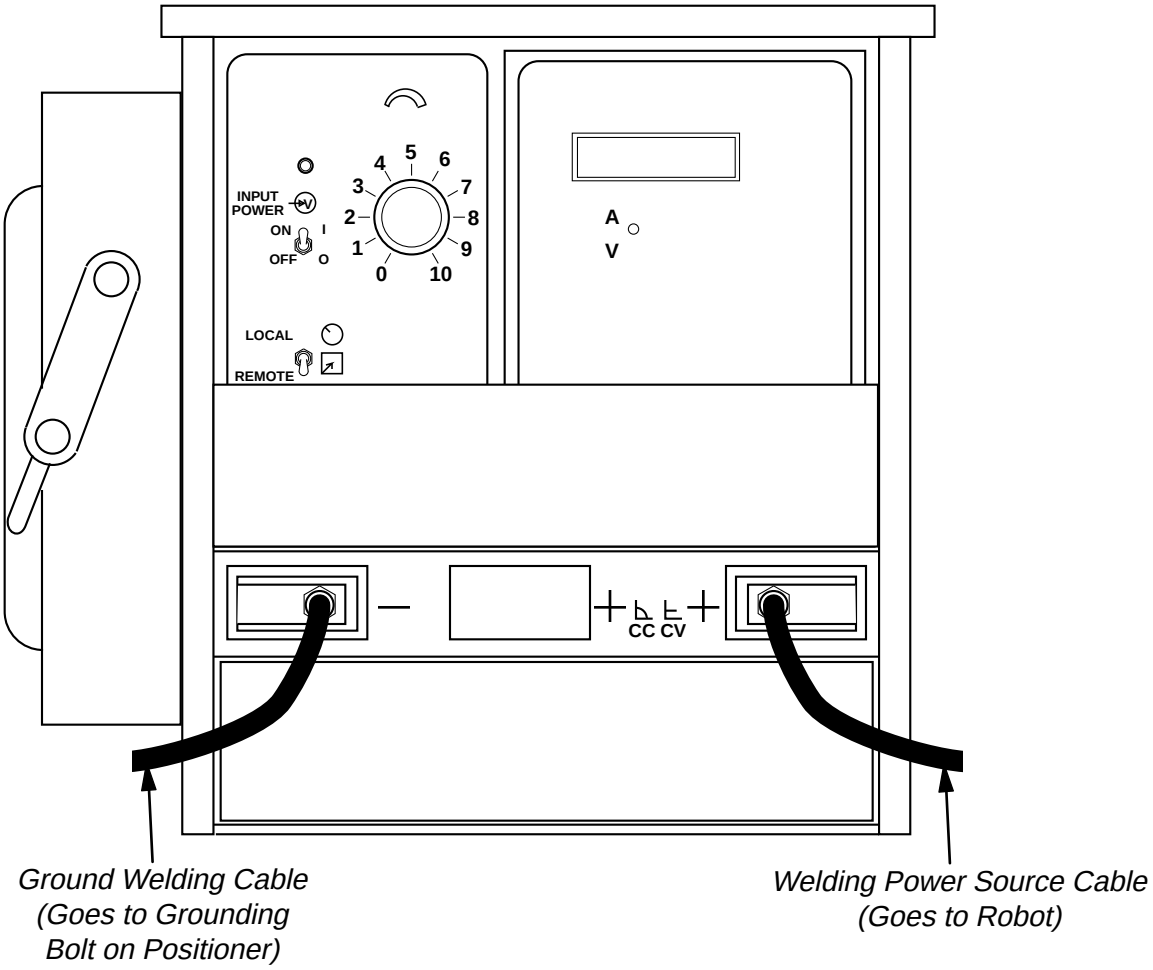

Figure 4-7 Positive and Negative Terminals on Welding Power Source

4.4 INSTALLING THE UWI

The Universal Weld Interface (UWI) consists of a UWI printed circuit (PC) board, a KXA motor speed control, and a transformer. Although the GMAW welding system arrives with the UWI already installed, there may be circumstances in which the UWI or one of its components needs to be replaced.

- For information on replacing the UWI, see Section 6.0.
- For information on replacing the KXA motor speed control, see Section 8.0.

4.5 INSTALLING AND CONNECTING SYSTEM OPTIONS

4.5.1 Torch Tender

The pneumatic nozzle-cleaning station (torch tender) is a stand-alone device that uses compressed air to drive a nozzle-vibrating device and to blow antispatter compound into the torch nozzle. The torch tender is shipped either in the crate with the robot and controller or on a separate wooden shipping skid. For detailed installation and operation instructions about the torch tender, refer to the Torch Tender Installation and Operation Instructions Manual.

NOTE: Air supply is required for operation of the torch tender.

To install the torch tender, follow these steps:

1. Remove the torch tender from the wooden shipping crate or skid.
2. Carefully remove the protective plastic wrapping from around the torch tender.
3. Inspect the torch tender for any damage.

NOTE: If damage is found, contact the shipper.

4. Set the torch tender into place.
5. Using lag bolts, lag the torch tender to the floor.

NOTE: Motoman recommends the use of epoxy grout anchor hardware.

4.5.2 Wire Cutter

The wire cutter automatically cuts welding wire to a desired length. The torch tender is shipped with the wire cutter already installed. For detailed installation and operation instructions about the wire cutter, refer to the Binzel Wire Cutting Station Instruction Manual.

To connect the wire cutter, follow these steps:

NOTE: One end of the wire cutter cable is hardwired to the ERC.

1. Connect the end of the cable (three-prong connector) to the connection on the wire cutter unit.

4.5.3 Com-Arc II

Com-Arc II performs seam tracking and can be used with or without a touch sensing function. Com-Arc II is shipped either in the crate with the robot and controller or on a separate wooden shipping skid. For detailed installation and operation instructions about the Com-Arc II, refer to the Com-Arc II Manual (Part Number 479235-7).

To install and connect the Com-Arc II, follow these steps:

1. Remove the Com-Arc II from the wooden crate or shipping skid.
2. Carefully remove the protective plastic wrapping from around the shunt box.
3. Inspect the shunt box for any damage.

NOTE: If damage is found, contact the shipper.

4. Set the Com-Arc II into place.

NOTE: One end of the Com-Arc II cable is hardwired to the ERC.

5. Connect the other end of the cable to the connection on the Com-Arc II unit.

5.0 EXCEL-ARC WELDING POWER SOURCE

5.1 DESCRIPTION OF EXCEL-ARC WELDING POWER SOURCE

The Hobart Excel-Arc 6045 welding power source (Part Number 131300-1) is a 3-phase, 60-Hertz, 450-amp, constant-voltage welding power source.

5.2 ADDITIONAL WELDING POWER SOURCES

The following welding power sources are also available for use with Motoman's Robotic Arc Welding Systems. These welding power sources are built by Hobart Brothers Company and are **specially modified** for use by Motoman.

Hobart Welding Power Sources	*Part Number*
Hobart ArcMaster 351 (Non-Robotic)	500123-1
Hobart ArcMaster 501 (Robotic)	500109-1
Hobart Excel-Arc 8065	131300-2

Other Welding Power Sources

Panasonic DipPulse 350

OTC TurboPulse 350

OTC TurboPulse 350SE

Miller DeltaWeld 451

Miller DeltaWeld 651

Lincoln DC-400

NOTE: Additional interface requirements and calibration charts for non-Hobart welding power sources can be obtained from Motoman.

6.0 UNIVERSAL WELD INTERFACE (UWI)

6.1 DESCRIPTION OF THE UWI

The Universal Weld Interface (UWI) consists of a UWI printed circuit (PC) board, a KXA motor speed control, and a transformer.

Through use of a microprocessor, the UWI PC board provides logic for the wire feeder, the welding power source, and the gas. The KXA motor speed control controls the speed of the wire feeder motor. The transformer steps 120 VAC down to 24 VAC for input to the KXA.

The UWI takes the arc on logic and provides logic control for the various components of the weld system. The UWI provides isolation of the welding power source analog (VWELD) and optional isolation of the wire feeder analog (AWELD). Test and calibration points are provided for calibration and adjustment of the inch-forward and inch-reverse speeds.

Jumpers on the UWI PC board provide compatibility for many different types of welding power sources. Replaceable relays provide interface to the KXA motor speed control and to auxiliary equipment and accessories.

This manual provides information on UWI calibration, testing, and troubleshooting. Generally, the UWI and the wire feeder are factory-calibrated; however, when UWI components are replaced, the component and/or system must be recalibrated.

6.2 UWI THEORY OF OPERATION

The UWI is a microprocessor-based control that handles all logic for wire feed, inch, and gas purge. The robot analog channels are isolated and scaled as required for the welding power source and the wire feed system.

When an ARCON command is received, the following sequence is executed:

1. The KXA is enabled.
2. The welding power source is enabled.
3. The gas valve is enabled.
4. Wire feed command is given to KXA.
5. Wire feed begins and the arc starts.

When the ARCOF command is executed, the reverse sequence occurs:

1. The wire feed to KXA command is removed, stopping the feeder.
2. The welding power source disables immediately.
3. Burnback occurs, either as a function of the welding power source setting or automatically based on the welding power source "wire sharpening circuit".
4. The gas valve is disabled.
5. The UWI is disabled.
6. Arc weld is complete.

The wire feeder can be inched forwarded or inch reversed at a fixed speed. The gas can be purged independently of the wire feed. Robot Output #3 is reserved for inch reverse, Output #4 is reserved for purge, and Output #63 is dedicated to inch forward. These outputs are assigned to teach pendant parameters SC220, SC221, and SC222. If the selected output groups are needed in other applications, these outputs may be reassigned to different output number addresses. Contact Motoman service for information about changing output addresses.

6.3 UWI SPECIFICATIONS

UWI Part Number:	130969-1 (FabStar 4030)
	130969-2 (Excel-Arc 6045/8065)
	130969-3 (Robotic ArcMaster 500)
Manufacturer:	Motoman
Cable connections:	KXA, welding power source, wire feeder, EW02 robot analog board, impact sensor.

6.4 UWI COMPATIBILITY

The UWI is compatible with the following welding power sources:

Hobart:	RC-300RVS to RC-650RVS Excel-Arc CV 6045/8065 ArcMaster 500, 501, and 351 FabStar 4030
Others:	Miller Lincoln OTC Kobelco Panasonic Others

NOTE: When welding power sources with built-in wire feeder controls are used (e.g., OTC, Mark III) the Motoman feeder is used.

The UWI is compatible with the following Motoman robots:

- K6SB
- K10S
- K10MS
- K6MS

Smaller robots can use the UWI and the wire feeder if the wire feeder is mounted off the robot arm. Older robots (e.g., L10WX and L106 with RX controller) require special interfaces. Contact Motoman Service for special requirements and interface details.

6.5 UWI INSTALLATION

The UWI is mounted on the front door of the ERC cabinet. The cables are routed from the UWI to the receptacle plates that are located on the lower right side of the ERC cabinet. Other cables are routed to their respective locations through the wireways and tied in place.

The 120 VAC UWI power is derived from the welding power source. The KXA motor speed control always has power applied when the welding power source is on. When the welding power source is turned off, the inch forward and reverse will not function. On standard systems, the welding power source provides the UWI power.

The GMAW welding system arrives with the UWI already installed. However, there may be circumstances in which the UWI needs to be replaced.

To install the UWI, follow these steps:

1. Open the door of the ERC cabinet.
2. Disconnect the Honda connector from the EW02 board.
3. Disconnect the wire feeder cable and the power source cable from the receptacle plates on the side of the ERC.
4. Remove the screws from the receptacle plates.
5. Pull the wire feeder cable and the power source cable through the access holes.
6. Remove the 2-pin connector (PL-4) from the UWI PC board.
7. Remove the sockethead capscrews that hold the UWI metal plate to the door.

6.6 UWI CALIBRATION FOR WELDING POWER SOURCE ANALOG ISOLATION

The UWI must be calibrated for welding power source analog isolation. Motoman recommends that the entire system be calibrated using system cables and welding power source under actual operating conditions.

6.6.1 Test Equipment Required

- Small screwdriver for pot adjustment
- Small jumper clip lead
- Digital VOM with four-digit resolution (Fluke model 87 or equivalent)
- Test jumper lead
- Resistance welding load bank capable of handling full power source load (optional)

6.6.2 UWI Calibration Procedure for Welding Power Source

The Hobart Excel-Arc 6045 and many other industry welding power sources require an isolated, adjustable, 0-to-10 VDC input for 44 volts of output at full load rating. Welding power sources smaller than 600 amps may have a maximum load voltage of less than 44 volts. The welding power source's maximum output is determined by its rated amperage output, but the welding power source is generally calibrated as if it is producing the maximum 44 volts.

To calibrate the welding power source, follow these steps:

1. Verify welding power source output voltage.

NOTE: A welding power source in the 300- to 350-amp range may provide a higher-than-rated voltage at a lower current. An example of this is when a power source will produce 40 volts at 180 amps. This does not necessarily occur on all industry power sources.

NOTE: Some welding power sources (e.g., OTC, Panasonic, and some Miller) have a minimum output and will not provide "0 volts output" at an analog of "0 volts input." With power sources that have a fixed minimum output, you need to calibrate the entire voltage range and "graph" the analog versus output voltage. Use the graph to develop the argument chart for those power source characteristics.

Table 6-1 Output Voltage Rating for All Welding Power Sources

Welding Power Source Output (Amperage Rated Amps)	*Welding Power Source Output (Voltage at Rated Amps)*
300 amps	32 volts
350 amps	34 volts
400 amps	36 volts
450 amps	38 volts
500 amps	40 volts
600 amps	44 volts
650 amps	44 volts

2. Create the following test job in the ERC with **NO MOVEMENT**.

➪ *DANGER!*

Robots can move unexpectedly. Always be aware of the possibility of robot movement. Unexpected operation can cause serious injury or death.

➪ *WARNING!*

Ensure that there is no feed roll tension or wire in the feeder. Wire feed during this test and during calibration can cause hazardous conditions and serious injury.

Line	*Step*	*Command*	*Remarks*
000		NOP	Beginning of job
001		VWELD 14.00	Sets power source voltage maximum
002		AWELD 0.00	Sets wire feed to zero
003		ARCON	Turns arc on
004		TIMER T=120	Keeps command on 120 seconds
005		ARCOF	Turns arc off
006		END	End of job

3. On the ERC controller IO03 PC board (located on the left side of the ERC), connect the jumper wire from terminal 6TB-8 to 4TB-6 in order to bypass the arc-established signal.
4. Disconnect the weld electrode and ground cable from the welding power source and remove the top set of feed rolls on the wire feeder.
5. Connect the welding power source to a resistance load bank, if available.
6. Plug the control cable into the power source and turn on the power source.

NOTE: The analog voltage input to the power source of 10.00 volts corresponds to a power source output of 44.0 volts. "Zero volts input" corresponds to "0 volts output" on most Hobart power sources. Calibration for other brands of power sources will be different. In some cases, the digital meters on the power source will display the set voltage and load bank testing will not be required.

7. Run the VWELD test job.
8. With the job running, adjust the VWELD Pot #1 located on the UWI PC board near the top large blue isolator.

NOTE: The welding power source should show an open circuit voltage. The only way to confirm actual arc voltage is to use a resistance load test bank capable of handling the maximum voltage and amperage.

NOTE: The welding power source open circuit voltage may be higher than the normal welding voltage set.

9. Measure across terminals J5-15 (positive) and J5-8 on the UWI PC board.
10. Adjust Pot #1 to obtain 10.00 ± 0.02 volts.

6.7 ARGUMENT CHART AND TABLE FOR HOBART WELDING POWER SOURCES

Data in the following chart is for the following Hobart welding power sources: ArcMaster, FabStar, Excel-Arc, and some RC models.

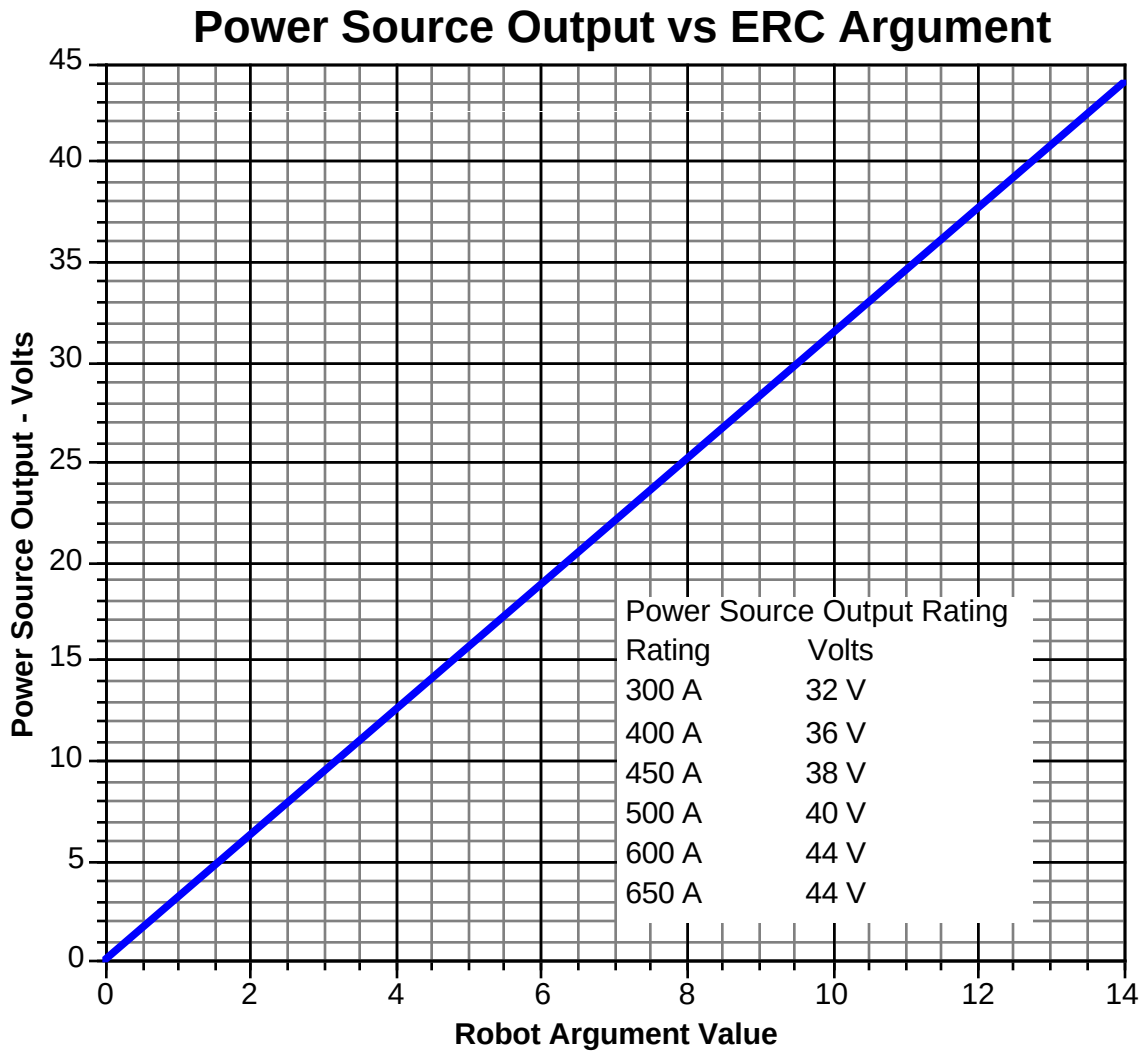

Figure 6-1 Hobart Welding Power Source Argument Chart

Table 6-2 Argument Table For K Robot And All Hobart Welding Power Sources

ERC. ARG	PSOUT VOLTS	ERC ARG.	PSOUT VOLTS	ERC ARG.	PSOUT VOLTS	ERC ARG.	PS OUT VOLTS	ERC ARG.	PS OUT VOLTS
0.00	0.0	2.81	8.8	5.67	17.8	8.53	26.8	11.39	35.8
0.06	0.02	2.92	9.2	5.78	18.2	8.64	27.1	11.50	36.1
0.17	0.5	3.03	9.5	5.89	18.5	8.75	27.5	11.61	36.5
0.28	0.9	3.14	9.9	6.00	18.9	8.86	27.8	11.72	36.8
0.39	1.2	3.25	10.2	6.11	19.2	8.97	28.2	11.83	37.2
0.50	1.6	3.36	10.6	6.22	19.5	9.08	28.5	11.94	37.5
0.61	1.9	3.47	10.9	6.33	19.9	9.19	28.9	12.05	37.9
0.72	2.3	3.58	11.2	6.44	20.2	9.30	29.2	12.16	38.2
0.83	2.6	3.69	11.6	6.55	20.6	9.41	29.6	12.27	38.6
0.94	3.0	3.80	11.9	6.66	20.9	9.52	29.9	12.38	38.9
1.05	3.3	3.91	12.3	6.77	21.3	9.63	30.3	12.49	39.2
1.16	3.6	4.02	12.6	6.88	21.6	9.74	30.6	12.60	39.6
1.27	4.0	4.13	13.0	6.99	22.0	9.85	30.9	12.71	39.9
1.38	4.3	4.24	13.3	7.10	22.3	9.96	31.3	12.82	40.3
1.49	4.7	4.35	13.7	7.21	22.7	10.07	31.6	12.93	40.6
1.60	5.0	4.46	14.0	7.32	23.0	10.18	32.0	13.04	41.0
1.71	5.4	4.57	14.4	7.43	23.3	10.29	32.3	13.15	41.3
1.82	5.7	4.68	14.7	7.54	23.7	10.40	32.7	13.26	4`.7
1.93	6.1	4.79	15.1	7.65	24.0	10.51	33.0	13.37	42.0
2.04	6.4	4.90	15.4	7.76	24.4	10.62	33.4	13.48	42.4
2.15	6.8	5.01	15.7	7.87	24.7	10.73	33.7	13.59	42.7
2.26	7.1	5.12	16.1	7.98	25.1	10.84	34.1	13.70	43.0
2.37	7.4	5.23	16.4	8.09	25.4	10.95	34.4	13.81	43.4
2.48	7.8	5.34	16.8	8.20	25.8	11.06	34.8	13.92	43.7
2.59	8.1	5.45	17.1	8.31	26.1	11.17	35.1	14.03	44.1
2.70	8.5	5.56	17.5	8.42	26.5	11.28	35.4		

NOTE: The maximum power source output is a function of the power source rating.

NOTE: The ERC analog output voltage is 14.00 at the pendant "VWELD" setting of 14.00. This is scaled to 10.00 volts for power source input. The relationship is linear.

NOTE: The analog level changes every 11th step of the pendant argument. The analog value changes at the argument listed in the table above. For example:

Pendant Indication	*Weld Voltage*	*Analog Voltage*
6.86	21.3	4.82
6.87	21.3	4.82
6.88	21.6	4.90
6.98	21.6	4.90
6.99	22.0	4.98
7.00	22.0	4.98

6.8 RELAY AND LED IDENTIFICATION

The following is a list of UWI relays and LEDs and their functions.

Relay	*LED #*	*Function*
-	1	Arc on input
-	2	Inch forward input
-	3	Inch reverse input
-	4	Gas purge input
CR1	5	Inch forward relay
CR2	5	Inch reverse relay
CR3	7	Feeder analog input
CR4	8	Gas purge
CR5	9	Power source enable
CR6	10	Feeder enable
CR7	11	Auxiliary feeder enable
CR8	12	Auxiliary relay enable
-	13	+5 VDC OK
-	14	+15 VDC OK

6.9 UWI RELAY AND LED OPERATION

NOTE: The +5 volt and +15 volt LEDs should be on all the time.

6.9.1 Inch Forward

The following relays and corresponding LEDs are lit during inch forward operation:

Relay On	*LED On*
	INCH-FWD
CR1	LED5
CR6	LED10
CR7	LED11 (No relay in socket)

6.9.2 Inch Reverse

The following relays and corresponding LEDs are lit during inch reverse operation:

Relay On	*LED On*
	INCH-REV
CR6	LED10
CR2	LED6

6.9.3 Purge

The following relays and corresponding LEDs are lit during purge operation:

Relay On	*LED On*
	PURGE
CR4	LED8

6.9.4 Arc On Condition

The following relays and corresponding LEDs are lit during arcon condition:

Relay On	*LED On*
	ARCON
CR3	LED7
CR4	LED8
CR5	LED9
CR6	LED10
CR7	LED11 (no relay in socket)
CR8	LED12 (no relay in socket)

6.10 UWI JUMPER DESIGNATIONS

Jumper designations are marked on the PC board. When a PC board is replaced, the jumpers must be on the same pins as they were on the original PC board.

6.11 JUMPER POSITIONS

Jumpers should be on the following jumper pins:

JMP6

JMP8

JMP9

JMP11

JMP12

JMP13

JMP14

JMP19

JMP20

JMP21

JMP24

JMP27

JMP30

NOTE: Extra jumpers for special applications are placed in a cloth bag that is attached to the UWI.

6.12 UWI FUSES

Fuse	*Value*	*Type*	*Mfr. #*	*Motoman #*	*Description*
FU1	4A	T-4A	Wickmann 19374K-4A	131265-1	Delay fuse for feeder transformer
FU2	.25A	Micro-.25A	Wickmann 19303K-250A	130947-1	Impact sensor protection
FU3	.50A	Micro-.5A	Wickmann 19303K-500A	130947-2	DC gas valve protection

NOTE: Extra fuses are placed in a cloth bag that is attached to the UWI.

6.13 UWI RELAYS

Relay	*Mfr.*	*Model*	*Rating*	*Motoman #*	*Use*
CR1-6	Takamisawa	RY-5W-K	120VAC, 5A 32VDC, 1A	130948-1	Standard
CR7-8	Guardian	A410-367021-30E	32VDC, 2A	130948-2	Optional

6.14 UWI PLUG AND SOCKET CONNECTORS

The following lists UWI plug and socket connectors and their descriptions (see Figure 6-2 for the locations of the plug and socket connectors on the UWI PC Board).

Connector	*Description*
J1	20-pin Honda connector from EW02 cable
J2	To wire feed motor, armature, tachometer, inch, gas control
J3	Shock sensor BB03 interface connections
J4	Auxiliary arc established
J5	Welding power source cable connections
J6	120 volts AC connections and 24 VAC jumpers from transformer
J7	Connections to wire feeder controller
J8	Auxiliary relay connections
J9	Auxiliary meter connections
J10	Arc off detect, gas, wire shortage input

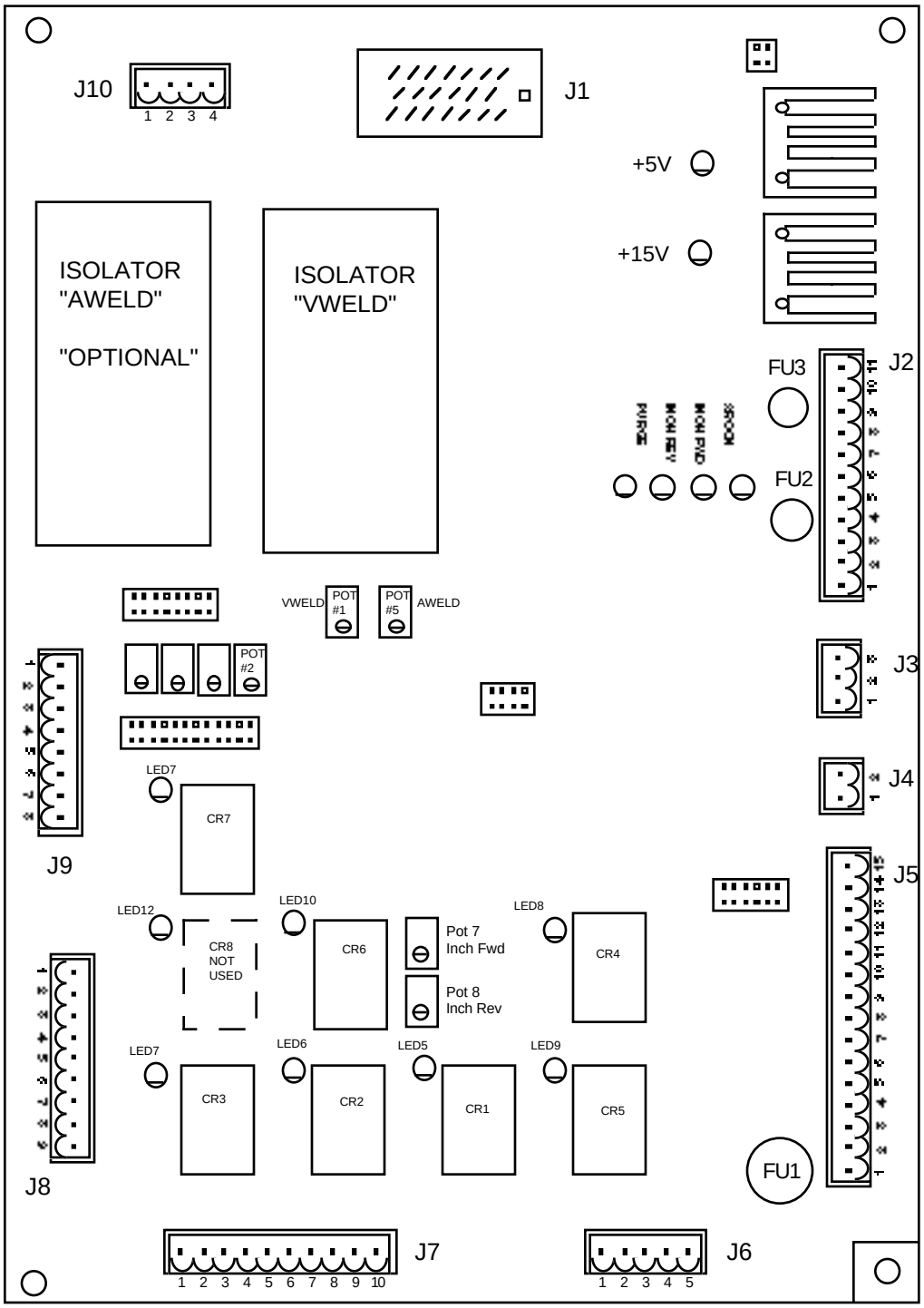

Figure 6-2 Plug and Socket Locations on the UWI PC Board

6.15 CONNECTOR PINS

6.15.1 J1 Honda 20-Pin Cable from EW02

J1-1 Wire stick +
J1-2 Wire stick -
J1-3 VWELD +
J1-4 No connection
J1-5 VWELD -
J1-6 Inch reverse (Output # 3)
J1-7 Purge (Output # 4)
J1-8 Isolated arc established to EW02 input
J1-9 Arc off detect
J1-10 Gas shortage
J1-11 Wire shortage
J1-12 Arc relay
J1-13 Inch forward
J1-14 Inch forward common
J1-15 AWELD +
J1-16 No connection
J1-17 AWELD -
J1-18 + 24 VDC
J1-19 Arc on common
J1-20 "0" volts common

6.15.2 Wire Feeder Motor 11-Pin Connector

J2-1 Motor armature +
J2-2 Motor armature -
J2-3 Tach -
J2-4 Tach +
J2-5 +24 VDC fused to shock sensor
J2-6 Impact sensor signal
J2-7 Impact sensor common (0 volt)
J2-8 +24 VDC fused to turn on gas valve
J2-9 Board common (same as 0 volt)
J2-10 Inch forward input
J2-11 Board common

6.15.3 Impact Sensor 3-Pin Connector

J3-1 +24 VDC for impact sensor

J3-2 Impact sensor signal

J3-3 Impact sensor common

6.15.4 Auxiliary Arc Established 2-Pin Connector

J4-1 Auxiliary arc established

J4-2 Auxiliary arc established

6.15.5 Welding Power Source 15-Pin Connector

J5-1 115 VAC hot

J5-2 115 Volt neutral

J5-3 115 Volt ground/frame - chassis ground

J5-4 Welding power source + wire stick

J5-5 Welding power source - wire stick

J5-6 Welding power source enable

J5-7 Welding power source enable

J5-8 Analog to welding power source

J5-9 Arc establish from welding power source (+ 12 TO 15 volts with arc)

J5-10 Welding power source DC common

J5-11 Welding power source VSENSE 1

J5-12 Welding power source VSENSE 2

J5-13 Welding power source shunt

J5-14 Welding power source shunt

J5-15 Analog high to welding power source control

6.15.6 24 VAC Power Transformer 5-Pin Connector

J6-1 No connection

J6-2 No connection

J6-3 115 hot unfused

J6-4 115 neutral

J6-5 115 fused

NOTE: If the welding power source supplies 24 VAC, then J6-1 is jumpered to J6-3 and J6-2 is jumpered to J6-4. Fuse/circuit breaker protection is in the power source and feeder control.

6.15.7 KXA 10-Pin Connector

J7-1 Motor controller enable

J7-2 +15 on motor controller (voltage for inch forward)

J7-3 -15 on motor controller (voltage for inch reverse)

J7-4 Tachometer (+) and ground on motor speed control

J7-5 AWELD input command to motor speed control

J7-6 Tachometer (-) (same as J2-4)

J7-7 Motor - (same as J2-2)

J7-8 Motor + (same as J2-1)

J7-9 No connection

J7-10 No connection

6.15.8 Auxiliary Relay Output Connector

J8-1 N/O CR7 relay contact

J8-2 N/C CR7 relay contact

J8-3 COM CR7 relay

J8-4 N/O CR8 relay contact

J8-5 N/C CR8 relay contact

J8-6 COM CR8 relay

J8-7 COM CR6 wire feed enable

J8-8 N/O CR6 wire feed enable

J8-9 N/C CR6 wire feed enable

6.15.9 Monitor Connector

J9-1 Monitor VWELD isolator output 0 to + 10.00

J9-2 Monitor VWELD output COM

J9-3 Monitor AWELD output scale 0 to + 10.00

J9-4 Monitor AWELD output scale COM

J9-5 Monitor VSENSE +

J9-6 Monitor VSENSE -

J9-7 Monitor shunt +

J9-8 Monitor shunt -

6.15.10 Auxiliary Gas/Wire Out Connector

J10-1 Arc off detect (same as J1-9)

J10-2 Gas shortage (same as J1-10)

J10-3 Wire shortage (same as J1-11)

J10-4 Board common/ground "0" volts

6.16 CALIBRATION POTENTIOMETERS

Pot1 VWELD input calibration - normally set to scale ± 14 to give 10V DC out

Pot2 VWELD command output meter scale

Pot3 Arc voltage meter scale

Pot4 Ammeter/shunt meter scale

Pot5 AWELD input calibration - normally set for ± 14 Vin to give 10V DC out

Pot6 AWELD command output meter scale

Pot7 Inch forward wire feed set

Pot8 Inch reverse wire feed set

NOTE: If a component of the UWI fails, the entire UWI PC board can be replaced but will require calibration. Check that the jumpers are the same as the original unit and calibrate the UWI as indicated above. If one of the blue isolators fail, it can be replaced without re-calibration.

6.17 TROUBLESHOOTING THE UWI

➪ CAUTION!

Replace fuses with the exact type and voltage rating.

PROBLEM	PROBABLE CAUSE	SOLUTION
There is no control of inch, purge, or welding, and no LEDs are lit on UWI PC board.	EW02 cable plug is loose on one or both ends (the EW02 provides partial voltage to the UWI). The 24 VDC fuse on the IO03 Yaskawa board is blown. An alarm should also indicate "24 VDC power supply failure."	Tighten both ends of the EW02 cable plug. Replace fuse (a spare 24 VDC 1/2-amp fuse is in the bag of Yaskawa spare parts). If the UWI does not receive 24 VDC, the two LEDs on the UWI power supplies will not light.
There is no purge or inch reverse from pendant, but inch forward works.	Outputs #3 and #4 have not been assigned to the pendant in the ERC ladder. Parameter SC221 should be 3 and parameter SC222 should be 4. The inch forward is automatically assigned as Output 63 in the ladder and pendant.	Set parameters SC229 and SC230 to 1 for momentary action of the above outputs. Test the outputs from the pendant after assigned. The LED on the UWI PC board should light when the wire is inched forward, reversed, or purge output is turned on. The corresponding relay LED should also light.
The wire feed is very erratic, and intermittent. The motor feed rolls turn.	The wire feed rolls are slipping because of problems with the contact tip, the gun liner is full of dirt, or the wire is tangled on the wire spool.	Remove the top set of feed rolls and try to pull wire through the welding torch. If you can't pull the wire, the feeder can't push it either. The use of knurled or gear/cog type feed rolls will give more pulling and pushing force; however, they will leave marks on the wire that will cause rapid tip and gun liner wear.

PROBLEM	PROBABLE CAUSE	SOLUTION
There is no wire feed, inch forward, or inch reverse, but there is gas purge. There is no green light on the motor speed control LED display.	The transformer power fuse is blown on the interface panel.	Check fuse FU1 (small round black fuse) on the upper right corner of the PC board. Replace fuse if it is blown. Two spare fuses are in the bag attached to the UWI.
	The welding power supply is turned off. The motor speed control is powered by the 24 VAC isolation transformer. The transformer gets its 120 VAC from the welding power source.	Turn on the welding power supply.
The robot is in HOLD continuously and the CRT displays "Impact Sensor Tripped". The impact sensor is normal.	There is a 1/4-amp fuse (FU1) on the UWI PC board that protects the impact sensor and 24 VDC power supply if there is a component or cable short.	Replace fuse FU1 after determining the reason for the short.

6.18 UWI DRAWINGS

This section contains the following UWI drawings:

Drawing Number	Title	Sheet Number
130961	Wire Feeder Harness	1
130962	Power Source Harness	1
130963	Shock Sensor Harness	1
130964	PMI Interface	1
130965	Transformer	1
130966	UWI PC Board	1
130969	UWI Interface	1
131403	UIW AWELD Isolator	1
131407	UWI System Diagram	1
131750	UWI Interface	1-2

7.0 PWF4-600 WIRE FEEDER

7.1 DESCRIPTION OF THE WIRE FEEDER

Motoman part number:	130967-2
Drive rolls:	Hobart four-roll feeder with replaceable feed rolls
Gun connection:	Hobart/Tweco 500-amp quick-connect robot torch connection
Maximum wire feed speed:	600 IPM (750 IPM in special applications)
Gas valve:	24 VDC built into wire feeder
Inch button:	Inch at preset speed of 120 IPM
Weight:	15 pounds
Mounting:	On upper arm with four robot mounting holes
Motor part number:	479002-2
Gear ratio:	24.41:1
Output rating:	54 Watt @3000 RPM
Type motor:	DC print armature
Amp/rating:	6.2 @18 VDC
Current limit:	100% rated load
Peak Current	12 amp (fold back after 2 seconds to rated amp)
Speed feedback:	Tachometer 6.3V=120 shaft RPM=600 IPM
Motor power cable:	131353-1 (25 ft.)

7.2 WIRE FEEDER INSTALLATION

➪ CAUTION!

Ensure that components and welding wire delivery parts are insulated from the feeder and support mechanism. The welding wire is always electrically hot (i.e., has welding voltage on it) during welding. If the wire package is different from the standard spool mount provided, ensure that the wire delivery system is insulated and cannot contact grounded surfaces.

The wire feeder is usually installed on the upper arm of the robot in order to keep the welding torch short, which improves feeding. The feed head may be mounted upside down on the robot upper arm when using an optional feeder variation. Some wire feeders are mounted on pedestals.

Usually feeder cables are routed from the feeder on the upper arm, down the lower axis and around the L-axis servo motor to the base. Sometimes the robot is

mounted upside down on a vertical pedestal, and the wiring is routed up the support to the robot. A tool balancer mounted on a support arm (attached to the wire feeder mounting bracket) is used to provide support for torch cables while the robot moves.

The GMAW system arrives with the wire feeder already installed. However, there may be circumstances in which the wire feeder needs to be replaced.

To replace the wire feeder, follow these steps:

1. Disconnect the cables, the torch, and the Z bracket.
2. Remove the four Allen socket-head capscrews from the old wire feeder.
3. Install the new wire feeder.
4. Reconnect the cables, the torch, and the Z bracket.

7.3 ADDITIONAL WIRE FEEDERS AVAILABLE

The following wire feeders are also available for use with Motoman's Robotic Arc Welding Systems:

- *SWF4-300/600 Wire Feeder*

  The SWF4-300/600 wire feeder uses an AC servo motor for rapid acceleration, precision speed control, and high power for large diameter wires. The feed rate (300 IPM or 600 IPM) is selected by a switch on the feeder interface that is mounted on the ERC door. The wire feeder uses an AC servo motor, control, and the Motoman Universal Weld Interface (UWI) to provide isolation and scaling of analog signals, feeder logic, and feeder protection.

- *SWF4-1500 Wire Feeder*

  The SWF4-1500 wire feeder uses an AC servo motor for rapid acceleration, precision speed control, and high feed speeds for small-diameter wires. The wire feeder uses an AC servo motor, control, and the Motoman Universal Weld Interface (UWI) to provide isolation and scaling of analog signals, feeder logic, and feeder protection.

7.4 TROUBLESHOOTING THE WIRE FEEDER

PROBLEM	PROBABLE CAUSE	SOLUTION
The wire feed motor runs forward at a very fast, uncontrolled speed.	The polarity of the tachometer input is reversed. The tach voltage at PL7-6 should be negative in reference to PL7-4 (COM). Refer to Table 8-6 for the proper voltage values.	Measure the voltage across UWI connector terminals J23 (+) and J2-4 (-). The meter should show a positive voltage. If necessary, reverse the tachometer leads at UWI connector J2.
	The SPEED/TORQUE mode selector switch SW-2 is set for torque mode.	Ensure that the mode selector switch SW-2 is set to the SPEED position.
	Feed motor tachometer has failed.	Replace the motor or feedhead assembly.

7.5 WIRE FEEDER DRAWINGS

This section contains the following wire feeder drawings:

Drawing Number	Title	Sheet Number
130967	4-Roll Pancake Feeder Assembly	1-4
131353	ERC to Wire Feeder Cable	1

8.0 KXA MOTOR SPEED CONTROL

8.1 KXA DESCRIPTION

This section contains instructions for the installation, calibration, and testing of the PMI KXA Series Servo Amplifier for use with Motoman arc welding systems. The instructions contained here apply specifically to the use of the KXA amplifier as a motor speed control for the PWF4 wire feeders.

The installation instructions provided in this manual cover the following situations:

- Replacement of an existing KXA motor speed control
- Replacement of an older VXA series motor speed control

Two versions of the KXA motor speed control are available. The first version (part number 131091-1) directly replaces an existing KXA unit. The second version (part number 132213-1) replaces the older VXA motor speed control. It is mounted on an aluminum bracket to fit in the original location on the welding interface.

The KXA motor speed control is a pulse width modulated, four quadrant speed control. It is designed for fast response print or disk type motors. With the control enabled, a positive analog input signal gives forward wire feed. A negative input causes the feed motor to run in reverse. An input level of 0 volts stops the wire feed motor. The motor speed control can operate in either speed or torque mode, with either tachometer or EMF feedback. Selector switches on the speed control circuit board set the mode of operation. When used with the PWF4 wire feeders, the KXA unit operates in speed mode with tachometer feedback.

The KXA motor speed control operates on 24 VAC provided through the welding interface. It has internal voltage rectifier and regulation circuits that supply the necessary DC output to the wire feed motor. The motor speed control also has fault protection features to guard against short circuits, excess current, and power supply failures. Voltage clamping circuitry protects against excessive reverse EMF due to high speed and high inertia reversals.

For additional information on the KXA amplifier, refer to the following PMI manual:

PWM Servo Amplifier
KXA Series
Operating Instructions for
Compact PWM Servo Amplifier

Contact PMI directly at the following address for copies of the manual:

PMI Motion Technologies
49 Mall Drive
Commack, NY 11725

Phone: (516) 864-1000
FAX: (516) 864-2084

8.2 KXA INSTALLATION

As mentioned previously, the Universal Weld Interface (UWI) consists of a UWI printed circuit (PC) board, a KXA motor speed control, and a transformer. Although the GMAW welding system arrives with the KXA already installed, there may be circumstances in which the KXA needs to be replaced.

The installation instructions provided in this section cover the following situations:

- Replacing an existing KXA motor speed control
- Replacing a VXA motor speed control

8.2.1 Replacing An Existing KXA Control

To replace an existing KXA motor speed control, follow these steps:

1. Make sure that system power is off.
2. Disconnect the PL7 plug from the UWI interface board.
3. Disconnect the two transformer wires from terminals TB3-1 and TB3-2 on the KXA motor speed control.
4. Remove the existing KXA motor speed control.
5. Install the new KXA motor speed control.
6. Connect the PL7 plug to the UWI interface board.
7. Connect the two transformer wires toterminals TB3-1 and TB3-2 on the KXA motor speed control and secure the two wires with wire ties.
8. Perform the calibration procedures provided in Section 8-3.

8.2.2 Replacing A VXA Control For UWI 130750-2

The KXA motor speed control has smaller mounting dimensions than the original VXA speed control. You can use the aluminum angle bracket included in the installation kit to mount the KXA control in the original location. Or, you can drill new mounting holes and install the new speed control directly on the UWI mounting plate.

The terminal strip connections on the control included in the replacement kit have the same identification markings as the old speed control.

To replace a VXA motor speed control with the KXA control, proceed as follows:

1. Make sure that system power is off.
2. Disconnect the PL7 plug from the UWI interface board.
3. Remove the existing VXA motor speed control.
4. Disconnect the wiring harness from the VXA terminal strips. Save the wiring harness for installation on the replacement control unit.

5. If you want to use the original mounting holes to mount the new KXA control proceed as follows, otherwise skip to Step 6.
   a. Connect the wiring harness to the KXA terminal strips. Refer to Section 8.7 for the PMI interface drawing (dwg. no. 130964-1).
   b. Use the aluminum mounting bracket to install the new KXA motor speed control.
   c. Connect the PL7 plug to the UWI interface board.
   d. Reverse the two tach leads connected to PL2, terminals 3 and 4.
   e. Perform the calibration procedures provided in Section 8.3.
6. To mount the KXA motor speed control directly on the UWI mounting plate, do the following:
   a. Drill new holes in the UWI mounting plate (see Figure 8-1).

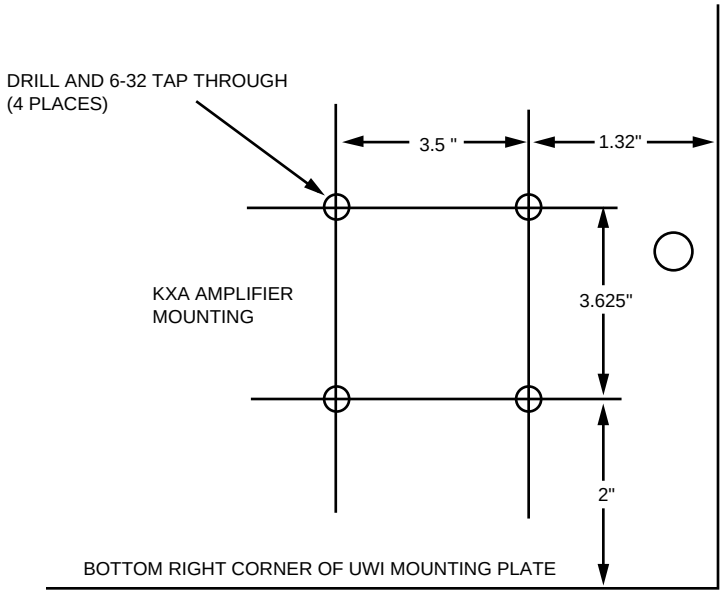

Figure 8-1 KXA Motor Speed Control Mounting Dimensions

   b. Remove any burrs from the drilled holes.
   c. Use a 6-32 tap to thread the drilled holes.
   d. Clean out any metal shavings in the tapped holes.
   e. Connect the wiring harness to the KXA connectors. Refer to Section 8.7 for the PMI interface drawing (dwg. no. 130964-2).
   f. Remove the backing sheet from the self-adhesive, heat sink pad included in the installation kit. Position the pad on the base of the KXA motor speed control. No heat sink compound or silicon grease is needed if you use the heat sink pad.
   g. Install the new KXA motor speed control.
   h. Connect the PL7 plug to the UWI interface board.

i. Reverse the two tach leads connected to PL2, terminals 3 and 4.

j. Perform the calibration procedures provided in Section 8.3.

8.2.3 Replacing A VXA Control For Welding Interface 479117

The KXA motor speed control has smaller mounting dimensions than the original VXA speed control. Use the aluminum angle bracket included in the installation kit to mount the KXA control in the original location.

The terminal strip connections on the control included in the replacement kit have the same identification markings as the old speed control.

To replace a VXA motor speed control with the KXA control, proceed as follows:

1. Make sure that system power is off.
2. Disconnect the wiring harness from the VXA terminal strips.

NOTE: Tag the wires as you remove them for easier identification during installation.

3. Remove the existing VXA motor speed control.
4. Use the aluminum mounting bracket to install the new KXA motor speed control.
5. Connect the wiring harness to the KXA terminal strips. Refer to Section 8.7 for the interface schematic diagram (dwg. no. 479117).
6. Perform the calibration procedures provided in Section 8.3.

8.3 KXA CALIBRATION

This section provides the instructions needed to calibrate the KXA motor speed control and UWI interface. We recommend that you check the system calibration periodically to ensure optimal performance. You also need to calibrate the system after you replace a UWI, motor controller, feed motor, or feed rolls.

Motoman robotic welding systems use either a PWF4-600 or PWF4-750 wire feeder. These wire feeders operate at different feed rates. Although the procedures to calibrate either wire feeder are the same, the calibration values are different. You can find the correct settings for each wire feeder in the calibration table. Be sure that you use the correct values for the wire feeder you are using.

8.3.1 Tools and Equipment Required

Table 8-1 lists tools and equipment required for the calibration of the KXA motor speed control. If you do not have the tools specified, you can substitute tools of equal or greater capacity and accuracy.

Table 8-1 Tools and Equipment

Tool or Equipment	**Specification**
Digital multimeter	4 digit resolution 15 Amp capture display (Fluke Model 87 or equivalent w/ peak capture)
Tachometer	0 to 150 RPM ± 1 RPM
Jumper leads	None
Screwdrivers	Small calibration screwdriver 00 Phillips 0 straight blade
Micro test clip leads (2)	For connection to small test points

8.3.2 Control Descriptions

The KXA motor speed control has several user controls on board. These controls consist of the following (see Figure 8-2):

- Adjustment potentiometers (pots)
- Selector switches

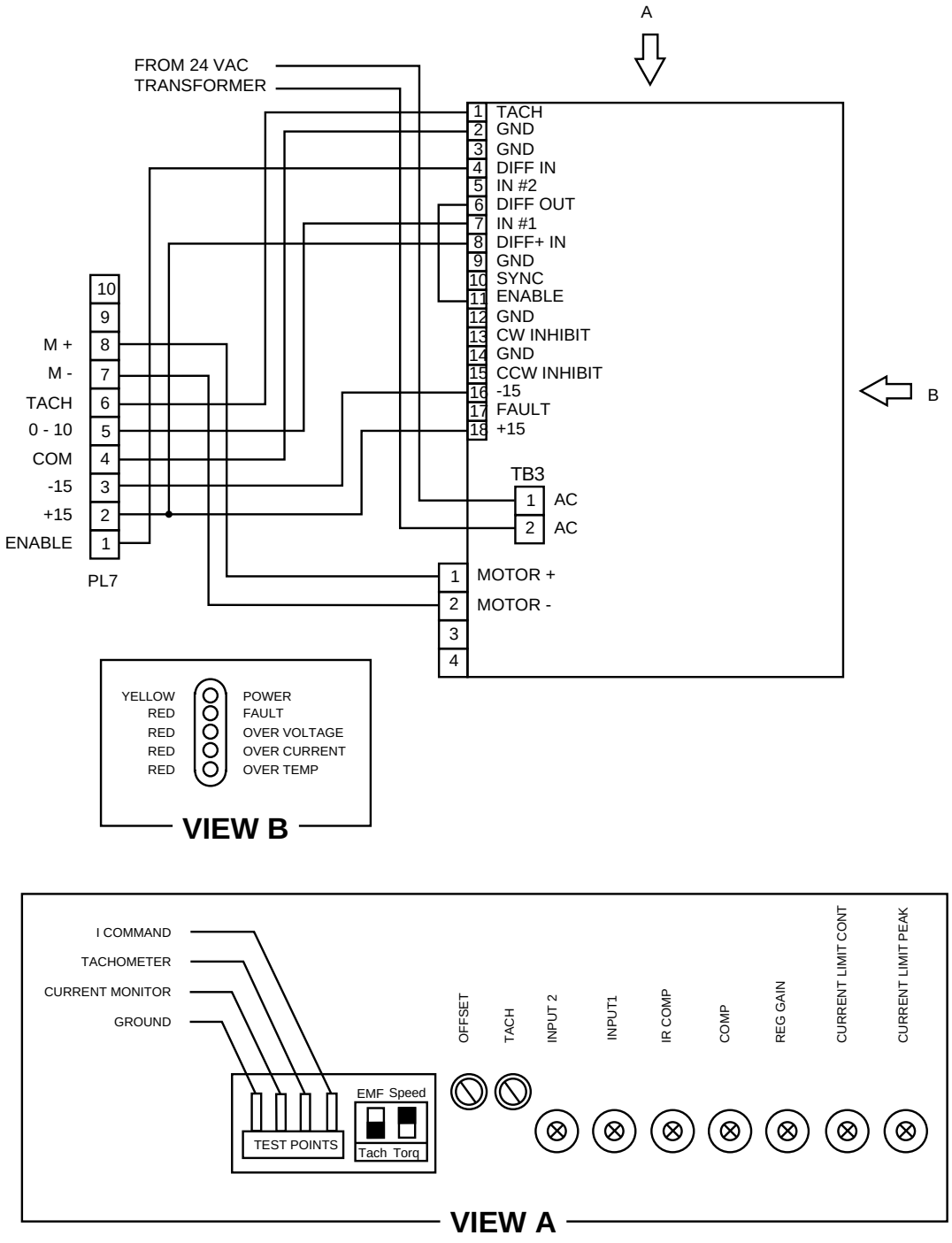

Figure 8-2 KXA Motor Speed Control with Connections for UWI

The selector switches set the speed control's mode of operation. These are two-position slide switches. Switch SW-1 selects either tachometer feedback or EMF sensing (with IR compensation) speed control. Switch SW-2 selects between velocity and torque modes of operation.

The TACH and OFFSET adjustment pots are multi-turn devices. These two pots cannot be pre-set, but must be adjusted as part of the calibration procedure. These controls provide the following functions:

TACH - provides a gain adjustment that calibrates the motor speed to the command signal. Turning the pot clockwise (CW) decreases gain and increases the motor speed. Turning the pot counterclockwise (CCW) increases gain and reduces the motor speed.

OFFSET - sets the motor speed to 0 when the AWELD argument equals 0. This adjustment eliminates any DC offset in the servo loop from internal or external sources.

The remaining adjustment pots are all single turn devices. These controls provide the following functions:

INPUT #1 and INPUT #2 - provide input gain adjustment. Both of these controls should be set to the extreme CCW position. This allows proper setting of the analog voltage for the AWELD command.

PEAK CURRENT - sets the peak current to the feeder motor. The peak current increases from 0 amps at the extreme CCW position to 16 amps at the extreme CW position. If the PEAK CURRENT pot is set lower than the CONTINUOUS CURRENT pot, the peak current setting prevails. When you perform the calibration procedures be sure that you set peak current first.

CONTINUOUS CURRENT - sets the maximum continuous current to the feeder motor. The continuous current setting can be adjusted from 0 amps at the extreme CCW position to 8 amps at the extreme CW position.

COMP and REGULATOR GAIN - control the feedback loop of the KXA unit. These controls are preset within an approximate range and fine tuned, if necessary, during the calibration procedure.

IR COMP - does not operate in tachometer mode. The IR compensation adjustment is used only with special feed motors (for example the Binzel torch motors) in EMF sensing mode.

8.3.3 Indicator Descriptions

A set of LED indicators on the KXA motor speed control show the operating status of the unit (see Figure 8-2). Table 8-2 lists each of the indicators and describes its function.

Table 8-2 KXA Motor Speed Control Indicators

Indicator	Name	Description
LED 1 (Yellow)	Power ON	
LED2 (Red)	Fault	Lights for any fault condition and when the motor speed control is disabled.
LED3 (Red)	Over Voltage	Lights if the bus voltage exceeds an upper set limit. This can happen if the input supply is wrong, or if the regeneration clamp circuit fails. This is a latched fault. The control remains disabled until the fault is corrected.
LED4 (Red)	Over Current	Lights when a ground short or faulty component allows excessive current flow. This is a latched fault. The control remains disabled until the fault is corrected.
LED5 (Red)	Over Temperature	Lights when a temperature sensor detects excessive heat in the power output stage. This is not a latched fault. The indicator goes off when the temperature falls below the threshold of the sensor.
Note: If a latched fault occurs, the motor speed control must be reset even if the cause of the fault has been corrected. To reset a fault you must do one of the following • *Remove and then restore power* • *Remove and then restore the ENABLE signal*		

8.3.4 AWELD Arguments

The PWF4 wire feeder motor uses a fast response, print motor armature with tachometer feedback. This motor provides quick response to either load or command changes. When properly calibrated, the PWF4-600 feed motor operates at a maximum speed of 120 RPM; the PWF4-750 at a maximum of 150 RPM. With a nominal feed roll circumference of 5.0 inches, this translates into maximum wire feed rates of 600 and 750 inches per minute (IPM) respectively.

During normal operation, the ERC supplies the AWELD analog signal that drives the wire feed system. The AWELD argument has a value that ranges from 0 to ±14 VDC. A potentiometer (or optional isolator) on the UWI interface board scales this signal to give 0 to ±10 VDC. The UWI interface applies this command signal to the input of the motor speed control through relay CR1. Tables 8-3 and 8–4 list series of AWELD arguments and the corresponding feed rates for each of the wire feeders.

Table 8-3 Argument Table for PWF4-600

ARG	IPM	ARG	IPM	ARG	IPM	ARG	IPM	ARG	IPM
0.00	0	2.81	120	5.67	243	8.53	365	11.39	487
0.06	3	2.92	125	5.78	247	8.64	370	11.50	492
0.17	7	3.03	130	5.89	252	8.75	375	11.61	497
0.28	12	3.14	134	6.00	257	8.86	379	11.72	502
0.39	17	3.25	139	6.11	262	8.97	384	11.83	506
0.50	21	3.36	144	6.22	266	9.08	389	11.94	511
0.61	26	3.47	149	6.33	271	9.19	393	12.05	516
0.72	31	3.58	153	6.44	276	9.30	398	12.16	520
0.83	36	3.69	158	6.55	280	9.41	403	12.27	525
0.94	40	3.80	163	6.66	285	9.52	407	12.38	530
1.05	45	3.91	167	6.77	290	9.63	412	12.49	535
1.16	50	4.02	172	6.88	294	9.74	417	12.60	539
1.27	54	4.13	177	6.99	299	9.85	422	12.71	544
1.38	59	4.24	181	7.10	304	9.96	426	12.82	549
1.49	64	4.35	186	7.21	309	10.07	431	12.93	553
1.60	68	4.46	191	7.32	313	10.18	436	13.04	558
1.71	73	4.57	196	7.43	318	10.29	440	13.15	563
1.82	78	4.68	200	7.54	323	10.40	445	13.26	568
1.93	83	4.79	205	7.65	327	10.51	450	13.37	572
2.04	87	4.90	210	7.76	332	10.62	455	13.48	577
2.15	92	5.01	214	7.87	337	10.73	459	13.59	582
2.26	97	5.12	219	7.98	342	10.84	464	13.70	586
2.37	101	5.23	224	8.09	346	10.95	469	13.81	591
2.48	106	5.34	229	8.20	351	11.06	473	13.92	596
2.59	111	5.45	233	8.31	356	11.17	478	14.03	600
2.70	116	5.56	238	8.42	360	11.28	483		

NOTE: The analog level does not change continuously for every argument. Instead it changes in increments at every 11th step of the pendant argument. The value changes at the argument listed in the table above. For example:

Pendant Indication	Wire Feed Speed
6.86	290
6.87	290
6.88	294
6.98	294
6.99	299
7.00	299

Table 8-4 Argument Table for PWF4-750

ARG	IPM	ARG	IPM	ARG	IPM	ARG	IPM	ARG	IPM
0.00	0	2.81	150	5.67	303	8.53	456	11.39	609
0.06	3	2.92	156	5.78	309	8.64	462	11.50	615
0.17	9	3.03	162	5.89	315	8.75	468	11.61	621
0.28	15	3.14	168	6.00	321	8.86	474	11.72	627
0.39	21	3.25	174	6.11	327	8.97	480	11.83	633
0.50	27	3.36	180	6.22	333	9.08	486	11.94	639
0.61	33	3.47	186	6.33	339	9.19	492	12.05	645
0.72	39	3.58	191	6.44	344	9.30	497	12.16	650
0.83	44	3.69	197	6.55	350	9.41	503	12.27	656
0.94	50	3.80	203	6.66	356	9.52	509	12.38	662
1.05	56	3.91	209	6.77	362	9.63	515	12.49	668
1.16	62	4.02	215	6.88	368	9.74	521	12.60	674
1.27	68	4.13	221	6.99	374	9.85	527	12.71	680
1.38	74	4.24	227	7.10	380	9.96	533	12.82	686
1.49	80	4.35	233	7.21	386	10.07	539	12.93	692
1.60	86	4.46	239	7.32	392	10.18	545	13.04	698
1.71	91	4.57	244	7.43	397	10.29	550	13.15	703
1.82	97	4.68	250	7.54	403	10.40	556	13.26	709
1.93	103	4.79	256	7.65	409	10.51	562	13.37	715
2.04	109	4.90	262	7.76	415	10.62	568	13.48	721
2.15	115	5.01	268	7.87	421	10.73	574	13.59	727
2.26	121	5.12	274	7.98	427	10.84	580	13.70	733
2.37	127	5.23	280	8.09	433	10.95	586	13.81	739
2.48	133	5.34	286	8.20	439	11.06	592	13.92	745
2.59	139	5.45	292	8.31	445	11.17	597	14.03	750
2.70	144	5.56	297	8.42	450	11.28	603		

NOTE: The analog level changes every 11th step of the pendant argument. The value changes at the argument listed in the table above. For example:

Pendant Indication	Wire Feed Speed
6.86	362
6.87	362
6.88	368
6.98	368
6.99	374
7.00	374

The charts shown in Figures 8-3 and 8-4 illustrate the relation between wire feed rate and the AWELD argument value. The relation shown is highly linear, any increase or decrease in AWELD value causes a corresponding change in wire feed rate. The KXA motor speed controller provides very precise and accurate speed control.

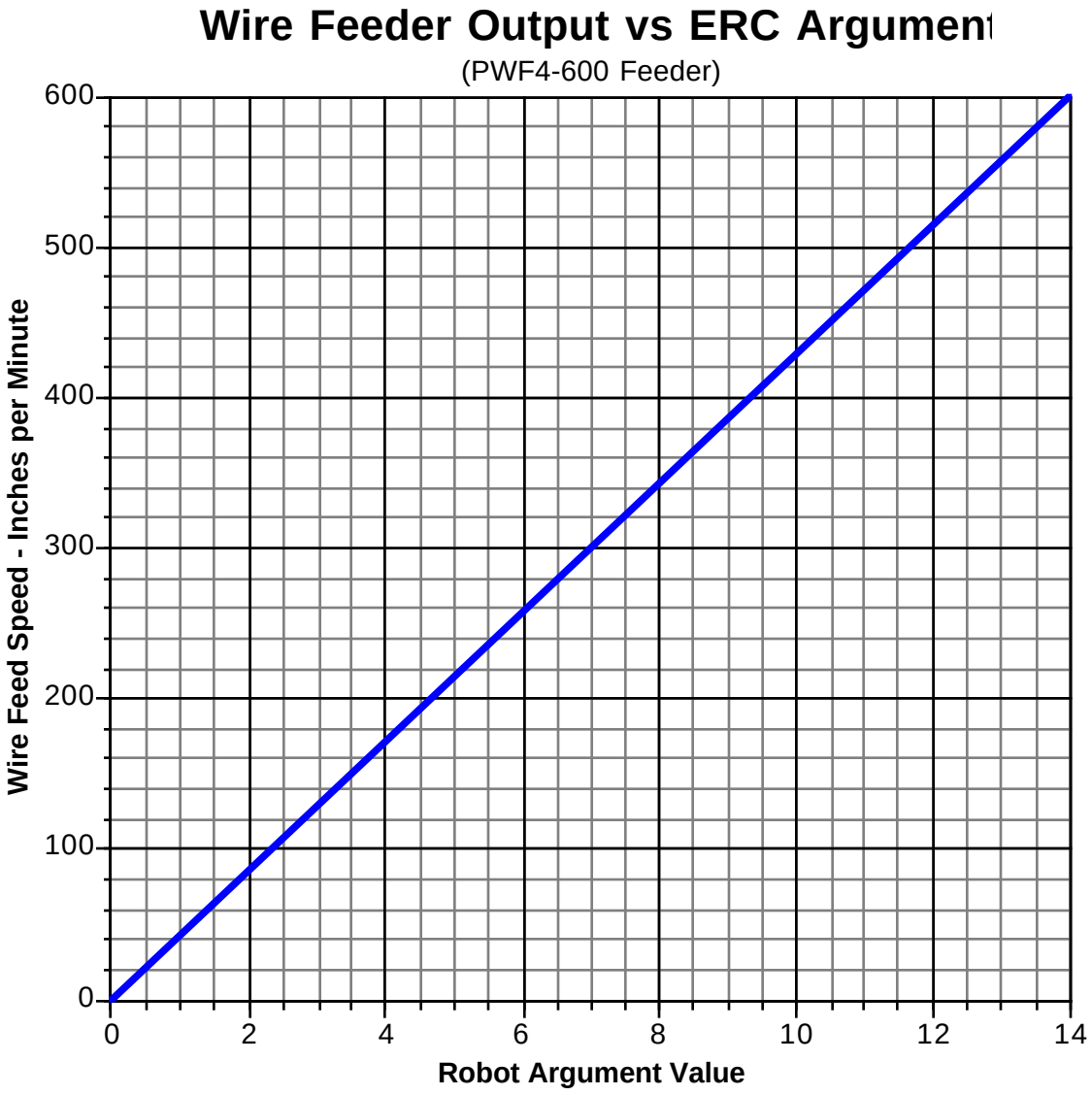

Figure 8-3 AWELD Argument Chart for PWF4-600

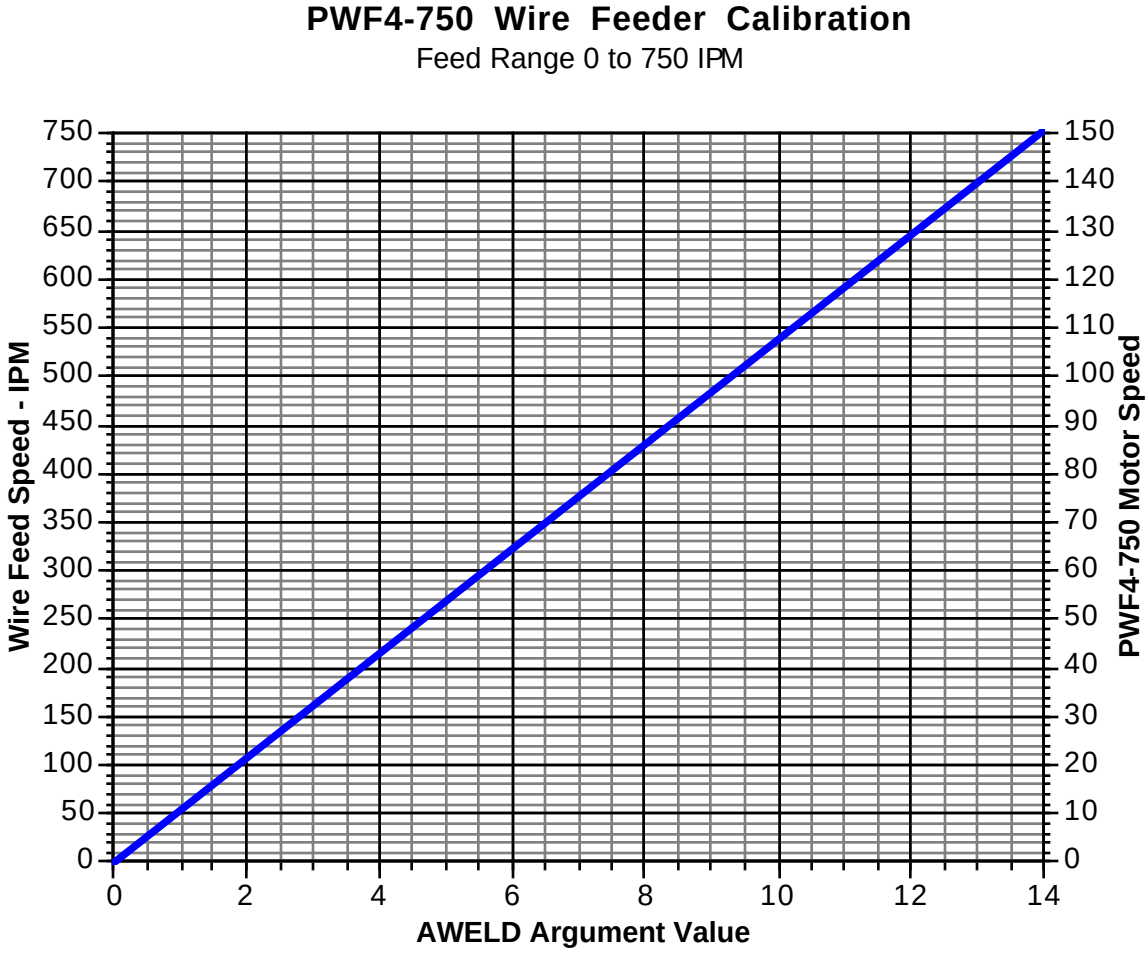

Figure 8-4 AWELD Argument Chart for PWF4-750

8.3.5 Calibration Procedures

Calibrating the wire feeding system helps to optimize the overall operation. Performing the calibration procedures provided helps to ensure the following conditions:

- AWELD command from the UWI interface to the motor speed control is properly scaled
- Motor speed control provides the appropriate output to drive the feed motor
- Feedback and compensation circuits operate to maintain selected motor speed
- Inch forward and inch reverse functions operate at correct rates
- Current limits are properly set

Perform the following procedures to calibrate the UWI interface and the KXA motor speed control for proper wire feed.

➪ *DANGER!*

Robots can move unexpectedly. Always be aware of the possibility of robot movement. Unexpected operation can cause serious injury or death.

➪ *WARNING!*

Unless instructed otherwise, make sure that there is no feed tension or wire in the wire feeder. Wire feed during these procedures can cause serious injury.

Disconnect the weld cables from the welding power source. This ensures that no voltage is present on the feed head, and helps prevent unintended arcing.

1. Teach the robot the following test job. Make sure that you do not include any movement instructions.

Line	Step	Command	Remarks
000	000	NOP	Beginning of job
001		VWELD 0.00	Sets PS voltage to zero
002		AWELD 14.00	Sets wire feed to maximum
003		ARCON	Turns arc on
004		TIMER T=120	Keeps command on 120 seconds
005		ARCOFF	Turns arc off
006		END	End of job.

2. Preset the potentiometers on the motor speed controller as listed in Table 8-5 (refer also to Figure 8-5). These are approximate settings and will be adjusted later.
3. Make sure that the weld cables are disconnected from the welding power source.
4. Connect a jumper lead across terminals 6TB-8 and 4TB-6 on the robot IO03 board. This jumper bypasses the ARC ESTABLISHED signal from the power source and simulates welding.

5. Run the test job listed above. The feed rolls will start to rotate.

Table 8-5 PWF4 Motor Speed Controller Preset Positions

Adjustment	Set Point	Function
Cont. Current	7 o'clock	Set to 6.6 Amps
Peak Current	7 o'clock	Set to 12.0 Amps peak
Reg. Gain	6 o'clock	Mid-scale
Comp	6 o'clock	Mid-scale
IR Comp	No adjustment	Not used
Input 1	2 o'clock	Set to full CCW
Input 2	2 o'clock	Set to full CCW
Tachometer	Adjust at test	15 turn potentiometer
Offset	Adjust at test	15 turn potentiometer

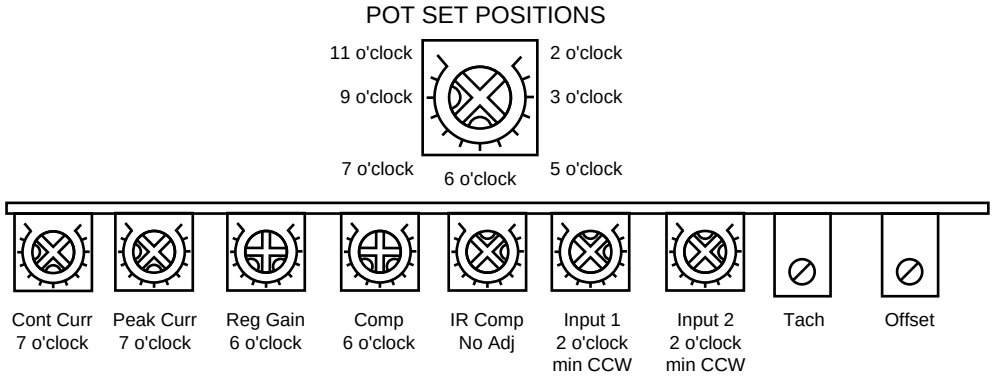

Figure 8-5 PWF4 Motor Speed Controller Trim Pots

6. Set the tachometer adjustment as follows:

   a. Measure the voltage across terminals PL7-4 and PL7-5 on the UWI motor speed controller plug. Refer to Figure 8-2.

   b. Adjust pot #5 (AWELD) on the UWI circuit board until the meter shows 10.00 ± 0.02 volts. Refer to Figure 8-6. Make sure that the feed motor output shaft rotates.

   c. Use a tachometer to measure the speed of the feed motor output shaft.

WARNING!

Use caution when measuring the wire feed speed. Moving feed rolls and potential pinch points can cause injuries.

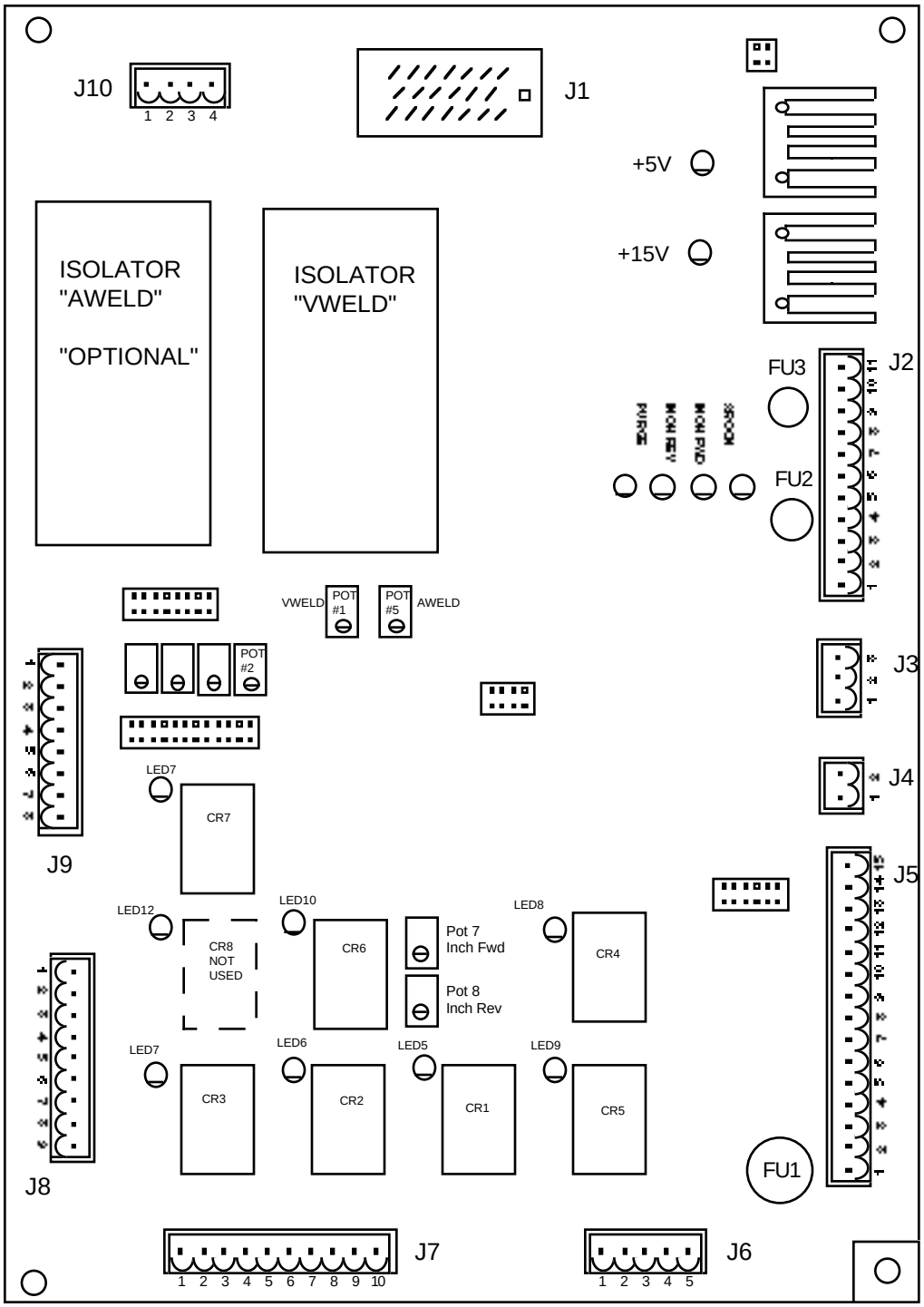

Figure 8-6 UWI Interface Board

d. Adjust the TACH trim pot on the motor speed control board as required to obtain the following:

- PWF4-600 - 120 ± 1 RPM, this setting corresponds to a feed rate of 600 IPM
- PWF4-750 - 150 ± 1 RPM, this setting corresponds to a feed rate of 750 IPM

NOTE: *If you do not have a precision tachometer, you can run the test job with wire in the feeder for a timed period. Measure the length of wire fed during the test run and divide the length by the number of seconds duration. Use as long a period as practical, but no less than 30 seconds to avoid short time errors.*

If you hear a loud squeal from the motor or controller, you will need to adjust the REGULATOR GAIN or COMP setting (refer to Step 9, below). Adjust either pot in the CCW direction until the squeal stops. This will allow you to proceed with the calibration procedure.

7. Set the offset adjust as follows:
   a. Change the test job to provide an AWELD of 0.0.
   b. Run the test job. The feed motor should not rotate or it may rotate very slowly.
   c. Use a jumper lead to short terminals PL7-4 and PL7-5 on the UWI plug PL7.
   d. Refer to Figure 8-7 and measure the voltage across test points TP4 (GROUND) and TP2 (I COMMAND).

➪ *CAUTION!*

Do not short the test points with the micro test leads.

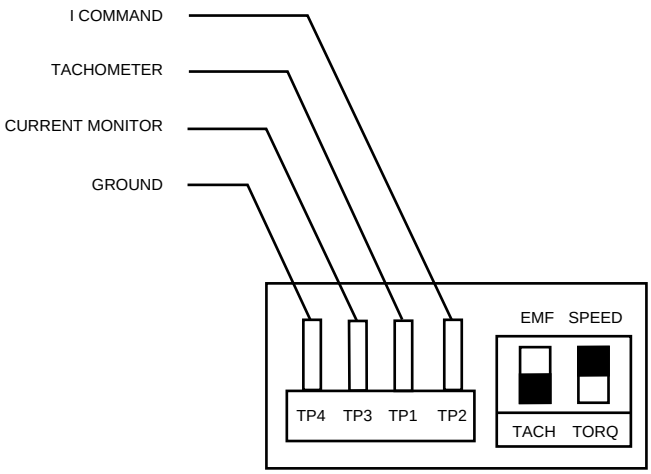

Figure 8-7 Test Point Identification

e. Adjust the OFFSET trim pot until the meter shows 0.0 ±0.01 volts. Make sure that the feed motor does not rotate.

f. Remove the jumper lead from terminals PL7-4 and PL7-5.

8. Follow the steps below to set the motor continuous current adjustment.

   a. Turn on the inch forward output #63 from the ERC diagnostics menu or on the teaching pendant.

   b. Set the ammeter to the 12 Amp DC current scale.

   c. Connect the ammeter across terminals PL7-7 and PL7-8 on the UWI plug PL7. This shorts the output of the motor speed control through the ammeter. There may be a slight spark when you short the meter leads across the terminals.

   d. Adjust the PEAK CURRENT trim pot so the meter shows 12 ± 0.2 Amps.

   e. The motor speed controller maintains the peak current level for only 2 to 3 seconds. If necessary, disconnect the ammeter and then repeat steps c and d until you get the correct peak current value.

   f. After setting the proper peak current value, adjust the CONTINUOUS CURRENT trim pot so the meter shows 6.6 ± 0.1 Amps.

   g. You can verify the current settings by measuring the voltage across test points TP4 (GROUND) and TP3 (CURRENT MONITOR). The meter shows 0.2345 volts/amp (6.6 amps = 1.547 volts, 12 amps = 2.81 volts).

   h. Turn off the inch forward output.

9. If the PWF4 wire feeder makes a loud squealing sound when running, set the compensation adjustments as follows; otherwise skip this step.

   a. Slowly turn the REGULATOR GAIN trim pot in a CCW direction until the noise stops.

   b. Slowly turn the COMP trim pot in a CW direction until the noise starts again.

   c. Turn the COMP trim pot back in a CCW direction until the noise stops. Then turn the pot an additional 1/8 turn CCW.

NOTE: For additional information regarding the compensation adjustments, refer to your PMI KXA Series Manual.

10. Inch speed has a range from close to zero to almost full speed. To set the inch forward speed, do the following:

    a. Turn on the inch forward Output #63 from the ERC diagnostics menu or on the teaching pendant.

b. Measure the voltage across terminals TB2-1 and TB2-3 on the motor control board. The meter should show 2.00 ±0.1 volts.

c. If necessary, adjust pot #7 on the UWI interface for a voltage reading across terminals TB2-1 and TB2-3 of 2.00 ±0.1 volts. This will give an output shaft speed of 24 ±1 RPM or 120 IPM

d. Turn off the inch forward output.

11. To set the reverse inch speed, do the following:

a. Turn on the inch reverse output #3 from the ERC diagnostics menu or on the teaching pendant.

b. Measure the voltage across terminals TB2-1 and TB2-3 on the motor control board. The meter should show 1.00 ±0.1 volts.

c. If necessary, adjust pot #8 on the UWI interface for a voltage reading across terminals TB2-1 and TB2-3 of 2.00 ±0.1 volts. This will give an output shaft speed of 12 ±1 RPM or 60 IPM

d. Turn off the inch reverse output.

12. Remove the shorting jumper from 4TB-6 and 6TB-8.

8.4 VOLTAGE MEASUREMENTS ON PMI CONTROLS

Table 8-6 gives voltage values for different characteristics of the KXA motor speed control. The Location column of each table identifies the test points where you can measure the voltages.

Table 8-6 Motor Speed Control Voltage Measurements

Characteristic	**Location**	**Voltage**
PWF4-600:		
V_{in} max. (AWELD = 14.00)	PL7-4 (-) and PL7-5 (+)	10.00 ± 0.01 VDC
V_{in} inch forward	PL7-4 (-) and PL7-5 (+)	2.00 ± 0.01 VDC
V_{in} inch reverse	PL7-4 (-) and PL7-5 (+)	-1.00 ± 0.01 VDC
V_{mtr} (motor voltage)*	PL7-7 (-) and PL7-8 (+)	15 ± 3 VDC
Tachometer voltage†	PL7-4 (-) and PL7-6 (+)	6.10 ± 0.5 VDC
Volts AC	TB3-1 and TB3-2	24 ± 3 VAC
PWF4-750:		
V_{in} max. (AWELD = 14.00)	PL7-4 (-) and PL7-5 (+)	10.00 ± 0.01 VDC
V_{in} inch forward	PL7-4 (-) and PL7-5 (+)	2.00 ± 0.01 VDC
V_{in} inch reverse	PL7-4 (-) and PL7-5 (+)	-1.00 ± 0.01 VDC
V_{mtr} (motor voltage)*	PL7-7 (-) and PL7-8 (+)	18 ± 3 VDC
Tachometer voltage‡	PL7-4 (-) and PL7-6 (+)	8.02 ± 0.5 VDC
Volts AC	TB3-1 and TB3-2	24 ± 3 VAC

* At AWELD = 14.00, V_{in} = 10.00. Motor voltage is approximate and depends on feeder load
† At 120 RPM (600 IPM)
‡ At 150 RPM (750 IPM)

8.5 FINAL TEST

The final test of the wire feeding is conducted under normal operating conditions for your application.

1. Load the system with the appropriate type and size of wire.
2. Engage the feeder rolls.
3. Press the inch forward button and make sure that the feed motor operates at the proper feed rate.
4. Check for wire marking due to feed roll slippage.
5. Turn on output #63 on the teach pendant and make sure that the motor operates at the proper feed rate.
6. Check for wire marking due to feed roll slippage.
7. Run a series of test jobs with AWELD values from 0.00 to 14.00. Use the teach pendant to change the AWELD setting as the job runs.
8. Check for the following conditions at all operating speeds:
   - wire marking due to feed roll slippage
   - bird nesting
   - oscillation of feed motor
9. Set up the system for normal operation. Use the proper wire, gas type, and base material.
10. Run a series of test jobs. Make sure that there is a minimum of arc hunting, and that the arc is stable while welding.

8.6 TROUBLESHOOTING

Table 8-1 lists problems commonly encountered, probable causes, and suggested remedies. To troubleshoot your system, identify the type of problem and look for it in the PROBLEM column. Next to this column we list a probable cause or causes. For each probable cause you can find one or more suggested remedies.

Be aware that sometimes more than one problem can occur at the same time. After you identify and resolve a problem, test the system thoroughly to make sure that no other problems exist.

Table 8-7 Troubleshooting

Problem	Probable Cause	Remedy
The wire feed motor runs forward at a very fast, uncontrolled speed.	The polarity of the tachometer input is reversed. The tach voltage at PL7-6 should be negative in reference to PL7-4 (COM). Refer to Table 8-6 for the proper voltage values.	Measure the voltage across UWI connector terminals J23 (+) and J2-4 (-). The meter should show a positive voltage. If necessary, reverse the tachometer leads at UWI connector J2.
	The SPEED/TORQUE mode selector switch SW-2 is set for torque mode.	Make sure that the mode selector switch SW-2 is set to the SPEED position.
	Feed motor tachometer has failed.	Replace the motor or feedhead assembly.
None of the LEDs on the KXA status indicator are lit.	Weld power source is not on.	Make sure that the weld power source is on.
	115 V fuse FU1 (4 amp) on the UWI interface board is blown.	Check for signs of electrical short on the UWI interface board. Correct any conditions that may have caused a short, and replace the fuse FU1.
	Fuse F1 (8 amp) on KXA motor speed control board is blown.	Check for signs of electrical short on the KXA board. Correct any conditions that may have caused a short, and replace the fuse F1.

Table 8-7 Troubleshooting (continued)

Problem	Probable Cause	Remedy
None of the LEDs on the KXA status indicator are lit. (Continued)	Loose or disconnected plug(s) PL5, PL6, or PL7.	Check the connectors PL5, PL6, and PL7. Make sure that they are properly connected.
	Loose or damaged wiring on KXA motor speed control board.	Check for loose or damaged wiring on the KXA board. Repair or replace the KXA board.
Feed motor stalls when feeding wire or welding.	Wire birdnest in torch gun, dirty/clogged liner, tip burn back, or wire crossed on spool.	Make sure that all components of the wire feed system are clean and operating properly.
	Current limit settings are too low. Refer to Table 8-6 for the proper voltage values.	Check the peak current and continuous current settings. Perform the calibration procedures if necessary. Refer to Calibration, Section 8.3.
	The EMF/TACH mode selector switch SW-1 is set to the EMF position.	Make sure that the mode selector switch SW-1 is set to the TACH position.

8.7 KXA DRAWINGS

This section contains a set of reference drawings for use with the KXA motor speed control. Table 8-8 lists the drawings included. For additional information refer to your KXA manual.

Drawing Number	Title	Sheet Number
131091	Motor Feeder Controller	1
132211	Motor Control Mounting Plate	1
132213	UWI Control Retrofit Package	1
130964	Interface, PMI, UWI	1
479117	Diagram, Schematic, Interface	1 and 2

9.0 TORCH INFORMATION

9.1 AIR-COOLED TORCH

For information about the TA-4 air-cooled torch, see the Hobart Model TA-4 Air-Cooled Welding Torch and Cable Assembly Operator's Manual. The TA-4 torch is built by Hobart Brothers Company and is **specially modified** for use with Motoman's Robotic Arc Welding Systems.

9.2 WATER-COOLED TORCH

For information about the TW-5 water-cooled torch, see the Hobart Model TW-5 Water-Cooled Welding Torch and Cable Assembly Operator's Manual. The TW-5 torch is built by Hobart Brothers Company and is **specially modified** for use with Motoman's Robotic Arc Welding Systems.

9.3 TORCHES AVAILABLE

The following torches are available for use with Motoman's Robotic Arc Welding systems.

9.3.1 TA-4 TORCHES

When ordering the following TA-4 Air-Cooled torches by the Motoman part number listed, you will receive a complete torch with a front end, nozzle, and tip.

Table 9-1 Air-Cooled Torch Information

379914-1 (5 Ft., .030 Assembly)	**379914-5 (5 Ft., .045 Assembly)**
Includes: Tip, Contact, 379304 Nozzle, 379981 Tip Fitting, 177002 Insulator, 377775-10 Torch Tube, 177027 Liner, 379984-1 Holder & Cable Assembly, 177022-1	Includes: Tip, Contact, 177000 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 177027 Liner, 379532-3 Holder & Cable Assembly, 177022-1
379914-2 (10 Ft., .030 Assembly)	**379914-6 (10 Ft., .045 Assembly)**
Includes: Tip, Contact, 379304 Nozzle, 379981 Tip Fitting, 177002 Insulator, 377775-10 Torch Tube, 177027 Liner, 379984-1 Holder & Cable Assembly, 177022-2	Includes: Tip, Contact, 177000 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 177027 Liner, 379532-3 Holder & Cable Assembly, 177022-2
379914-3 (5 Ft., .035 Assembly)	**379914-7 (5 Ft., .052 Assembly)**
Includes: Tip, Contact, 379394 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 177027 Liner, 379532-3 Holder & Cable Assembly, 177022-1	Includes: Tip, Contact, 379395 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 177027 Liner, 379531-3 Holder & Cable Assembly, 177022-1
379914-4 (10 Ft., .035 Assembly)	**379914-8 (10 Ft., .052 Assembly)**
Includes: Tip, Contact, 379394 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 177027 Liner, 379532-3 Holder & Cable Assembly, 177022-2	Includes: Tip, Contact, 379395 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 177027 Liner, 379531-3 Holder & Cable Assembly, 177022-2

Table 9-1 Air-Cooled Torch Information (continued)

379914-9 (5 Ft., 1/16 Assembly)	**379914-13 (4.5 Ft., .045 Assembly)**
Includes: Tip, Contact, 379298 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 177027 Liner, 379531-3 Holder & Cable Assembly, 177022-1	Includes: Tip, Contact, 177000 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 177027 Liner, 379532-3 Holder & Cable Assembly, 177022-6
379914-10 (10 Ft., 1/16 Assembly)	**379914-14 (4.5 Ft., .052 Assembly)**
Includes: Tip, Contact, 379298 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 177027 Liner, 379531-3 Holder & Cable Assembly, 177022-2	Includes: Tip, Contact, 379395 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 177027 Liner, 379531-3 Holder & Cable Assembly, 177022-6
1379914-11 (4.5 Ft., .030 Assy)	**379914-15 (4.5 Ft., 1/16th Assy)**
Includes: Tip, Contact, 379304 Nozzle, 379981 Tip Fitting, 177002 Insulator, 377775-10 Torch Tube, 177027 Liner, 379984-1 Holder & Cable Assembly, 177022-6	Includes: Tip, Contact, 379298 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 177027 Liner, 37 9531-3 Holder &Cable Assembly, 177022-6
379914-12 (4.5 Ft., .030 Assembly)	
Includes: Tip, Contact, 379394 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 177027 Liner, 379532-3 Holder & Cable Assembly, 177022-6	

9.3.2 TW-5 TORCHES

When ordering the following TW-5 Water-Cooled torches by the Motoman part number listed, you will receive a complete torch with a front end, nozzle, and tip.

Table 9-2 Water-Cooled Torch Information

379915-1 (5 Ft., .030 Assembly)	**379915-5 (5 Ft., .045 Assembly)**
Includes: Tip, Contact, 379304 Nozzle, 379981 Tip Fitting, 177002 Insulator, 377775-10 Torch Tube, 379899 Liner, 379984-1 Holder & Cable Assembly, 177022-3	Includes: Tip, Contact, 177000 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 379899 Liner, 379532-3 Holder & Cable Assembly, 177022-3
379915-2 (10 Ft., .030 Assembly)	**379915-6 (10 Ft., .045 Assembly)**
Includes: Tip, Contact, .030, 379304 Nozzle, Slip On, 379981 Tip Fitting, 177002 Insulator, 377775-10 Torch Tube, 379899 Liner, 379984-1 Holder & Cable Assembly, 177022-4	Includes: Tip, Contact, 177000 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 379899 Liner, 379532-3 Holder & Cable Assembly, 177022-4
379915-3 (5 Ft., .035 Assembly)	**379915-7 (5 Ft., .052 Assembly)**
Includes: Tip, Contact, .035, 379394 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 379899 Liner, 379532-3 Holder & Cable Assembly, 177022-3	Includes: Tip, Contact, 379395 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 379899L Liner, 379531-3 Holder & Cable Assembly, 177022-3
379915-4 (10 Ft., .035 Assembly)	**379915-8 (10 Ft., .052 Assembly)**
Includes: Tip, Contact, 379394 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 379899 Liner, 379532-3 Holder & Cable Assembly, 177022-4	Includes: Tip, Contact, 379395 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 379899 Liner, 379531-3 Holder & Cable Assembly, 177022-4

Table 9-2 Water-Cooled Torch Information (continued)

379915-9 (5 Ft., 1/16 Assembly)	**379915-14 (4.5 Ft., .035 Assembly)**
Includes: Tip, Contact, 379298 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 379899 Liner, 379531-3 Holder & Cable Assembly, 177022-3	Includes: Tip, Contact, 379394 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 379899 Liner, 379532-3 Holder & Cable Assembly, 177022-5
379915-10 (10 Ft., 1/16 Assembly)	**379915-15 (4.5 Ft., .045 Assembly)**
Includes: Tip, Contact, 379298 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 379899 Liner, 379531-3 Holder & Cable Assembly, 177022-4	Includes: Tip, Contact, 177000 Nozzle, 379981 Tip Fitting, 379987 Insulator, 377775-10 Torch Tube, 379899 Liner, 379532-3 Holder & Cable Assembly, 177022-5
379915-11 (5 Ft., 3/32 Assembly)	**379915-16 (4.5 Ft., .052 Assembly)**
Includes: Tip, Contact, 379297 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 379899 Liner, 177018-3 Holder & Cable Assembly, 177022-3	Includes: Tip, Contact, 379395 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 379899 Liner, 379531-3 Holder & Cable Assembly, 177022-5
379915-12 (10 Ft., 3/32 Assembly)	**379915-17 (4.5 Ft., 1/16 Assembly)**
Includes Tip, Contact, 379297 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 379899 Liner, 177018-3 Holder & Cable Assembly, 177022-4	Includes: Tip, Contact, 379298 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 379899 Liner, 379531-3 Holder & Cable Assembly, 177022-5
379915-13 (4.5 Ft., .030 Assembly)	**379915-18 (4.5 Ft., 3/32 Assembly)**
Includes: Tip, Contact, 379304 Nozzle, 379981 Tip Fitting, 177002 Insulator, 377775-10 Torch Tube, 379899 Liner, 379984-1 Holder & Cable Assembly, 177022-5	Includes: Tip, Contact, 379297 Nozzle, 379981 Tip Fitting, 379988 Insulator, 377775-10 Torch Tube, 379899 Liner, 177018-3 Holder & Cable Assembly, 177022-5

9.3.3 WH 650 Neck Change Torches

When ordering the following WH 650 Neck Change torches by the Motoman part number listed below, you will receive the torch neck, torch cable, torch mount, and adapter kit.

Torch Description	*Motoman Part Number*
WH 650 Steel Neck Change Torch - .045	131157-1
WH 650 Steel Neck Change Torch - .052	131157-2
WH 650 Steel Neck Change Torch - .062	131157-3

9.3.4 ROBO 650 Standard Torches

When ordering the following ROBO 650 Standard torches by the Motoman part number listed below, you will receive the torch assembly, torch mount, and adapter kit.

Torch Description	*Motoman Part Number*
ROBO 650 Steel Standard Torch - .045	131160-1
ROBO 650 Steel Standard Torch - .052	131160-2
ROBO 650 Steel Standard Torch - .062	131160-3

9.3.5 ROBO 455 Standard Torches

When ordering the following ROBO 455 Standard torches by the Motoman part number listed below, you will receive the torch assembly, torch mount, and adapter kit.

Torch Description	*Motoman Part Number*
ROBO 455 Steel Standard Torch - .030	131163-1
ROBO 455 Steel Standard Torch - .035	131163-2
ROBO 455 Steel Standard Torch - .045	131163-3
ROBO 455 Steel Standard Torch - .052	131163-4
ROBO 455 Steel Standard Torch - .062	131163-5

9.3.6 WH 455 Neck Change Torches

When ordering the following WH 455 Standard torches by the Motoman part number listed below, you will receive the torch neck, torch cable, torch mount, and adapter kit.

Torch Description	*Motoman Part Number*
WH 455 Steel Neck Change Torch - .030	131166-1
WH 455 Steel Neck Change Torch - .035	131166-2
WH 455 Steel Neck Change Torch - .045	131166-3
WH 455 Steel Neck Change Torch - .052	131166-4
WH 455 Steel Neck Change Torch - .062	131166-5

9.3.7 Push/Pull Torches

When ordering the following Push/Pull torches by the Motoman part number listed below, you will receive the torch kit, torch mount, and neck adapter kit.

Torch Description	*Motoman Part Number*
K6SB PWF Steel Push/Pull Torch - .030	130595-21
K6SB PWF Steel Push/Pull Torch - .035	130595-22
K6SB PWF Steel Push/Pull Torch - .045	130595-23
K6SB PWF Steel Push/Pull Torch - .052	130595-24
K6SB PWF Steel Push/Pull Torch - .062	130595-25
K6SB PWF Aluminum Push/Pull Torch - .030	130595-31
K6SB PWF Aluminum Push/Pull Torch - .035	130595-32
K6SB PWF Aluminum Push/Pull Torch - .046	130595-33
K6SB PWF Aluminum Push/Pull Torch - .052	130595-34
K6SB PWF Aluminum Push/Pull Torch - .062	130595-35
K10S PWF Steel Push/Pull Torch - .030	130595-26
K10S PWF Steel Push/Pull Torch - .035	130595-27
K10S PWF Steel Push/Pull Torch - .045	130595-28
K10S PWF Steel Push/Pull Torch - .052	130595-29
K10S PWF Steel Push/Pull Torch - .062	130595-30
K10S PWF Aluminum Push/Pull Torch - .030	130595-36
K10S PWF Aluminum Push/Pull Torch - .035	130595-37
K10S PWF Aluminum Push/Pull Torch - .046	130595-38
K10S PWF Aluminum Push/Pull Torch - .052	130595-39
K10S PWF Aluminum Push/Pull Torch - .062	130595-40

9.4 TORCH ALIGNMENT INSTRUCTIONS

9.4.1 Description Of The Torch Alignment Block

The torch realignment block allows the operator to adjust the torch to a known orientation if the torch is knocked out of alignment. The block and the CHECKGUN jobs enable the operator to correct adjustment problems quickly and easily, therefore minimizing downtime.

The torch alignment block is an 8" x 1 1/2" x 1 1/2" iron bar with two 1/4 " contact slots (1 3/4" long), two 5/16" contact slots (1 3/4" long), one keystock (3/8" x 1 1/2"), and a slot milled on the top of the block. The slot and the keystock are used to align the torch in the Z direction.

The four milled contact slots, one on each side, are used to align the torch on the X and Y axes. The outside diameter of the welding contact determines whether the 1/4" or the 5/16" slots are used.

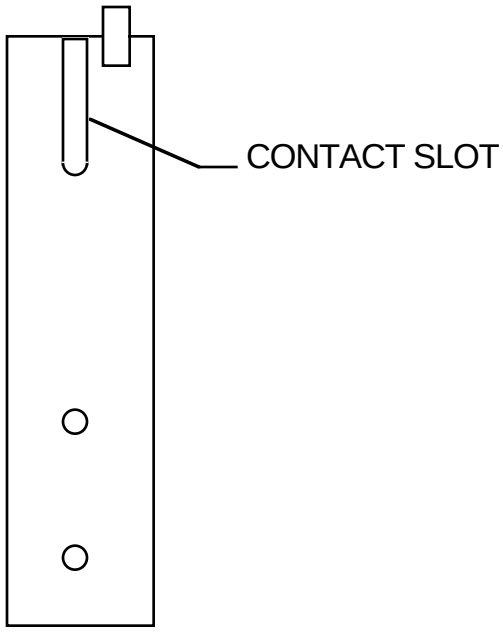

Figure 9-1 Torch Realignment Block

9.4.2 Installing The Torch Alignment Block

To install the torch alignment block, follow these steps:

1. Mount the torch alignment block parallel to the robot in a location that the robot can reach.

NOTE: *The operator must be able to see the two sides of the block that the contact tip fits, and to easily maneuver the contact tip into the block. The block must also be mounted in a position where it will stay relatively free of spatter and dirt.*

2. Depending on outside diameter of weld contact tip (1/4" or 5/16"), mount the block so that the operator will be able to observe the two slots in which the contact tip fits.
3. Using a punch, create a punch mark in the top center of the torch alignment block.
4. Remove the nozzle.
5. Cut off any wire that is sticking out of the contact tip for each point.
6. Create a CHECKGUN job. When positioning the contact tip, keep tip as plumb as possible to the contact slots. Record a point for each axis.

Following is a sample job (also see Figures 9-2 and 9-3):

Line	*Step*	*Function*
000		NOP
001	001	MOVJ VJ =.78%
002		'Start position
003	002	MOVJ VJ =.78%
004	003	MOVL V = 66
005		'Z position
006	004	MOVL V = 66
007	005	MOVL V = 66
008	006	MOVL V = 66
009	007	MOVL V = 66
010		'X position
011	008	MOVL V = 66
012	009	MOVL V = 66
013	010	MOVL V = 66
014	011	MOVL V = 66
015		'Y position
016	012	MOVL V = 66
017	013	MOVJ VJ = .78%
018		'Check wire stickout
019	014	MOVL V = 66
020	015	MOVJ VJ = .78%

```
021                    END
```

7. Step through the job in TEACH mode (very slowly) to verify accuracy.

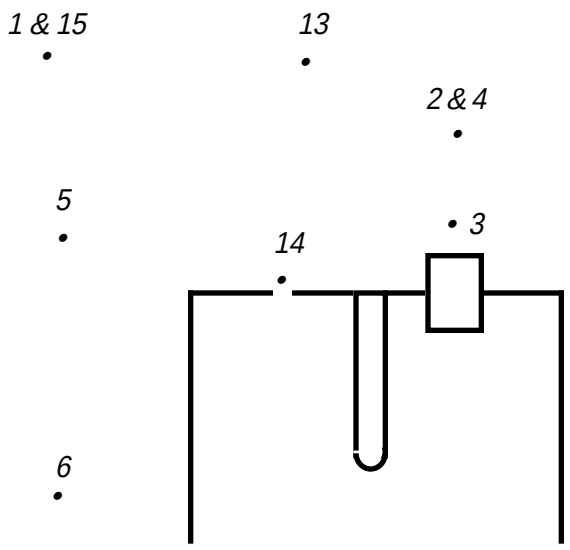

Figure 9-2 CHECKGUN Setup Points (Side View)

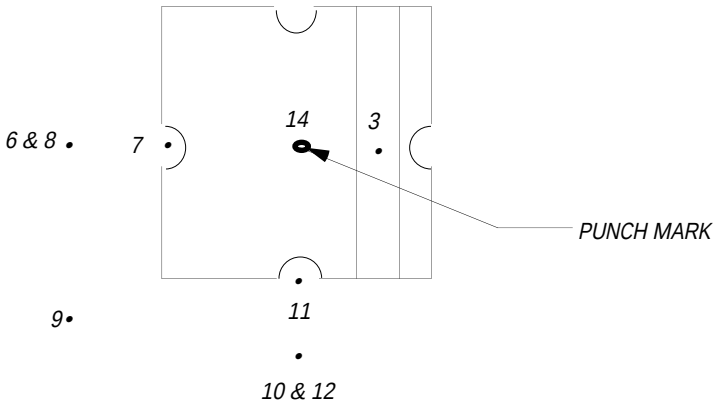

Figure 9-3 CHECKGUN Setup Points (Top View)

9.4.3 Checking Torch Alignment

It is necessary to check the torch alignment whenever weld locations are off or torch crash has occurred.

To check torch alignment, follow these steps:

NOTE: If point editing has been done on job before these steps have been completed, points will vary.

1. Remove the nozzle.
2. Cut off any wire sticking out of the torch tip.
3. In TEACH mode, step through the job and check each position.
4. When teaching through the CHECKGUN job, if the welding torch contact tip does not align properly to the three contact points, loosen the four Allen bolts on the breakaway sleeve.
5. Rotate, twist, and make adjustments to the gun barrel until all three axes are aligned. Step through the CHECKGUN job after each adjustment to ensure proper alignment.
6. If adjustment of the breakaway sleeve fails to bring the torch back into alignment, check for a bent barrel or slippage in the breakaway joints.

NOTE: If the torch barrel is bent or deformed, alignment may not be possible. In this case, the torch barrel must be replaced.

7. If the barrel is not bent and there is no slippage in the breakaway joints, perform a TCP check using the proper wire stickout and the punch mark on the top of the torch alignment block.
8. If the TCP is not accurate, program a new tool center point (refer to the Tool Center Point Definition Instructions in Section 11 of this manual).

NOTE: If TCP is changed, points may vary and editing will be necessary.

9.4.4 Air-Cooled and Water-Cooled Torch Drawings

This section contains the following mechanical drawings:

Drawing Number	Title	Sheet Number
379914	Air-Cooled Torch	1 and 2
379915	Water-Cooled Torch	1 and 2

10.0 RAM TORCH BREAKAWAY

10.1 DESCRIPTION OF RAM TORCH BREAKAWAY

The Motoman RAM torch breakaway is a robot safety device that detects an impact to the application tool in an X, Y, or Z direction. When a collision occurs, the RAM torch breakaway sends a signal to the controller. The controller stops the robot motors and turns off power to the servo motors.

Although the GMAW welding system arrives with the RAM torch breakaway already installed, there may be circumstances in which the RAM torch breakaway needs to be replaced.

10.2 EQUIPMENT REQUIRED FOR INSTALLATION

The following equipment is required for installation of the RAM breakaway:

- 9/64 Allen wrench
- 7/64 Allen wrench
- 3/32 Allen wrench
- 3/16 Allen wrench
- 4 mm Allen wrench (ball-end preferred)
- 5/32 Allen wrench (ball-end preferred)
- 7/16 socket wrench
- Soft mallet
- Four M5 x 12 mm socket-head capscrews (for L106 and L10W users only)

10.3 RAM TORCH BREAKAWAY INSTALLATION PROCEDURE

For additional RAM breakaway information, see the engineering drawings at the end of this section

To install the RAM torch breakaway, follow these steps:

NOTE: Users with a Binzel Torch WH-ROBO Welding Gun will need to remove the mounting block (which contains six screws) from the gun, discard the mounting block, and use the six screws to mount the torch to the RAM Breakaway.

1. Remove the four #10-32 x 1/2 inch socket-head capscrews (Item #36, Figure 10-1) from the insulator plate (Item #17) to remove the robot mount plate (Item #14). Save these screws; they will be used later.
2. With the robot mount plate (Item #14) free, use the four M6 x 16 mm flat-head capscrews (Item #35) to attach the insulator plate (Item #17) to the robot.

NOTE: There is a locator pin in this plate that locates breakaway orientation.

NOTE: L106 and L10W users need to use the four M5 x 12 mm socket-head capscrews for installation of this plate.

3. After the robot mount plate (Item #14) is in place, mount the breakaway unit to the robot using the four #10-32 x 1/2 inch socket-head capscrews (Item #36) that were removed in Step 1.

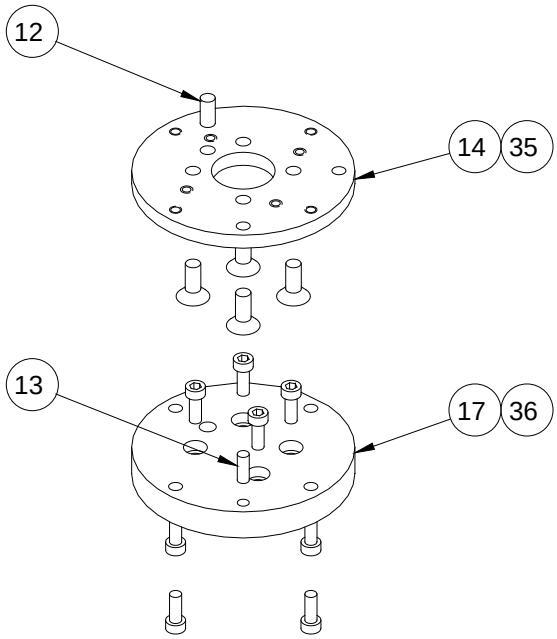

Figure 10-1 Insulator Plate and Mounting Plate

4. Install the welding torch in the torch mount (see Figure 10-2, Item #32) and adjust radially so the torch tip is located under the T-axis of the robot.
5. Using the four #8-32 x 3/4 inch socket-head capscrews (Item #40), tighten the torch mount around the welding gun housing, .
6. To adjust the torch angle, loosen but do not remove the three #6-32 x 1/2 inch socket-head capscrews (Item #38) located in the pull plate (Item #33).
7. Using a soft mallet, gently strike the three #6-32 x 1/2 inch socket-head capscrews (Item #38) while holding the torch at the tip area. This will break the taper lock bushing in the adjustment link arm mount (Item #31).

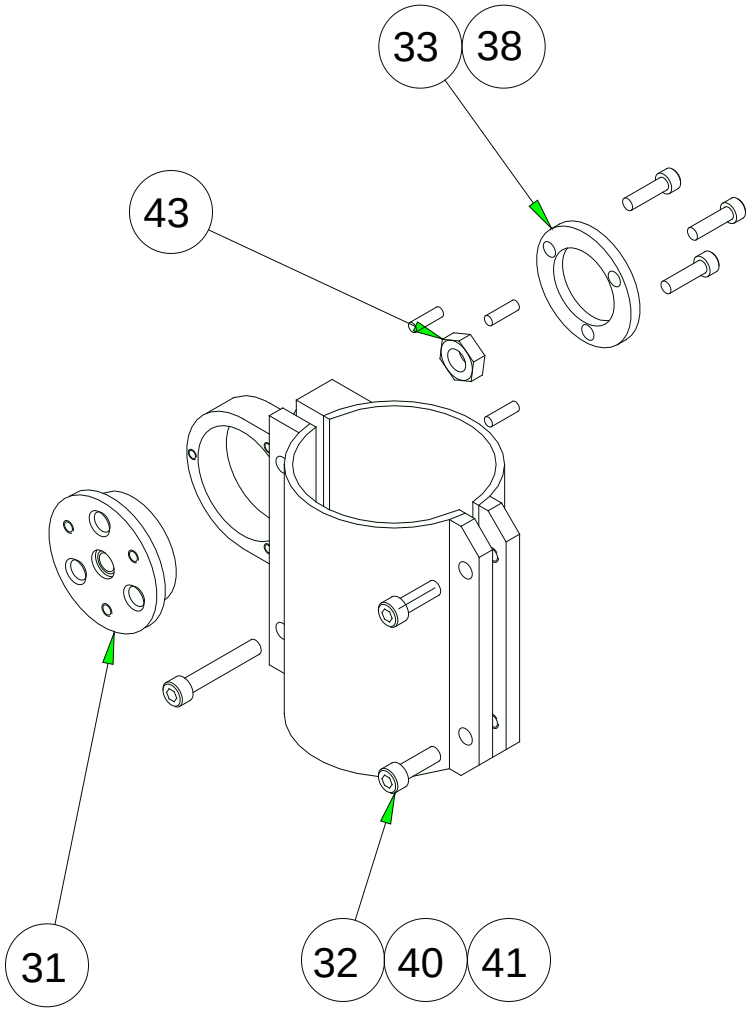

Figure 10-2 Welding Torch Mount

8. Rotate the torch until it is in line with the T-axis of the robot (see Figure 10-3).
9. Tighten the three #6-32 x 1/2 inch socket-head capscrews (Item #38) located in the pull plate (Item #33). This will reset the taper lock bushing in the adjustment link arm mount (Item #31).

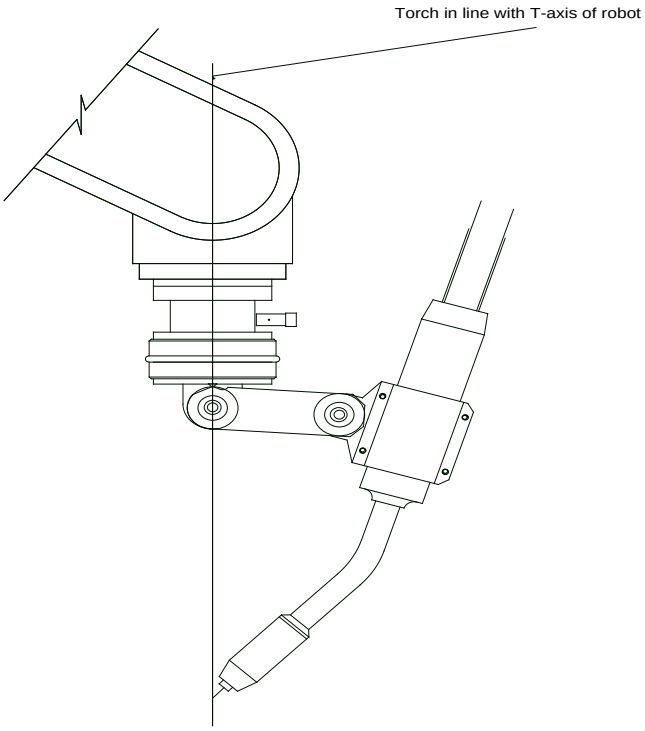

Figure 10-3 Torch Alignment with T-Axis

10. With the breakaway unit in place, connect the retractile cable (see Figure 10-4, Item #2) to the proximity switch on the breakaway.
11. Remove the front and back screws that mount the motor housing casting on the robot arm.
12. Mount the P-clamp/conduit assembly in position.
13. To secure the assembly, replace the front and back screws that mount the motor housing casting
14. Connect the CPC plug to the wire feeder to complete the coupling of the circuit.

NOTE: Existing wire feeders that do not have a serial number must use Kit #131168-2.

15. When installation is complete, refer to the Tool Center Point Definition section of this manual.

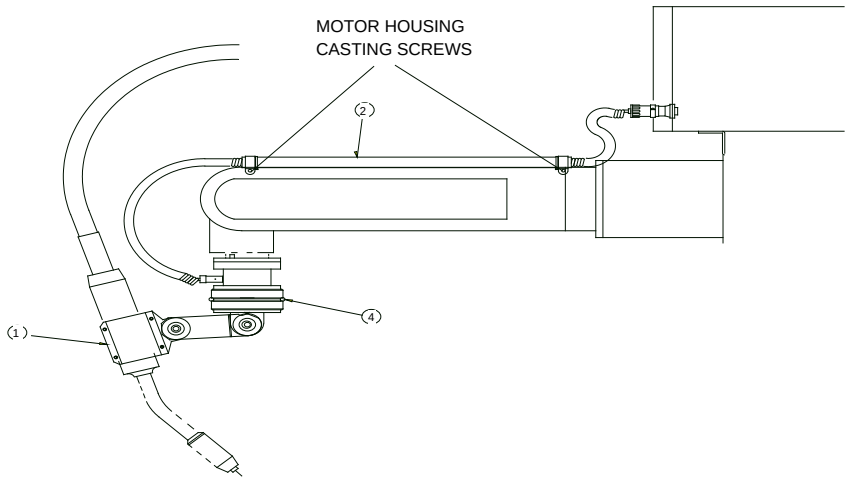

Figure 10-4 Mounting the P-Clamp and Conduit Assembly

10.4 RAM TORCH BREAKAWAY TROUBLESHOOTING

Periodically, various components of the RAM torch breakaway unit may need to be inspected, adjusted, or replaced. The following procedures cover RAM Torch Breakaway checks and adjustments.

NOTE: The breakaway switch is normally closed. Abnormal movement causes the switch to open, which results in motor power loss.

10.4.1 UWI Fuse Check

If the coiled impact sensor cable breaks, it may result in a blown 1/4-amp fuse in the RAM circuit on the UWI.

If the light on the proximity switch is not lit, follow these steps:

1. Inspect the 1/4-amp fuse on the UWI. Replace fuse if necessary.
2. Inspect the electrical connection plug. Replace plug if necessary.
3. Inspect the impact sensor cable if necessary. Replace cable if necessary.

10.4.2 Separation Joint Adjustment

The separation distance between the robot mount assembly and the torch mount assembly must be 1/16 of an inch. If the separation distance is not 1/16 of an inch, the separation joint must be adjusted.

To adjust the separation joint, follow these steps:

1. Adjust the three #10-32 setscrews for the locating balls of the separation joint until 1/16 of an inch is achieved.

10.4.3 Radial Adjustment

A radial adjustment consists of a link arm (joint 1) adjustment and a torch joint (joint 2) adjustment (see Figure 10-5) and Motoman Drawing 130550, Sheet 2, 3, or 4.

To adjust the link arm (joint 1), follow these steps:

1. Loosen but do not remove the jam nut (Item #43).
2. Tighten the shoulder bolt (Item #3).
3. Tighten the jam nut (Item #43) while holding the shoulder bolt.
4. Move the link arm (Item #29) to ensure proper operation of the joint located directly below the breakaway unit. The head of the shoulder screw should **not** rotate.

To adjust the torch joint (joint 2), follow these steps:

1. Using a 7/16 wrench, loosen (but do not remove) the jam nut (Item #43).
2. Tighten the shoulder bolt (Item #3).
3. Tighten the jam nut (Item #43) while holding the shoulder bolt.
4. Move the link arm (Item #29) to ensure proper operation of the joint located directly below the breakaway unit. The shoulder bolt **should** rotate when the torch tip is moved.

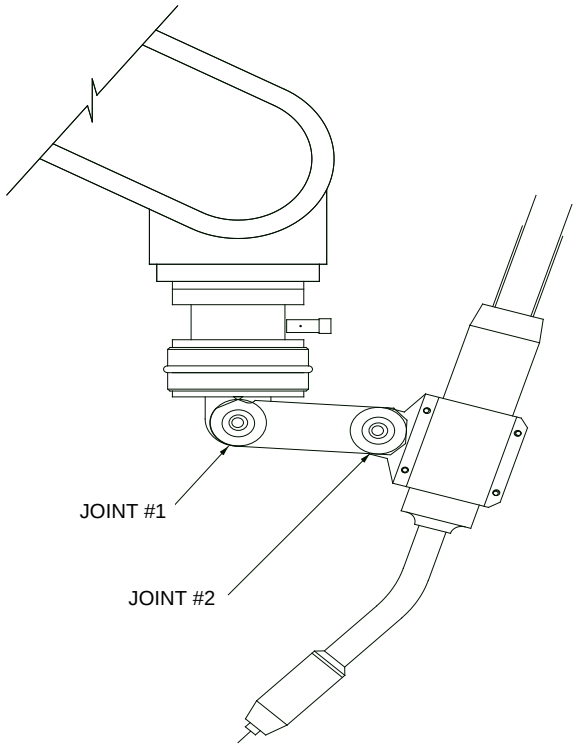

Figure 10-5 Link Arm and Torch Joint

10.4.4 Jumper Check

If the proximity switch is on all the time even though the breakaway is out of position, the shock sensor circuit jumper must be checked.

To check the jumper, follow these steps:

1. Check the shock sensor circuit jumper in the ERC.
2. If jumper is in position SW#2-1 on IO03 board, move jumper to position SW#2-5.

10.4.5 Proximity Switch to Shaft Collar Positioning Check

If the jumper is already in the correct position, the positioning of the proximity switch to the shaft collar must be checked.

To check the proximity switch to shaft collar positioning, follow these steps:

1. Remove the cable from the proximity switch (see Figure 10-6, Item #4).
2. Remove the breakaway from the robot by loosening the four #10-32 socket head screws (Item #36) on the insulator plate (Item #17).
3. Remove the four #10-32 cap screws (Item #36) located on the insulator plate, separating it from the switch cap (Item #15).
4. Remove the five #10-32 cap screws (Item #36) located on the perimeter of the switch cap. Removing this cap will expose the proximity switch mount assembly.
5. Verify that the operating distance for the proximity switch is 1/16 of an inch.
6. Note the current position of the shaft collar (Item #9).

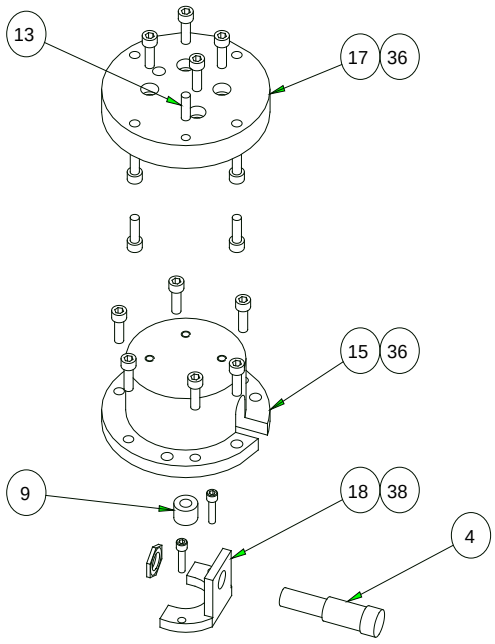

Figure 10-6 Jumper/Shaft Collar Adjustments

10.4.6 Shaft Collar Adjustment

If the proximity switch is working properly but is opening either too soon or not soon enough, the shaft collar may need to be adjusted.

To adjust the shaft collar, follow these steps:

1. Attach the cable to the proximity switch (see Figure 10-6, Item #4).
2. Apply power to the robot.
3. Locate the LED on the proximity switch.
4. Loosen but do not remove the set screw on the shaft collar (Item #9).
5. Move the collar up or down vertically until LED light comes on and tighten the set screw.
6. Holding firmly to the unit, have someone else grab the torch and move the link arm through normal up and down movement.

NOTE: The LED should turn off when the link arm is moved out of position. When the link arm is moved back into position, the LED should come back on.

7. Assemble the shaft collar and breakaway by reversing the previous steps.

10.4.7 Proximity Switch Adjustment

The proximity switch must be 1/16 of an inch from the face of the shaft collar. If the proximity switch is not 1/16 of an inch away from the face of the shaft collar, the proximity switch must be adjusted.

To adjust the proximity switch, follow these steps:

➪ *WARNING*

The proximity switch must not touch the shaft collar. Contact between the proximity switch and the shaft collar will impede proper operation of the breakaway.

1. Use an adjustable open-end wrench to loosen the jam nut located on the inside of the proximity mount (see Figure 10-6, Item 18).
2. With the jam nut loose, rotate the proximity switch which moves the barrel. Continue rotating until a 1/16-inch gap is achieved.
3. Tighten the jam nut.
4. Connect the cable to the proximity switch.
5. Turn on the power to the ERC and servo motors.
6. Holding firmly to the unit, have someone else grab the torch and move the link arm through normal up and down movement.

NOTE: The LED should turn off when the link arm is moved out of position. When the link arm is moved back into position, the LED should come back on. If the LED does not turn off and on, the shaft collar should be adjusted (see Section 10.4.6).

7. Assemble the proximity mount and breakaway by reversing the previous steps.

10.4.8 Proximity Switch Replacement

If the proximity switch is still not working correctly after adjustment of both the shaft collar and the proximity switch, the proximity switch must be replaced.

To replace the proximity switch , follow these steps:

1. Use an adjustable open-end wrench to loosen the jam nut located on the inside of the proximity mount (see Figure 10-6, Item 18).
2. Remove and discard old proximity switch.
3. Install a new proximity switch (Motoman Part Number 130554-1).
4. With the jam nut loose, rotate the proximity switch, which moves the barrel. Continue rotating until a 1/16-inch gap is achieved.
5. Tighten the jam nut.
6. Connect the cable to the proximity switch.
7. Turn on the power to the ERC and servo motors.
8. Holding firmly to the unit, have someone else grab the torch and move the link arm through normal up and down movement.

NOTE: The LED should turn off when the link arm is moved out of position. When the link arm is moved back into position, the LED should come back on. If the LED does not turn off and on, the shaft collar should be adjusted.

9. Assemble the proximity mount and breakaway by reversing the previous steps.

10.4.9 RAM Breakaway Drawings

This section contains the following RAM breakaway drawings:

Drawing Number	Title	Sheet Number
131168	Motoman Robots Torch Mount	1-6
130550	Breakaway Torch Mount	1-4
130585	Motoman Robots Torch Mount	1 and 2

11.0 TOOL CENTER POINT DEFINITION

A well-defined Tool Center Point (TCP) is necessary for most applications, especially any type of process work. A well-defined TCP allows easier teaching; it also provides a much more accurate path and travel speed. An accurate TCP definition is a must for welding, sealing, and cutting.

The ERC is capable of storing up to nine different TCPs:

- The first TCP is called the Standard Tool, or Tool 0. Robots with one tool are concerned only with the Standard Tool.
- The remaining eight TCPs are called Universal Tools, or Tools 1-8. Robots with multiple tools (such as two-handed grippers) use Universal Tools along with the Standard Tool.

There are two methods for defining the TCP: manual TCP definition and automatic TCP definition.

11.1 MANUAL TCP DEFINITION

Manual TCP definition is used when a tool has definite dimensions and orientation. To define a TCP manually, follow these steps:

1. Press TEACH.
2. Press OP1.
3. Press TOOL (F2).
4. Press right arrow soft key.
5. Press DISP. CHG. (F5).
6. Choose either STD. TOOL (F3) or UNIV. TOOL (F4).
7. Press DATA STORE (F5).
8. Move the cursor to the first tool dimension.
9. Press PANEL (F4).
10. Using the data keys, input the dimensions of the tool relative to the wrist flange.
11. Press ENTER.
12. Repeat steps 8 through 11 for each tool dimension.

The TCP is now defined. To ensure accuracy of the TCP, use the rotate-about X, Y, and Z keys to roll, bend, and twist the tool around the TCP. The TCP should not move.

11.2 AUTOMATIC TCP DEFINITION

Automatic TCP definition is used when a tool has a more complex geometry (for example, angles or offsets). A tool center point probe is needed to use this function.

To define a TCP automatically, follow these steps:

1. Detach the tool.
2. Attach the probe to the robot. In most cases, the probe is attached at the breakaway.
3. Put a punch mark on the work table or fixture.

NOTE: The table should be lagged to the floor to ensure sturdiness.

4. Using the teach pendant, bring the tip of the probe into the punch mark.
5. Put the teach pendant in Joint Coordinates.
6. Move the T-axis. If the probe is aligned, the tip will stay in the punch mark. If the tip moves out of the punch mark, use the probe thumbscrews to bring it in line with the T-axis.
7. Create a new job called TCP.

NOTE: The job TCP will have two points which will be taught in Linear motion. The first point will be with the probe in the punch mark and vertically plumb (a level should be used to ensure that the probe is not rolled or bent out of plumb). Also, the T-axis must be at 0 pulse counts. The second point will be up high enough so that it is possible to safely detach the probe and reattach the tool.

8. Ensure that the probe is vertically plumb. If probe is not vertically plumb, put the teach pendant in World Coordinates and use the rotate-about-X and the rotate-about-Y keys to orient the probe so that it is vertically plumb.
9. Press DISP.
10. Press POSITION (F2).
11. Press PULSE (F1). This displays the robot's position.
12. With the teach pendant in Joint coordinates, move the T-axis to 0 pulse counts.
13. Ensure that the probe is still in the punch mark. If the probe is not in the punch mark, use the X, Y, and Z keys to move the probe back into the punch mark.

14. With the probe in the punch mark and vertically plumb, and the T-axis at 0 pulses, record the first point (see Figure 11-1).

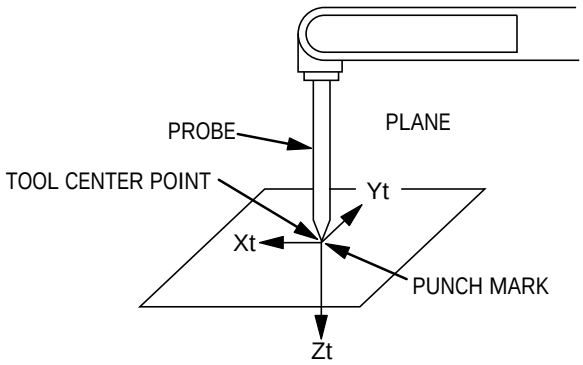

Figure 11-1 Tool Center Point

15. Raise the robot up to where the probe can be detached.
16. Record the second point.
17. Move the robot back to the first point in the job.
18. Press OP1.
19. Press TOOL (F2).
20. Press right arrow soft key.
21. Press DISP. CHG. (F5).
22. Press CALIB. TOOL (F2). This calls up the calibration screen.
23. Press DATA STORE (F5).
24. Press MANUAL (F5).
25. Enable the teach pendant. The teach pendant display will read TOOL MASTER.
26. Press RECORD. The teach pendant display will blink.
27. Disable the teach pendant.
28. Return to the OpPanel and press EXIT (F3).
29. Measure the distance from the robot wrist flange to the punch mark.
30. Move the cursor to the Z dimension.
31. Press DATA STORE (F5).
32. Press PANEL (F4).
33. Using the data keys, input the measurement from Step 29.
34. Press ENTER. This enters the measurement in the Z dimension of the Tool Calibration File. All other dimensions should already be set to 0.

35. Using the teach pendant, move the robot to the second point in the job.
36. Detach the probe and reattach the tool.

NOTE: For process work, the tool must be rotated so that it is vertically plumb in the punch mark (see Figure 11-2).

37. Determine which side of the tool will be the front side.

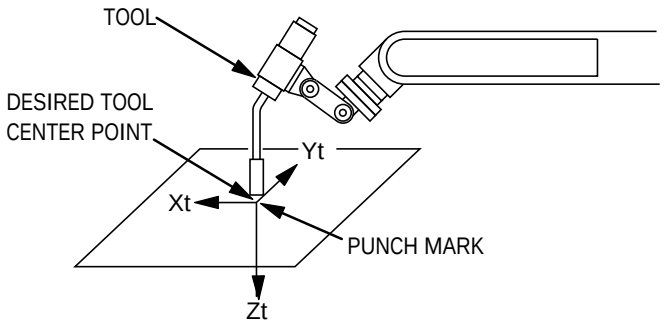

Figure 11-2 Correspondence of Tool and Punch Mark

38. Put the robot in World coordinates and move the X+ axis.
39. Using the rotate-about-Z keys, rotate the front of the tool so that the tool points in the same direction that the robot moved in Step 38.
40. Using World coordinate -Z, move the robot straight down toward the punch mark. If the tool's desired TCP is not in the punch mark, move the TCP to the punch mark by using the axis keys.
41. Press OP1.
42. Press TOOL (F2).
43. Press right arrow key.
44. Press DISP. CHG. (F5).
45. Press STD. TOOL (F3). This calls up the Tool File.
46. Press DATA STORE (F5).
47. Press MANUAL (F5).
48. Enable the teach pendant. It will read Tool 0.
49. Press RECORD. The display will blink and the Tool File on the OpPanel will generate all the dimensions and rotations of the tool.
50. Disable the teach pendant.
51. Return to the OpPanel and press EXIT (F3).

The TCP is now defined. To ensure accuracy of the TCP, use the rotate-about X, Y, and Z keys to roll, bend, and twist the tool around the TCP. The TCP should not move.

12.0 ERC SETTING OF ABSOLUTE WELDING VALUES

This section contains instructions for ERC setting of absolute welding values. For software version 4.11 and all following releases, there are two ways to set the welding parameters for the ERC:

- using AWELD and VWELD arguments
- using absolute values of volts and amperes

12.1 INTRODUCTION TO ABSOLUTE WELDING VALUES

ERC software prior to Version 4.11 used argument tables to set the absolute welding values. For example, a VWELD 7.00 represented 22 volts and an AWELD 7.00 represented a wire feed speed of 300 IPM that provided about 140 amperes with .035" diameter wire.

ERC Software Version 4.11 allows the voltage and amperage to be set by ABSVOL 22 amps and ABSCUR 140 amps. Welders find this easier for some applications. **The absolute conditions for volts and amps can only be set in whole numbers; for example, you cannot set 22.5 volts or 125.5 amps.** The absolute conditions can also be set by the "D Variables," but only in whole digits.

Tables containing wire burnoff characteristics are available in welding manuals, filler metal data sheets, and weld data books. These tables vary considerably depending on the following:

- welding currents
- wire size
- gas mixtures
- wire stick-out

Therefore, setting up a table for special wires requires test welds to be completed in order to determine the curve. Generally, wire burnoff characteristics are more non-linear with higher mixtures of argon gas.

12.2 WELDING POWER SOURCE COMPATIBILITY

The following welding power sources and wire feeders are compatible with the direct setting of voltage and amperage for the ERC.

Welding Power Sources (Hobart Models)

- Excel-Arc 6045/8065 *
- RC-450RVS, 300RVS, and 650RVS
- Fabstar 4030 (with blocking diode kit) *
- ArcMaster 500 (CV mode only)

** These welding power sources require modification by Motoman.*

Wire Feeders

- PWF2-600 feeder and interface
- PWF4-600 feeder and interface
- SWF4-1500 servo wire feeder and interface

NOTE: Other brands of welding power sources may be compatible, but they have not been tested.

The following welding power sources and interfaces **are not compatible** with direct amperage and voltage output calibration; however, they will work with normal AWELD and VWELD settings.

- Hobart Ultra-Arc 350
- Hobart Ultra-Weld or Logica 350
- Hobart Mega-Pulse in Pulse mode
- Hobart Quanta-Con RX interface
- Hobart Mega-Con 111, 112, 113, 114, 115, 116, 117

NOTE: Most pulse power sources operated in the pulse or synergic mode will not be compatible with the ERC's direct amperage and voltage set function. But the normal AWELD, VWELD, and additional channels -- AOUT are required and will work.

NOTE: In Figure 12-1, the range is given as 0 to 44.0 volts. Not all welding power sources will be able to produce 44 volts at their rated current. For example, an Excel-Arc 6045 (rated at 450 amps, 36 volts) may produce 44 volts at 100 amperes, but not at 450 amperes.

12.3 ABSOLUTE WELDING VOLTAGE DATA INFORMATION

The absolute welding voltage curve is the easiest to set up since it is usually linear. The power source or arc voltage is directly proportional to the input command voltage to the power source. With most Hobart power sources, "0" volts input gives "0" volts output and 10.00 volts input gives 44 arc volts. Motoman scales the normal ERC analog from 14.00 volts to 10.00 volts to match the power source. In special or non-regulated power sources, the curve may be non-linear. You must develop the curve for that specific power source.

The absolute welding data will be entered into an eight-point table (see Figure 12-1). The ERC uses a curve fit program and the absolute data to estimate actual welding current and voltage. The first data point cannot be entered with a command value of "0" with a measured value of "0" in the table. This will cause problems during actual welding if the setting is called by the computer.

NOTE: *The chart in Figure 12-1 is for the Excel-Arc 6045, the Excel-Arc 8045, the ArcMaster 351, the ArcMaster 500, and the ArcMaster 501. Other welding power sources will be different. Contact Motoman for the correct tables for other welding power sources.*

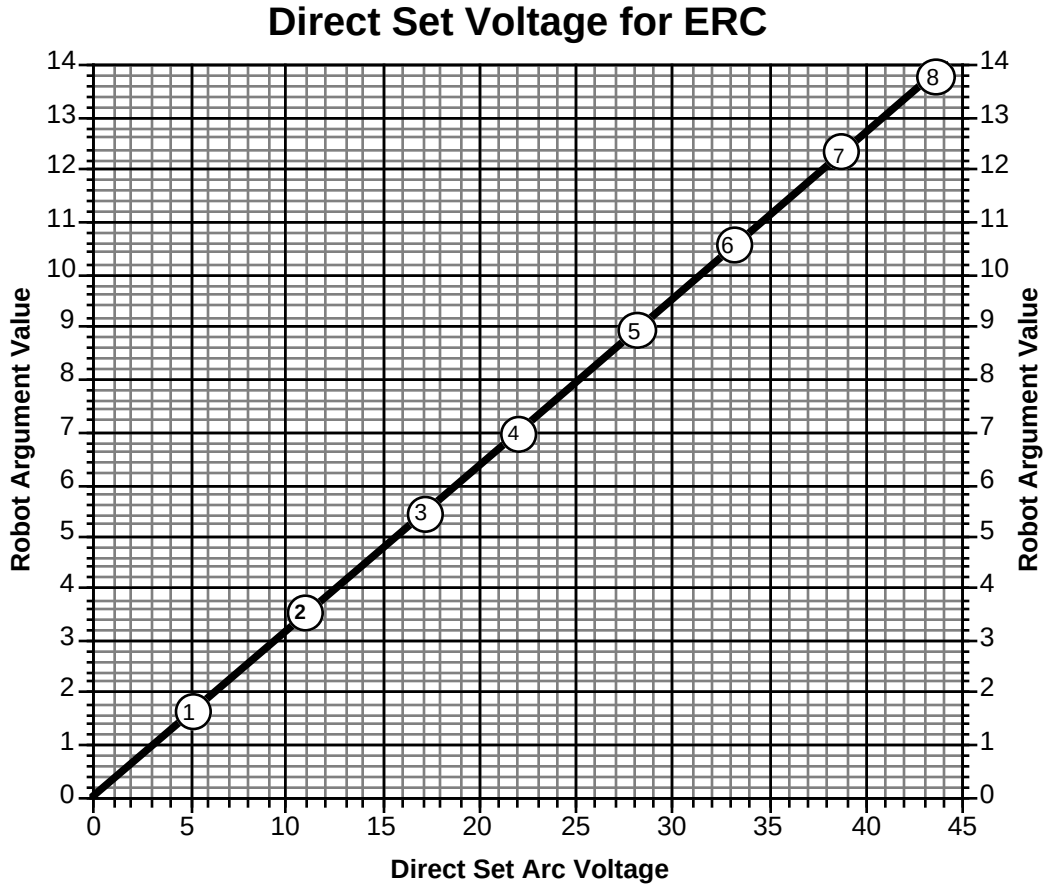

Figure 12-1 Absolute Welding Voltage Settings

After the eight points have been selected on the chart, this data will be entered into the following table:

WELDING VOLTAGE		NAME: HB RC300 RANGE: +
POINT	COMMAND VALUE (V)	MEASURED VALUE (V) STORED: NOT YET
1	1.80	6
2	3.50	11 ADJ.-RATIO: 1.00
3	5.40	16
4	7.00	22
5	9.00	28
6	10.60	34
7	12.50	39
8	14.00	44

12.4 ABSOLUTE WELDING AMPERAGE DATA INFORMATION

The following chart shows typical settings for an .035" diameter ER-7093. These values will change for various wire types and size, and with various gases.

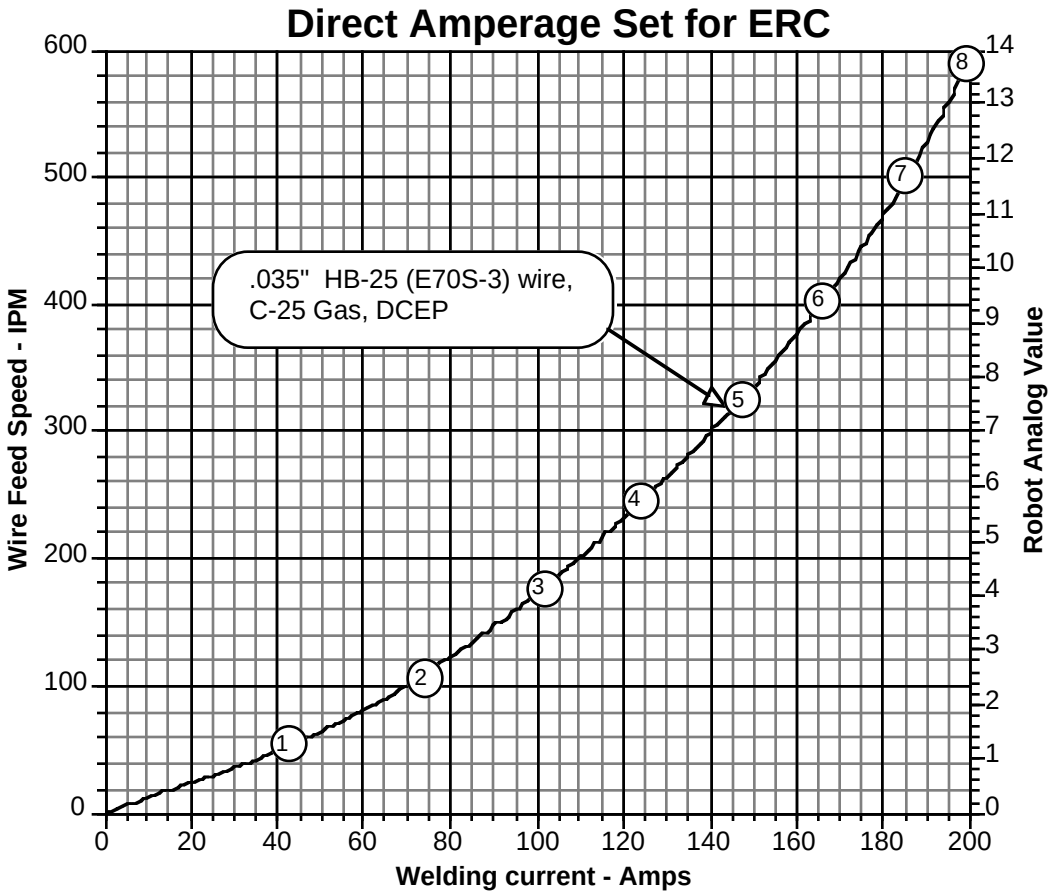

Figure 12-2 Absolute Welding Amperage Settings

The following is an example of the ERC screen for the above chart:

WELDING CURRENT		NAME: AMPS 035HB25C25	
		RANGE: +	
POINT	COMMAND VALUE (V)	MEASURED VALUE (A)	
		STORED: NOT YET	
1	1.40	45	
2	2.70	76	ADJ. -RATIO: 1.00
3	4.20	102	
4	5.80	125	
5	7.65	148	
6	9.60	168	
7	11.65	185	
8	14.00	200	

12.5 ABSOLUTE WELDING AMPERAGE AS WIRE FEED SPEED

Some users will want to set the parameters as volts and wire feed speed. This can be done by using the left and right vertical axes on the blank chart (see Figure 12-3), and entering the command voltage value on the right corresponding to wire feed speed on the left side of the chart. The first data point cannot be entered with a command value of "0" with a measured value of "0" in the table. If called in a job, the ABSCUR of "0" will cause a polarity change of the analog signal and give full reverse wire feed speed.

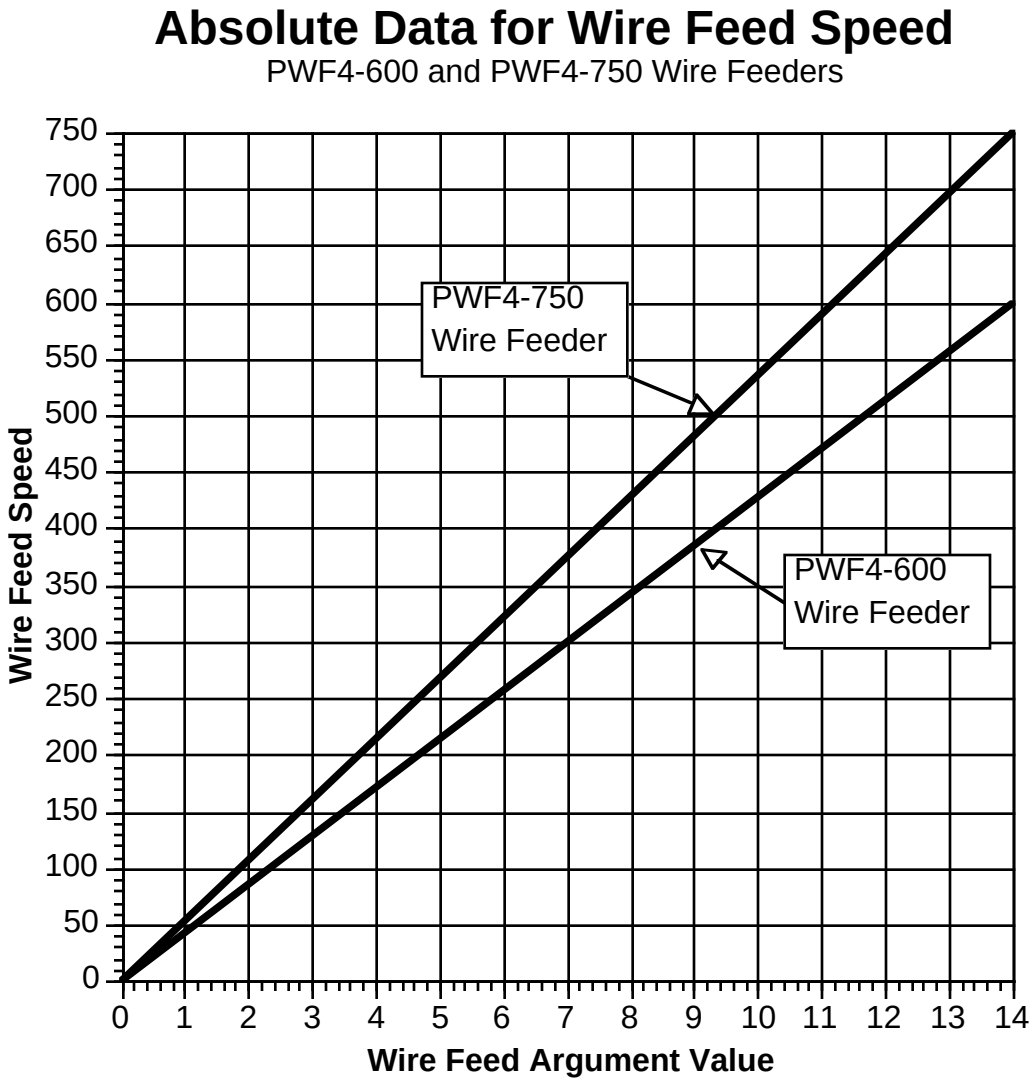

Figure 12-3 Absolute Welding Amperage Settings as Wire Feed Speed

The weld current now represents wire feed speed and is linear as shown below:

NOTE: *The data is entered in Measured (A) column, but is actually wire feed speed.*

WELDING CURRENT NAME: ABS WFS 600IPM
RANGE: +

POINT	COMMAND VALUE (V)	MEASURED VALUE (A)	STORED: NOT YET
1	2.00	80	
2	4.00	175	ADJ. -RATIO: 1.00
3	6.00	250	
4	7.00	300	
5	9.00	380	
6	11.00	470	
7	12.50	530	
8	14.00	600	

12.6 SETTING WELDING PARAMETER WE004 TO ACTIVATE ABSOLUTE DISPLAY

The ERC is usually shipped with the absolute data already set. However, there may be circumstances in which the welding parameter needs to be set.

To set parameter WE004, follow these steps:

1. Press the OP2 key
2. Enter 00000000 (8 zeros).
3. Press Parameter (F1).
4. Press the right arrow key (>).
5. Press WE (F1).
6. Move the cursor to WE004.
7. Press Data chg (F3).
8. Press CANCEL.
9. Enter the value of 1.
10. Reset the ERC by powering down, and then powering up again.

12.7 NAMING THE WELDING FILE

The name of the welding file should be based on wire type, size, or gas. For example, an appropriate name for the voltage file of a Hobart RC300RVS welding power source would be HOBARTRC300RVS.

To name a weld file, follow these steps:

1. Press OP2.
2. Enter 00000000 (eight zeroes)
3. Press the right arrow key three times.
4. Press WELD COND. (F2).
5. Press Ers Data (F2).
6. Press Data chg (F4).
7. Press ABC (F1). The character display appears.
8. Move cursor to the desired alphabet letter.
9. Press ENTER.
10. Move cursor to the next desired alphabet letter.
11. Press ENTER again.
12. Repeat Steps 9 and 10 until spelling is complete.
13. Press Exit (F5).
14. Press ENTER.

Once the voltage table is entered and set, the table will remain the same for various wires. The voltage table is linear and has a direct relationship with the analog value.

12.8 SETTING WELDING POWER SOURCE POLARITY

Most Hobart RC-450, ExcelArc 6045, and ArcMaster 500 welding power sources use a positive range (+). The Fabstar has a negative (-) range for voltage.

To set welding power source polarity, follow these steps:

1. Press CHG. RANGE (F3) until the correct polarity is selected. Pressing CHG. RANGE (F3) toggles the positive and negative polarities back and forth.
2. Press Exit (F1).

12.9 ENTERING DATA INTO THE ABSOLUTE DATA TABLES

Generally, Motoman enters data for .045" diameter wire (or other specified wire size) into the absolute condition table before the robot is shipped. If there is no data on this screen, data must be entered either manually or by floppy disk. Pressing DISP CHG. (F5) displays either the amperage table or the voltage table. The tables toggle back and forth.

To enter data into the absolute condition table, follow these steps:

1. Using down arrow key, move cursor to first line under COMMAND VALUE (V).
2. Press Disp Chg (F5) to select either the voltage or the amperage table.
3. Press Data Chg (F4).
4. Press CANCEL.
5. Enter each command value from the chart in Figure 12-1.
6. Using down arrow key, move cursor to first line under MEASURED VALUE (V).
7. Press Data Chg (F4).
8. Press CANCEL.
9. Enter each command value from the chart in Figure 12-1.
10. Press Exit (F1). This stores the data. If the data isn't yet stored, the "STORED:" indicator on the screen will display "NOT YET." When the data is saved, the indicator will display "DONE.
11. Press DISP CHG. (F5) to select the remaining (voltage or amperage) table.
12. Repeat Steps 2 through 10.

12.10 STORING ABSOLUTE DATA

If the data is not stored after pressing Exit (F1) in Step 10 above, alarm 1530 "Destroyed File (Weld Condition)" will display when the job is run. If this situation occurs, do as follows:

1. Return to the direct data table.
2. Press Exit (F1) for both the voltage and the amperage data tables.

12.11 ERASING ABSOLUTE DATA

There are two methods for erasing existing data in the files:

- Using the DATA DLT (F1) key
- Overwriting existing data on the screen.

12.12 TESTING ABSOLUTE DATA

Once the curves and tables are generated, it is necessary to weld at the various settings to confirm that the settings are accurate. If there are major errors, the data in the table must be corrected so that it corresponds to the actual measured values. Pick a normal travel speed for a given wire size, current, and voltage.

12.13 ADJUSTING THE ABSOLUTE DATA TABLE RATIOS

Welding power source calibration and characteristics may vary slightly between models or units. To adjust table ratios, change the adjustment ratio to compensate for line voltage changes or individual power source characteristics.

NOTE: *If the weld voltage is lower than the set value in the table, the scale can be changed to 0.90 to increase all values 10%. The maximum range of change is 0.80 to 1.20 (± 20% adjustment) times the values in the table.*

12.14 RESOLUTION OF ANALOG ARGUMENTS

Although there are 1400 steps to the pendant setting and analog settings, the actual analog voltage changes every 11th step. For example, the analog voltage might change at 5.45 then remain constant until 5.56 then remain constant until 5.78. The resolution of the analog signal contains 128 settings. A new setting occurs every 11 arguments on the teach pendant. When the absolute values are changed on the pendant, they change in whole units. Decimal changes do not occur, which is different from normal AWELD.

12.15 NUMBER OF WELDING CONDITION FILES

Only one welding condition file at a time can be saved to floppy disk. If a separate welding file is developed for a different wire, it must be saved to a separate floppy disk. Only one file can be used in the ERC at a time.

12.16 ACCURACY OF ABSOLUTE DATA

The accuracy of the data is dependent upon the accuracy and care used in measuring the data during actual welding. Factors such as push angle, wire stickout, and speed can affect the accuracy of the data.

Using the meters on the welding power source can sometimes lead to inaccurate data. Welding power source meters can vary as much as 5% from one power source to another and as much as 10% or more between brands of welding equipment. The best welding power source meters have accuracies of ± 2-3%, but the welding shunt can add an additional ± 2% error.

When testing new weld data for the table, use the same precision calibrated instruments for all power sources. Digital voltmeters and ammeters can sometimes lead to errors and should be checked against other standards. The wave shape of the DC welding current can cause meters to read differently. A true RMS digital ammeter will correct for wave shape, but may indicate a slightly lower value than normal welding power source DC meters.

12.17 CREATING NEW ABSOLUTE WELDING AMPERAGE DATA

12.17.1 Equipment Required

- Precision digital ammeter or calibrated ammeter 0-400 amps (or maximum range of test)
- Digital IPM meter or measurement device

NOTE: If the range of the wire feeder is different from those given in tables 12-18 through 12-36, the data must be replotted to fit the scale used.

- Precision voltmeter
- Test leads as required

12.17.2 Welding Setup Procedure

To conduct a welding setup procedure, follow these steps:

1. Set the power source for control from the robot.
2. Confirm the speed range of the wire feeder (usually 0-600 IPM).
3. Use weld material thick enough for maximum current.
4. Set gas flow.
5. Set torch tip to work distance (3/8" to 3/4") and torch perpendicular to weld.
6. Set up a test job in ERC with travel speed set to correct speed for amperage.

12.17.3 Weld Test

To conduct a weld test, follow these steps:

➪ *DANGER!*

DO NOT LOOK AT THE ARC WITHOUT EYE PROTECTION. Serious eye injury will result from looking at exposed arc.

➪ *DANGER!*

Always be aware that the robot can make unexpected moves. Unexpected robot moves can cause serious injury or death.

1. Estimate the welding current and wire feed speeds and voltages from typical data given on weld wire data sheets.
2. Make welds at eight points. Start at the higher current first, then lower settings to the minimum amperage.
3. Record the voltage, wire feed speed (or use motor RPM and convert to IPM), amperage, and other parameters such as gas flow, travel speed, torch angle, etc., for reference. This can be done by using the normal AWELD and VWELD parameters or an estimated burnoff curve for the direct volts and amperage. Typically, it is best to use the AWELD and VWELD values.
4. Using Figure 12-3, plot the wire feed speed versus amperage for the particular wire being used.
5. Draw a smooth line through the points to generate the curve. Usually the curve is more linear at the lower currents and has a sharper upward bend at higher currents as indicated by the chart in the first part of this instruction for .035" wire.
6. Pick eight points that are evenly spaced along the curve. Since the wire feed speed has a linear relationship with ERC analog values, the right axis on the chart represents the normal AWELD value for wire feed speed on the left vertical axis. An AWELD of 7.00 will give 300 IPM. An AWELD of 14 gives 600 IPM. The amperage is not linear compared to wire feed speed.
7. At each point selected, draw a line horizontally from the point on the curve to the right "Robot Analog Value" axis. The point where the line intersects the right axis is the "Command Value".
8. Enter the "Command Value"into the table along with the welding's current value. The scale is not detailed enough to read two decimal points of accuracy. The data will also have some error due to meter readings, fluctuations of amperage during welding, and stick out.
9. Once the eight points of data are registered in the table, name the weld file by following the procedure in Section 12.7.

NOTE: The voltage values are linear with the argument values. Data from previous direct voltage settings can be used if you use the same power source and it is a regulated type.

NOTE: Some non-regulated power sources or special power sources may have a slight non-linear characteristic or minimum cut-off voltage. If this is the case, either perform the welding voltage test with a high current load bank (0-400 amps) or weld.

NOTE: It is impossible to create absolute data for "pulse type" welding power source. This is due to the very non-linear characteristics of the output voltage versus frequency.

12.18 BLANK AMPERAGE SETTING CHART AND TABLE

12.18.1 Blank Direct Amperage Setting Chart

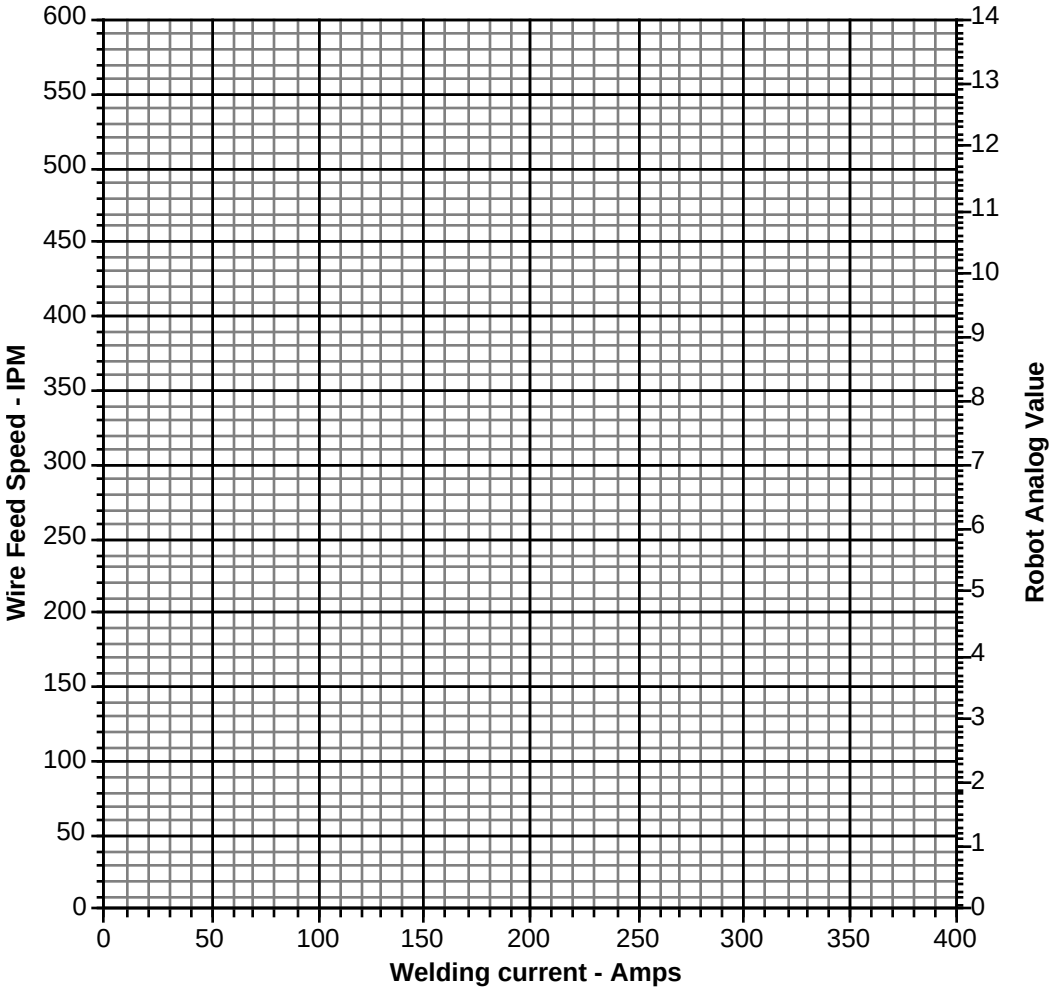

Figure 12-4 Blank Amperage Setting Chart

12.18.2 Blank Amperage Setting Table

WELDING CURRENT NAME: _____
RANGE: + (normally positive)

POINT	COMMAND VALUE (V)	MEASURED VALUE (A)	
			STORED: NOT YET
1	____	____	
2	____	____	ADJ. -RATIO: 1.00
3	____	____	
4	____	____	
5	____	____	
6	____	____	
7	____	____	
8	____	____	

12.19 CREATING NEW ABSOLUTE WELDING VOLTAGE DATA

The data for Hobart power sources has been given and tables created. Other power sources will have different output voltages and require their own absolute voltage data.

12.19.1 Equipment Required

- Precision digital ammeter or calibrated ammeter 0-400 amps (or maximum range of test)
- Digital IPM meter or measurement device

NOTE: If the range of the wire feeder is different from those given in the tables in the appendix, the data must be replotted to fit the scale used.

- Precision voltmeter
- Test leads as required

12.19.2 Welding Setup Procedure

To conduct a welding setup procedure, follow these steps:

1. Set the power source for control from the robot.
2. Confirm the speed range of the wire feeder (usually 0-600 IPM).
3. Use weld material thick enough for maximum current.
4. Set gas flow.
5. Set torch tip to work distance (3/8" to 3/4") and torch perpendicular to weld.

6. Set up a test job in ERC with travel speed set to correct speed for amperage.

12.19.3 Weld Test

➪ *DANGER!*

DO NOT LOOK AT THE ARC WITHOUT EYE PROTECTION. Serious eye injury will result from looking at exposed arc.

➪ *DANGER!*

Always be aware that the robot can make unexpected moves. Unexpected robot moves can cause serious injury or death.

To conduct a weld test, follow these steps:

1. Weld at two separate voltages as low and as high as possible.
2. Record the VWELD command and arc voltage (from power source) at TEACH setting.
3. Plot the two points and draw a straight line through the points..
4. Select eight points equally along the straight line and enter that into the blank table (see Section 12.18.2)
5. Create a job with absolute voltage and amperage.
6. Modify Adjust Ratio to bring data close to actual.

12.19.4 Blank Voltage Setting Chart

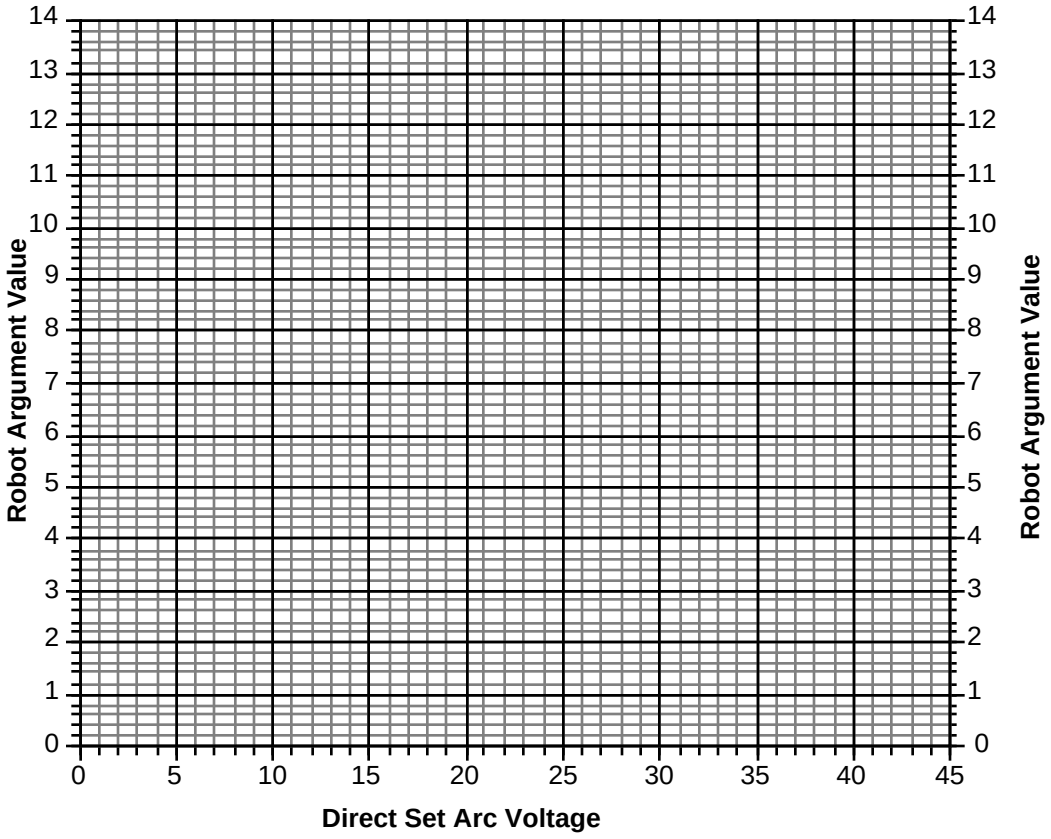

Figure 12-5 Blank Voltage Setting Chart

12.19.5 Blank Direct Voltage Setting Table

WELDING VOLTAGE NAME: _____
RANGE: + (normally positive)

POINT	COMMAND VALUE (V)	MEASURED VALUE (A)
		STORED: NOT YET
1	____	____
2	____	____ ADJ. -RATIO: 1.00
3	____	____
4	____	____
5	____	____
6	____	____
7	____	____
8	____	____

12.20 SETTING VOLTAGE FOR HOBART RC SERIES WELDING POWER SOURCES

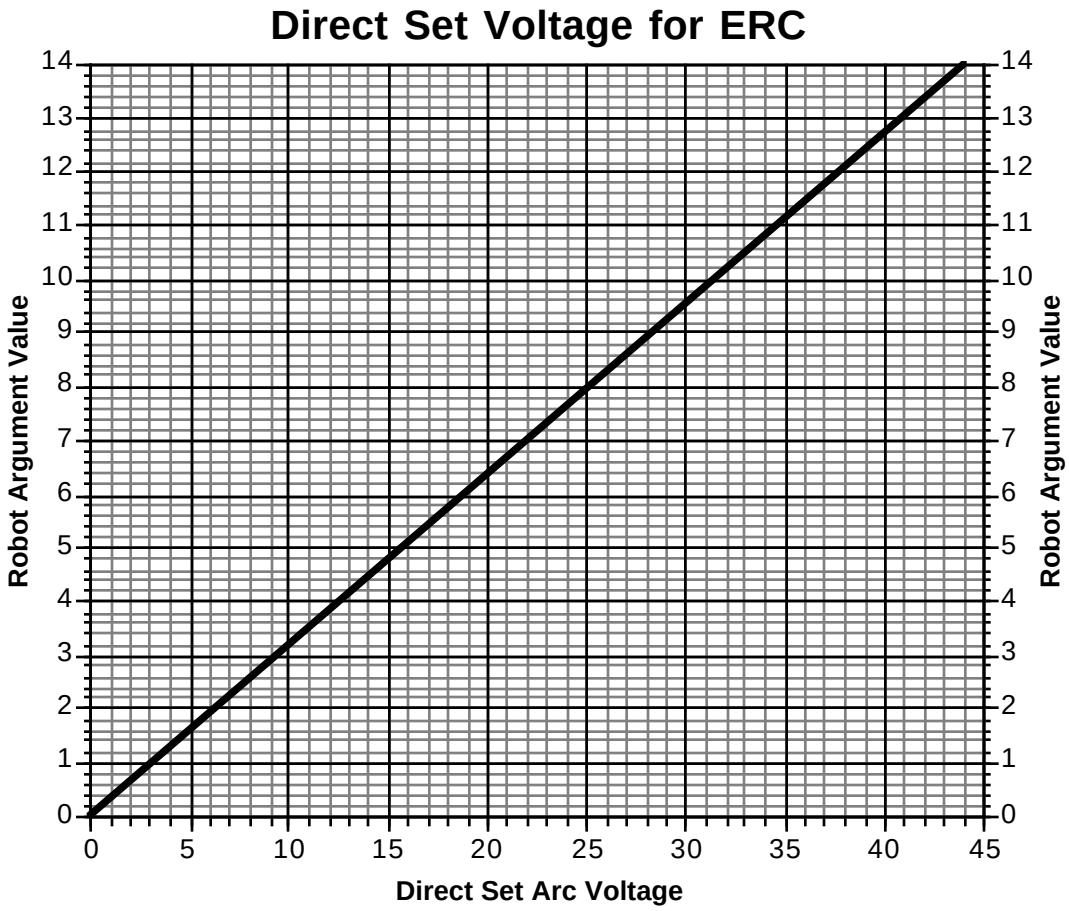

Figure 12-6 Setting Voltage for Hobart RC Series Welding Power Sources

WELDING VOLTAGE	NAME: HOBART-VOLTS RANGE: +
COMMAND VALUE (V)	MEASURED VALUE (V) STORED: NOT YET
1.80	6
3.50	11 ADJ.-RATIO: 1.00
5.40	16
7.00	22
9.00	28
10.60	34
12.50	39
14.00	44

12.21 SETTING VOLTAGE FOR HOBART FABSTAR 4030

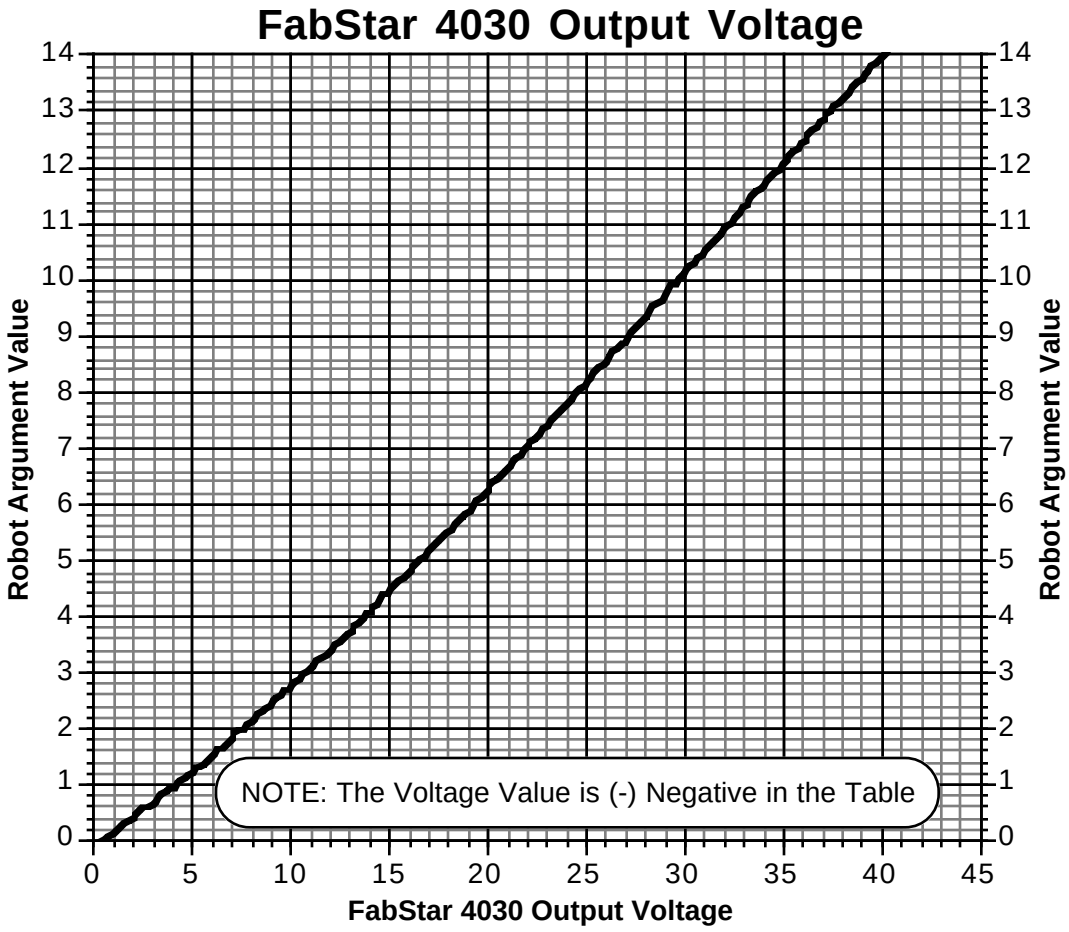

Figure 12-7 Setting Voltage for Hobart Fabstar 4030

WELDING VOLTAGE	NAME: FABSTAR-VOLTS RANGE: - (Negative)
COMMAND VALUE (V)	MEASURED VALUE (V) STORED: NOT YET
-1.00	5
-3.00	11
-4.80	16 ADJ.-RATIO: 1.00
-6.50	20
-8.00	25
-10.00	30
-12.00	35
-14.00	40

(Use ABSVOL as Positive Value in arc job)

12.22 SETTING AMPERAGE FOR .030 ER70S-3 WITH C-25 (75% ARGON, 25% CO2) GAS

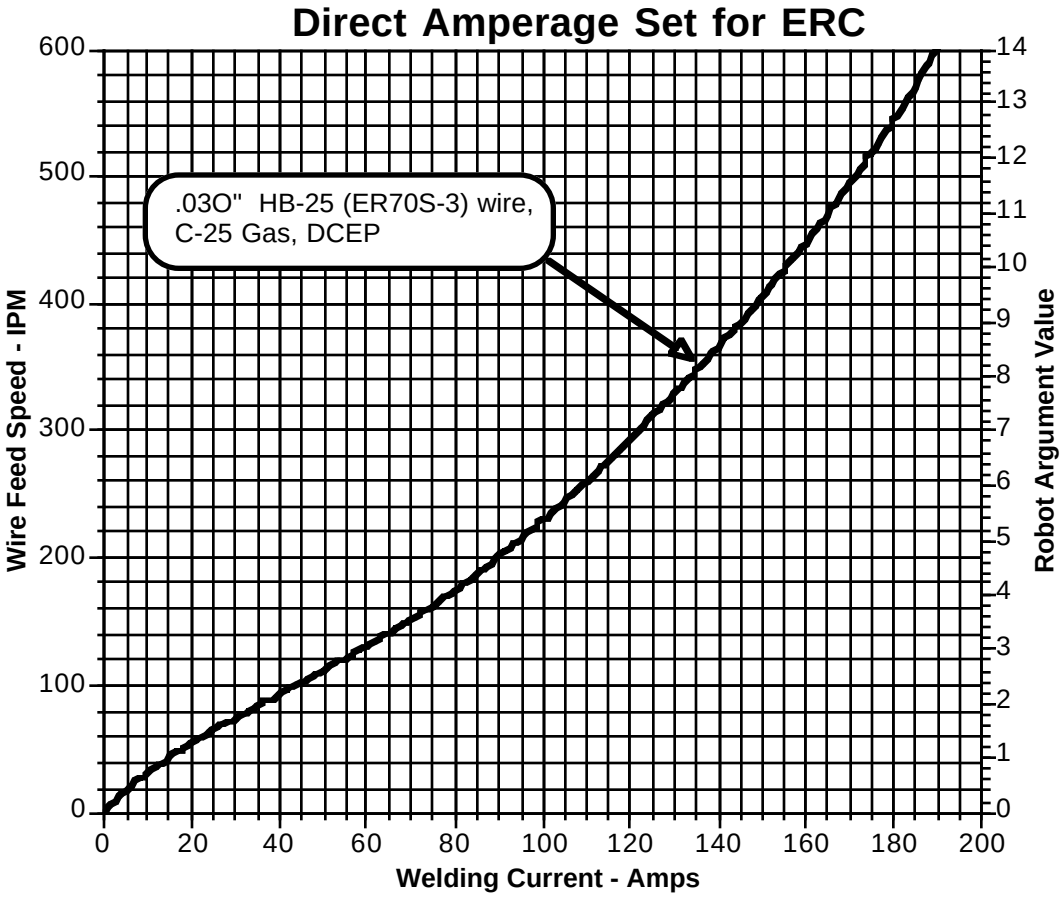

Figure 12-8 Setting Amperage for .030 ER70S-3 with C-25 (75% Argon, 25% CO2) Gas

WELD CURRENT NAME: 030HB-25,C-25
RANGE: ±

POINT	COMMAND VALUE (V)	MEASURED VALUE (A) STORED: NOT YET
1	1.60	26
2	2.80	55 ADJ. -RATIO: 1.00
3	4.30	85
4	5.90	110
5	7.80	133
6	9.80	148
7	11.80	172
8	14.00	190

12.23 SETTING AMPERAGE FOR .035 ER70S-3 WITH C-25 (75% ARGON, 25% CO2) GAS

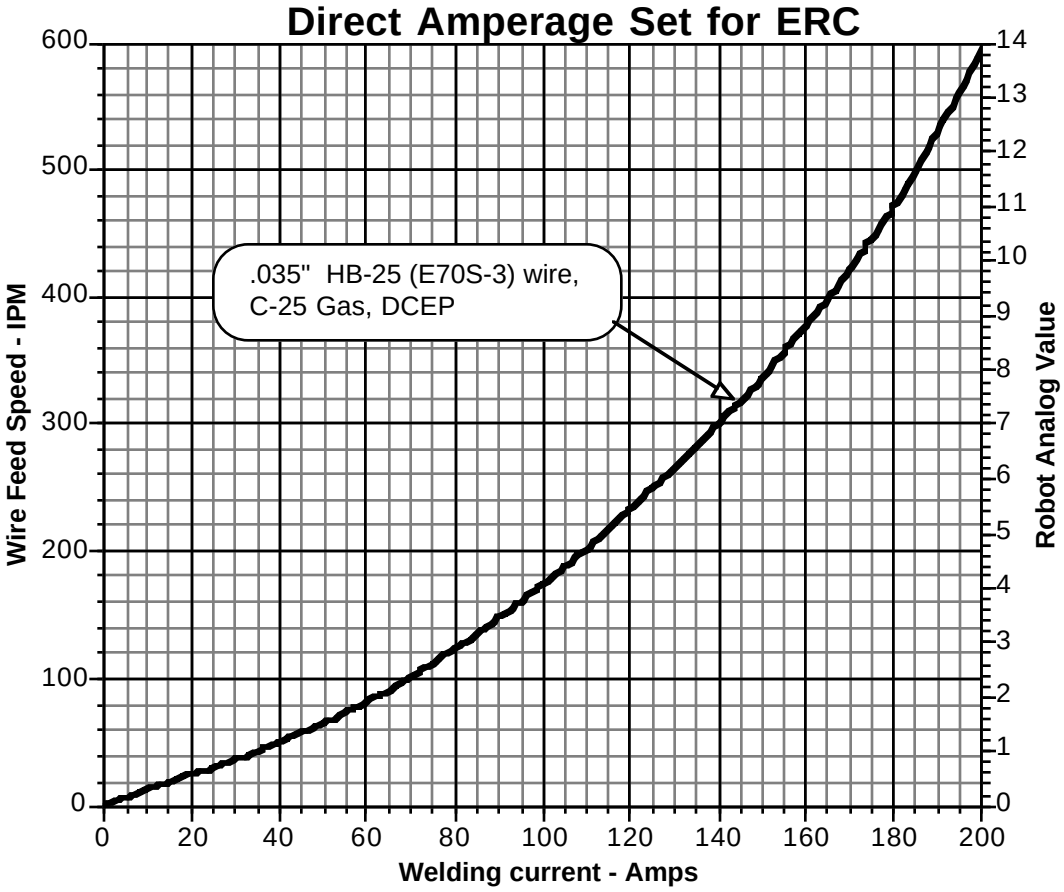

Figure 12-9 Setting Amperage for .035 E70S-3 With C-25 (75% Argon, 25% CO2) Gas

WELD CURRENT — NAME: 035HB-25,C-25
RANGE: +

POINT	COMMAND VALUE (V)	MEASURED VALUE (A) STORED: NOT YET
1	1.40	45
2	2.70	76 ADJ. -RATIO: 1.00
3	4.20	102
4	5.80	125
5	7.65	148
6	9.60	168
7	11.65	185
8	14.00	200

12.24 SETTING AMPERAGE FOR .045 ER70S-3 WITH C-25 (75% ARGON, 25% CO2) GAS

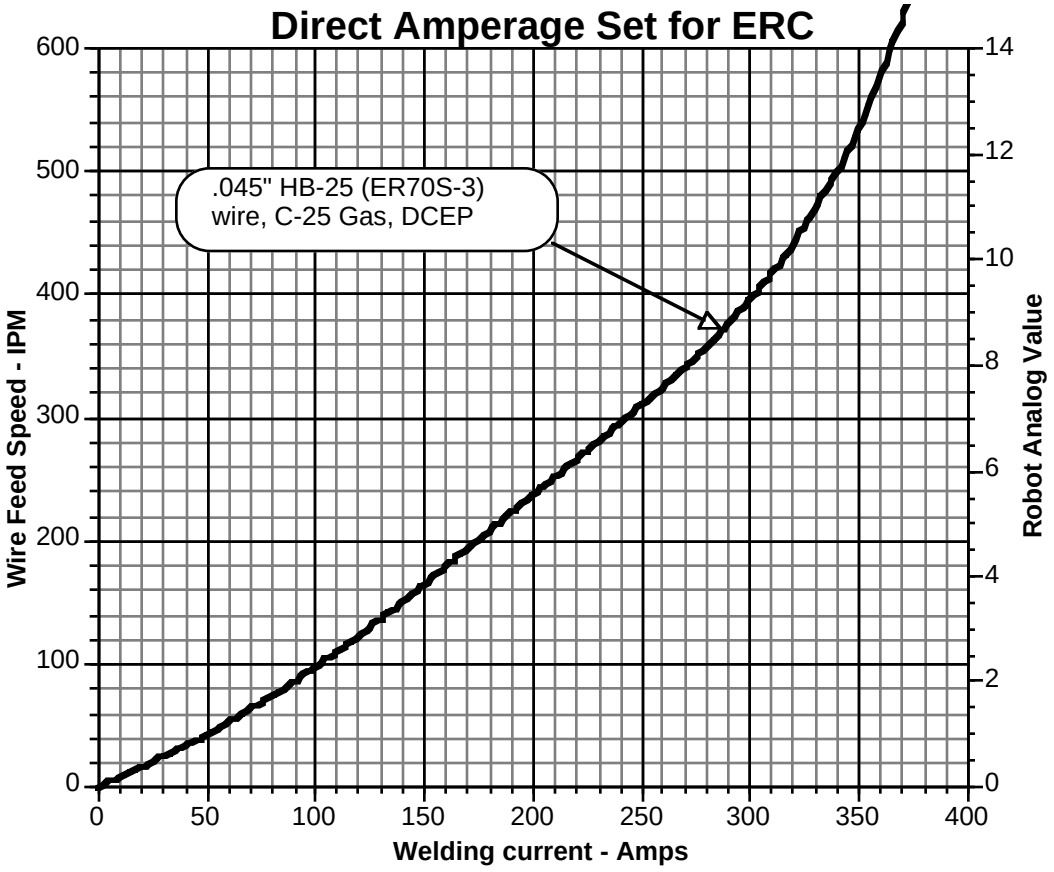

Figure 12-10 Setting Amperage for .045 E70S-3 With C-25 (75% Argon, 25% CO2) Gas

WELD CURRENT NAME: 045HB-25,C-25
RANGE: +

POINT	COMMAND VALUE (V)	MEASURED VALUE (A) STORED: NOT YET	
1	1.40	60	
2	2.70	110	ADJ. -RATIO: 1.00
3	4.25	160	
4	6.10	210	
5	7.60	260	
6	9.40	300	
7	11.50	340	
8	14.00	365	

12.25 SETTING AMPERAGE FOR .052 ER70S-6 WITH CO_2 GAS

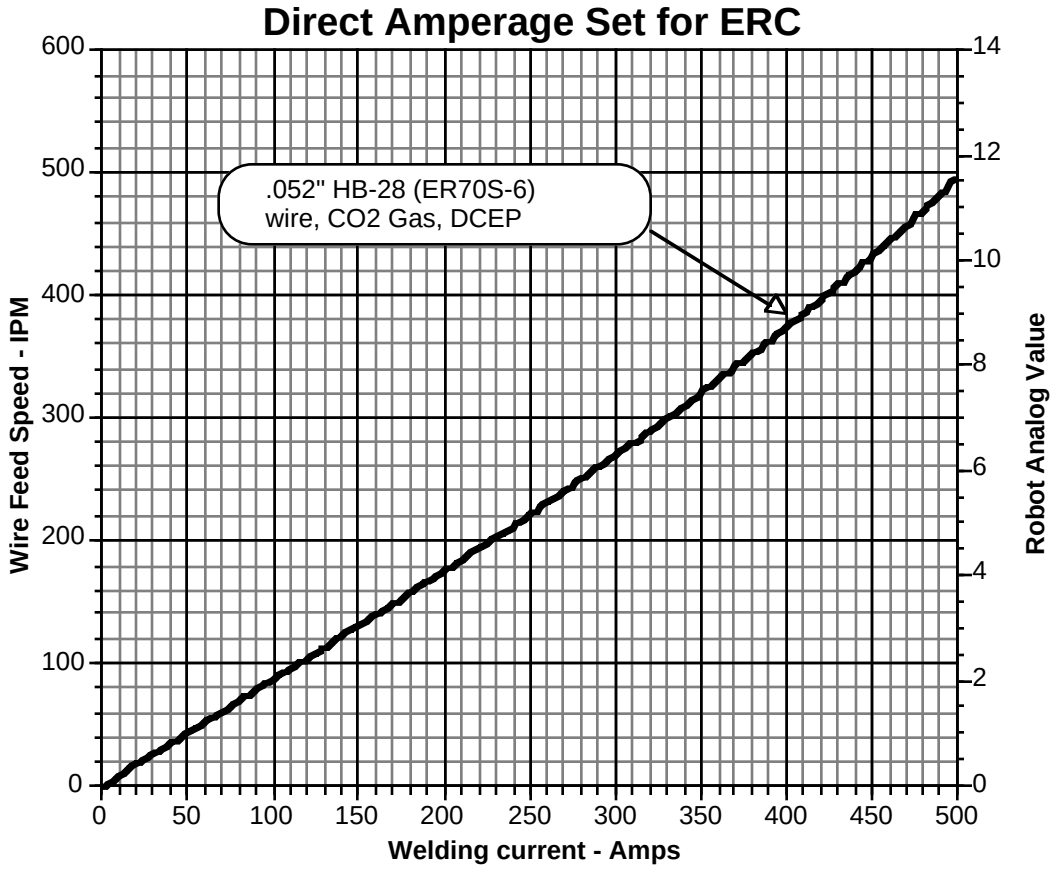

Figure 12-11 Setting Amperage for .052 ER70S-6 With CO2 Gas

WELD CURRENT

NAME: 052HB-28,CO2
RANGE: +

POINT	COMMAND VALUE (V)	MEASURED VALUE (A) STORED: NOT YET
1	2.40	120
2	3.75	180 ADJ. -RATIO: 1.00
3	5.00	245
4	6.10	290
5	7.30	345
6	8.70	400
7	10.00	450
8	11.50	500

12.26 SETTING AMPERAGE FOR .045 ER70S-3 WITH 90% ARGON, 10% CO2 GAS

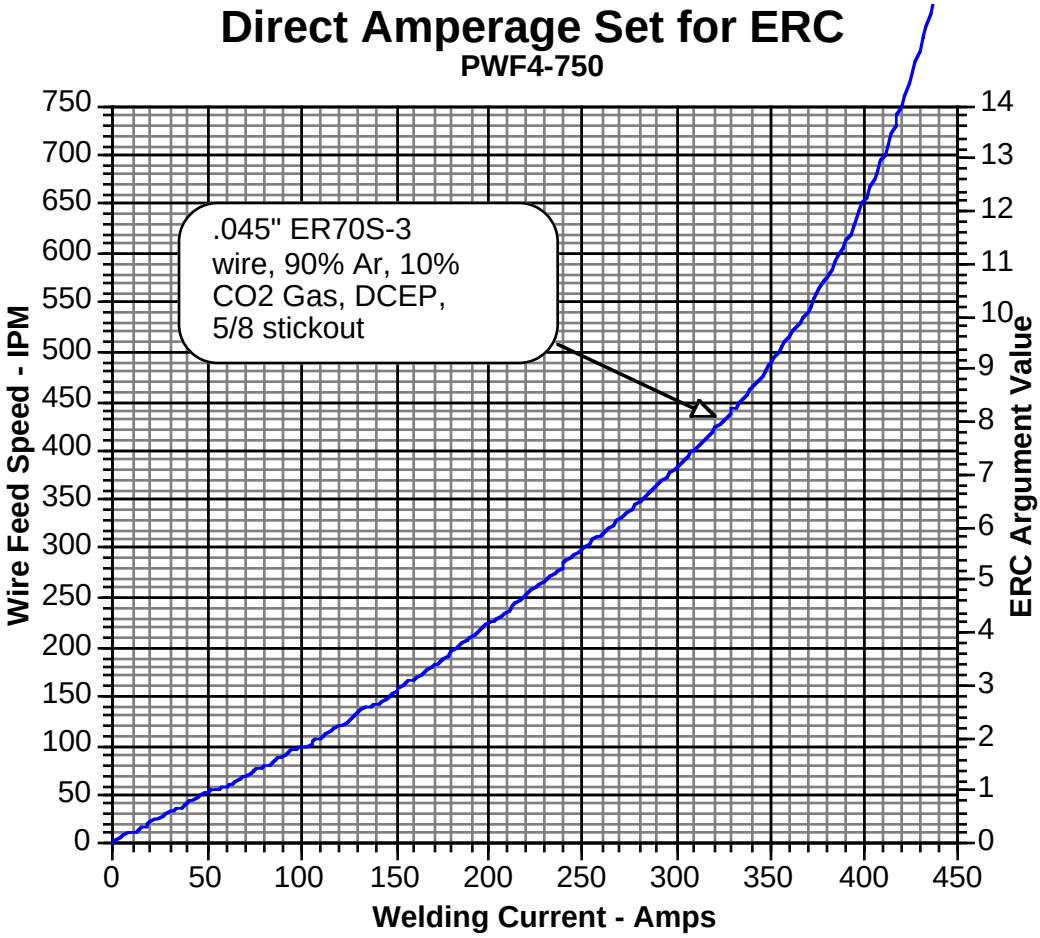

Figure 12-12 Setting Amperage for .045 ER70S-3 With 90% Argon, 10% CO2 Gas

WELD CURRENT		NAME: 045E70S-3,90/10 RANGE: ±
POINT	COMMAND VALUE (V)	MEASURED VALUE (A) STORED: NOT YET
1	1.20	70
2	2.60	130 ADJ. -RATIO: 1.00
3	4.30	205
4	5.70	250
5	7.60	315 (5/8" stickout)
6	9.60	360
7	11.60	390
8	14.00	420

12.27 SETTING AMPERAGE FOR 1/16 ER70S-6 WITH C-25 (75% ARGON, 25% CO2) GAS

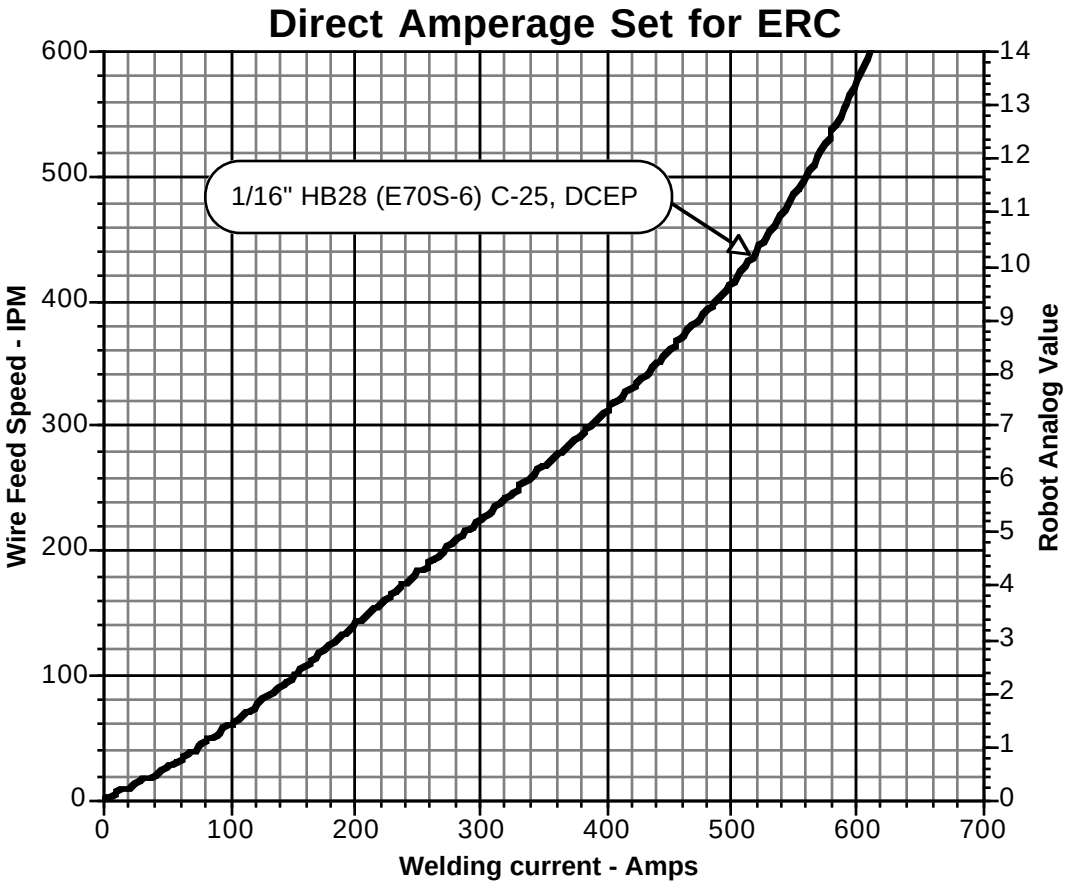

Figure 12-13 Setting Amperage for 1/16 ER70S-6 With C-25 (75% Argon, 25% CO2) Gas

WELD CURRENT		NAME: 1/16HB-25,C-25 RANGE: +	
POINT	COMMAND VALUE (V)	MEASURED VALUE (A) STORED: NOT YET	
1	2.40	130	
2	4.00	230	ADJ. -RATIO: 1.00
3	5.40	310	
4	6.95	380	
5	8.40	450	
6	10.20	515	
7	12.00	570	
8	14.00	610	

12.28 SETTING AMPERAGE FOR .052 ER70S-6 WITH C-25 (75% ARGON, 25% CO2) GAS

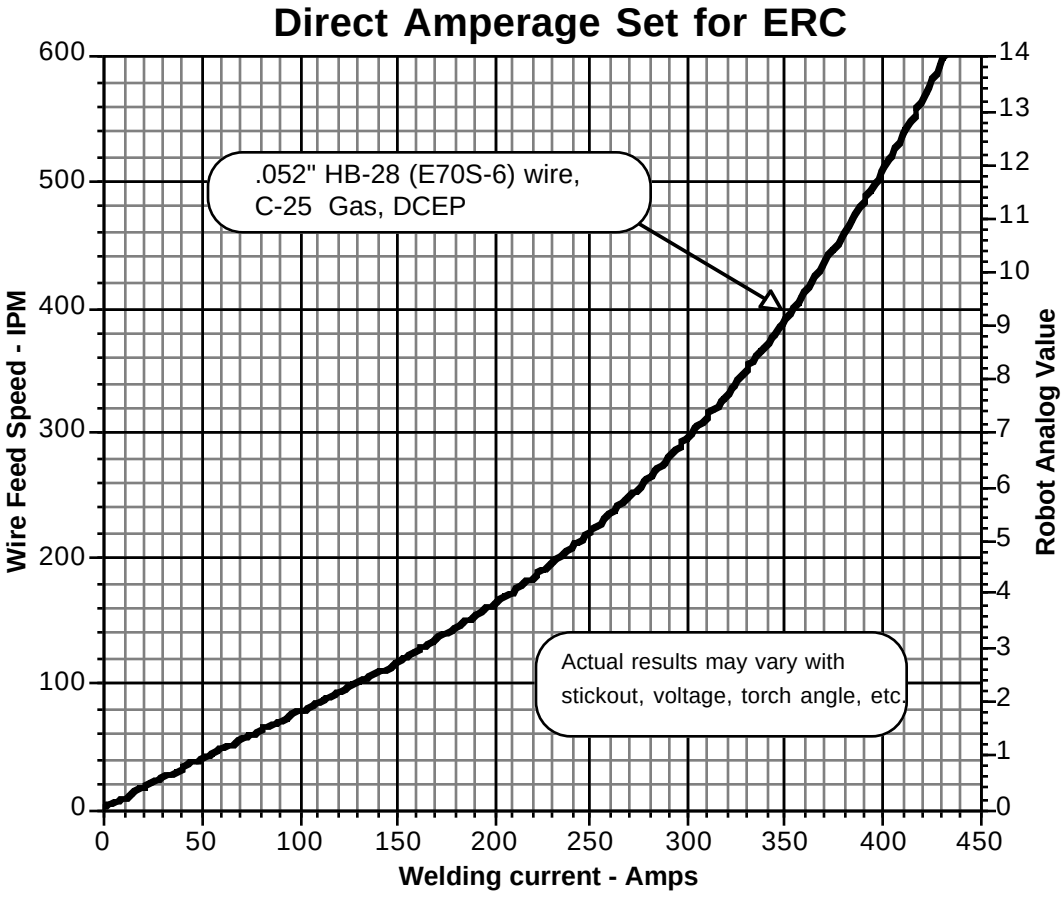

Figure 12-14 Setting Amperage for .052 ER70S-6 With C-25 (75% Argon, 25% CO2) Gas

WELD CURRENT		NAME: 052HB-28,C-25	
		RANGE: ±	
POINT	COMMAND VALUE (V)	MEASURED VALUE (A)	
		STORED: NOT YET	
1	1.10	70	
2	2.40	135	ADJ. -RATIO: 1.00
3	3.80	200	
4	5.50	260	
5	7.30	310	
6	9.30	350	
7	11.30	390	
8	14.00	430	

12.29 SETTING AMPERAGE FOR .045 FABCOR 86 ER70T-1 WITH C-25 (75% ARGON, 25% CO2) GAS

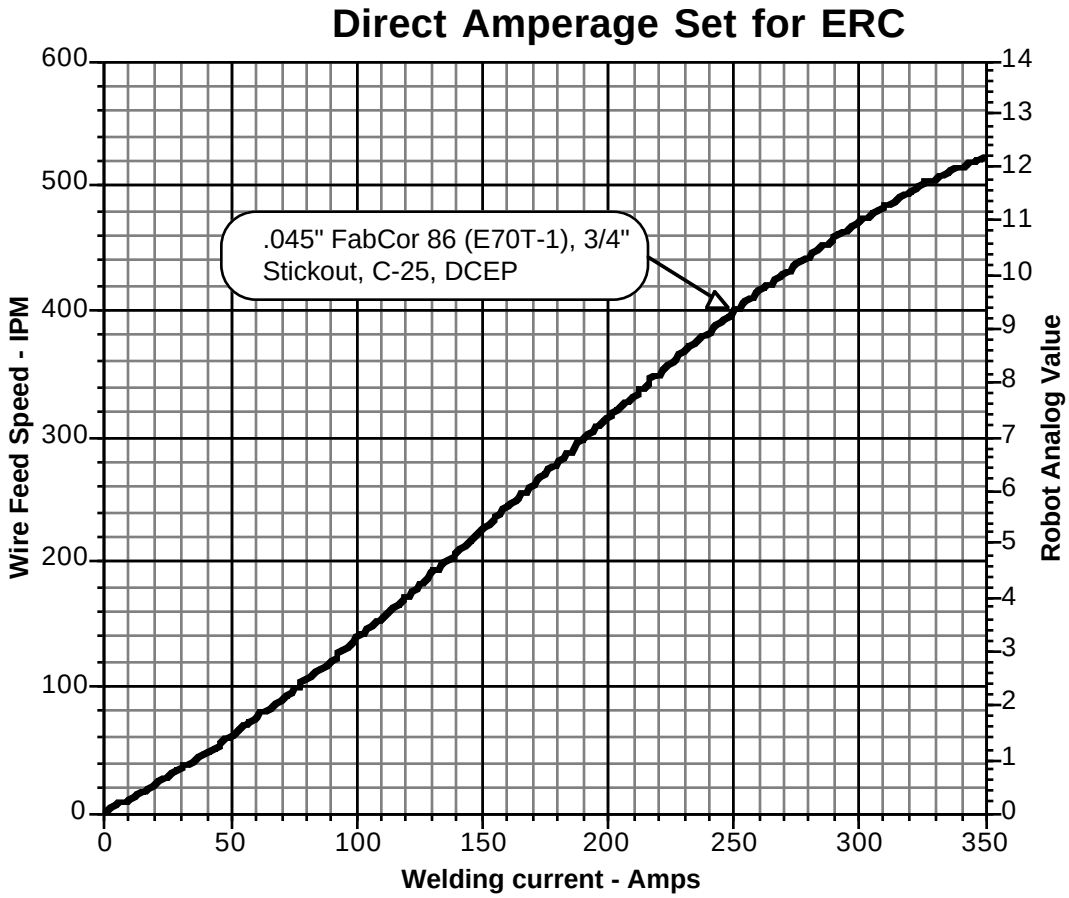

Figure 12-15 Setting Amperage for .045 Fabcor 86 ER70T-1 With C-25 (75% Argon, 25% CO2) Gas

WELD CURRENT

NAME: 045FABCOR86CO2
RANGE: +

POINT	COMMAND VALUE (V)	MEASURED VALUE (A) STORED: NOT YET
1	1.00	40
2	2.90	90 ADJ. -RATIO: 1.00
3	4.50	130
4	6.20	170
5	8.00	215
6	9.60	255
7	11.00	300
8	12.20	350

12.30 SETTING AMPERAGE FOR 1/16 RXR E70T-1 WITH CO_2 GAS

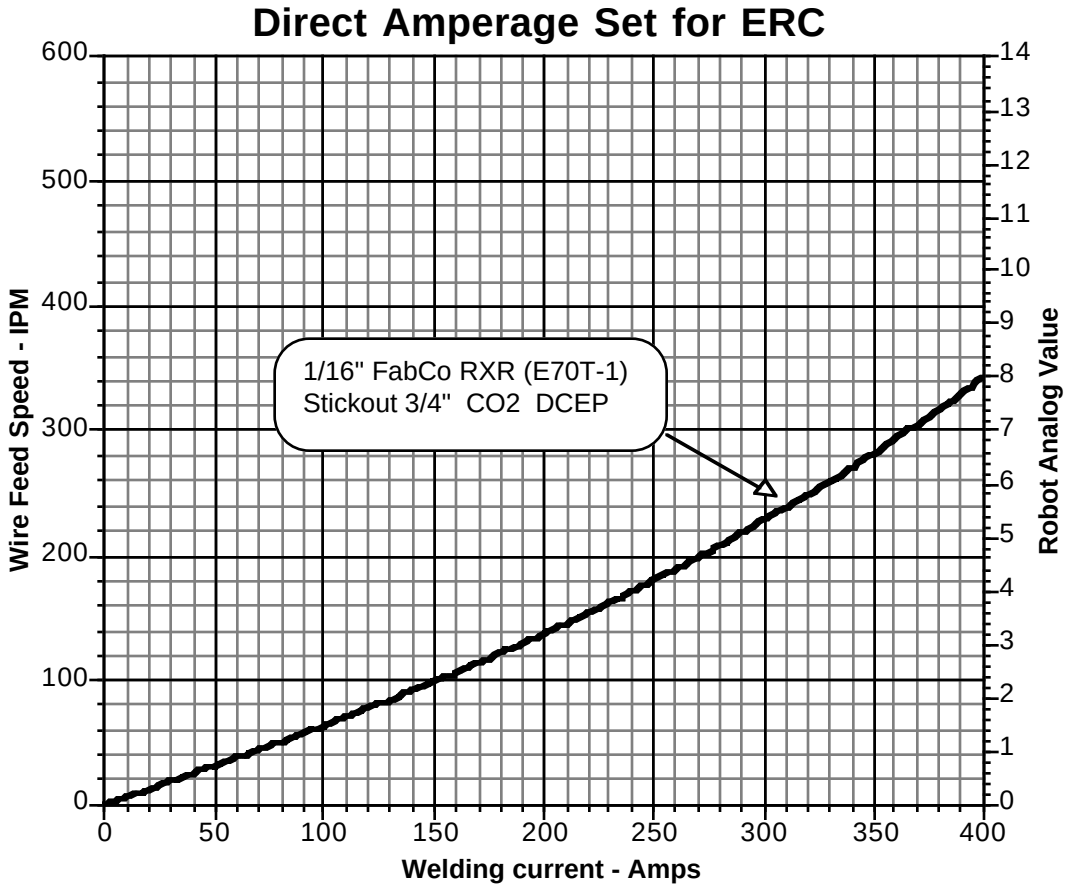

Figure 12-16 Setting Amperage for 1/16 RXR ER70T-1 With C02 Gas

WELD CURRENT		NAME: 1/16 RXR CO2 RANGE: +	
POINT	COMMAND VALUE (V)	MEASURED VALUE (A) STORED: NOT YET	
1	0.80	50	
2	1.50	100	ADJ. -RATIO: 1.00
3	2.50	160	
4	3.40	208	
5	4.40	260	
6	5.60	305	
7	6.80	350	
8	8.00	400	

12.31 SETTING AMPERAGE FOR 3/64 4043 ALUMINUM WITH ARGON GAS

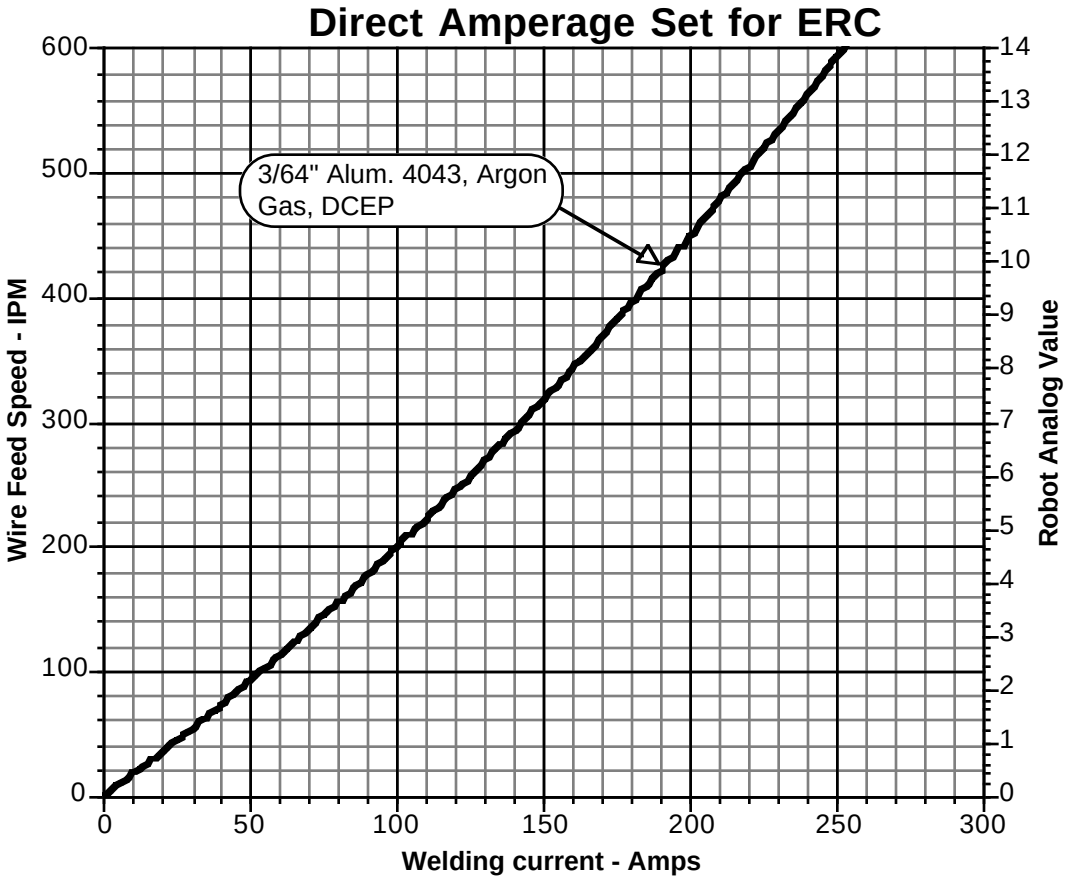

Figure 12-17 Setting Amperage for 3/64 4043 Aluminum with Argon Gas

WELD CURRENT		NAME: 3/64Alum4043AR RANGE: +	
POINT	COMMAND VALUE (V)	MEASURED VALUE (A) STORED: NOT YET	
1	2.35	50	
2	4.00	85	ADJ. -RATIO: 1.00
3	5.60	115	
4	7.00	145	
5	8.80	165	
6	10.50	200	
7	12.20	225	
8	14.00	250	

12.32 SETTING AMPERAGE FOR 1/16 4043 ALUMINUM WITH ARGON GAS

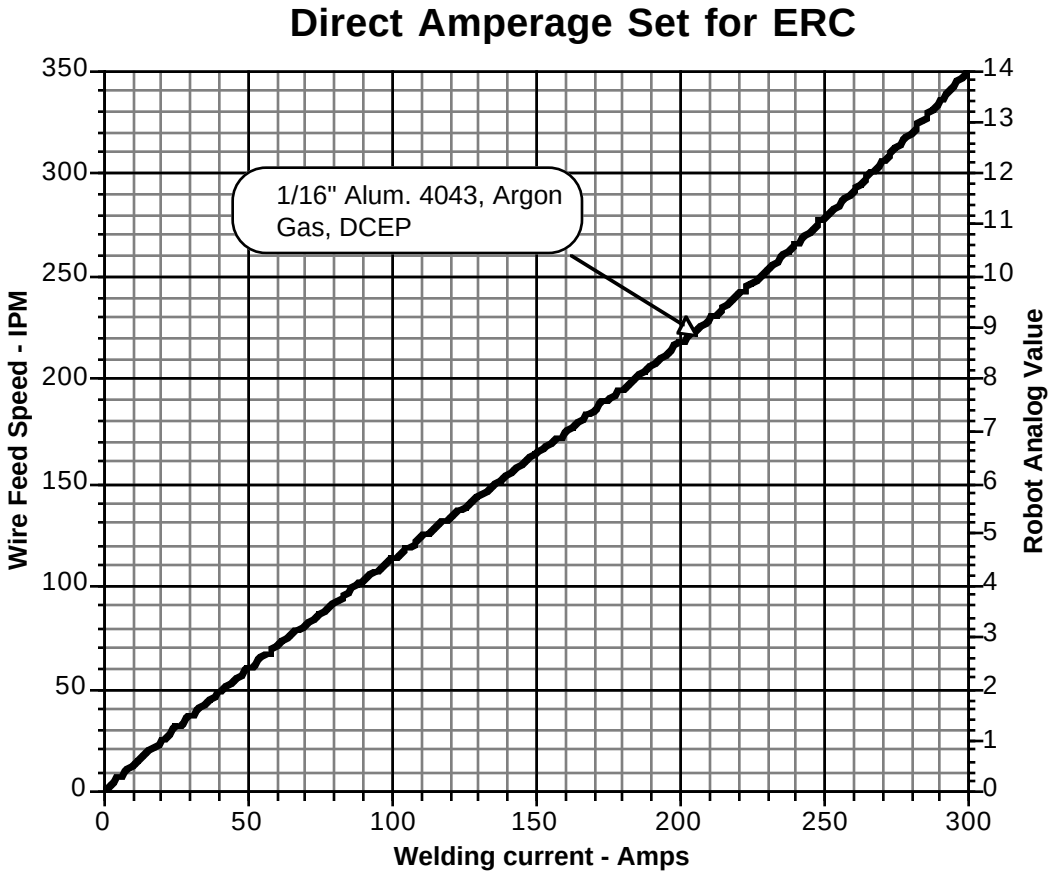

Figure 12-18 Setting Amperage for 1/16 4043 Aluminum With Argon Gas

WELD CURRENT NAME: 1/164043ALUMAR
RANGE: +

POINT	COMMAND VALUE (V)	MEASURED VALUE (A)	STORED: NOT YET
1	3.60	75	
2	5.00	110	ADJ. -RATIO: 1.00
3	6.40	145	
4	7.70	175	
5	9.00	205	
6	10.50	240	
7	12.20	270	
8	14.00	300	

12.33 SETTING AMPERAGE FOR .035 WITH C-25 (75% ARGON, 25% CO2) GAS

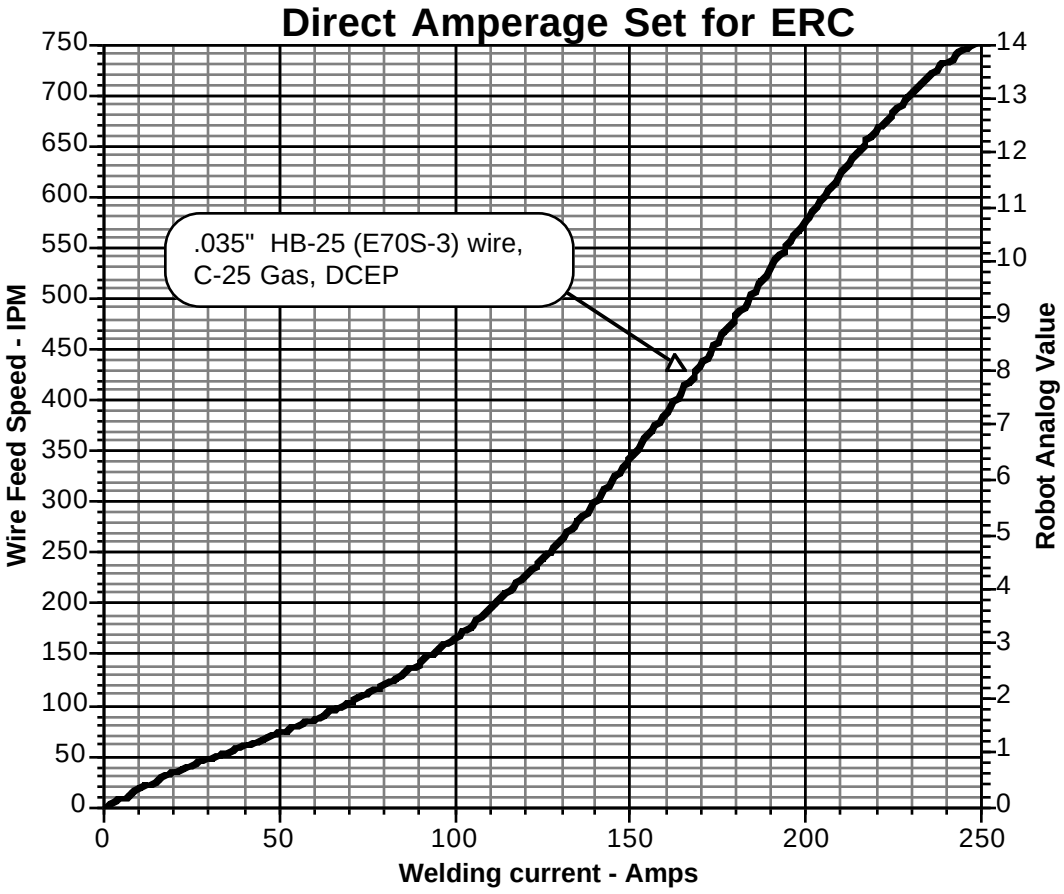

Figure 12-19 Setting Amperage for .035 HB-25 With C-25 (75% Argon, 25% CO2) Gas

WELD CURRENT NAME: 035HB-25,C-25
RANGE: +

POINT	COMMAND VALUE (V)	MEASURED VALUE (A) STORED: NOT YET	
1	1.90	70	
2	3.20	100	ADJ. -RATIO: 1.00
3	4.70	130	
4	6.50	150	
5	8.40	175	
6	10.60	200	
7	12.20	220	
8	14.00	250	

12.34 SETTING AMPERAGE FOR .035 ER120S-1 WITH 82% ARGON, 18% CO_2 GAS

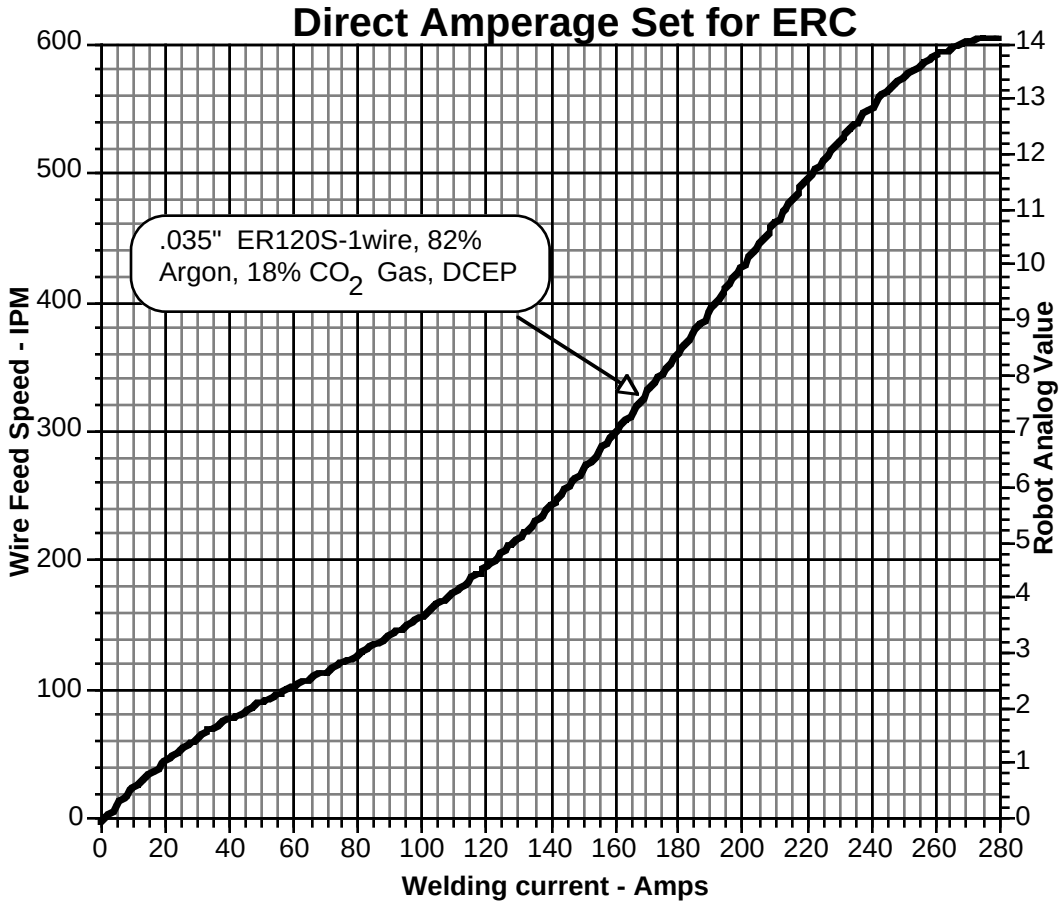

Figure 12-20 Setting Amperage With .035 ER120S-1 With 82% Argon, 18% C02 Gas

WELD CURRENT

NAME: 035" ER120S-1 82% Ar 18%CO2
RANGE: ±

POINT	COMMAND VALUE (V)	MEASURED VALUE (A)
		STORED: NOT YET
1	1.40	36
2	2.70	72 ADJ. -RATIO: 1.00
3	4.20	105
4	5.80	140
5	7.65	180
6	9.60	195
7	11.65	215
8	14.00	280

12.35 SETTING AMPERAGE FOR .035 ER308L WITH 98% ARGON, 2% OXYGEN GAS

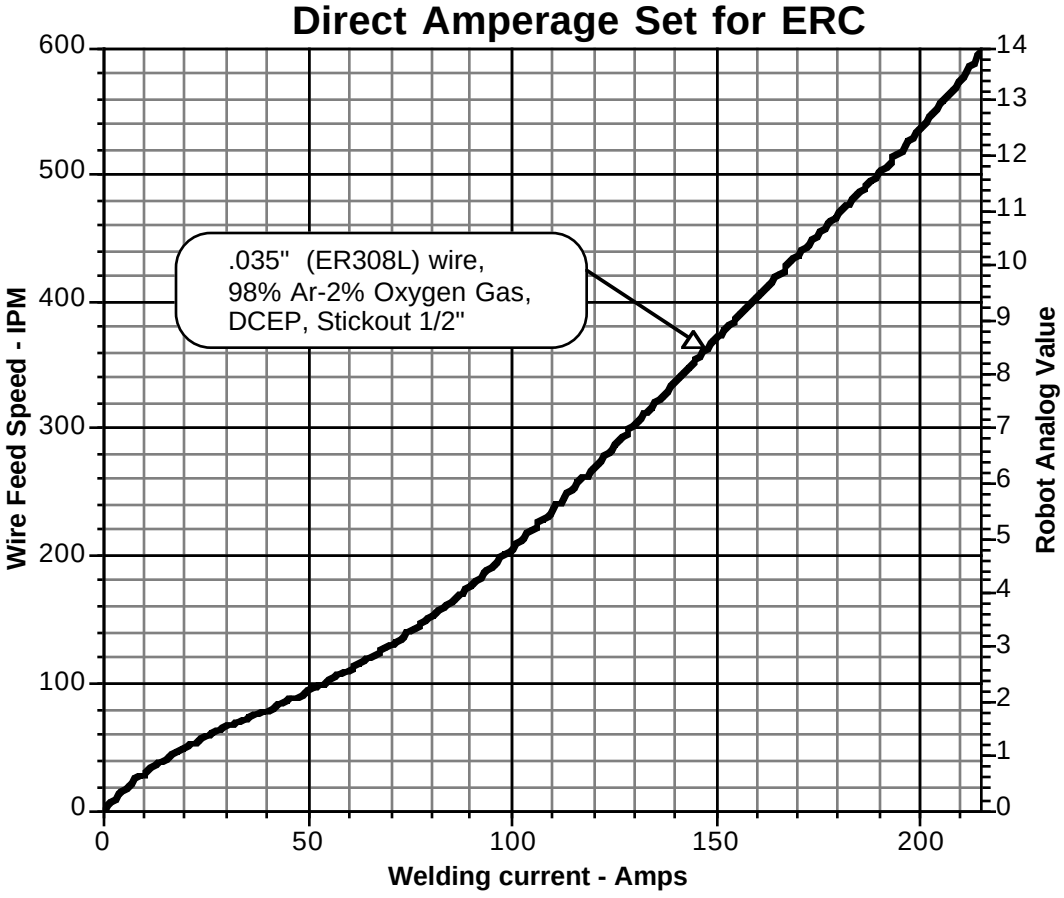

Figure 12-21 Setting Amperage With .035 ER308L With 98% Argon, 2% Oxygen Gas

WELD CURRENT		NAME: 035-308L-98/2 RANGE: ±	
POINT	COMMAND VALUE (V)	MEASURED VALUE (A) STORED: NOT YET	
1	1.40	30	
2	2.80	65	ADJ. -RATIO: 1.00
3	4.70	100	
4	6.60	125	
5	8.50	150	
6	10.80	170	
7	12.60	200	
8	14.00	215	

12.36 SETTING AMPERAGE FOR .045 308L WITH 98% ARGON, 2% OXYGEN GAS

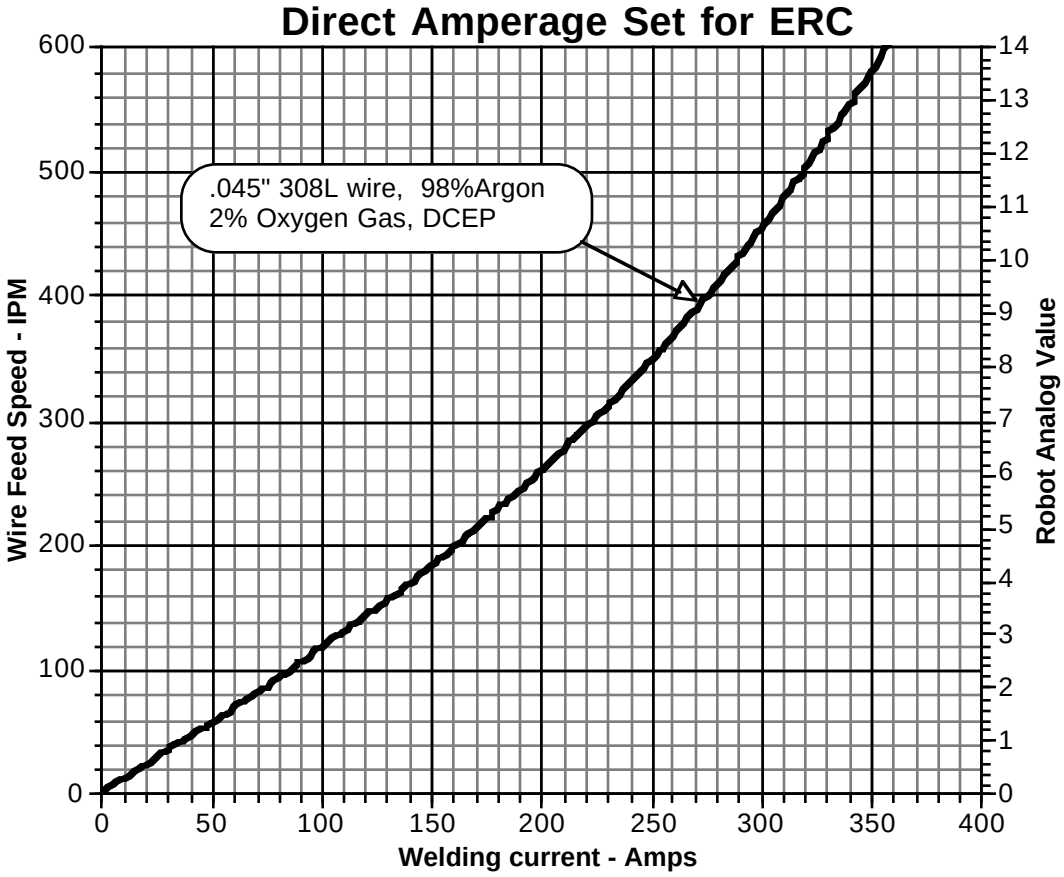

Figure 12-22 Absolute Amperage With .045 308L With 98% Argon, 2% Oxygen Gas

WELD CURRENT		NAME: 035-308L-98/2 RANGE: ±	
POINT	COMMAND VALUE (V)	MEASURED VALUE (A STORED: NOT YET	
1	1.40	50	
2	2.80	100	ADJ. -RATIO: 1.00
4	6.60	210	
5	8.50	260	
6	10.80	305	
7	12.60	330	
8	14.00	355	

12.37 TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE	SOLUTION
Alarm 1530 is displayed indicating "Destroyed Absolute Data."	The data entered into the absolute data table was not stored.	Store the data by pressing **EXIT** (F1) when data entry is complete. If any change is made in the data, it has to be stored again (see page 13 in the Alarm and Error Display section of the TEO-C945-161B Manual).
Part of the direct amperage setting points are correct but there is a major error at the higher currents.	Many welding handbooks contain charts of wire feed speed versus welding amperage. These charts are usually developed from typical data and CO_2 gas and at normal welding speeds. Quite often, the high end scale of the chart is not accurate using Argon-CO2 Gas mixtures. The table is set up for a maximum wire feed speed of 600 IPM at a normal AWELD of 14.00 volts input. If the analog value is not 14.00 volts or feed motor speed calibration is off, there will be an error at the higher amperages.	Follow procedure in Section 12.17 to create data. Calibrate power source and wire feeder.
One data point seems to be off at one point in the table.	Data entered incorrectly in Table.	Check the smoothness of the data points by plotting them on a chart. Plot the arc voltage versus the command signal. It should be linear and all points should fall on a line from "0 to 44" Volts. The amperage should fall on a smooth curve similar to what is shown on these instructions.
There is no output voltage control from the power source.	The range has been set incorrectly with a negative value when it should be positive.	Change polarity. On the Mega-Pulse and FabStar 4030, the RANGE is negative for normal operation.
Error 1090 "Illegal Data in file." is displayed.	When setting the data in the table, multiple measured values were entered. For example, Point 6 is 200 amps and point 7 is 200 amps.	Enter the correct values.
The wire feed runs backwards and there is no arc.	The wire feed RANGE command is set to negative.	Set the range to positive.

13.0 ARC RETRY FUNCTION

The Motoman optional Arc Retry function allows the robot to automatically retry a failed arc start. This function is useful when the weldments are dirty or oxidized. It requires internal changes to the ERC concurrent I/O PLC ladder and the development of special weld jobs.

➪ WARNING!

Improper programming may result in damage to the robot! Check all programs at slow speed.

The arc retry function is programmed using special instructions and job calls from within the user's jobs. Job calls are made to a special ARCON1 job that calls the ARCRETRY job. These programmer lines are included in a job when arc retry is needed.

➪ WARNING!

The following jobs are examples only. Your system may have other features and options requiring program changes. Double check your programs at slow speed.

13.1 THEORY OF OPERATION

A typical arc ignition sequence allows the robot arm to approach the weldment at a slow speed while the wire feeder starts to feed filler wire and the power source is started. If the weld is not stabilized within 1-3 seconds, the system shuts down and generates an alarm (Alarm #2020 - Missing Arc Generation Confirm).

The arc retry function allows the robot to attempt to start the arc several times before generating this alarm. This function is only needed for welds that are difficult to start. The welds that are easy to start can continue to use a standard ARCON job.

Cycle time increases when the arc retry function is used. The reasons for this are:

- The arc retry function replaces the normal ARCON command with a subroutine call to the ARCRETRY job. This job call and the additional program lines take time to process.
- After the first arc retry, each additional arc retry requires extra time for the robot to backup and approach the part again. The programmer can reduce this MOV time by keeping the arc start position and approach point close - typically under one inch.

The arc retry function allows the customer to repeat the arc ignition sequence a preset number of times before generating an alarm. The value of the arc retry count is set at 3 before shipment, but can be changed by the user based upon the number of restarts appropriate for his weldments (typical values are two or three). Welding wire is advanced each time arc retry is attempted; therefore, keep this number small. This number is entered into the Arc Retry Counter (B99) in the ARCRETRY job. (See the Programming Manual for "B" variable explanation.)

Motoman modified the ERC Concurrent I/O PLC ladder to facilitate arc retry. The PLC controls when the Alarm #2020 "Missing Arc Generation Confirm" will be generated. The alarm is temporarily bypassed while the robot tries to start the arc.

13.2 TYPICAL WELD JOB

Shown below is a typical weld job that uses the arc retry function. Any weld job can contain the special ARCON1/ARCRETRY sequence. Some welds may not require the arc retry function and can therefore use the standard ARCON job call.

➪ CAUTION!

Failure to insert Line 3 in each job will result in a robot crash.

Line	Step	Function	Comments
000		NOP	Beginning of job
001	001	MOVJ VJ=50.00	Start position
002	002	MOVJ VJ=50.00	High-speed approach to next weld
003		SET PO58 $PO1	Store this robot position
004	003	MOVJ VJ=12.50	Arc start position
005		CALL JOB: ARCON1	Call special arc retry arc on job
006	004	MOVL V=66	Finish this weld bead
007		CALL JOB:ARCOFF1	Call standard arc off job
008	005	MOVJ VJ=25.00	Slow-speed move away from weld
009	006	MOVJ VJ=50.00	High-speed move to next weld

(Lines 2 through 4 must be repeated for each arc retry.)

13.3 SPECIAL ARCON1 JOB

Shown below is a typical ARCON1 job for the arc retry function. Several ARCON jobs may be required for different welding voltages and wire feed speeds. The AWELD and VWELD values shown may differ for your welding application.

Line	Step	Function	Comments
000	000	NOP	
001		VWELD 6.0	Customer-supplied value (voltage)*
002		AWELD 6.0	Customer-supplied value (wire speed)*
003		CALL JOB:ARCRETRY	Call special arc retry job
004		TIMER T=0.2 SEC	Wait for arc to stabilize (typical)
005		VWELD 7.0	Customer-supplied value (voltage)**
006		AWELD 8.0	Customer-supplied value (wire speed)**
007		RET	
008		END	

** Starting voltage and current*
*** Welding voltage and current*

13.4 SPECIAL ARC RETRY JOB

Shown below is a line-by-line explanation of the ARCRETRY job. The B99 arc retry counter on Line #2 and the timer on Line #8 can be adjusted by the programmer to give the optimum weld performance.

➪ WARNING!

Failure to have Line 2 in the job will cause the robot to crash.

➪ CAUTION!

Welding wire is fed for each arc retry! Successive arc retries may cause excessive stickout. Keep the number of retries to a minimum.

Line	*Step*	*Function*	*Comments*
000		NOP	
001		SET P059 $P01	Save the current arc start robot position
002		SET B99 3	Number of retries (three preferred) arc retry counter
003		* RETRY	Label
004		JUMP *LASTRY IF B99<1	Have all attempts failed?
005		DEC B99	One try is in process - subtract one from the arc retry counter
006		PULSE OT#59=1 T=0.10	Start the automatic timer
007		ARCON	Standard arc on command - initiate the arc
008		WAIT IN#96=1 T=1.00	Wait one second for arc to establish
009		JUMP *OK IF IN#96=1	OK if arc is established
010		ARCOFF	Standard arc off command
011	001	MOVJ P058 VJ=12.50	Back up to approach position
012	002	MOVJ P059 VJ=12.50	Move to arc start position - try again
013		JUMP *RETRY	Loop
014		* LASTRY	Label
015		ARCON	Initiate the arc one last time
016		* OK	Label
017		RET	
018		END	

14.0 WELDING TROUBLESHOOTING

This section lists commonly encountered welding problems, probable causes, and suggested solutions. Be aware that sometimes more than one problem can occur at the same time. After a problem has been identified and resolved, the system should be thoroughly tested to ensure that no other problems exist.

PROBLEM	PROBABLE CAUSE	SOLUTION
Porosity (gas pockets in the weld metal that may be scattered in small clusters or along the entire length of the weld). These voids left in the weld cause the weld to be weakened. Porosity may be either internal or on the surface of the welding bead, or both.	Inadequate shielding gas flow rate.	Increase shielding gas flow rate.
	Wind drafts that deflect the shielding gas coverage	Set up wind shields.
	Shielding gas flow is blocked when spatter builds up on nozzle.	Clean the nozzle of the welding gun.
	Shielding gas is wet or contaminated.	Replace the cylinder of shielding gas.
	Excessive welding current.	Lower the welding current (reduce the wire feed speed).
	Excessive welding voltage.	Decrease welding voltage.
	Excessive electrode extension.	Decrease electrode extension
	Excessive travel speed.	Reduce travel speed.
	Moisture or dirt on surface of base metal or filler wire.	Clean surface of base metal or filler wire.
	Impurities in the base metal.	Use a different base metal (with a different composition).
Wormhole porosity (elongated gas pockets)	Sulfur in the steel.	Use a more weldable grade of steel.
	Moisture on the surface of the base metal, which becomes trapped in the weld joint.	Clean the surface of the joint and preheat to remove moisture.

PROBLEM	PROBABLE CAUSE	SOLUTION
Undercutting (a groove melted in the base metal next to the toe or root of a weld that is not filled by the weld metal)	Excessive welding current.	Reduce welding current.
	Arc voltage too high.	Reduce arc voltage.
	Excessive travel speed.	Use a travel speed slow enough that the weld metal can completely fill all of the melted-out areas of the base metal.
	Erratic feeding of electrode wire.	Clean the nozzle inside of the contact tube, or remove the jammed electrode wire.
	Excessive weaving speed.	Pause at each side of the weld bead when a weaving technique is used.
	Incorrect electrode angles, especially on vertical and horizontal welds.	Correct the electrode angle being used.
Incomplete fusion. This occurs when the weld metal is not completely fused to the base metal	Excessive travel speed (causes an excessive convex weld bead or does not allow adequate penetration.	Reduce travel speed.
	Welding current too low.	Increase welding current.
	Poor joint preparation.	Better joint preparation.
	Letting weld metal get ahead of the arc, or letting the weld layer get too thick, which keeps the arc away from the base metal.	Use proper electrode angles or increase the travel speed.
Slag inclusions (small glassy slag segments on surface of weld)	Welding over the slag segments in multiple pass welds.	Clean the surface of the weld bead, especially the toes of the weld where any slag can be easily trapped.
Oxide inclusions (when oxide coatings on certain metals become mixed in the weld puddle)	Excessively high travel speeds when welding metals such as aluminum, magnesium, or stainless steel.	Reduce travel speed, increase the welding voltage, and use a more highly deoxidizes type of electrode.

PROBLEM	PROBABLE CAUSE	SOLUTION
Overlapping (protrusion of the weld metal over the edge or toe of the weld bead)	Travel speed too slow. This allows the weld puddle to get ahead of the electrode. Arc welding current is too low Incorrect electrode angle. This allows the force of the arc to push the molten weld metal over unused sections of the base metal.	Increase travel speed. Use a higher welding current. Use the correct electrode angle.
Melt-through (when arc melts through the bottom of the weld and creates holes)	Excessive welding current. Travel speed too slow. A root opening that is too wide or a root face that is too small.	Reduce the welding current. Increase travel speed. Reduce the width of the root opening by using a slight weaving motion or by increasing the electrode extension.
Excessive welding spatter	Excessive welding current, arc voltage, or electrode extension. Arc voltage too low.	Reduce welding current, arc voltage, or amount of stickout. Increase arc voltage.
Centerline cracks	Weld bead is too small for the thickness of the base metal. Poor fit-up. High joint restraint. Extension of a crater crack.	Increase bead size. Decrease gap width. Preheat part to be welded. Prevent weld craters by using crater fill program.

PROBLEM	PROBABLE CAUSE	SOLUTION
Wire feed stoppages	There is a clogged contact tube.	Clean the contact tube.
	There is a clogged conduit in the welding torch assembly.	Use compressed air to clean the conduit.
	Sharp bends or kinks in wire feed or torch conduit.	Straighten or replace wire feed or torch conduit.
	Excessive pressure on wire feed rolls, which can cause wire breakage.	Reduce pressure on the wire feed rolls.
	Inadequate pressure on wire feed rolls.	Increase pressure on the wire feed rolls.
	Operator is attempting to feed the wire over excessively long distances.	Use a shorter distance from the wire package to the wire feeder.
	Wire spool is clamped too tightly to the wire reel support.	Reduce clamping pressure on the spool of wire.
The wire feeder rolls turn but there is no arc.	Power source overload tripped.	Reset power source.
There is no wire feed and no arc, and the robot displays the "Failure to generate arc" message.	Power source is turned off.	Turn power source on.
There is no wire feed speed and no voltage.	Blown fuse on UWI.	Replace fuse on UWI.