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Printed in the United States of America

### Revision Record

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FOREWORD

Thank you for purchasing a Miyachi Unitek Series 300 Fast Response Weld Head System.

Upon receipt of your equipment, please thoroughly inspect it for shipping damage prior to its installation. Should there be any damage, please immediately contact the shipping company to file a claim, and notify us at:

Amada Miyachi America  
1820 South Myrtle Avenue  
Monrovia, California  91016  
Phone:   (626) 303-5676  
FAX:      (626) 358-8048  
E-mail:   info@amadamiyachi.com

The purpose of this manual is to supply operating and maintenance personnel with the information needed to properly and safely operate and maintain the Series 300 Fast Response Weld Head System.

We have made every effort to ensure that the information in this manual is accurate and adequate.

Should questions arise, or if you have suggestions for improvement of this manual, please contact us at the above location/numbers.

Amada Miyachi America is not responsible for any loss due to improper use of this product.
SAFETY NOTES

This instruction manual describes how to operate, maintain and service the Series 300 Fast Response Weld Head System, and provides instructions relating to its SAFE use. Procedures described in this manual MUST be performed, as detailed, by QUALIFIED and TRAINED personnel.

For SAFETY, and to effectively take advantage of the full capabilities of the tester, please read these instruction manuals before attempting to use the workstation.

Procedures other than those described in this manual or not performed as prescribed in it, may expose personnel to electrical hazards.

After reading this manual, retain it for future reference when any questions arise regarding the proper and SAFE operation of the tester.

Please note the following conventions used in this manual:

**WARNING:** Comments marked this way warn the reader of actions which, if not followed, might result in immediate death or serious injury.

**CAUTION:** Comments marked this way warn the reader of actions which, if not followed, might result in either damage to the equipment, or injury to the individual if subject to long-term exposure to the indicated hazard.
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UNITEK MIYACHI CORPORATION

Declaration of Conformity


Type of Equipment: Resistance Welding Machine for Small Parts Welding

Applied Standards: EN50081-2, EN50082-1, EN55011, IEC 801-2, IEC 801-3, IEC 801-4

Model Nos: 301H, 350C/100, 350C/115, 350C/208, 350C/230

Authorized Representative: Weld Equip Sales BV
Within European Community: Engelseweg 217
Postbus 164
5700 AD Helmond HOLLAND

Manufacturer’s Name and Address: UNITEK MIYACHI CORPORATION
1820 South Myrtle Avenue
Monrovia, CA 91017 U.S.A.

Based on the Declaration of Conformity Certificates issued by the test laboratories, I declare that the equipment specified above conforms to the listed directive and standards.

Place: Monrovia, CA
Date: December 30, 1996

Signature

Richard Trujillo
Full Name

Manager of Quality Assurance
Title

Mark G. Rodighiero
Full Name

Vice President, Research and Development
Title
LIMITED WARRANTY

1. (a) Subject to the exceptions and upon the conditions set forth herein, Seller warrants to Buyer that for a period of one (1) year from the date of shipment ("Warranty Period"), that such Goods will be free from material defects in material and workmanship.

(b) Notwithstanding the foregoing and anything herein to the contrary, the warranty set forth in this Section 1 shall be superseded and replaced in its entirety with the warranty set forth on Exhibit A hereto if the Goods being purchased are specialty products, which include, without limitation, laser products, fiber markers, custom systems, workstations, Seller-installed products, non-catalogue products and other custom-made items (each a “Specialty Products.”)

(c) EXCEPT FOR THE WARRANTY SET FORTH IN SECTION 1(A), SELLER MAKES NO WARRANTY WHATSOEVER WITH RESPECT TO THE GOODS (INCLUDING ANY SOFTWARE) OR SERVICES, INCLUDING ANY (a) WARRANTY OF MERCHANTABILITY; (b) WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE; (c) WARRANTY OF TITLE; OR (d) WARRANTY AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY; WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE.

(d) Products manufactured by a third party and third party software ("Third Party Product") may constitute, contain, be contained in, incorporated into, attached to or packaged together with, the Goods. Third Party Products are not covered by the warranty in Section 1(a). For the avoidance of doubt, SELLER MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO ANY THIRD PARTY PRODUCT, INCLUDING ANY (a) WARRANTY OF MERCHANTABILITY; (b) WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE; (c) WARRANTY OF TITLE; OR (d) WARRANTY AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY; WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE. Notwithstanding the foregoing, in the event of the failure of any Third Party Product, Seller will assist (within reason) Buyer (at Buyer’s sole expense) in obtaining, from the respective third party, any (if any) adjustment that is available under such third party’s warranty.

(e) Seller shall not be liable for a breach of the warranty set forth in Section 1(a) unless: (i) Buyer gives written notice of the defect, reasonably described, to Seller within five (5) days of the time when Buyer discovers or ought to have discovered the defect and such notice is received by Seller during the Warranty Period; (ii) Seller is given a reasonable opportunity after receiving the notice to examine such Goods; (iii) Buyer (if requested to do so by Seller) returns such Goods (prepaid and insured to Seller at 1820 South Myrtle Avenue, Monrovia, CA 91016 or to such other location as designated in writing by Seller) to Seller pursuant to Seller’s RMA procedures and Buyer obtains a RMA number from Seller prior to returning such Goods for the examination to take place; and (iii) Seller reasonably verifies Buyer’s claim that the Goods are defective and that the defect developed under normal and proper use.

(f) Seller shall not be liable for a breach of the warranty set forth in Section 1(a) if: (i) Buyer makes any further use of such Goods after giving such notice; (ii) the defect arises because Buyer failed to follow Seller’s oral or written instructions as to the storage, installation, commissioning, use or maintenance of the Goods; (iii) Buyer alters or repairs such Goods without the prior written consent of Seller; or (iv) repairs or modifications are made by persons other than Seller’s own service personnel, or an authorized representative’s personnel, unless such repairs are made with the written consent of Seller in accordance with procedures outlined by Seller.
(g) All expendables such as electrodes are warranted only for defect in material and workmanship which are apparent upon receipt by Buyer. The foregoing warranty is negated after the initial use.

(h) Subject to Section 1(e) and Section 1(f) above, with respect to any such Goods during the Warranty Period, Seller shall, in its sole discretion, either: (i) repair or replace such Goods (or the defective part) or (ii) credit or refund the price of such Goods at the pro rata contract rate, provided that, if Seller so requests, Buyer shall, at Buyer’s expense, return such Goods to Seller.

(i) THE REMEDIES SET FORTH IN SECTION 1(H) SHALL BE BUYER’S SOLE AND EXCLUSIVE REMEDY AND SELLER’S ENTIRE LIABILITY FOR ANY BREACH OF THE LIMITED WARRANTY SET FORTH IN SECTION 1(A). Representations and warranties made by any person, including representatives of Seller, which are inconsistent or in conflict with the terms of this warranty, as set forth above, shall not be binding upon Seller.
Limited Warranty

EXCEPT FOR THE WARRANTY SET FORTH BELOW IN THIS EXHIBIT A, SELLER MAKES NO WARRANTY WHATSOEVER WITH RESPECT TO THE GOODS (INCLUDING ANY SOFTWARE) OR SERVICES, INCLUDING ANY (a) WARRANTY OF MERCHANTABILITY; (b) WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE; (c) WARRANTY OF TITLE; OR (d) WARRANTY AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY; WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE.

Warranty Period: The Warranty Period for Specialty Products is for one (1) year, and the Warranty Period for laser welders and laser markers is two (2) years (unlimited hours), and the Warranty Period for the laser pump diodes or modules is two (2) years or 10,000 clock hours, whichever occurs first (as applicable, the “Warranty Period”). The Warranty Period begins as follows: (i) on orders for Goods purchased directly by Buyer, upon installation at Buyer’s site or thirty (30) days after the date of shipment, whichever occurs first; or (ii) on equipment purchased by a Buyer that is an OEM or systems integrators, upon installation at the end user’s site or six (6) months after the date of shipment, whichever occurs first.

Acceptance Tests: Acceptance Tests (when required) shall be conducted at Amada Miyachi America, Inc., Monrovia, CA, USA (the “Testing Site”) unless otherwise mutually agreed in writing prior to issuance or acceptance of the Acknowledgement. Acceptance Tests shall consist of a final visual inspection and a functional test of all laser, workstation, enclosure, motion and accessory hardware. Acceptance Tests shall include electrical, mechanical, optical, beam delivery, and software items deliverable under the terms of the Acknowledgement. Terms and conditions for Additional Acceptance Tests either at Seller’s or Buyer’s facility shall be mutually agreed in writing prior to issuance or acceptance of the Acknowledgement.

Performance Warranty: The system is warranted to pass the identical performance criteria at Buyer’s site as demonstrated during final Acceptance Testing at the Testing Site during the Warranty Period, as provided in the Acknowledgement. Seller explicitly disclaims any responsibility for the process results of the laser processing (welding, marking, drilling, cutting, etc.) operations.

Exclusions: Seller makes no warranty, express or implied, with respect to the design or operation of any system in which any Seller’s product sold hereunder is a component.

Limitations: The limited warranty set forth on this Exhibit A does not cover loss, damage, or defects resulting from transportation to Buyer’s facility, improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the equipment, or improper site preparation and maintenance. This warranty also does not cover damage from misuse, accident, fire or other casualties of failures caused by modifications to any part of the equipment or unauthorized entry to those portions of the laser which are stated. Furthermore, Seller shall not be liable for a breach of the warranty set forth in this Exhibit A if: (i) Buyer makes any further use of such Goods after giving such notice; (ii) the defect arises because Buyer failed to follow Seller’s oral or written instructions as to the storage, installation, commissioning, use or maintenance of the Goods; (iii) Buyer alters or repairs such Goods without the prior written consent of Seller; or (iv) repairs or modifications are made by persons other than Seller’s own service personnel, or an authorized representative’s personnel, unless such repairs are made with the written consent of Seller in accordance with procedures outlined by Seller.
Seller further warrants that all Services performed by Seller’s employees will be performed in a good and workmanlike manner. Seller’s sole liability under the foregoing warranty is limited to the obligation to re-perform, at Seller’s cost, any such Services not so performed, within a reasonable amount of time following receipt of written notice from Buyer of such breach, provided that Buyer must inform Seller of any such breach within ten (10) days of the date of performance of such Services.

Seller shall not be liable for a breach of the warranty set forth in this Exhibit A unless: (i) Buyer gives written notice of the defect or non-compliance covered by the warranty, reasonably described, to Seller within five (5) days of the time when Buyer discovers or ought to have discovered the defect or non-compliance and such notice is received by Seller during the Warranty Period; (ii) Seller is given a reasonable opportunity after receiving the notice to examine such Goods and (a) Buyer returns such Goods to Seller’s place of business at Buyer’s cost (prepaid and insured); or (b) in the case of custom systems, Seller dispatches a field service provider to Buyer’s location at Buyer’s expense, for the examination to take place there; and (iii) Seller reasonably verifies Buyer’s claim that the Goods are defective or non-compliant and the defect or non-compliance developed under normal and proper use.

All consumable, optical fibers, and expendables such as electrodes are warranted only for defect in material and workmanship which are apparent upon receipt by Buyer. The foregoing warranty is negated after the initial use.

No warranty made hereunder shall extend to any product whose serial number is altered, defaced, or removed.

**Remedies:** With respect to any such Goods during the Warranty Period, Seller shall, in its sole discretion, either: repair such Goods (or the defective part). **THE REMEDIES SET FORTH IN THE FOREGOING SENTENCE SHALL BE BUYER’S SOLE AND EXCLUSIVE REMEDY AND SELLER’S ENTIRE LIABILITY FOR ANY BREACH OF THE LIMITED WARRANTY SET FORTH IN THIS EXHIBIT A.** Representations and warranties made by any person, including representatives of Seller, which are inconsistent or in conflict with the terms of this warranty, as set forth above, shall not be binding upon Seller.

Products manufactured by a third party and third party software (“Third Party Product”) may constitute, contain, be contained in, incorporated into, attached to or packaged together with, the Goods. Third Party Products are not covered by the warranty in this Exhibit A. For the avoidance of doubt, **SELLER MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO ANY THIRD PARTY PRODUCT, INCLUDING ANY (a) WARRANTY OF MERCHANTABILITY; (b) WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE; (c) WARRANTY OF TITLE; OR (d) WARRANTY AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY; WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE.** Notwithstanding the foregoing, in the event of the failure of any Third Party Product, Seller will assist (within reason) Buyer (at Buyer’s sole expense) in obtaining, from the respective third party, any (if any) adjustment that is available under such third party’s warranty.
CHAPTER 1
DESCRIPTION

Section I: Features

Overview

The Series 300 Fast Response Weld Head System is designed for any bench-top, semi or fully automated resistance welding applications. It provides programmable, highly-controlled weld force and extremely fast follow-up response required by precision resistance welding applications. The system consists of either an on-line or offset weld head, called the Actuator, and a control. An optional stand assembly is also available. This manual covers the following models:

<table>
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<tr>
<td>301H/100V</td>
<td>2-301-XX-01</td>
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<tr>
<td>301H/230V</td>
<td>2-301-XX-02</td>
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</tr>
<tr>
<td>302H/208V</td>
<td>2-302-XX-03</td>
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</tbody>
</table>

For the rest of this manual any of the Linear Actuator Modules will simply be referred to as the Actuator, and any model Electronic Weld Head Control will simply be referred to as the Control, unless unique descriptions for specific models are required.

Performance Features

Through two unique features – programmable follow-up force and weld-to-displacement – the Weld Head System solves critical problems in conventional pneumatic or cam-driven welding systems.

Programmable Follow-Up Force

Through programmable follow-up force, the Weld Head System is able to quickly and repeatedly position the electrode during the molten or plastic phase of the welding process. This unique feature prevents workpiece expulsion during the welding operation. Maximum strength welds result, and previously difficult-to-weld material combinations, such as tungsten wire to tungsten wire and tungsten wire to molybdenum foil, are easily made. Furthermore, due to the absence of sparking, electrode life is dramatically increased.
CHAPTER 1: DESCRIPTION

Weld-to-Displacement

This feature ensures consistent nugget size by regulating the energy cutoff point of the power supply, thus controlling the amount of material collapse or set-down.

Weld Head Dynamics

The dynamics of the Actuator during the weld operation are detailed in Appendix C. The information will be useful in installing, setting up and operating the Weld Head System.

Other Important Features

Other important performance features of the Weld Head System are:

- Precise measurement of setdown displacement for each weld provides an indication of weld quality.
- Weld-to-displacement feature shuts off the power supply when a programmed setdown displacement is reached.
- Over force and “hammering” are eliminated, even at high weld repetition rates.
- Real time graphical display of programmed and actual weld force and setdown displacement for each weld.
- Storage of up to 128 welding schedules allows rapid setups for applications that require different force and setdown control.
- Unique electrode dress mode that minimizes electrode maintenance down time.
Equipment Description

The Series 300 Fast Response Weld Head System consists of either the Model 301H or 302H Linear Actuator Module (figure 1-1) and the Model 350C Electronic Weld Head Control (figure 1-2). The Model 301H Actuator (shown) has an in-line electrode. The Model 302H Actuator has an offset electrode. Additional equipment required but not supplied includes the appropriate welding transformer model, high-frequency resistance welding power supply, and a two-level foot switch. The system equipment is listed in table 1-1. In addition, an MK301 (in-line) or MK302 (off set) stand is available for mounting the Actuator.

NOTE: For clarity of communication throughout this manual, it is assumed you are using the HF2 Welding Transformer, HF2 Power Supply (with appropriate transformer), HF25 Power Supply, or UB25 Power Supply, and the FS2L Foot Switch with your Weld Head System. If you are using equivalent equipment, please refer to the manufacturer’s manuals for information about that equipment.
### Table 1-1. Series 300 System Equipment List

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<th>Notes</th>
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<td>Model 301H Linear Actuator</td>
<td>4-34858-01</td>
<td>In-line welding</td>
<td>Only one weld head provided with system, depending on which is ordered.</td>
</tr>
<tr>
<td>Model 302H Linear Actuator</td>
<td>4-34857-01</td>
<td>Offset welding</td>
<td></td>
</tr>
<tr>
<td>Model 350C Electronic Weld Head Control</td>
<td>4-34831-01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Other Required Items (Not Supplied)**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding Power Supply</td>
<td>Model HF2 (with transformer), HF25, UB25, or equivalent.</td>
</tr>
<tr>
<td>Two-level Foot Switch</td>
<td>Equivalent to Miyachi Unitek Model 4-28945-01</td>
</tr>
<tr>
<td></td>
<td>Equivalent to Miyachi Unitek Model FS2L</td>
</tr>
</tbody>
</table>

**Optional Items**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weld Head Stand</td>
<td>In-line weld head (Model 301H)</td>
</tr>
<tr>
<td>Weld Head Stand</td>
<td>Offset weld head (Model 302H)</td>
</tr>
</tbody>
</table>

The Linear Actuator Module (Weld Head) is electro-magnetically controlled by the Weld Head Control according to the travel and force profile program that you select. Through the program, electrode position can be controlled to within 0.001 in. (25μm) but measured to within 0.0001 in (2.5μm). The weld force and duration can be set to between 1 lb (0.45 kg) and 20 lbs (9 kg) at a 15% duty cycle.

Depending on the travel and force profile that you select, weld rate can be as high as four per second with no impact force on the weld parts.

The Weld Head Control will interface with any programmable power supply that will initiate weld energy through a dry-contact closure. However, the Weld Head Control is particularly effective when used with a power supply that can be programmed to turn on weld energy in 1 millisecond increments.

Communication with external, user-supplied equipment is handled by the Weld Head Control through a control signal input port, control signal output port, and a serial port for RS-485 data communications. The addressable RS-485 serial port permits on-line logging of weld dynamics data and alarm conditions on your data logger or PC. An accessories port is present for future communications needs.
System Controls

The front control panel of the 350C Weld Head Control is illustrated in figure 1-3. The only other system controls are the POWER switch on the rear panel of the Weld Head Control, and the power circuit breaker on the power supply.

![Weld Head Control Front Panel Controls](image)

Figure 1-3. Weld Head Control Front Panel Controls

The eight-line liquid crystal displays provide essentially the same functions on the Weld Head Control and the Power Supply. Alphanumeric screens allow you to program up to 128 different weld force profiles and monitor alarm conditions. Graphic screens allow you to fine-tune the time, follow-up force and weld energy relationships. Additionally, on-line help screens allow you to interrogate the system for quick look-up information about installation and operation issues.

**NOTE:** The functions of the key clusters on the HF2 Power Supply and the Weld Head Control are identical. So, the following descriptions of the key clusters apply to them both. The HF25 and UB25 Power Supplies are slightly different; you should refer to the user manual for your power supply.

**Data Keypad**

This cluster of twelve numerical keys enters numerical information. Use the keys to enter values directly to the screens instead of incrementally with the ▲▼ keys. Use [.] to key in decimal values. Press [ENTER] after keying in data to complete the entry.
CHAPTER 1: DESCRIPTION

Control Keypad

This cluster of six keys allows you to access the various control screens on the display and control the editing (changing) of data on the screens.

[MENU] Provides a screen (display) menu listing of user options that are common to all weld schedules.

[PROG] Each time you press [PROG], it accesses the next programming screen in a sequence of programming screens. It also disables the RUN state.

[RUN] Pressing [RUN] exits the PROGRAM state (the state in which the Weld Head Control is to be programmed) or the MENU (user options) state, and enters the RUN state. In the RUN state, you can view the screens while you make a weld and analyze weld force, weld current, and electrode position (follow-up) relationships dynamically.

[CHNG] Pressing [CHNG] allows you to either:
- Select different screen menu options, or
- Restore the previous contents of a screen programmable field, or
- Toggle through the series of screen of the RUN state.

[HELP] Accesses detailed on-line help screens for any program variables or alarm messages. The screens provide helpful information about any menu option or flashing programmable field. Pressing [HELP] a second time returns you to the original screen state.

[SAVE] This key is active only in the PROGRAM state. Pressing [SAVE] saves the changes to the weld schedule that you just entered to the program screen, then automatically selects the RUN state.

Select Keypad

This is a cluster of four arrow keys. In the RUN state, you actuate them to increment or decrement weld schedules. In the alphanumeric PROGRAM or MENU states, you actuate them to move the cursor up, down and sideways on the screens to select value field for editing. In the graphical PROGRAM state, you can increment or decrement programmed values.

WELD/NO WELD Switch (Power Supply). Placing this switch in the NO WELD position cuts off weld current. It is the position that is required to adjust the weld head. Note that a complete electrode positioning sequence can be executed without weld current flowing. You must place the switch in the WELD position to make a weld.

RUN/DRESS Switch (Weld Head Control). Placing this switch in the RUN position allows normal execution of the weld cycle. In the DRESS position, it allows you to dress (clean) the electrodes by executing a setdown on cleaning material that you insert between the electrodes. Setdown force for dressing is programmable.
CHAPTER 2
GETTING STARTED

Section I: Planning for Installation

Space Requirements

We recommend that you install the Series 300 Fast Response Weld Head System in a well-ventilated area that is free from excessive dirt and moisture. Allow sufficient clearance around both sides and back of the 350C Electronics Weld Head Control, the welding power supply, and the welding transformer so that cooling air can flow properly.

Series 300 Installation Dimensions

The dimensions and weight for a complete welding system are listed in table 2-1.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Width (in/cm)</th>
<th>Height (in/cm)</th>
<th>Depth (in/cm)</th>
<th>Weight (lbs/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>350C Weld Head Control</td>
<td>10.5/26.7</td>
<td>8.5/21.6</td>
<td>15.1/38.4</td>
<td>68.0/30.8</td>
</tr>
<tr>
<td>301H/302H Linear Actuator Module</td>
<td>2.0/5.1</td>
<td>10.4/26.4</td>
<td>4.0/10.2</td>
<td>13.0/5.9</td>
</tr>
<tr>
<td>(Weld Head)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weld Head Stand (optional)</td>
<td>2.4/6.0</td>
<td>20.5/52.0</td>
<td>10.2/26.0</td>
<td>8.2/3.7</td>
</tr>
</tbody>
</table>
Linear Actuator Installation

All units of the Series 300 System are stand-alone except the Linear Actuator (weld head), which must be mounted on a stable, vibration-proof work surface. If you purchase the optional L-Stand Assembly, which provides a flexible method of installing the actuator for non-automated applications, refer to that specific paragraph, below.

Basic Installation

NOTE: The Linear Actuator has three sets of mounting holes, with identical hole patterns, so the unit can be mounted on its back or either side. An optional adapter plate (P/N 4-33273-01) is available from Amada Miyachi America and is already included in the optional L-Stand Assembly.

Referring to figure 2-1 and the Installation Drawing (included in the Ship Kit), perform the following steps.

1. Secure the actuator to an adapter plate with four 1/4-20 screws. If you are using the above-mentioned adapter plate, these should be 1/4-20 x 3/4" flat head Phillips screws (P/N 625-595).

2. Secure the adapter plate to a vertical mounting surface using two machine bolts and flat washers. The height of the upper electrode holder above the lower electrode holder (to be installed in step 3) should allow for no more than 1.06 in. (27mm) of upper electrode travel.

3. Secure the lower electrode holder (user furnished, but included in the optional L-Stand Assembly) to the horizontal work surface, in alignment with the upper electrode holder. The misalignment between the upper and lower electrode center lines should be less than 10% of the smallest electrode diameter or width dimensions.
Optional L-Stand Installation

**NOTE:** The L-Stand Adapter contains a completely-assembled L-stand, adapter plate (P/N 4-33273-01), and lower electrode holder. The Ship Kit contains the necessary mounting hardware.

Referring to figure 2-2, perform the following steps.

1. Lay the L-stand on its back. This will prevent the T-nuts (P/N 465-208) from moving during the next few steps.

2. Remove the two M8-1.25 x 25mm bolts (P/N 160-047) and 5/16 flat washers (P/N 755-044) securing the adapter plate to the L-stand.

3. Secure the actuator to the adapter plate with four ¼-20 x ¾ flat head Phillips screws (P/N 625-595).

4. Re-install the adapter plate to the T-slot nuts in the L-stand with the bolts and washers removed in step 2.

5. Install the assembly to a horizontal work surface that provides firm (non-deflectional) support using two T-slot nuts (P/N 465-208), M8-1.25 x 50mm studs (P/N 625-578), 5/16 flat washers (P/N 755-044), and M8 nuts (P/N 465-208), contained in the Ship Kit.

6. Adjust the height of the upper electrode holder above the lower electrode holder to allow for no more than 1.06 in. (27mm) of upper electrode travel.

7. Adjust the lower electrode holder so that any misalignment between the upper and lower electrodes is less than 10% of the smallest electrode diameter or width dimensions.
Section II: Power Supply Connections

Power Line Voltage, Current, and Wire Size Requirements

Use the values listed in table 2-2 to select the correct power line circuit breaker and wire gauge sizes for installing the 350C Weld Head Control.

**CAUTION:** The 350C Weld Head Control is assembled at the factory for operation at a specific input power line voltage. *Serious damage can result if an input voltage is used other than the voltage for which the Weld Head Control is wired.*

Table 2-2. Input Power Circuit Breaker and Wire Size Recommendations

<table>
<thead>
<tr>
<th>Service Voltage (RMS)</th>
<th>Circuit Breaker Current (RMS)</th>
<th>Copper AWG Wire Gauge</th>
<th>Outside Wire Dia.(in./mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>115</td>
<td>15 Amps</td>
<td>12</td>
<td>0.083/2</td>
</tr>
<tr>
<td>208 to 230</td>
<td>6 Amps</td>
<td>12</td>
<td>0.083/2</td>
</tr>
</tbody>
</table>

Connector Functions

The functions and pin assignments of the connector on the rear panel of the 350C Weld Head Control are described in Appendix B.

Welding Transformer to Weld Head Connections

Refer to figure 2-3.

1. Connect the upper weld cable to the negative (-) terminal on the power supply or transformer.
2. Connect the lower weld cable to the positive (+) terminal on the power supply or transformer.

![Figure 2-3. Weld Head Connections to Power Supply or Transformer](image-url)
**Power Supply and Foot Switch to Weld Head Control Connections**

Refer to figure 2-4.

1. Connect the MECHANICAL FIRING SWITCH cable from the power supply to the 350C Weld Head Control WELD FIRE SWITCH cable.
2. Connect the power supply CONTROL SIGNALS cable to the 350C Weld head Control CONTROL SIGNAL OUTPUT connector.
3. Connect the Foot Switch cable to the 350C Weld Head Control FOOT SWITCH connector.

**Figure 2-4. Power Supply Connections**
NOTE: The information in this section gives you a ‘quick start’ method for starting to weld with minimal programming. For more detailed information regarding the screens and their functions see Chapter 3, Operating Instructions.

Nomenclature and Symbols

The following nomenclature, symbols, and conventions are used in this manual for expressing control and key actuations, and display readings, on the Weld Head System (both the 350C Weld Head Control and the HF2 Power Supply). If you are not using an HF2 Power Supply, refer to your user's manual for appropriate nomenclature:

- Press and release front panel keys that are enclosed by [ ] symbols.
- To select (highlight) a requested menu option, press the vertical cursor keys [▲▼] in conjunction with the horizontal cursor keys [◄►]. Then press the [ENTER] key.
- The words shown in UPPER CASE ITALIC letters or overlaid with shading indicate flashing menu options on the display (screens).

Electrode Installation

Install the appropriate electrodes in the Weld Head electrode holders. Your choice of electrodes depends on your specific welding applications, but keep in mind the following considerations:

- Use a flat electrode face for most applications.
- Use a ‘domed’ face if surface oxides are a problem.
- If either of the parts is a wire, the diameter of the electrode face should be equal to or greater than the diameter of the wire.
- Pencil point electrodes cause severe electrode sticking to the parts and unexplained explosions. They also increase the required weld heat substantially because of the reduced electrode-to-part contact area.

Weld Head Control Power Up and Initialization

To turn on 350C Weld Head Control power and set initial conditions, proceed as follows:

1. Set the RUN/DRESS switch on the Weld Head Control front panel to the RUN position. (The screen will prompt you to do so if the switch is in the DRESS position).
2 Set the POWER switch on the Weld Head Control rear panel to the ON (up) position. The Weld Head Control will automatically run a self-test cycle, during which it:

- Determines the downstop position (DNST) of the opposing electrode. It then resets the DNST so that it is calibrated as 0.000. The upstop (UPST) and search (SRCH) positions are then referenced to DNST.

- Verifies the calibration of the position and force control systems.

- Determines the location of the inward-most position of the Linear Actuator output shaft relative to DNST. The location is the maximum UPST to which the Weld Head System can be programmed for the current length and placement of the electrodes.

3 At the end of the self-test, the alphanumerical RUN screen appears. The first time it appears, it will show the factory default settings, as shown here.

If the space between the top and bottom electrodes is substantially less than 1 inch (25 mm), the default settings for the UPST and SRCH positions will be different than those shown.

Also, the Linear Actuator head moves to the upstop position (UPST) specified by the initial positioning schedule.

**NOTE:** The head may run into the limits of inward travel, as determined during the automatic self-test cycle. If it does, a message appears on the lowest (alarm) line of the screen. It is safe to continue operation and correct the electrode settings later.

### Setting the Upstop and Search Positions

Note on the alphanumerical RUN screen that the default positions for electrode upstop (UPST) and electrode search (SRCH) are .800 inch (20.3 mm) and .100 inch (2.5 mm) respectively. These positions are with respect to the position of the lower electrode, which the Weld Head Control senses during its power up calibration cycle. You will now need to reset these values to accommodate the combined thickness of the workpieces that you will be welding.
Figure 2-5 shows an example of setting new UPST and SRCH positions that are suitable for a typical combined workpiece thickness of 0.020 inch (0.51 mm). A space of 0.25 inch (6 mm) between the upper electrode tip and the workpieces will set the UPST position at 0.270 inch (6.8 mm). A nominal space of 0.25 inch (6 mm) reduces the travel time for the upper electrodes to reach the workpieces. Enter the UPST value of 0.27 inch as follows.

1. Assuming that the default alphanumerical RUN screen is still accessed (Step 2 of the power up Weld Head Control procedure in the previous section), press the [PROG] key to access the alphanumerical PROGRAM screen.

**NOTE:** Instructions for selecting parameters on the screen and entering values are annotated on the instruction (bottom) line of the screen.
2 With the [▲▼] keys, select (highlight with the cursor) the UPST position, which now reads the default value of .800.

3 Enter the new UPST position value directly with the DATA keypad. In this example, key in .270 on the DATA keypad and press [ENTER].

4 Press [►] to select the default SRCH position value of .100. A SRCH space that is 0.020 inch (0.5mm) greater than the combined workpiece thickness helps to visually align the upper electrode with the workpieces (see figure 2-5). For this example, key in .040 inch.

5 At this point, you have entered the new SRCH position, but you have not yet saved it. Press [SAVE] to save both the UPST and SRCH positions to the weld schedule.

6 If you forget to save in Step 5 and press [RUN] to go to the run mode, the Weld Head Control puts up the CHANGES NOT SAVED screen. The three highlighted options allow you to save the new UPST and SRCH positions to the weld schedule (SAVE), go to the run mode and save the new UPST and SRCH positions to Schedule 000 (RUN), or cancel the changes (ENTER).

**Power Supply Power Up and Initialization**

To turn on the Power Supply and set initial conditions, proceed as follows:

1 Set the Power Supply front panel WELD/NO WELD switch to NO WELD.

2 Set the circuit breaker located on the Power Supply rear panel to the ON (up) position. The default (factory set) graphical weld RUN screen for the BASIC WELD function (SCHEDULE 000) appears after a series of power up screens. This is the default screen for the Power Supply at power up.
CHAPTER 2: GETTING STARTED

Note the NO WELD notice at the bottom right-hand corner. It is a reminder that the WELD/NO WELD switch is in the NO WELD position.

3 Press the [MENU] key. The MAIN MENU screen for the Power Supply appears.

4 Select ■ TRANSFORMER MODEL with the [◄▲▼►] keys and press [ENTER]. The TRANSFORMER MODEL screen appears.

5 Select MULTIPLE HEADS: OFF. If the display reads ON, press [CHNG] until OFF is displayed.


7 Press [MENU] to return to the MAIN MENU screen.

8 Select ■ OPTIONS and press [ENTER]. Press [►] as many times as is necessary to access the OPTIONS 2 screen. If not already set, change WELD HEAD TYPE to MANUAL and SWITCH DEBOUNCE TIME to 0ms.

9 Press [RUN] to return to the graphical RUN screen (Step 2).

Making Test Welds with Round-to-Round or Round-to-Flat Stock

To arrive at the point where you make a successful first weld will require you to make several test welds, using identical weld pieces each time for true process control.

You should make the first test welds with low energy settings. You can then adjust each of the welding parameters one at a time until you can make a successful weld.

You will be adjusting weld energy (current over time) with the Power Supply, and weld force (WELD), follow-up force (FWUP), and follow-up force delay (DLY) with the Weld Head Control.
WARNING: Always wear safety glasses when welding.

1. At the Power Supply, set the WELD/NO WELD switch to WELD to go to the run state. Note that the NO WELD legend on the Power Supply graphical RUN screen is replaced by the weld time.

2. At the Weld Head Control, press [CHNG] twice to access the Weld Head Control graphical setdown RUN screen.

3. Make a test weld by placing the weld pieces on the lower electrode and pressing on the Weld Head foot switch. The first level press of the foot switch will send the upper electrodes to the SRCH position that you programmed, 0.020 inch above the workpieces. The second level pressing of the foot switch will send the upper electrode to the weld piece surface and trigger the weld cycle.

4. If a partial weld has taken place, peel the welded materials apart. A satisfactory weld will show residual material pulled from one material to the other. The default WELD time of 1ms and the default CURRENT of 0.5kA, as shown on the Power Supply graphical RUN screen, will probably not be sufficient to make a good weld, or any weld. Also, weld force will need to be adjusted at the Weld Head Control.

NOTE: When insufficient weld energy is supplied, oscillations just below the .000 setdown line are typical for round-to-round or round-to-flat welding applications. When sufficient weld energy is applied, a negative (downward) swing of the setdown trace is typical.
5. Press [PROG] on the Power Supply front panel. Use the [►] key to increase the WELD TIME. Use the [▲] key to increase WELD CURRENT. In this example, WELD CURRENT has been increased to 0.75kA and WELD TIME has been increased to 0005ms.

6. Press [SAVE] on the Power Supply front panel to save your program to Schedule 000. The Power Supply is now back in the weld run state.

**NOTE:** Use the minimum time and current necessary to make a good weld so that the weld joint heat affected zone will be minimized.

7. Keep increasing the weld time and weld current for each test weld until the setdown trace on the graphical setdown RUN screen is swinging negatively below the .000 setdown reference line and a weld nugget has formed between the two workpieces.

8. Press [PROG] to access the Weld Head Control alphanumerical PROGRAM screen.

9. Select DLY TIME with the [▲▼◄►] keys. The screen now shows a delay (DLY) time of 5.0ms.

---

**The second test weld:** increasing Power Supply weld current and weld time

5. Press [PROG] on the Power Supply front panel. Use the [►] key to increase the WELD TIME. Use the [▲] key to increase WELD CURRENT. In this example, WELD CURRENT has been increased to 0.75kA and WELD TIME has been increased to 0005ms.

6. Press [SAVE] on the Power Supply front panel to save your program to Schedule 000. The Power Supply is now back in the weld run state.

**NOTE:** Use the minimum time and current necessary to make a good weld so that the weld joint heat affected zone will be minimized.

7. Keep increasing the weld time and weld current for each test weld until the setdown trace on the graphical setdown RUN screen is swinging negatively below the .000 setdown reference line and a weld nugget has formed between the two workpieces.

---

**The optimum test weld:** adjusting the weld head delay time

The relationship of the follow-up force profile and the electrode setdown trace is important. Its center must be fairly well aligned with the center of the setdown curve. If there is misalignment, you can adjust the delay of the follow-up force profile with the actual setdown curve.

8. Press [PROG] to access the Weld Head Control alphanumerical PROGRAM screen.

9. Select DLY TIME with the [▲▼◄►] keys. The screen now shows a delay (DLY) time of 5.0ms.

---

**Follow-up Delay Relationship with Setdown for Round-to-Round or Round-to-Flat Workpieces**
10 Increase or decrease DLY time by 1 millisecond.

11 Press [SAVE] and press [CHNG] twice to display the graphical setdown RUN screen.

12 Make another test weld.

13 Repeat Steps 10 through 12 to achieve coincidence between the centers of the follow-up profile and the setdown trace.

14 If you get sparking between the electrodes and the workpieces, or within the workpieces, you need to adjust the Weld Head Control weld force and follow-up force. As before, use the Weld Head Control alphanumerical PROGRAM screen to make these adjustments until the sparking ceases.

15 Repeat Steps 10 through 14 to optimize the weld.

**Making Test Welds with Flat-to-Flat Stock**

The approach to selecting weld values for this type of stock is the same as for round-to-flat or round-to-round stock. The only difference is in the appearance of the setdown trace in the Weld Head Control graphical set-down screen, where the setdown trace will always be initially in the positive direction (above the .0000 setdown line). This is because, when weld energy is first applied to flat stock, expansion of the stock forces the electrode upward until melting and electrode penetration occurs.

**NOTE:** When insufficient weld energy is applied, an oscillation of the setdown trace about the .000 setdown line is typical.

Just as for round stock welding applications, the relationship of the follow-up force profile to the electrode setdown trace is important. Their centers should be aligned as closely as possible.
Overview of the Series 300 Weld Head Operation

An understanding of the processes involved in the weld cycle will be helpful in following the programming instructions for the Weld Head Control. The Weld Head Control, in conjunction with the Power Supply, executes the sequence of actions shown in figure 3-1 during the weld cycle. The circled numbers refer you to the step numbers in weld head cycle table 3-1.

When doing manual welding, the two-level Foot Switch FS2L allows you to move the electrode between the upstop (UPST) position and the search (SRCH) position as often as you need before completing the weld with setdown (STDN). This way, you can carefully align the materials to be welded during the first downstroke of the electrode (first level of the foot switch), then commit to the weld with the final downstroke of the electrode (second level of the foot switch).
### Table 3-1. The Complete Weld Cycle

<table>
<thead>
<tr>
<th>Step</th>
<th>Event</th>
<th>Linear Actuator Action</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ready</td>
<td>At UPST position.</td>
<td>Run state. Ready to make a weld.</td>
</tr>
<tr>
<td>2</td>
<td>First level of the foot switch is actuated</td>
<td>Moves to SRCH position.</td>
<td>Slew rate is programmable: FAST, MED, SLOW. If the foot switch is released, the head moves back to the UPST position. By activating and releasing the first level of the foot switch, the head moves between the UPST and SRCH positions.</td>
</tr>
<tr>
<td>3</td>
<td>Second level of the foot switch is actuated</td>
<td>Moves toward weld material.</td>
<td>Slew rate is programmable: FAST, MED, SLOW.</td>
</tr>
<tr>
<td>4</td>
<td>Electrode touches weld material</td>
<td>Force builds up to WELD force.</td>
<td>The time required to reach the WELD force is programmable. This is called the squeeze (SQZ) time.</td>
</tr>
<tr>
<td>5</td>
<td>WELD force is reached</td>
<td>Start signal (contact closure) to Power Supply is initiated and follow-up force delay timer (DLY) is started.</td>
<td>You must set the switch debounce time in the Power Supply to 0 msec.</td>
</tr>
<tr>
<td>6</td>
<td>DLY time is expired</td>
<td>Force rapidly increases from the WELD force to the follow-up (FWUP) force.</td>
<td>Force change occurs in about 1 millisecond and remains at the FWUP force level for the programmed FWUP time duration. Round-to-round or round-to-flat parts collapse (set down) during the FWUP period. Flat-to-flat parts expand.</td>
</tr>
<tr>
<td>7</td>
<td>End of FWUP time</td>
<td>Force rapidly decreases back to the WELD force.</td>
<td>WELD force is applied for the remaining WELD time.</td>
</tr>
<tr>
<td>8</td>
<td>End of WELD time</td>
<td>Head retracts to the UPST position.</td>
<td>Slew rate is the same as in step 2.</td>
</tr>
<tr>
<td>9</td>
<td>UPST position is reached</td>
<td>Head remains at the UPST position for the duration of a hidden STOP time, which is automatically determined from the programmed and actual force and time information.</td>
<td>New weld cannot be initiated until the end of the STOP time. Also, the foot switch must be released and reactivated to start the next weld cycle. The STOP time ensures that the head will not overheat.</td>
</tr>
</tbody>
</table>
The HELP Screens

The Weld Head Control offers you context-sensitive, on-line help screens. They are available when the system is either running or is being programmed. To access the related help screen, all you need to do is press the [HELP] key; an on-line screen will appear with narrative explaining the function that is currently in effect.

For example, if you are setting up the electrode upstop position, the upstop program screen will be accessed.

From the alphanumerical RUN screen, press [PROG] twice. The SET THE UP-STOP POSITION screen appears.

Now, press the [HELP] key. The related on-line help screen will appear to give you more information about setting the upstop position. To return to the set upstop screen, press [HELP] again.

Press [RUN] to return to the alphanumerical RUN screen.

A Closer Look at the PROGRAM Screens

Press the [PROG] key to enter the program mode. Repeatedly pressing the [PROG] key cycles the display through five programming screens. Each screen is updated with the programming changes, regardless of which screen is used to enter the schedule information.
CHAPTER 3: OPERATING INSTRUCTIONS

Alphanumerical PROGRAM Screen

This screen allows you to set all force, time and position fields using the numerical keys. Use all four [►◄▲▼] keys to select the various fields. The setdown displacement alarms and the weld-to-displacement feature are not programmed on this screen; they are programmed in the setdown PROGRAM screen.

UPST Position PROGRAM Screen

This screen provides an alternative way of programming the upstop position. The UPST position is where the head is located while the Series 300 System is ready (in the run state).

Upon entering this screen, the head is positioned at the UPST position. You use the [▲▼] keys to raise or lower the head, or program the UPST position directly using the numerical keys. Since the head responds immediately to your actions, this screen is particularly helpful for fine tuning the UPST position.

SRCH Position PROGRAM Screen

The search (SRCH) position is the location where the head stops on its way down to allow the user to accurately align the materials to be welded. Typically, this position is set up so the electrodes are just above the weld material.

Upon entering this screen, the head is positioned in the SRCH position. You use the [▲▼] keys to lower the head, or program the SRCH position directly using the numerical keys. Since the head responds immediately to your actions, this screen is particularly helpful for fine-tuning the SRCH position.
CHAPTER 3: OPERATING INSTRUCTIONS

Graphical Force PROGRAM Screen

This screen allows you to program the weld force magnitude and duration using a graphical screen. Pressing the [ENTER] key selects the next segment of the graph to program. The segment is indicated by the horizontal window located on the horizontal time line. Pressing the [▲▼] keys adjusts the force of selected segment. Pressing the [◄►] keys increases or decreases the time duration of the selected segment.

Setdown PROGRAM Screen

The term ‘setdown’ (STDN) is the small electrode position displacement that occurs during the weld. This screen shows the actual setdown versus time graph of the last weld, and allows you to superimpose upper and lower setdown displacement limits. In addition, the weld-to-displacement feature is programmed on this screen (refer to Weld-to-Displacement Feature at the end of this chapter).

Press [ENTER] to select the UPPER or LOWER setdown limit alarms, or the WELD STOP displacement for the weld-to-displacement feature. Set the limit and stop line values with the [▲▼] keys. Note that the LOWER setdown limit must be programmed before the UPPER limit.

Press the [CHNG] key to remove either limit lines or weld-stop displacement.

A Closer Look at the RUN Screens

Press the [RUN] key to ensure that the Weld Head Control is in the RUN state. Now press the [CHNG] key a few times. Notice that the display changes screens each time you press the [CHNG] key. The [CHNG] key alternates the display among three RUN screens:

- Alphanumeric (text and numbers)
- Graphical Force (force over time)
- Graphical Setdown (electrode position over time)
CHAPTER 3: OPERATING INSTRUCTIONS

Alphanumerical RUN Screen

This screen displays the schedule number and all the programmed schedule information. (The # characters define user-programmable values.) Other information such as SCHEDULE number, tare FORCE 8, and cumulative WELD count are also displayed. The fields are defined in table 3-2.

Graphical Force RUN Screen

The graphical force RUN screen relates the programmed and actual force (vertical axis) with time (horizontal axis). The force profile shows the complete WELD time interval, including the SQZ time (force ramp-up) and the FWUP force impulse. The programmed force is shown as a line graph, and the actual force is shown as a 'filled-in' graph after the weld cycle is repeated.

The force is shown on the vertical axis, and the time is shown on the horizontal axis. The total time duration of the SQZ and WELD periods is indicated in the lower right corner. After a weld cycle is completed, the peak FWUP force is indicated in the upper right corner.

Cycle the weld head a few times. Notice that the actual force graph is redrawn each time.
CHAPTER 3: OPERATING INSTRUCTIONS

Table 3-2. Alphanumerical Screen Field Definitions

<table>
<thead>
<tr>
<th>Field</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHEDULE: 000</td>
<td>Schedule number from 000 - 127. Use the [▲▼] keys or numerical keys to select a different schedule number when in the RUN state.</td>
</tr>
<tr>
<td>WELD: 0000000</td>
<td>Weld counter. Increments each time a weld is completed.</td>
</tr>
<tr>
<td>FORCE: 2.0 lbs.</td>
<td>Tare force. Force required to keep the weld head electrode holder in the UPST position. Tare force is not programmable.</td>
</tr>
<tr>
<td>POSITION: .000 inch</td>
<td>Current position of the weld head.</td>
</tr>
<tr>
<td>TIME: UPST</td>
<td>Rate at which the head moves toward or away from the upstop position:</td>
</tr>
<tr>
<td></td>
<td>FAST: 30 inches (76.2 cm)/second</td>
</tr>
<tr>
<td></td>
<td>MED: 8 inches (20.3 cm)/second</td>
</tr>
<tr>
<td></td>
<td>SLOW: 1 inch (2.5 cm)/second</td>
</tr>
<tr>
<td>POSITION: UPST</td>
<td>Upstop position is relative to 0.000, where the electrodes touch each other.</td>
</tr>
<tr>
<td>TIME: SRCH</td>
<td>Rate at which the head moves between search position and where the electrode touches the weld material:</td>
</tr>
<tr>
<td></td>
<td>FAST: 0.5 inches (12.7 mm)/second</td>
</tr>
<tr>
<td></td>
<td>MED: 0.1 inches (2.5 mm)/second</td>
</tr>
<tr>
<td></td>
<td>SLOW: 0.05 inches (1.3 mm)/second</td>
</tr>
<tr>
<td>POSITION: SRCH</td>
<td>Search height position is relative to 000.0, where the electrodes touch each other.</td>
</tr>
<tr>
<td>TIME: SQZ</td>
<td>Time duration for force to build up to the WELD force. (50ms recommended)</td>
</tr>
<tr>
<td>TIME: WELD</td>
<td>Time duration for WELD. The start signal to the Power Supply is asserted for this time period.</td>
</tr>
<tr>
<td>FORCE: WELD *</td>
<td>Force maintained for the duration of the WELD time, except for the interval during which the follow-up force is applied.</td>
</tr>
<tr>
<td>TIME: DLY</td>
<td>Time interval from the start of the WELD period to application of follow-up force. The optimal programming of this parameter to achieve good welds is important. Refer to <em>The Importance of Follow-Up Force</em> in this chapter.</td>
</tr>
<tr>
<td>TIME: FWUP</td>
<td>Time duration of follow-up force. The optimal programming of this parameter to achieve good welds is important. Refer to <em>The Importance of Follow-Up Force</em> in this chapter.</td>
</tr>
<tr>
<td>FORCE: FWUP *</td>
<td>Follow-up force must be greater than or equal to WELD force.</td>
</tr>
</tbody>
</table>

* Note:  Force accuracy of unit is only maintained if the head is calibrated in the same position as it is used. Head is factory calibrated in horizontal position. This does not affect force repeatability.
Graphical Setdown RUN Screen

The graphical setdown RUN screen shows five categories of information:

- Follow-up (FWUP) time profile
- Actual electrode setdown into the workpieces
- User programmed weld stop (setdown limit)
- User programmed lower limit
- User programmed upper limit

The upper and lower limits are shown on the graph by the dashed lines only if you have programmed them. If you have programmed the weld-to-displacement (weld stop) feature, the weld stop horizontal dotted line is shown intersecting the actual displacement graph at the exact displacement at which the Power Supply start signal is terminated. The displayed time is normally less than the programmed WELD time period.

If the weld-to-displacement feature is not programmed, the displayed time is equal to the programmed WELD time period. Refer to Weld-to-Displacement Feature toward the end of this chapter for details of the weld-to-displacement feature.

The final setdown displacement is listed alphanumerically at the top center of the screen; in this weld schedule, it is shown as SETDOWN: .0068 inch. The total duration of the weld time (8.9ms) is indicated in the upper right corner of the screen.

Select each of these screens and exercise the weld head to see how the fields and graphs update during and after each weld cycle.
The MAIN MENU Screen

You set up the program options for the Weld Head Control through a menu system, as presented on the MAIN MENU screen. The options are normally set up during installation, and they affect the operation of the system regardless of which schedule you select.

Like a tree with many branches, there are multiple menu levels. You access each new menu level by selecting an option and pressing the [ENTER] key. To return to a menu level, you press the [MENU] key.

Press the [MENU] key on the Weld head Control front panel to access the MAIN MENU. Use the [►◄▲▼] keys to select a topic (for example, #OPTIONS or #CALIBRATION), then press [ENTER] to go to the menu screen of the selected topic.

The #OPTIONS Selection

The Weld head Control makes twelve different system options available to you through three screens: OPTION 1, OPTION 2, and OPTION 3. Most of these programmed options allow you to modify how an external input, such as a foot switch, interfaces with the Weld Head Control. Output relay options allow you to interface the Weld Head Control with an external computer or Programmable Logic Control (PLC).

1. From the MAIN MENU screen, select #OPTIONS. The OPTIONS 1 screen appears. Five option items appear as shown.

- **POWER UP SCHEDULE**: This option determines which weld schedule will be used when the Weld Head Control is switched ON: either (a) Schedule Number 0-127, or (b) the weld schedule that was selected just before the power was switched OFF. To select (a) or (b):
  
  a) Press [CHNG] to select 000, then key in the weld schedule number that you want the Weld Head Control to display on power up, or

  b) Press [.] to change a specific weld schedule to LAST.

- **END WELD BUZZER**: OFF
- **KEY CLICK**: ON
- **RELAY 1 ON CONDITION**: ALARM
- **RELAY 2 ON CONDITION**: ALARM
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- **END WELD BUZZER:** ON means that an audible signal will be given at the end of each weld process as your signal to release the foot pedal. Press [CHNG] to select *ON* or *OFF*.

- **KEY CLICK:** This option provides a ‘click’ sound when you press any front panel key. Press [CHNG] to select *ON* or *OFF*.

- **RELAY 1 ON CONDITION:** This feature has four options that allow you to select when RELAY 1 will activate. RELAY 1 is a contact closure terminating at the CONTROL SIGNAL INPUT connector (see Appendix B) that you can use as an event monitor. The options for contact closure are:
  
  > **ALARM** When an alarm condition exists  
  > **RUN STATE** During the RUN state  
  > **WELD PERIOD** During the weld period  
  > **ENTIRE** During the entire weld cycle

- **RELAY 2 ON CONDITION:** This feature is identical to the RELAY 1 ON CONDITION.

2. Press [►] (More Options) to access the submenu of options on the OPTIONS 2 screen.

- **FOOTSWITCH WELD ABORT:** Select ON or OFF with the [CHNG] key. This option controls how the Weld Head Control interfaces with a foot switch or a force firing switch. Either or both switches may be defined as the ‘initiation switch.’

  The ON selection means the welding process is initiated by the closure of the initiation switch(es) and continues to its conclusion as long as the initiation switch(es) remain closed. If the initiation switch(es) open during the welding process, the welding process will terminate.

  The ON selection is preferred for human operators since it allows you to abort the welding process by releasing the foot switch or foot pedal. Use OFF when controlling the Weld Head Control with a host computer or PLC.
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- **DEBOUNCE TIME:** Single pole mechanical firing switch contacts ‘bounce’ when they close. The debounce time feature allows you to specify that the firing switch must remain closed for 0, 10, 20, or 30 milliseconds before the weld period can be initiated, to minimize false weld cycle initiation due to contact ‘noise’ on the foot switch signal. The Weld Head Control automatically sets the debounce time to 0.0 milliseconds whenever a 3-wire or optical coupling switch is selected. Press [CHNG] to select 0, 10, 20, or 30 msec.

- **UNITS MEASURE OF FORCE:** Press the [CHNG] key to select pounds, kilograms or newtons as units of force measurement.

- **UNITS MEASURE OF POSITION:** Press the [CHNG] key to select inches or millimeters as units of position measurement.

- **NO WELD MATERIAL CHECK:** Press the [CHNG] key to select ON or OFF. When you select ON, the weld head will expect material thickness of at least 0.005 inch. If the weld head does not sense material by the time the electrodes are 0.005 inch apart, the weld cycle aborts and a warning message appears on the alphanumeric RUN screen. Press [MENU] to return to the MAIN MENU screen or press [RUN] to return to the weld graphical RUN screen.

3 Press [►] (More Options) to access the submenu of options on the OPTIONS 3 screen.

- **SELF-CHECK DURING BOOT-UP:** When you set this option to OFF, the self-checking procedure will be skipped during boot-up. When the head is retracting to the upstop position, a SKIPPING SELF-CHECK OPERATION message will be displayed.

When you set it to ON, the self-checking procedure will be executed. Regardless of the option state, the self-checking procedure will always be executed when returning from the dress mode.

- **SELF-CHECK FORCE LIMIT:** With this option, you may limit the amount of force applied by the electrodes during calibration (self-check) so that the force will not bend miniature or angled electrodes.

**NOTE:** This option does not apply to weld force or follow-up force.
You should set the self-check force to 10 pounds for directly opposed electrodes, as noted on the HELP screen. For angled electrodes, select the maximum force the electrodes can tolerate without bending.

**EMERGENCY STOP OPERATION:**
You can configure the Emergency Stop switch input at the CONTROL SIGNAL INPUT connector to operate either in the normally open or normally closed mode. Note that the OPTION 3 screen is showing a selection of normally open (NO). You toggle the selection to normally closed (NC) with the CHNG key.

Refer to Appendix B under *CONTROL SIGNAL INPUT Connector, Emergency Shutdown Input*, for Emergency Stop signal input details. When you configure the Emergency Stop switch on the OPTIONS 3 screen, you must change the wiring to the emergency stop input on the CONTROL SIGNALS connector. For normal operation, the circuit must be open in the NO case and shorted in the NC case.

**MATERIAL SEARCH FORCE:** This is the force used to detect the weld material. You can set it from 2 to 10 lbs., or to AUTO, by pressing the CHNG key. AUTO is the default setting. When set to AUTO, the material search force will change according to the search (SRCH) rate setting of the selected weld schedule (see table 3-2). With the SRCH rate set to FAST or MED, the force will be 3 lbs. When SRCH is set to SLOW, the force will be 2 lbs.

**NOTE:** You will not be able to set a weld force lower than the MATERIAL SEARCH FORCE setting.

**OBJECT DETECTION FORCE:** This is the maximum force to be used during the approach mode (from upstop to search position). Referring to table 3-2, the object detection force is 10 lbs. for FAST rate and 3 lbs. for MED and SLOW rate.

You can set the force from 3 to 10 lbs., or to AUTO, by pressing the CHNG key. AUTO is the default setting. In the AUTO state, the object detection force will change according to the search (SRCH) rate of the selected weld schedule. With the search rate set to FAST, the object detection force will be 10 lbs. With the search rate set to MED or SLOW, the object detection force will be 3 lbs.
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The ■WELD COUNTER Selection

The Weld Head Control contains one standard weld counter and three additional weld counters if the built-in Weld sentry is installed in the Power Supply. These counters increment each time a weld is made in any weld schedule.

1. From the MAIN MENU screen, select #WELD COUNTER. The WELD COUNTER screen appears.

2. Select the weld count number for TOTAL NUMBER OF WELDS. To set the counter:
   - To zero, select the count number and press the [0] numerical key. If you change your mind, press [CHNG] before leaving the WELD COUNTER screen; the original count will appear.
   - To another number, select the count number, key in the change with the numerical keys, and press [ENTER].

3. Press [MENU] to return to the MAIN MENU screen, or press [RUN] to return to the weld graphical RUN screen.

The ■COPY a SCHEDULE Selection

All Weld Head Control weld schedules can be easily copied from one weld schedule to another by using the COPY A SCHEDULE option listed under the MAIN MENU.

1. From the MAIN MENU, select #COPY A SCHEDULE. The COPY SCHEDULE Screen will appear with the TO SCHEDULE field selected as a default.

2. With the numerical keys, key in the number of the destination schedule to the TO SCHEDULE field; for example, key in 127 to copy a schedule to be selected to Schedule 127.

   NOTE: Schedule information previously stored in Schedule 127 will be overwritten by the new information coming from the source schedule.
CHAPTER 3: OPERATING INSTRUCTIONS

3 Press [◄] to select the COPY SCHEDULE FIELD. With the numerical keys, key in the number of the source schedule. For example, key in 12 as the source schedule.

4 Press [ENTER] to complete the schedule copy process and to automatically return to the weld graphical RUN screen.

The SYSTEM SECURITY Selection

All Weld Head Control weld schedules can be protected from operator changes by programming the Weld Head Control with a user defined protection code.

1 From the MAIN MENU screen, select #SYSTEM SECURITY. The SYSTEM SECURITY screen will appear. The first character position of the code status line should be flashing.

2 Enter a seven-digit number from 1 to 9999999.

3 If unauthorized operators are to be kept from changing weld schedules, select SCHEDULE LOCK: OFF and use [CHNG] to select ON. When ON is selected, all other weld schedules are locked out and cannot be used for welding.

4 Press [ENTER] to enable System Security. SECURITY STATUS: will now display PROTECTED.

5 Press [MENU] to return to the MAIN MENU screen or press [RUN] to return to the weld graphical RUN screen.

6 To unlock the Weld Head Control, return to the SYSTEM SECURITY screen and re-enter the security code. The SECURITY STATUS: will now display UNPROTECTED.

7 If you forget or misplace the security code:
   a Return to the SYSTEM SECURITY screen.
   b Press and hold [◄].
   c Press [SAVE] and release [◄]. SECURITY STATUS: will now display UNPROTECTED.

COPY SCHEDULE
COPY SCHEDULE [ 12 ] TO SCHEDULE [ 127 ]
◄▲ Select, NUMBER Change, ENTER Proceed

SYSTEM SECURITY
SECURITY STATUS : UNPROTECTED
SCHEDULE LOCK : OFF
ENTER CODE TO CHANGE STATUS: [____________]
NUMBERS for Code followed by ENTER

SYSTEM SECURITY
SECURITY STATUS : PROTECTED
SCHEDULE LOCK : OFF
ENTER CODE TO CHANGE STATUS: [____________]
NUMBERS for Code followed by ENTER
CHAPTER 3: OPERATING INSTRUCTIONS

The ■SYSTEM HELP Selection

System Help provides detailed descriptions of all hardware features on the Weld Head Control. From the MAIN MENU screen, select #SYSTEM HELP. The SYSTEM HELP screen will appear. Select the desired topic, then press [ENTER]. Use the [◄▲▼►] keys to review each page.

The ■CALIBRATION Selection

Please observe the NOTE, CAUTIONS and WARNINGS in this section.

NOTE: The Weld Head and Weld Head Control are calibrated together at the factory and are not interchangeable. If they are interchanged, calibration will be nullified.

CAUTION: The Weld Head Control can be calibrated only by a qualified electronics technician since the Weld Head Control cover must be removed to provide access to the adjustments while AC power is ON.

1 Set the POWER switch on the rear panel of the Weld Head Control to OFF.

WARNING: Be sure to observe the instructions given in Step 2. If you do not perform Step 2, or you perform it improperly, you could be seriously injured. Up to 230 VAC could be present in the chassis area.

2 Disconnect the AC input power to the Weld Head Control.

3 Remove the Weld Head Control Cover.

WARNING: Be extremely careful when reconnecting the input power. Up to 230 VAC could be present in the chassis area.

4 Reconnect input power to the Weld Head Control and set the POWER switch to ON.

5 From the MAIN MENU screen, select #CALIBRATION and press [ENTER]. This accesses the PRE-CALIBRATION screen. Disregard the password message. See the HELP screen for further instructions.

6 Locate the Weld Head Control printed circuit board, positioned on the right-hand side of the Weld Head Control. Follow the calibration instructions listed on each screen page. The only tools you will need are a flat-bladed screwdriver and voltmeter for making the potentiometer adjustments.
CHAPTER 3: OPERATING INSTRUCTIONS

CAUTION: Do not attempt to re-adjust the factory-adjusted LVDT position.

WARNING

Be sure to observe the instructions given in the next step. If you do not perform it, or you perform it improperly, you could be seriously injured. Up to 230 VAC could be present within the chassis area.

7 Set the POWER switch on the rear panel of the Weld Head Control to OFF and disconnect the AC input power.

8 Replace the Weld Head Control cover.

The ■RESET to DEFAULTS Selection

The Reset To Defaults feature allows you to reset all system parameters or all weld schedules to their original factory default settings.

NOTE: You will not reset the weld counter.

1 From the MAIN MENU screen, select #RESET TO DEFAULTS. The RESET DEFAULTS screen will appear.

2 Select #RESET SYSTEM PARAMETERS and press [ENTER]. The RESET SYSTEM PARAMETERS PROCEED? Option line appears.

3 Press [CHNG] to change NO to YES to reset all system parameters to their factory default settings, then press [ENTER]. Table 3-3 lists the factory default settings. When the reset process is complete, the bottom of the screen will display the message SYSTEM PARAMETERS ARE RESET.
4 Select #RESET ALL SCHEDULES/PROGRAMS and press [ENTER]. The RESET ALL SCHEDULES/PROGRAMS PROCEED? Option line appears.

5 Press [CHNG] to change NO to YES to reset all weld schedules to their factory default settings. Then press [ENTER]. When the reset process is complete, the bottom of the screen will display the message SCHEDULES/PROGRAMS ARE RESET.

6 Press [MENU] to return to the MAIN MENU screen or press [RUN] to return to the weld graphical RUN screen.

**The ■INSTALLATION Selection**

The installation option provides narrative (no illustrations) instructions about how to set up the Weld Head Control. At the MAIN MENU screen, press [ENTER] to select this option. Then, press [►] for each new page of instructions. The best procedure is to follow the instructions in Chapter 2: Getting Started in this manual.
The Weld-to-Displacement Feature

Successfully using the weld-to-displacement feature requires some understanding of the timing relationship between the Power Supply and the Weld head Control. The discussion below assumes that the Weld Head Control is connected to a Miyachi Unitek power supply. If you are not using a Miyachi Unitek power supply, refer to your power supply user's manual for specific instructions.

When the weld head reaches the WELD force, the firing switch solid state relay closes. This is the ‘start’ signal to the Power Supply. The Power Supply starts within a couple of milliseconds, and the FWUP force occurs later, exactly at the time set for DLY milliseconds. You must set up the Power Supply properly so that the FWUP force occurs at the right point in the weld cycle. Here is a check-list to ensure that the Power Supply and the Weld Head Control are synchronized for the weld-to-displacement function (it assumes that the units are interconnected as described in Chapter 2):

1. Set the switch debounce option to 0ms. This eliminates the time delay between receipt of the start signal to the time when the Power Supply actually delivers energy to the weld.
2. Set the weld head type to MANUAL. This allows the Power Supply to be activated through the force firing switch input.
3. Set the footswitch abort option to ON. This allows the Weld Head Control to shut off the Power Supply by disabling the start signal when the programmed displacement is reached.
4. Program the Power Supply for the desired weld function (BASIC, PRE/POST HEAT, etc.) to properly perform the weld.
5. Set the weld current to a low value. For example, try 1 kA.

Program the profile for the weld as follows:
1. Access the graphical setdown RUN screen.

2. Try a weld.

**NOTE:** The weld time that you program into the Weld Head Control is the total time that the Power Supply energy will be supplied to the weld materials. Start out with short weld times and work up to the minimum time that a weld requires.

3. Gradually increase the WELD time and/or the Power Supply weld energy until you produce a satisfactory weld.

4. Note the appearance of the SETDOWN graph on the setdown RUN screen. The graph should not have abrupt changes in it, but rather a ‘sideways S’ shape as shown.

5. Set the DLY time so that the FWUP force impulse (the trapezoid on the top line) occurs just when the SETDOWN graph shows the welding materials just starting to melt (that is, the SETDOWN displacement just starts to change rapidly).

6. Experiment with WELD time, WELD force, FWUP time, FWUP force DLY time, and Power Supply energy until you achieve the desired weld and setdown displacement.

**NOTE:** Do not experiment with Power Supply time.

7. Access the graphical setdown PROGRAM screen and select the WELD STOP feature. Using the [▲▼] keys, move the weld stop line to just above the final setdown line.

8. Increase the WELD time by 20 milliseconds. Now, the weld-to-displacement programming will shut off the Power Supply when the programmed setdown displacement is achieved.

9. Repeat the weld. The Power Supply should now shut off prior to the end of the WELD time programmed on the Weld Head Control.

10. Experiment with the WELD STOP program to achieve consistently good welds with the desired setdown displacement.
CHAPTER 3: OPERATING INSTRUCTIONS

The Importance of Follow-Up Force

The programmable follow-up force is the key to high performance and consistent weld quality achievable with the Weld Head System. Depending on the type of weld, the weld material melts or becomes plastic as the weld progresses, causing the force between the electrodes to diminish. Unless the weld head can quickly accelerate the electrode into the weld material during this crucial time period, material will be expelled from the weldment, producing a poor weld. The small movement of the electrodes during the course of the weld is called ‘follow-up.’ The ability to rapidly accelerate the electrodes during follow-up, thus maintaining force on the weld material and preventing expulsion, is a key performance measure of a weld head.

Conventional weld heads – whether pneumatic, pedal, hand, or cam operated – typically use a mechanical spring or pneumatic cylinder to develop the weld force. The maximum follow-up acceleration is limited by the moving weld head mass (including electrode, electrode holder, and output shaft) and the weld force. The relationship between follow-up acceleration, weld force, and moving mass follows Newton’s first law of motion: $\text{Acceleration} = \frac{\text{force}}{\text{mass}}$. Since the moving mass is constant for a given weld head, the maximum follow-up acceleration is proportional to the weld head force. This means that for low force welds, or for welds that require a lot of follow-up acceleration (such as wire-to-foil or cross-wire welds), conventional weld heads have a fundamental limit to their follow-up performance.

The Series 300 Weld Head System, however, uses an electromagnetic linear actuator to develop the weld force. A user-programmed force impulse (FWUP) accelerates the electrode into the material during the follow-up period. The resulting precise head movement outperforms any other weld head technology.

Use the following procedure as a starting point to set up the FWUP force:

1. Start with default WELD, FWUP force, DLY and FWUP time settings.
2. Use the graphical setdown RUN screen and PROGRAM screen to assist in fine-tuning the programming of the timing and magnitude of the follow-up force.
3. Make a few welds. Notice where the setdown displacement starts to change rapidly. This is the point where the weld materials start to melt. Adjust the DLY to position the FWUP impulse at this point.
4. If sparking or splashing occurs, increase both the WELD and FWUP forces. To calculate the new FWUP force, multiply 2.5 lbs./0.001 inch (44.6 kg/0.0254 mm) by the measured electrode displacement. Add this new constant to the weld force value. Use the combined total as the new FWUP force.
5. For large WELD and FWUP force operations, increase the FWUP time to match the actual melting or setdown period as indicated by the ‘S’ shaped portion of the actual setdown graph.
6. Experiment with the FWUP force, time duration, and delay time to optimize the weld.
CHAPTER 4
Maintenance

Section I: Service Precautions

General Operator Safety

Warning: Always wear safety glasses any time you are operating the Weld Head.

Never wear loose clothing or jewelry when operating the weld head. It could be caught in the mechanism.

Before operating the Weld Head, read this manual and the power supply manual. Particularly note the specific hazards associated with those components.

Section II: Operation Troubleshooting

Your Series 300 Fast Response Weld Head system is designed with reliability as a top user priority. But, occasionally, you will run into a problem and need some help to get back to normal operation. Reading this chapter will speed up the process.

General Kinds of Problems

NOTE: It has been our experience that 99% of all weld head and resistance welding power supply ‘problems’ are caused by lack of material control, process control and electrode tip surface maintenance.

The problems that you might encounter fall into two groups:

- **Soft** – The problem is transient, and you can correct it by re-calibrating the system or re-setting limits, for example.

- **Hard** – The problem is imbedded in the system and some form of repair or upgrade will be needed.

In either case, built-in automatic self-test and self-calibration routines will bring up alarm messages on the display screen. These messages will usually let you know what action is required of you to correct the reason for the alarm. For a complete listing of the alarm messages, what they mean, and what to do about them, please refer to table 4-1.
### Table 4-1. Alarm Message Listing

<table>
<thead>
<tr>
<th>Alarm Message</th>
<th>Description</th>
<th>Corrective Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALARM EMERGENCY STOP</td>
<td>An Emergency Stop signal was received on the CONTROL SIGNALS connector. The Weld Head Control cannot operate in the RUN state.</td>
<td>Remove the Emergency Stop signal.</td>
</tr>
<tr>
<td>ALARM SEARCH POSITION</td>
<td>Electrode encountered an obstacle before it reached the programmed search position.</td>
<td>Remove the obstacle.</td>
</tr>
<tr>
<td>CALIBRATION SELECTED</td>
<td>The CALIBRATION switch has been actuated.</td>
<td>Press the CALIBRATION switch.</td>
</tr>
<tr>
<td>DOWNSTOP OUT OF RANGE</td>
<td>Weld Head output shaft bottoms out before the upper electrode reaches the lower electrode.</td>
<td>Adjust the position of the lower electrode, using the centering bar displayed in the DRESS mode. Set the RUN/DRESS switch to RUN. The Weld Head Control will automatically recalibrate the downstop position.</td>
</tr>
<tr>
<td>ERROR. TOO LITTLE SETDOWN</td>
<td>Measured setdown is less than the programmed upper limit.</td>
<td>1. Reprogram a higher upper setdown limit. 2. Replace the weld material. 3. Troubleshoot the Welding Power Supply.</td>
</tr>
<tr>
<td>ERROR. TOO MUCH SETDOWN</td>
<td>Measured setdown is greater than the programmed lower limit.</td>
<td>1. Reprogram a lower lower setdown limit. 2. Replace the weld material. 3. Troubleshoot the Welding Power Supply.</td>
</tr>
<tr>
<td>ERROR. WELD ABORTED</td>
<td>Foot switch did not stay actuated during the weld cycle.</td>
<td>Actuate the foot switch again.</td>
</tr>
<tr>
<td>FOLLOW-UP TIME TOO SMALL</td>
<td>Time entered was below the minimum value allowed.</td>
<td>Reprogram the follow-up time to be at least the 1ms minimum.</td>
</tr>
<tr>
<td>FOLLOW-UP TOO LOW</td>
<td>Follow-up force entered is less than the weld force.</td>
<td>Reprogram a higher follow-up force or lower weld force.</td>
</tr>
<tr>
<td>FORCE CALIBRATION IS OFF</td>
<td>Force setting and force reading differ by more than 0.3 lbs.</td>
<td>Recalibrate force with the CALIBRATION selection on the MAIN MENU.</td>
</tr>
<tr>
<td>ILLEGAL CODE ENTERED</td>
<td>The system is security-protected against unauthorized entry and you have attempted to enter an unauthorized security code.</td>
<td>Enter the original code used to protect the system. If you do not know it, change the system to unprotected status as follows: 1. Set the WELD/NO WELD switch to NO WELD. 2. Access the SYSTEM SECURITY screen. 3. Press and hold [=]. 4. Press [SAVE] and release [=]. SECURITY STATUS: will now read UNPROTECTED.</td>
</tr>
<tr>
<td>INPUT TOO LARGE</td>
<td>Value entered is too large for the field.</td>
<td>Enter a value within the field upper limit.</td>
</tr>
<tr>
<td>INPUT TOO SMALL</td>
<td>Value entered is too small for the field.</td>
<td>Enter a value within the field lower limit.</td>
</tr>
<tr>
<td>Alarm Message</td>
<td>Description</td>
<td>Corrective Actions</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>HEAD NOT READY</td>
<td>Foot switch was actuated before the end of the OFF time calculated by the Weld Head Control for the weld schedule.</td>
<td>Reactuate the foot switch at the end of the OFF time.</td>
</tr>
<tr>
<td>NO RESPONSE FROM THE HEAD</td>
<td>Weld Head is not responding to the Weld Head Control.</td>
<td>1. Tighten the weld head to Weld Head Control cable. 2. Contact your authorized service agent for technical assistance.</td>
</tr>
<tr>
<td>NO SAMPLE DATA EXISTS</td>
<td>No setdown displacement data is available to display because the last weld schedule used is not the current weld schedule.</td>
<td>To display the setdown data graph, make a weld with the current weld schedule.</td>
</tr>
<tr>
<td>NO WELD MATERIAL</td>
<td>The upper electrode has traveled to 0.005 in. (0.12 mm) above the lower electrode and has not encountered weld material.</td>
<td>1. Insert weld material. 2. Reposition the electrodes.</td>
</tr>
<tr>
<td>POSITION CALIBRATION IS OFF</td>
<td>The position setting and position reading differ by more than 0.015 in. (0.38 mm).</td>
<td>Recalibrate position with the CALIBRATE selection on the MAIN MENU.</td>
</tr>
<tr>
<td>SAVE ERROR</td>
<td>Weld Head Control could not save the weld schedule.</td>
<td>Contact your authorized service agent for technical assistance.</td>
</tr>
<tr>
<td>SCHEDULE LOCKED</td>
<td>System is protected and the schedule is locked.</td>
<td>Unlock the schedule as follows: 1. At the MAIN MENU, access the SYSTEM SECURITY selection. 2. Enter your security code and change SCHEDULE LOCK to OFF.</td>
</tr>
<tr>
<td>SEARCH POSITION TOO LOW</td>
<td>Specified search position is lower than the lower limit of 0.005 in. (0.12 mm).</td>
<td>Reset the search position above the lower limit.</td>
</tr>
<tr>
<td>STANDBY REMOTE SCHEDULE</td>
<td>The Weld Head Control is waiting for external equipment to input a weld schedule number code via the CONTROL SIGNAL INPUT connector (see Appendix B).</td>
<td>Refer to the user’s manual for the external equipment.</td>
</tr>
<tr>
<td>UPSTOP POSITION TOO HIGH</td>
<td>Specified upstop position cannot be reached.</td>
<td>Enter a smaller upstop position value.</td>
</tr>
<tr>
<td>UPSTOP POSITION TOO LOW</td>
<td>Specified upstop position is lower than or equal to the search position.</td>
<td>Enter an upstop position value that is higher than the search position value.</td>
</tr>
<tr>
<td>WELD TIME TOO SMALL</td>
<td>Specified weld time is less than the combined delay time and follow-up time.</td>
<td>Enter a weld time that is longer than the sum of the delay time and the follow-up time.</td>
</tr>
</tbody>
</table>
Electrode Maintenance

When a welding schedule has been suitable for a particular welding application over many welds, but poor quality welds are now resulting, electrode deterioration could be the problem. If you are needing to increase weld current to maintain the same welding quality, the electrode tip has probably increased in surface area (that is, mushroomed), effectively increasing weld resistance. Try replacing the electrode.

The rough surface of a worn electrode tip tends to stick to the workpieces. So, periodic tip resurfacing (dressing) is required to remove pitting, oxides and welding debris from the electrode. You should limit cleaning of an electrode tip on the production line to using a #400-600 grit electrode polishing disk.

If you must clean a badly damaged tip with a file, be sure that the electrode surfaces are maintained parallel, and use a polishing disk after filing to ensure that the electrode tip faces are smooth.

The best method of preventing electrode problems is to regularly re-grind electrode tip surfaces and shapes in a certified machine shop.

Figure 4-1. Electrode Tip Surface Maintenance
Section IV: Repair Service

Parts Replacement

**CAUTION:** Only authorized repair personnel should replace parts. Removal of the unit covers by unauthorized personnel could be hazardous and may void the warranty.

If you need to replace a part, table 4-2 lists the repair parts for the 301H and 302H Linear Actuators.

**Table 4-2. 301H and 302H Linear Actuator Module Repair Parts List**

<table>
<thead>
<tr>
<th>Amada Miyachi America P/N</th>
<th>Description</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-33274-01</td>
<td>Flexure</td>
<td>301H and 302H</td>
</tr>
<tr>
<td>4-33967-02</td>
<td>Electrode Holder (Upper)</td>
<td>301H</td>
</tr>
<tr>
<td>4-33474-01</td>
<td>Electrode Holder Handle Clamp</td>
<td>301H</td>
</tr>
<tr>
<td>4-33712-02</td>
<td>Electrode Holder</td>
<td>302H</td>
</tr>
</tbody>
</table>

Technical Assistance

If you need further technical assistance, please contact either your authorized service agent or Amada Miyachi America Customer Service at the number provided in the Foreword of this manual.
Section V. Calibration

Series 300 Weld Head System with the 350C Weld Head Control

Applicable Models
2-350-xx-xx

Equipment Required
- An NIST traceable force gauge in the 20lb range.
- A calibrated, 4+ digit voltmeter, accurate to at least ± 0.1%

**WARNING:** Calibration should be performed only by a qualified electronics technician since the cover must be removed to provide access to the adjustment potentiometers. Contact with voltages present in the control may cause serious injuries.

Preliminary Setup
Set the POWER switch to the ON position and allow the Weld Head Control and all test equipment to warm up for 15 minutes prior to calibrating the system.

Procedure
1. Set the POWER switch on the rear panel of the Weld Head Control to the OFF position.
2. Disconnect the AC input power to the Weld Head Control.
3. Remove the Weld Head Control cover.
4. Reconnect the AC input power to the Weld Head Control and set the POWER switch to the ON position.
5. From the MAIN MENU screen, select CALIBRATION and press [ENTER]. This accesses the PRE-CALIBRATION screen. A series of screens will be displayed that will guide you through the calibration procedure. You may soon find it more convenient to follow only the calibration screens as you become more familiar with the process. You will need a small, flat blade screwdriver for making potentiometer adjustments.
Figure 1-1. Control Board Test and Adjustment Points

6 Locate the Control Board, which is on the right hand side of the Weld Head Control. All of the test points and adjustment potentiometers are located on the Control Board. Refer to figure 1-1 on the last page of this procedure to locate the test and adjustment points.

7 Set the Calibration pushbutton switch on the top edge of the Control Board to the Calibration (UP) position.

8 Connect the voltmeter to test point TP1 and ground it at test point TPG. Adjust potentiometer R19 for a reading of 0.00 VDC, ± 1mV, on the voltmeter.

9 Press right arrow key [►]. The voltmeter should now read approximately 5 volts. Adjust potentiometer R9 for a reading of 5.786 VDC, ± 3mV, on the voltmeter.

10 Press right arrow key [►]. Adjust potentiometer R51 to set the indicator bar to center scale, or zero. Notice there is a 4-digit number just to the right of the word “Calibrate.” For best accuracy, adjust this reading to 0000, ± 2.

11 Press right arrow key [►]. Move the voltmeter lead to test point TP2. Adjust potentiometer R11 for a reading of 0.00 VDC, ± 1mV on the voltmeter.

12 Press right arrow key [►]. Adjust potentiometer R3 for a reading of -2.014 VDC, ± 1mV, on the voltmeter.

13 Remove the voltmeter from the circuit. Press right arrow key [►]. Adjust potentiometer R71 to set the indicator bar to center scale, and the 4-digit reading to 0000, ± 3.

14 Press right arrow key [►]. Adjust potentiometer R105 to set the indicator bar to center scale, and the 4-digit reading to 0000, ± 3.

15 Press right arrow key [►]. Adjust potentiometer R90 to set the indicator bar to center scale, and the 4-digit reading to 0000, ± 3.

16 Press right arrow key [►]. Set the Calibration switch to the normal (DOWN) position. Adjust potentiometer R108 to set the indicator bar to center scale, and the 4-digit reading to 0000, ± 3.
17 Insert the force gauge between the two electrodes. Press right arrow key [►]. Adjust potentiometer R118 for a reading of 10lb, ± 0.1lb (4.54 kg, ± 0.04 kg) on the force gauge.

**Note:** Make certain that the force gauge is absolutely perpendicular to the electrodes. A holding fixture installed in the lower electrode holder is recommended.

18 Press right arrow key [►]. Adjust potentiometer R113 to zero the indicator bar to center scale, and the 4-digit reading to 0000, ± 3.

19 Press right arrow key [►]. Verify that the reading on the force gauge is 2lb, ± 0.3lb (0.91 kg, ± 0.14 kg). If the force gauge reading is out of tolerance, press [RUN] to exit and restart calibration from step 5 of this procedure. If the reading is within tolerance, press right arrow key [►] and continue.

20 Use the up and down arrow keys to adjust the force gauge reading to 2lb, ± 0.2lb (0.91 kg, ± 0.09 kg).

21 Press right arrow key [►]. No more adjustments are necessary. Remove the force gauge from between the electrodes. Press [RUN] to exit the calibration screens and save the calibration settings in memory. The head will go through its start-up routine.

22 After the Weld Head Control screen has reached the MAIN MENU, set the POWER switch to the OFF position and disconnect the AC input power.

23 Apply Glyptol to all of the adjustment potentiometers, and replace the Weld Head Control cover. The calibration procedure is now complete.
## APPENDIX A
### TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Dimensions</strong></td>
<td></td>
</tr>
<tr>
<td>Model 301H / 302H Linear Actuator Module</td>
<td><strong>Dimensions:</strong> 14 in. (H) x 2 in. (W) x 4 in. (D) 35.56 cm (H) x 5.08 cm (W) x 10.16 cm (D) <strong>Weight:</strong> 13 lbs. (5.9 kg) excluding electrode holder</td>
</tr>
<tr>
<td>Model 350C Electronic Weld Head Control</td>
<td><strong>Dimensions:</strong> 8 ½ in. (H) x 10 ½ in. (W) x 15 ¾ in. (D) 21.59 cm (H) x 26.67 cm (W) x 38.42 cm (D) <strong>Weight:</strong> 45 to 48 lbs. (20.41 to 21.77 kg)</td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
</tr>
<tr>
<td>Line Voltage:</td>
<td>100/115/208/230 VAC, single phase, 50/60 Hz</td>
</tr>
<tr>
<td>Line Current:</td>
<td>10A rms @ 100/115 VAC, 5A rms @ 208/230 VAC</td>
</tr>
<tr>
<td>Weld Current Input (max):</td>
<td>5 kA</td>
</tr>
<tr>
<td>Control Signals:</td>
<td>Refer to Appendix B</td>
</tr>
<tr>
<td><strong>Operational</strong></td>
<td></td>
</tr>
<tr>
<td>Force:</td>
<td>Response Rate: 50,000 lbs./sec (22,680 kg/sec) Rating (RMS) 7.8 lbs. (3.53 kg) Weld and Hold 20lbs. (0 to 9.07 kg) Impulse 50 lbs. (0 to 22.68 kg) Resolution 0.1 lb. (45 g)</td>
</tr>
<tr>
<td>Displacement (Setdown):</td>
<td>Resolution 0.001 in. (25 microns) Measurement Resolution 0.0001 in. (2.5 microns)</td>
</tr>
<tr>
<td>Position Overshoot:</td>
<td>None</td>
</tr>
<tr>
<td>Rate:</td>
<td>Slew (max) 30 in. (76.2 cm)/sec Weld Repetition (self-limiting) (max) 4/sec</td>
</tr>
<tr>
<td>Stroke (max):</td>
<td>0.999” in. (2.54 cm)</td>
</tr>
<tr>
<td>Electrode Holders 301H</td>
<td>In Line, Quick Change, 0.204 in. (6 mm) to 0.25 in. (6.35 mm) O.D. electrodes</td>
</tr>
<tr>
<td>302H</td>
<td>1/8-inch offset electrodes</td>
</tr>
</tbody>
</table>
APPENDIX B

WELD HEAD CONTROL
INPUT/OUTPUT SIGNALS
Weld Head Control Connector Functions

The connectors on the rear panel of the 350C Weld Head Control are shown in figure B-1. The functions of the connectors are as follows:

- **ACCESSORY PORT**: 25-pin D-type connector to accommodate future expansion.

- **SERIAL PORT**: 25-pin D-type connector transmits weld force and weld displacement data, using RS-485 protocol, to a user data logging device or host computer. Refer to Appendix D and the Series 350 Serial Communications Interface Manual, No. 990-116, for pin assignments.
APPENDIX B: WELD HEAD CONTROL INPUT/OUTPUT SIGNALS

- **CONTROL SIGNAL INPUT:** 15-pin D-type connector that receives control signals from external automation equipment for schedule selection, emergency shutdown, process inhibit and alarm relay control.

- **CONTROL SIGNAL OUTPUT:** 15-pin D-type connector that furnishes remote schedule selection signals to the power supply.

- **WELD FIRE SWITCH:** Initiates the power supply weld current.

- **FOOT SWITCH:** Initiates the weld cycle.

- Lower central cable with right-angle connector: Conducts command signals to, and feedback signals from, the Linear Actuator.

- Right bottom corner cable: Power mains input.

**CONTROL SIGNAL INPUT Connector**

The CONTROL SIGNAL INPUT connector interfaces with a Programmable Logic Control (PLC) or host computer for operation in an automated environment. As shown in figure B-2, the connector accommodates three functional groups of signals: remote schedule selection, relay contact outputs, and process stop external inputs. The signal functions and pin assignments are listed in table B-1. Typical control signal input circuits are shown in figure B-3.

![Figure B-2. PLC Interface Schematic Diagram](image-url)
Remote Schedule Selection

These signals allow schedule selection via a binary parallel interface. The controlling device — a PLC or host computer, for example — should provide isolated dry relay contacts or open collectors from opto-couplers to activate these signals.

Table B-1. CONTROL SIGNAL INPUT Connector Pin Assignments

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARALLEL REMOTE SCHEDULE SELECTION INPUTS. May be set up at any time during operation. Next first-level foot switch contact closure selects the next schedule. All lines have internal 1k ohm pull up to +5V and are active low. See figure B-3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>$2^0$</td>
<td>Binary remote schedule select bit 1 (input 1)</td>
</tr>
<tr>
<td>2</td>
<td>$2^1$</td>
<td>Binary remote schedule select bit 2 (input 2)</td>
</tr>
<tr>
<td>3</td>
<td>$2^2$</td>
<td>Binary remote schedule select bit 3 (input 4)</td>
</tr>
<tr>
<td>4</td>
<td>$2^3$</td>
<td>Binary remote schedule select bit 4 (input 8)</td>
</tr>
<tr>
<td>12</td>
<td>$2^4$</td>
<td>Binary remote schedule select bit 5 (input 16)</td>
</tr>
<tr>
<td>5</td>
<td>$2^5$</td>
<td>Binary remote schedule select bit 6 (input 32)</td>
</tr>
<tr>
<td>14</td>
<td>$2^6$</td>
<td>Binary remote schedule select bit 7 (input 64)</td>
</tr>
<tr>
<td>ISOLATED SOLID STATE RELAY CONTACT OUTPUTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Relay K2 Output</td>
<td>+5-50 VDC (from user supplied power)</td>
</tr>
<tr>
<td>8</td>
<td>Relay K1 Output</td>
<td>5-35 VAC (from user supplied power)</td>
</tr>
<tr>
<td>13</td>
<td>Relay K2 Return</td>
<td>+5-50 VDC return</td>
</tr>
<tr>
<td>15</td>
<td>Relay K1 Return</td>
<td>5-35 VAC return</td>
</tr>
<tr>
<td>PROCESS STOP EXTERNAL INPUTS. All lines have internal 10 k ohm pull up to +5V and are active low.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Process Inhibit</td>
<td>Process stop input</td>
</tr>
<tr>
<td>10</td>
<td>Emergency Shutdown</td>
<td>Emergency stop input</td>
</tr>
<tr>
<td>11</td>
<td>Circuit Ground</td>
<td>DC common</td>
</tr>
</tbody>
</table>
Emergency Shutdown Input

Connect a switch, reed relay or the collector of an opto-coupler to Pin 10 of the CONTROL SIGNAL INPUT connector to immediately terminate the welding process. No welding process can be initiated until the inhibit status of the input has been removed. The emitter of the opto-coupler must be connected to pin 11.

You can select the state of the input (normally open or normally closed) with the OPTIONS 1 screen. Refer to Chapter 3 under Options Selection.

Process Inhibit Input

Connect a reed relay or the open collector of an opto-coupler to pin 9 of the CONTROL SIGNAL INPUT connector to prevent a new welding process from beginning. No welding process can be initiated until the switch closure has been removed. The emitter of the opto-coupler must be connected to pin 11.

Output Relays

Output relays K1 and K2 (see figure B-4) can be used to provide status or timing signals to a Programmable Logic Control (PLC) or host computer. When used for status signals, the relays can be independently programmed to close:

(a) when an alarm condition exists
(b) during the RUN state
(c) during the weld period, or
(d) during the entire welding cycle.

As shipped, either relay can switch either AC or DC current. AC signals are limited to from 5 to 35 volts RMS at 0.5 amps maximum. DC signals are limited to from 5 to 50 volts at 0.7 amps. Polarity does not have to be observed.
To switch higher DC currents, either relay can be removed from its socket and reinserted two positions to the right. Maximum relay current is limited to 1.0 amps. Polarity must now be observed.

**CONTROL SIGNAL OUTPUT Connector**

When the control signal output cable is connected between this connector and the CONTROL SIGNALS connector on the HF2 or HF25 Power Supply, selecting a new schedule on the Weld Head Control automatically selects the identical schedule number on the power supply. On the UB25 Power Supply, the schedule must be separately set on the power supply. See table B-2 for the connector pin assignments.

**Table B-2. CONTROL SIGNAL OUTPUT Connector Pin Assignments**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2^0</td>
<td>Binary remote schedule select bit 1 (input 1)</td>
</tr>
<tr>
<td>2</td>
<td>2^1</td>
<td>Binary remote schedule select bit 2 (input 2)</td>
</tr>
<tr>
<td>3</td>
<td>2^2</td>
<td>Binary remote schedule select bit 3 (input 4)</td>
</tr>
<tr>
<td>4</td>
<td>2^3</td>
<td>Binary remote schedule select bit 4 (input 8)</td>
</tr>
<tr>
<td>12</td>
<td>2^4</td>
<td>Binary remote schedule select bit 5 (input 16)</td>
</tr>
<tr>
<td>5</td>
<td>2^5</td>
<td>Binary remote schedule select bit 6 (input 32)</td>
</tr>
<tr>
<td>14</td>
<td>2^6</td>
<td>Binary remote schedule select bit 7 (input 64)</td>
</tr>
<tr>
<td>7</td>
<td>Logic Out</td>
<td>Not implemented</td>
</tr>
<tr>
<td>6</td>
<td>Logic In</td>
<td>Not implemented</td>
</tr>
<tr>
<td>11, 13</td>
<td>Circuit Ground</td>
<td>DC Common</td>
</tr>
<tr>
<td>Shroud</td>
<td>Chassis Ground</td>
<td>Power return</td>
</tr>
<tr>
<td>8, 9, 10, 15</td>
<td>None</td>
<td>Not used</td>
</tr>
</tbody>
</table>
Weld Fire Switch Cable

The 5-foot weld fire switch cable is terminated with an Amphenol 80-MC2M connector (Amada Miyachi America P/N 520-001) to connect to the power supply weld fire switch cable. Pin 1 is signal and pin 2 is digital ground. The weld fire switch signal initiates the power supply weld current when the 301H Linear Actuator (weld head) reaches the programmed weld force.

FOOT SWITCH Connector

The FOOT SWITCH connector uses a 4-pin Amphenol 91-PC4F (Amada Miyachi America P/N 550-006) bulkhead connector that mates with an Amphenol 91-MC4M (Amada Miyachi America P/N 520-009). The connections for the two-level FS2L Foot Switch are shown schematically in figure B-5. The pin assignments are listed in table B-3.

When the foot switch is pressed to the first level, the Weld Head Control energizes the weld head, causing the Upper Electrode to descend to the search position. If you release the foot switch before you press the foot switch to the second level, the Weld Head Control will automatically return the upper electrode to its up position so that you can reposition the parts. Once the second level has been reached and the programmed weld force has been reached, weld current will flow and the Weld Head Control will automatically return the upper electrode to its up position.

The FOOT SWITCH connector also accommodates a reed relay or an opto-coupler to initiate the weld operation. The emitter of an opto-coupler must be connected to pin 4.
Table B-3. FOOT SWITCH Connector Pin Assignments

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chassis</td>
<td>Chassis ground</td>
</tr>
<tr>
<td>2</td>
<td>1-Level</td>
<td>Foot switch level-1 input. Internal 10 k ohm pull up to +5V. When grounded, head moves to SRCH position.</td>
</tr>
<tr>
<td>3</td>
<td>2-Level</td>
<td>Foot switch level-2 input. Internal 10 k ohm pull up to +5V. When grounded, head completes weld cycle.</td>
</tr>
<tr>
<td>4</td>
<td>Com</td>
<td>DC common</td>
</tr>
</tbody>
</table>
APPENDIX C

WELD HEAD DYNAMICS

This appendix describes graphically and textually the dynamics of the Series 300 Actuator during a weld cycle. The explanation should be useful to those who are tasked to install, set up and operate the system.
The following narrative steps describe the electrode status or action at each stage of the weld cycle.

1. The electrodes are brought into contact with the weld material.

2. The electrode force is increased to the programmed weld force. When the electrode stops moving and the weld force is established, the net force acting on the electrode is 0 (zero). That is, the weld force supplied by the linear actuator (or spring) is balanced by the reaction force of the weld material.

3. The resistance welding power supply is turned on.

4. Weld current flows through the electrodes and the weld material.

5. After a short period, the weld material softens or melts.

6. The net force on the electrodes is now no longer 0 (zero). The reaction force provided by the weld material decreases because the material has softened. Now, the electrodes start to move into the weld material. This movement, called ‘follow-up,’ compresses the weld material until the reaction force builds up again and exactly balances the applied weld force.

7. During the follow-up movement, the electrodes move from a dead stop to a certain speed throughout the follow-up period. Then, they stop when the reaction force builds up again. The time that is most crucial to weld quality is when the electrodes just start to move. They must accelerate rapidly to maintain force on the weld material to prevent expulsion.
The above graph shows the relationship between the follow-up displacement (position), speed and acceleration over follow-up time during a typical cross-wire weld cycle. Note that the amount of acceleration needed to follow the deformation of the weld material is 8,400 inches (213 meters)/second², or about a 22 g acceleration. That means that the weld force during the follow-up acceleration period must be at least equal to the applied weld force, plus 22 times the weight of the moving head mass (the electrode, flexures, weld head shaft, and so on).

Suppose the moving mass of the weld head weighs 1.4 lbs. (636 grams). In order for the weld head to execute the required motion shown in the diagram while maintaining a weld force of 4 lbs. (1.81 kilograms) on the weld material, the applied force must be increased to:

\[
1.81 + (22 \times 0.63) = 15.7 \text{ kg, or}
\]

\[
4 + (22 \times 1.4) = 34.8 \text{ lbs}
\]

A spring-driven weld head is adjusted to provide the weld force needed to create the right heat balance at the weld joint. If a spring drive were adjusted to provide 4.0 pounds of weld force for the above-describe weld, the electrode could not possibly accelerate fast enough to follow the deformation of the weld material and so avoid expulsion. This means that, with a spring-driven weld head, a compromise must be reached between proper heat balance and follow-up performance.
The Model 301H Linear Actuator, on the other hand, has the unique feature of a programmable follow-up force that is independent of the weld force. You can optimize both the weld force and the follow-up movement to get the best possible weld head dynamic behavior by:

- Setting the follow-up delay time (DLY) to cause the follow-up force to occur when the electrode should be accelerating into the weld material during follow-up, and
- Adjusting the follow-up force magnitude and duration (FWUP) to maintain the proper force on the weld material while the electrode is moving.

As a general guide for programming FWUP, multiply 2.5 lbs per each 0.001 inch (44.6 Kg/millimeter) of electrode displacement, then add this new constant to the weld force value. Use the combined total as the new programmed follow-up force. For example:

**Given:**

<table>
<thead>
<tr>
<th>Existing weld force</th>
<th>10 lbs (4.54 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrode displacement</td>
<td>0.004 in. (0.10 mm)</td>
</tr>
</tbody>
</table>

**New Constant:**

\[
(2.5/0.001) \times 0.004 = 10
\]

**New FWUP Force:**

\[
\text{New constant} + \text{existing weld force} = 10 + 10 = 20 \text{ lbs. (9 kg)}
\]

This degree of control and flexibility allows the Series 300 Fast Response Weld Head System to execute consistently high quality welds.
APPENDIX D
RS-232 Serial Communications

Overview

The 350C Weld Head Control has a single RS-232/485 SERIAL PORT connector for transmitting weld data to a serial data collecting device such as a Personal Computer (PC) or host computer. Multiple Weld Head Controls can be placed on a multi-drop RS-485 communications line for weld data collection by a host computer using the ASCII command language and protocol listed in the Series 350 User’s Manual, Amada Miyachi America Part Number 990-116.

Table D-1. Interface Protocol

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud Rate</td>
<td>1.2k, 2.4k, 4.8k, 9.6k, 14.4k, 19.2k or 28.8k bits/second</td>
</tr>
<tr>
<td>Stop Bits</td>
<td>1</td>
</tr>
<tr>
<td>Data Bits</td>
<td>8</td>
</tr>
<tr>
<td>Parity</td>
<td>None</td>
</tr>
<tr>
<td>Duplex</td>
<td>Half</td>
</tr>
</tbody>
</table>

RS-232 SERIAL PORT Connections

Refer to figure D-1. The RS-232 SERIAL PORT connector is a standard 25-pin female D-Sub connector. This connector will mate with any standard 25-pin male D-Sub connector, such as the Amada Miyachi America P/N 250-479 connector (+ 250-027 connector shell).

Connect an RS-232 cable between your host computer COM1 or COM2 ports and the Weld Head Control serial data port.

Figure D-1. RS-232C Serial Data Port Connections
RS-232 Serial Printer Operation

You can send weld data from the Weld Head Control directly to an RS-232 serial printer or host computer. To send weld data directly to a printer or PC, proceed as follows:

1. On the Weld Head Control, press [MENU] to access the MAIN MENU screen.
2. On the MAIN MENU screen, select ■COMMUNICATIONS to access the COMMUNICATIONS screen.
3. On the COMMUNICATIONS screen, select ROLE: SLAVE.
4. Press [CHNG] to change the role to ROLE: MASTER.
5. Press [RUN] to return the Weld Head Control to the run state.
6. Connect a serial printer or PC using a straight-through RS-232 cable to the Weld Head Control SERIAL PORT connector.
7. Set the printer or PC communication parameters in accordance with the parameters listed in table D-1.
8. The Weld Head Control will now automatically send out weld data for each weld.

Weld Data Output Format

The data fields in the weld data report packet are organized as follows:

\[ \text{weld_count, schedule_number, thickness, setdown, weld_time, weld_status} \]

The fields are separated with commas and all fields are in integer format. The six fields in a report packet are as follows:

- **weld_count**: Weld count of the weld (0 - 9999999)
- **schedule_number**: Schedule number of the weld (0 - 127)
- **thickness**: Thickness of the weld material before the weld starts, in inches or millimeters. Resolution is 0.001 inch.
- **setdown**: Reading of the final setdown, in inches or millimeters. Resolution is 0.001 inch.
**weld_time:** Duration of the weld signal. Resolution is 0.1 milliseconds.

**weld_status:** Status of the weld.

An example of a weld data print out is:

17,0,0.005,-0.0004,10,0

where:

17 = weld count

0 = weld schedule number

0.005 = material thickness of 0.005 inch

-0.0004 = setdown of -0.0004 inch

10 = weld time of 10.0 milliseconds

0 = weld status of 0, which is good.
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