USER'S MANUAL

Swagelok®

REGULATORY

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Swagelok®

REGULATORY

This module contains the following information:

- Warranty Information Form
- Declaration of Conformity
- Registration Information
- Safety Summary
- Power Supply Warning Label
- Referenced Specifications.

The Warranty Information Form must be completed and returned to your Swagelok Representative to activate the warranty.

The Registration Information page provides a convenient place to record pertinent Power Supply and Weld Head information.

Swagelok Welding System

Warranty Information Form

IMPORTANT

Please complete and return this form to your Swagelok® Representative for warranty activation.

Date of Delivery: _____

Power Supply Model Number: _____
Serial Number: _____

Weld Head Model Number: _____
Serial Number: _____

Company Name: _____

Local Swagelok Distributorship: _____

_____

_____

Market Area *(check all that apply)*

- ❑ Semiconductor
- ❑ Oil & Gas
- ❑ Power
- ❑ Bioprocess / Pharmaceutical
- ❑ Analytical Instrumentation
- ❑ Process Instrumentation
- ❑ Steam / Utilities
- ❑ Other (*Please describe)* _____

_____

User Type *(check all that apply)*

- ❑ O.E.M.
- ❑ Fabricator
- ❑ Contractor
- ❑ Maintenance Department
- ❑ University or Research and Development Lab
- ❑ Operator Training Program
- ❑ Other (*Please describe)* _____

_____

Intended Use *(check all that apply)*

- ❑ Maintenance
- ❑ New Construction
- ❑ Research and Development
- ❑ Distributor Use (*Rental, Demonstration, Service)*
- ❑ Cleanroom *Class:* _____
- ❑ Training
- ❑ Other (*Please describe)* _____

_____

CE

DECLARATION OF CONFORMITY

CE-DECLARATION DE CONFORMITE, EG-ÜBEREINSTIMMUNGSERKLÄRUNG,
DICHIARAZIONE DI CONFOMITÀ-CE, EC-DECLARACIÓN DE CONFORMIDAD

Manufacturer:
Swagelok Company
29500 Solon Road
Solon, Ohio 44139-3492
USA

Authorized Representative:
Swagelok AG
St. Gallerstrasse 84
CH-8853 Lachen
Switzerland

Product:
Produit, Produkt, Prodotto, Producto:
Orbital Gas Tungsten Arc Welding (GTAW) System

Model:
Modèle, Modell, Modello, Modelo:
SWS-M100

This Product Complies With The Following European Community Directives:

Ce produit conforme aux directives suivantes de la Communauté Européenne,
Dieses Produkt entspricht den nachstehend aufgeführten Richtlinien der Europäischen Union,
Questo prodotto é conforme ai seguenti direttivi della Comunità Europea,
Este producto cumple con las directivas siguientes de la Comunidad Económica Europea:

EMC DIRECTIVE 89/336/EEC
LOW VOLTAGE DIRECTIVE 73/23/EEC
AS AMENDED BY THEIR COUNCIL DIRECTIVES

The Following Standards Were Used To Verify Compliance With The Directives:

Les normes suivantes ont été appliquées pour vérifier que ce produit conforme aux directives,
Die folgenden Normen wurden angewendet zur Überprüfung der Übereinstimmung mit den oben genannten Richtlinien,
Sono state usate le seguenti norme per verificare la conformità ai direttivi,
Las normas siguientes han sido utilizadas para verificar que el producto cumple con las directivas correspondientes:

EMC STANDARDS: EN 50199, EN 55011, IEC 1000-4-2, IEC 1000-4-3, IEC 1000-4-4
LOW VOLTAGE STANDARDS: EN 60974-1, EN 60974-12

Approved By:
Approuvée Par, Genehmigt Durch,
Approvato da, Aprobado por:

Position:
Poste, Position, Posto, Puesto:
Vice President of Operations

Date:
Date, Datum, Data, Fecha:
25 March, 1999

Swagelok®

BCL - 101

Registration Information

Your Swagelok representative provides support and service for your Swagelok Welding System (SWS) and maintains a local stock of precision fittings and valves.

Please take a moment to fill out the information listed below. Keep this information available in case you need to contact your Swagelok representative.

Power Supply:

Model Number: _____

Serial Number: _____

Delivery Date: _____

See rating label on the rear of the unit, shown in Figure 1.

Weld Head(s):

Weld Head:

Model Number: _____

Serial Number: _____

Delivery Date: _____

Model Number: _____

Serial Number: _____

Delivery Date: _____

Model Number: _____

Serial Number: _____

Delivery Date: _____

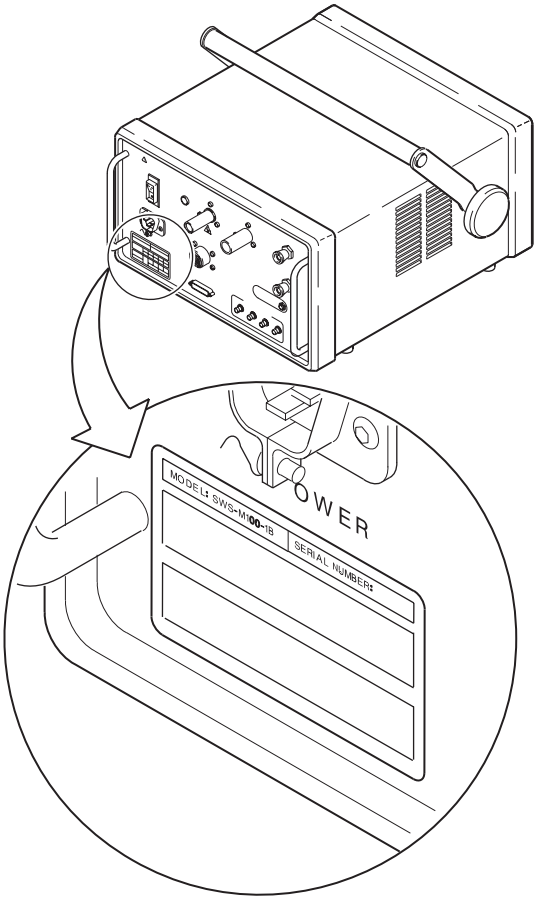


Figure 1 Rating Label

Safety Summary

The safety information presented here pertains to both the Swagelok® Welding System (SWS) and the process of Gas Tungsten Arc Welding (GTAW).

Read Operating Instructions

Read all of the instructions in this manual prior to operating the SWS.

Statements

Caution!	Statements identify conditions or practices that could result in damage to the equipment or other property.
WARNING!	Statements identify conditions or practices that could result in personal injuries or loss of life.

Symbols

The following symbols are used in this manual and on the equipment to visually identify where warning or caution information is found. Consult symbols and related instructions below for necessary actions to avoid the hazards.

WARNING or Caution

This symbol identifies the location of all other types of warning or caution information which don't have specific symbols. Accompanying text will identify the specific nature of the condition and if the condition is a warning or caution.

ELECTRIC SHOCK can kill.

Touching live electrical parts can cause fatal shocks and severe burns. Incorrectly installed or improperly grounded equipment is a hazard.

- Do not touch live electrical parts.
- No user serviceable parts in the power supply other than a fuse. Refer all other power supply servicing to your Authorized Swagelok representative.
- Keep all panels and covers securely in place. Do not touch electrode connector, electrode, or rotor after pressing start. The electrode is live during the weld cycle.
- Verify that the power supply is properly grounded before use. Make sure the power cord is plugged into a properly wired and grounded receptacle.
- Follow local electrical codes and the guidelines in the manual when installing the SWS. Failure to do so may create an electrical shock hazard. Shock hazards can exist even when equipment is properly installed, so it is important that the operator be trained in the proper use of the equipment and follow established safety practices.
- Frequently inspect input power cord for damage or bare wiring – replace immediately if damaged.
- Properly unplug the power cord. Grasp the plug to remove it from the receptacle.
- Do not use extension cords that are in poor physical condition or have insufficient current capacity. Failure to do so can pose fire and shock hazards.

FUMES AND GASES can be hazardous.

Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health. Build-up of gases can displace oxygen and cause injury or death.

- Do not breathe fumes or gases.
- If inside, ventilate the area and/or use exhaust at the arc to remove welding fumes and gases.
- If ventilation is poor, use an approved air-supplied respirator.
- Read the Material Safety Data Sheets (MSDSs) and the manufacturer's instructions for metals, consumables, coatings, cleaners, and degreasers.
- Work in a confined space only if it is well ventilated or while wearing an air-supplied respirator. Always have a trained watch-person nearby. Welding fumes and gases can displace air and lower the oxygen level causing injury or death. Be sure the breathing air is safe.
- Do not weld in locations near degreasing, cleaning, or spraying operations. The heat and rays of the arc can react with vapors to form highly toxic and irritating gases.
- Do not weld on coated metals, such as galvanized, lead, or cadmium plated steel, unless the coating is removed from the weld area, the area is well ventilated, and if necessary, while wearing an air-supplied respirator. The coatings and any metals containing these elements can give off toxic fumes if welded.
- The ultraviolet light emitted by the welding arc acts on the oxygen in the surrounding atmosphere to produce ozone. Test results①, based upon present sampling methods, indicate the average concentration of ozone generated in GTAW process does not constitute a hazard under conditions of good ventilation and welding practice.

  ① **WELDING HANDBOOK, VOLUME 2, 8TH EDITION, AMERICAN WELDING SOCIETY**.

- Shut off shielding gas supply when not in use.

ARC RAYS can burn eyes.
NOISE can damage hearing.

Arc rays from the welding process produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes. The SWS is meant for use only with enclosed weld heads which minimize exposure to these harmful rays.

- Do not look at welding arc.
- Use protective screens or barriers to protect others from flash and glare; warn others not to watch the arc.
- Wear approved ear protection if noise level is high.

WELDING can cause fire or explosion.

Welding on closed containers, such as tanks, drums, or pipes, can cause them to blow up. The hot work piece and hot equipment can cause fires and burns. Check and be sure the area is safe before doing any welding.

- Protect yourself and others from the hot work piece.
- Watch for fire, and keep a fire extinguisher nearby.
- Do not weld on closed containers such as tanks, drums, or pipes, unless they are properly prepared according to AWS F4.1.
- Do not use welder to thaw frozen pipes.
- Do not use extension cords that are in poor physical condition or have insufficient current capacity. Failure to do so can pose fire and shock hazards.

Safe Practices and Safety Precautions

Read ANSI Z49.1

Safety and safe practices in welding, cutting and allied processes are covered in ANSI Z49.1, *Safety in Welding and Cutting*. When using the SWS, follow all basic safety practices.

CYLINDERS can explode if damaged.

Shielding gas cylinders contain gas under high pressure. If damaged, a cylinder can explode. Since gas cylinders are normally part of the welding process, be sure to treat them carefully.

WARNING!

SHIELDING GAS CYLINDERS CAN EXPLODE IF DAMAGED OR IMPROPERLY TREATED.

- Protect compressed gas cylinders from excessive heat, mechanical shocks, slag, open flames, sparks, and arcs.
- Install cylinders in an upright position by securing to a stationary support or cylinder rack to prevent falling or tipping.
- Keep cylinders away from any welding or other electrical circuits.
- Never weld on a pressurized cylinder – explosion will result.
- Use only correct shielding gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and associated parts in good condition.
- Turn face away from valve outlet when opening cylinder valve.
- Keep protective cap in place over valve except when cylinder is in use or connected for use.
- Read and follow instructions on compressed gas cylinders, associated equipment, and CGA publication P-1 listed in *Safety Standards.*

HOT PARTS can cause severe burns.

After welding, the work piece, weld head,
and electrode can be extremely hot and may cause burns.

WARNING!

HOT PARTS ARE PRESENT AFTER WELDING AND MAY CAUSE BURNS.

MAGNETIC FIELDS can affect pacemakers.

- Pacemaker wearers keep away.
- Wearers should consult their doctor before going near arc welding operations.

WARNING!

PACEMAKER WEARERS KEEP AWAY.

User Precautions

- **Power Supply Grounding**

  The power supply is grounded through the ground connector of the power cord. Avoid electrical shock by making sure the power cord is plugged into a properly wired and grounded receptacle before turning on the unit.

- **Water and Moisture**

  Do not expose the SWS equipment to water or visible moisture.

- **Proper Use and Storage**

  Do not store or use near hazardous materials. Store indoors and cover the system when not in use.

- **Weld Heads**

  Disconnect the weld head completely from the power supply prior to servicing.

  User service, including cleaning or component replacement, is limited to those operations identified in this manual.

- **Fixture Blocks**

  Disconnect the fixture block from the weld head prior to servicing. User service, including cleaning or component replacement, is limited to those operations identified in this manual.

- **Power Supply Service**

  There are no user serviceable parts in the power supply other than a fuse. Refer all other servicing to your Authorized Swagelok sales and service representative.

WARNING!

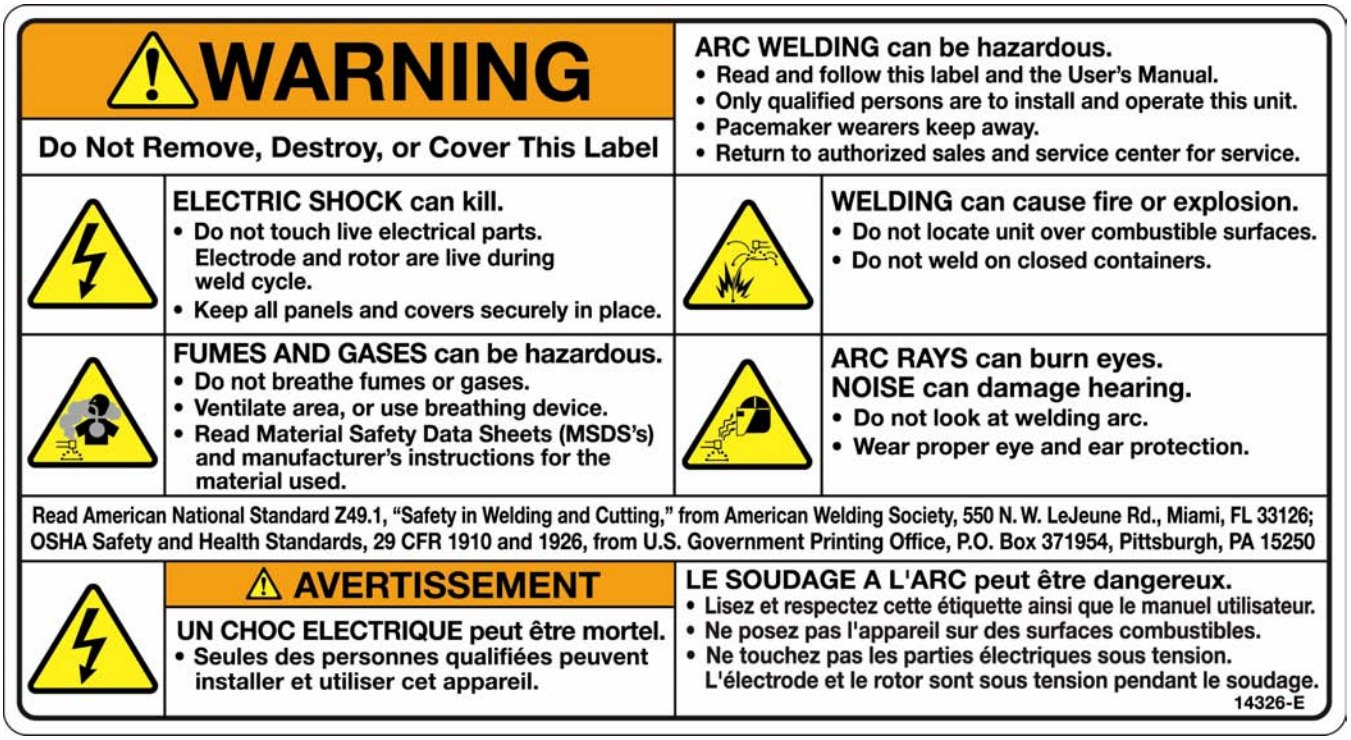
VERIFY THE SYSTEM IS PROPERLY GROUNDED BEFORE USE.

WARNING!

USERS SHOULD NOT SERVICE THE POWER SUPPLY.

Power Supply Warning Label

This warning label is affixed to the power supply.



Referenced Specifications

1. **AWS F4.1**, *Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping.*
   American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126 (www.aws.org).

2. ***ANSI Z49.1**, Safety in Welding Cutting, and Allied Processes.*
   American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126 (www.aws.org).

3. **CGA Publication P-1**, *Safe Handling of Compressed Gases in Cylinders.*
   Compressed Gas Association, 4221 Walney Road, 5th Floor, Chantilly VA 20151-2923, (www.cganet.com).

4. **OSHA 29CFR 1910 Subpart Q**, *Welding Cutting, and Brazing.*
   Aquire from U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250 (www.osha.gov).

5. **OSHA 29CFR 1926 Subpart J**, *Welding and Cutting.*
   Aquire from U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250 (www.osha.gov).

Printed in U.S.A., PPI
September 2005, R1
MS-13-202

M100 Power Supply

User's Manual

Swagelok®

M100 Power Supply

The M100 power supply features microcontroller electronics and closed-loop circuitry to precisely control output current. The software is accessible using the M100 operator display and keypad or the remote keypad. The data recording printer prints program information as well as welded outputs. The PC card may be used to store weld data and transfer data to a PC for QA/QC records.

The M100-HP model also features a HEPA 0.3 micron filter on the exhaust fan, non-shedding clean room paper in the internal thermal printer, non-marking acetal feet, and a smooth, white powder-coated finish for clean rooms.

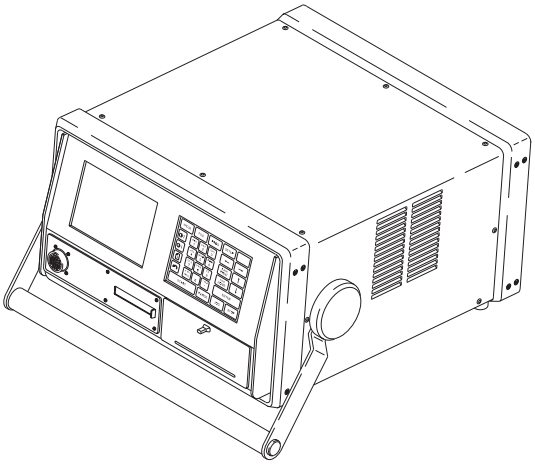


Figure 1 Power Supply

The M100 power supply uses screen-prompted software for weld parameter control. See Figure 2. The appropriate settings are generally defined by the work pieces to be welded and are refined using test welds. The correct settings used for a specific job are developed into a weld procedure guideline. The guideline is used to maintain repeatability and quality control for subsequent jobs of the same type.

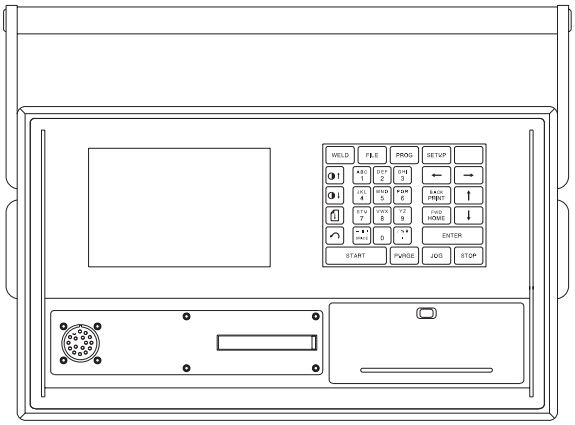


Figure 2 Power Supply Operator Display and Keypad

Installation

Tools and Accessory Requirements

You need the following tools and accessories to install and operate your SWS.

Tool/Accessory	Included?	Provided with
Hex Wrenches (0.050 in. to 5/32 in.)	Yes	Weld Head
Electrode Package	Yes①	Weld Head
Arc Gap Gauge	Yes①	Weld Head
Flat Blade Screw Driver	Yes	Weld Head
Centering Gauge	Yes①	Fixture Block
Quick-Connect Stem	Yes	Power Supply
Secondary Solenoid Bypass Plug	Yes	Power Supply
Dial/Digital Calipers or Micrometer	No	-
Purge Connector(s)	No	-
Shielding/Purge Gas Lines ②	No	-
Shielding/Purge gas Source ③	No	-
Pressure Regulator	No	-
Internal Purge Gas Flow Meter	No	-
Shielding Gas Flow Meter	No	-
Internal Pressure Gauge	No	-

① The Series 40 weld head does not include an arc gap gauge, centering gauge, or electrode package.

② All lines used for shielding/purge gas should be the low moisture absorption type.

③ A compressed gas bottle or liquid Dewar source can be used. Argon is the gas most frequently used.

Electrical Requirements

Table 1 Power Supply Electrical Requirements

Power Supply Model	Voltage Requirement	Service Current
SWS-M100-1 SWS-M100-HP-1	115 V*(ac)	20 A
SWS-M100-2 SWS-M100-HP-2	230 V (ac)	15 A

* If the input voltage is 100 V or less, the output power capabilities may be reduced.

Follow the electrical system guidelines below for power supply installation.

- All wiring and related components must be installed according to local code and National Electrical Code.
- A dedicated electrical circuit may be desired due to current need.

WARNING!

THE POWER SUPPLY MUST BE GROUNDED. IF IT IS NOT GROUNDED, ELECTRICAL SHOCK CAN OCCUR.

Using an Extension Cord

If it is necessary to use an extension cord, follow the guidelines below.

- Use only extension cords that meet the specifications indicated in Table 31.
- Extension cords longer than 100 ft (30 m) are not recommended.

Caution!

The voltage drop in an extension cord 100 ft long may affect the output performance of the SWS M100.

Unpacking the Power Supply

The SWS M100 power supply is packaged in a plastic shipping container. The power supply part number and serial number are located on a label on the outside of the container.

Note:
Keep the shipping container for storing and/or shipping.

Table 2 Shipping Container Contents

Part Description	Part No.	Qty.
Welder Power Supply	SWS-M100-* SWS-M100-HP-* *(Examples: SWS-M100-1 or SWS-M100-HP-2)*	1
Power Cord	CWS-CORD-* *(Examples: CWS-CORD-1 or CWS-CORD-9)*	1
1/4 in. Male Quick-Connect	SS-QC4-S-400	1
Secondary Solenoid Bypass Plug	-	1
Swagelok Welding System User's Manual	SWS-MANUAL-M100-** *(Examples SWS-MANUAL-M100-E or SWS-MANUAL-M100-J)*	1
PC Memory Card	SWS-PCCARD-1MB	1
PC Interface Cable	SWS-PC-CABLE	1

* Denotes Model
** Denotes Language

Remove the contents of the shipping container by performing the following steps:

1. Remove the following items:
   - Swagelok Welding System user's manual
   - Swagelok Quick-Connect stem
   - Secondary solenoid bypass plug
   - Power cord
   - PC memory card
   - PC interface cable
2. Remove the power supply by lifting it by the handle. Place the power supply on a stable cart, platform, or table.
3. Check the power supply and accessories for damage. Check that a roll of thermal printing paper is installed in the data-recording printer.
4. Check that the serial number on the rear panel of the power supply matches the serial number on the shipping container label.
5. Record the model number, serial number, and the delivery date on the Registration Information page in the Regulatory Module.

Installing the Power Supply

To get the maximum performance and reliability from your SWS, it must be set up and installed properly.

To install the power supply, follow these steps:

1. Position the power supply so that the front and rear panel controls are easily accessible.
2. Insert the power cord into the polarized receptacle on the rear of the power supply. See Figure 3.
3. Tighten the connector lock at the base of the receptacle to secure the cord in the receptacle.
4. Ensure that the power cord reaches an electrical outlet.

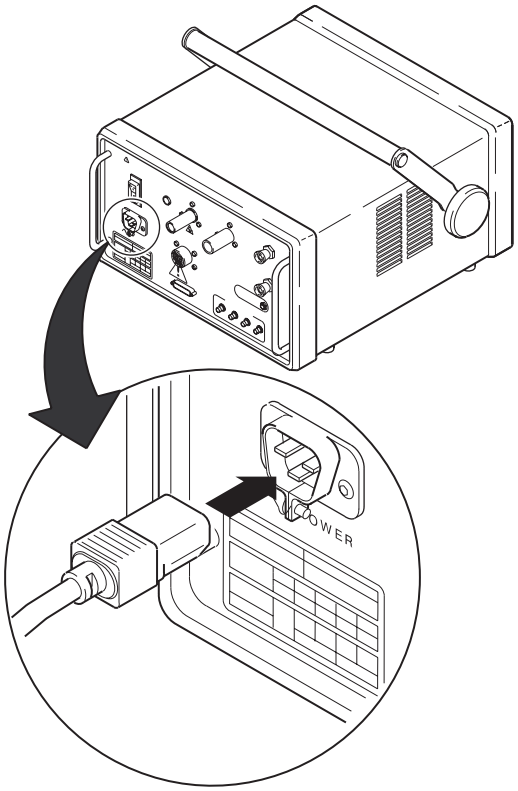


Figure 3 Insert the Power Cord Here

WARNING!

DO NOT CONNECT THE POWER CORD TO THE OUTLET AT THIS TIME.

5. Turn off the power supply circuit breaker on the rear panel of the unit. See Figure 4.

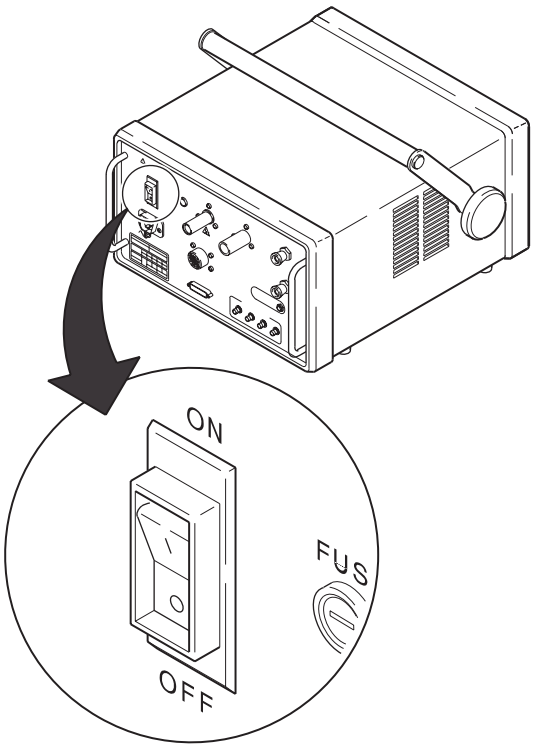


Figure 4 Turn Off Circuit Breaker

Installing the Weld Head

The weld head assembly has four connectors that plug into the power supply. See Figure 5.

The four connectors on the cable are:

- Threaded multi-pin connector
- Electrode (red)
- Work (green)
- Weld head shielding gas.

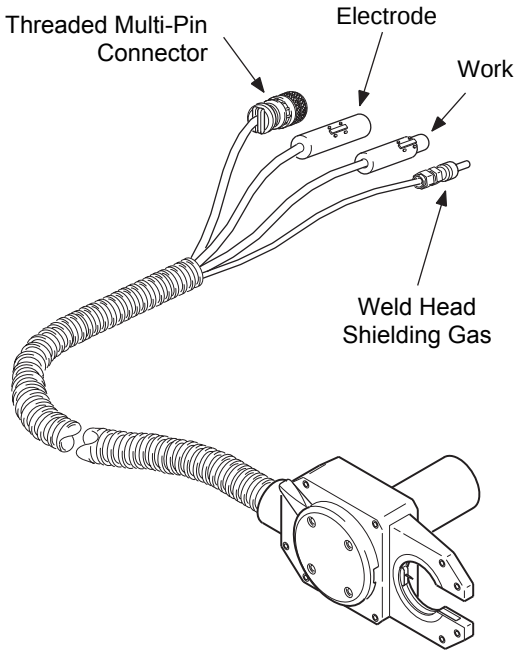


Figure 5 Weld Head Assembly

Connect the four connectors to the rear panel of the power supply by performing the following steps (see Figure 6):

1. Align the notch on the multi-pin connector with the small tab in the mating socket on the rear panel labeled FIXTURE. Insert the connector in the socket. Turn the connector sleeve clockwise by hand until it is tight. This connection provides the control signals to drive the weld head.
2. Insert and fully seat the red connector into the socket on the rear panel labeled ELECTRODE. Twist the connector one quarter-turn clockwise to lock it into place. This connection is the negative (-) terminal of the weld head.
3. Insert the green connector into the socket on the rear panel labeled WORK. Twist the connector one quarter-turn clockwise to lock it into place. This connection is the positive (+) terminal of the weld head.
4. Insert the weld head shielding gas connector into the Swagelok Quick-Connect stem labeled TO WELD HEAD.

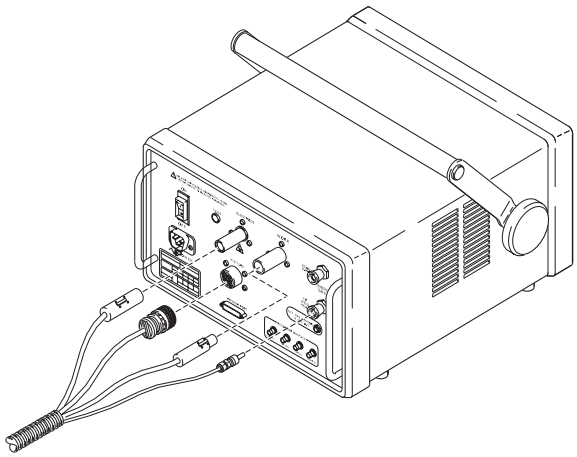


Figure 6 Weld Head Connectors

Caution!

Ensure that the threaded multi-pin connector is fully seated in the mating socket and the threaded sleeve is tight.

Note:
The weld head shielding gas connector must be a single-end shut-off (SESO) Swagelok Quick-Connect stem (SS-QC4-S-400).

Caution!

Ensure that the weld head shielding gas connector is firmly attached. This connection provides shielding gas to the weld head through a solenoid valve in the power supply.

Installing the Gas Delivery System

The gas delivery system provides shielding gas to the weld head to reduce oxidation or contamination of the weld puddle, tungsten electrode, and Heat Affected Zone (HAZ).

There are two types of gas delivery systems commonly used. For a typical gas delivery system, refer to the installation procedure below.

For a gas delivery system using a secondary shielding gas solenoid valve, see *Optional Gas Delivery System* beginning on page 11.

Typical Shielding/Purge Gas Delivery System

Figure 7 shows a typical system. Be sure to adhere to the following precautions:

- Ensure that the gas storage container(s) are secured before using them.
- Ensure all connections are tight and do not leak.
- Use only a Swagelok single-ended shut-off Quick-Connect stem on the shield/purge line for the shielding gas connector.
- Adjust the low-pressure regulator gauge to reduce the gas storage container source pressure to 25 to 50 psig (1.9 to 3.5 bar).

When complete, continue to the *Preliminary Check* procedure beginning on page 13.

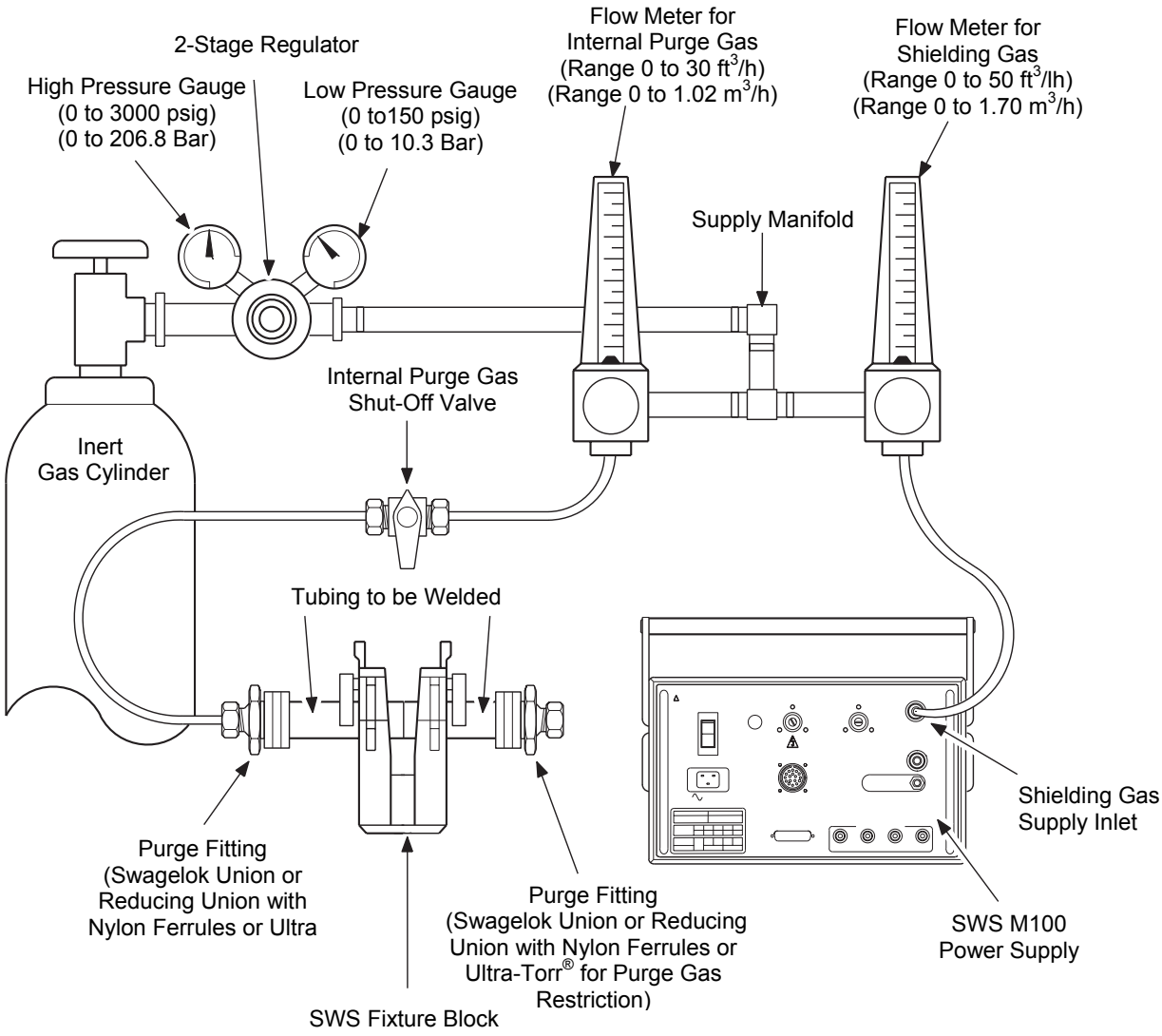


Figure 7 Typical Gas Delivery System

Optional Gas Delivery System

The optional gas delivery system is generally used in Ultra High Purity (UHP) gas sytems where quick connects are not permitted. This type of system uses an external 12 V (dc) secondary solenoid valve instead of using the solenoid valve located inside the power supply. If necessary, the secondary solenoid valve may be the high purity type.

A secondary solenoid bypass plug is inserted in the EXT GAS CONTROL connector on the rear panel to disable the solenoid inside the power supply and provide +12 V to control the secondary solenoid.

Caution!

Do not insert the secondary solenoid bypass plug into the connector unless you are using a secondary solenoid. Inserting the plug disables the power supply solenoid.

For the gas delivery system using a secondary shielding gas solenoid valve, locate the:

- Secondary solenoid bypass plug
- Secondary shielding gas solenoid valve
- 1/4-turn internal purge gas shut-off valve.

Referring to Figure 8, install the optional gas delivery system. Be sure to adhere to the following precautions:

- Ensure that the gas storage container(s) are secured before using them.
- Ensure all connections are tight and do not leak.
- Observe correct polarity on the secondary solenoid bypass plug.
- Adjust the low pressure regulator gauge to reduce the gas storage container source pressure to 25 to 50 psig (1.9 to 3.5 bar).

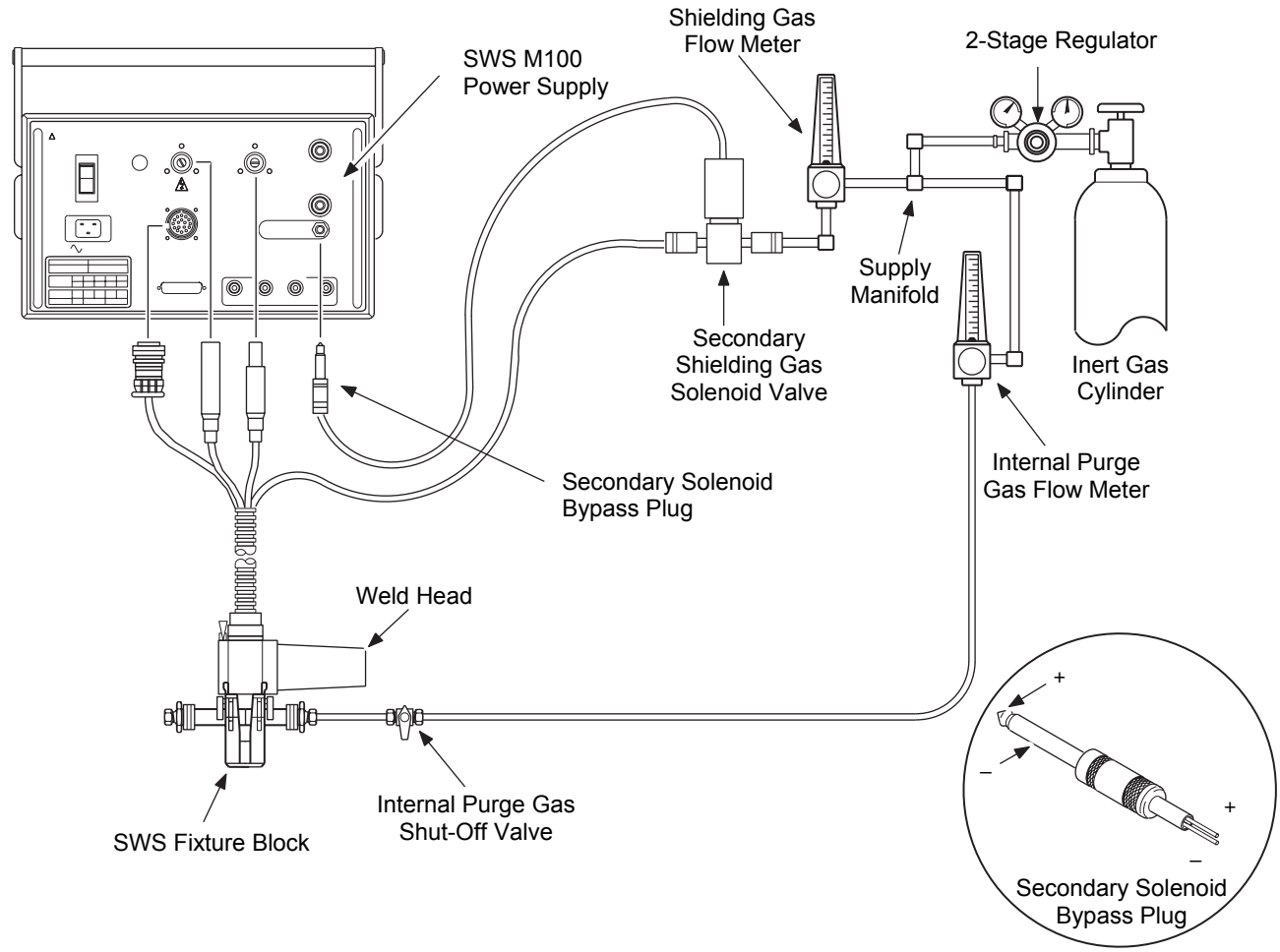


Figure 8 Optional Gas Delivery System

Preliminary Check

Before placing the SWS into operation, you should make some preliminary checks to verify the power supply is operating correctly.

To check the system, follow these steps:

1. Connect the power supply power cord to an appropriate electrical outlet.
2. Turn on the power supply circuit breaker.
3. At this point, an owner password, which can be up to 11 characters in length, is requested. You must enter a password to continue.
   - The programmer or the welding user does not need the owner password. Discrete passwords are available for these users.
   - The owner of the welding system should consider the owner password a “master key” and protect it as such.

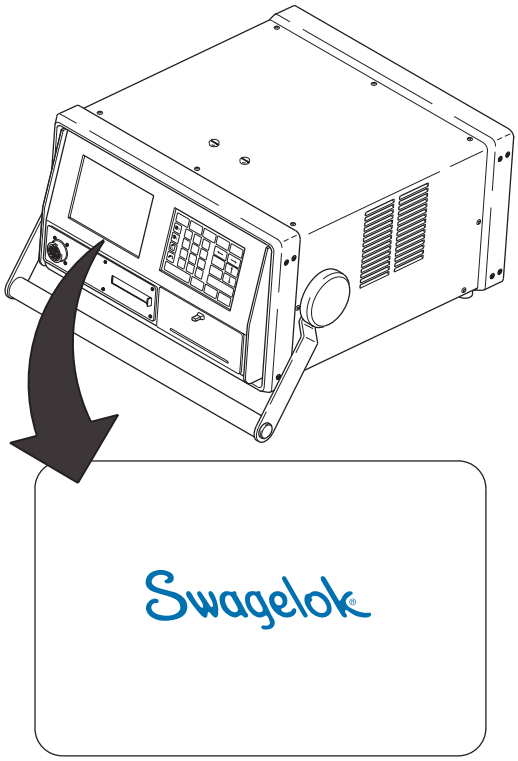


Figure 9 Password Requested

4. Position the weld head so that the rotor can be easily seen. See Figure 10. Do not attach the fixture block to the weld head.

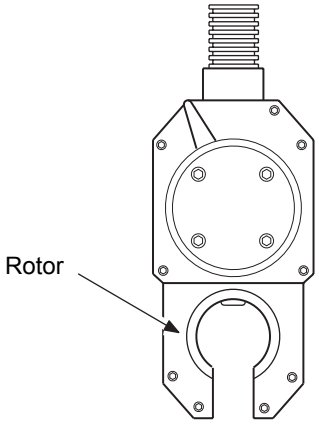


Figure 10 Postitioning the Weld Head to View the Rotor Rotation

5. Press **WELD**, then **JOG** on the operator keypad to return the rotor to its home position.
6. Turn off the power supply.
7. If problems occur, refer to the Troubleshooting manual for a list of possible causes and corrective actions.

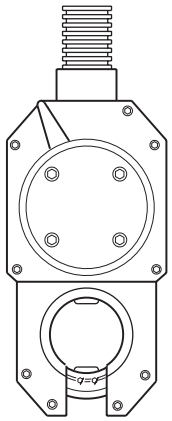


Figure 11 Checking the Rotor Rotation

Operation

This section describes the basic operation of the Swagelok Welding System (SWS). This section covers:

- Front panel controls
- M100 modes of operation and functions
- Entering the weld parameters
- Setting the shield gas flow
- Starting and completing the weld
- Using the data recording printer
- Using the PC memory card

The welding process described in this section uses a weld procedure guideline for tubing with a 1/2 in. OD and 0.049 in. wall thickness. A weld procedure guideline is a list of weld parameter settings for a particular job. Keep in mind that the weld parameters listed in this section are for demonstration purposes and may not produce an optimum weld. Weld Parameter Development describes how to optimize welding parameters.

Front Panel Controls

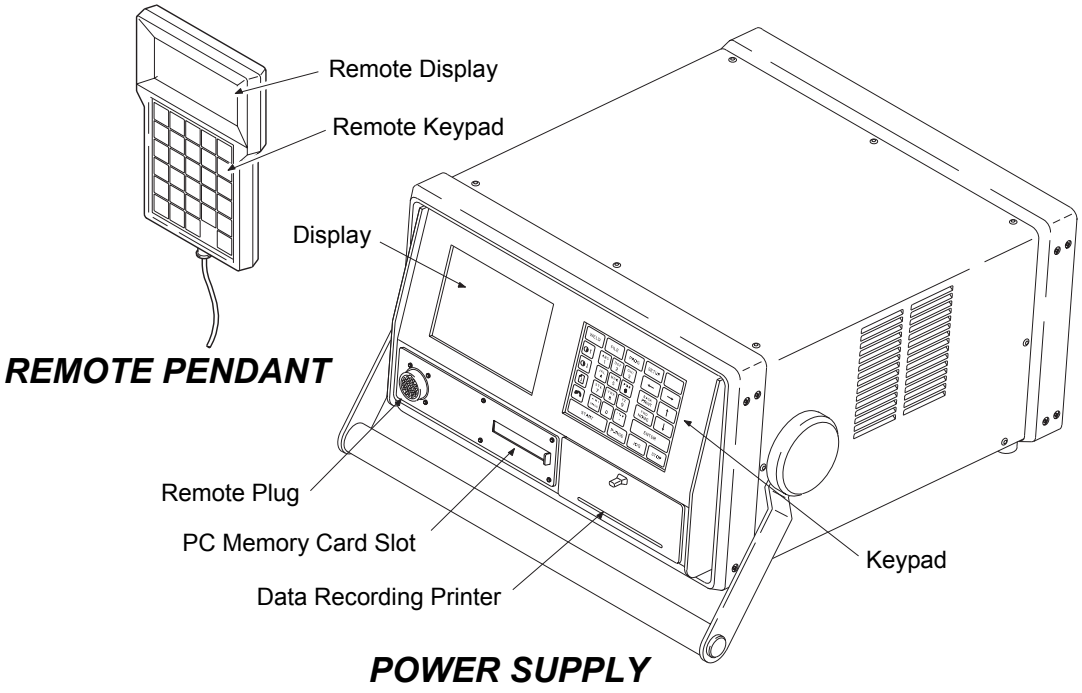


Figure 12 Front Panel Controls

The operator interface on the front panel of the power supply includes a keypad and the display. The keypad provides a means of entering information needed to operate the M100. The display allows you to monitor the welding process and to perform programming and file operations.

A remote pendant can also be used to operate the unit. It has a keypad and a display.

A Swagelok PC memory card is a flash memory device designed for use with the M100 power supply. No other memory card may be used in its place.

The PC memory card has a Write Protect Switch. When the switch is on, the card will read only. The M100 power supply will prompt you if the switch is on and you attempt to write or delete.

The PC memory card has three (3) basic functions:

1. Weld procedures may be stored outside the internal memory of the unit on the PC memory card. The procedures may be re-installed into the internal memory of any M100 power supply or used directly from the card.
2. Weld data logs may be stored on the PC memory card as they are made or downloaded from the internal memory to the card for transfer to a PC.
3. Front panel application software may be loaded into the M100 power supply using the PC memory card.

Operator Display

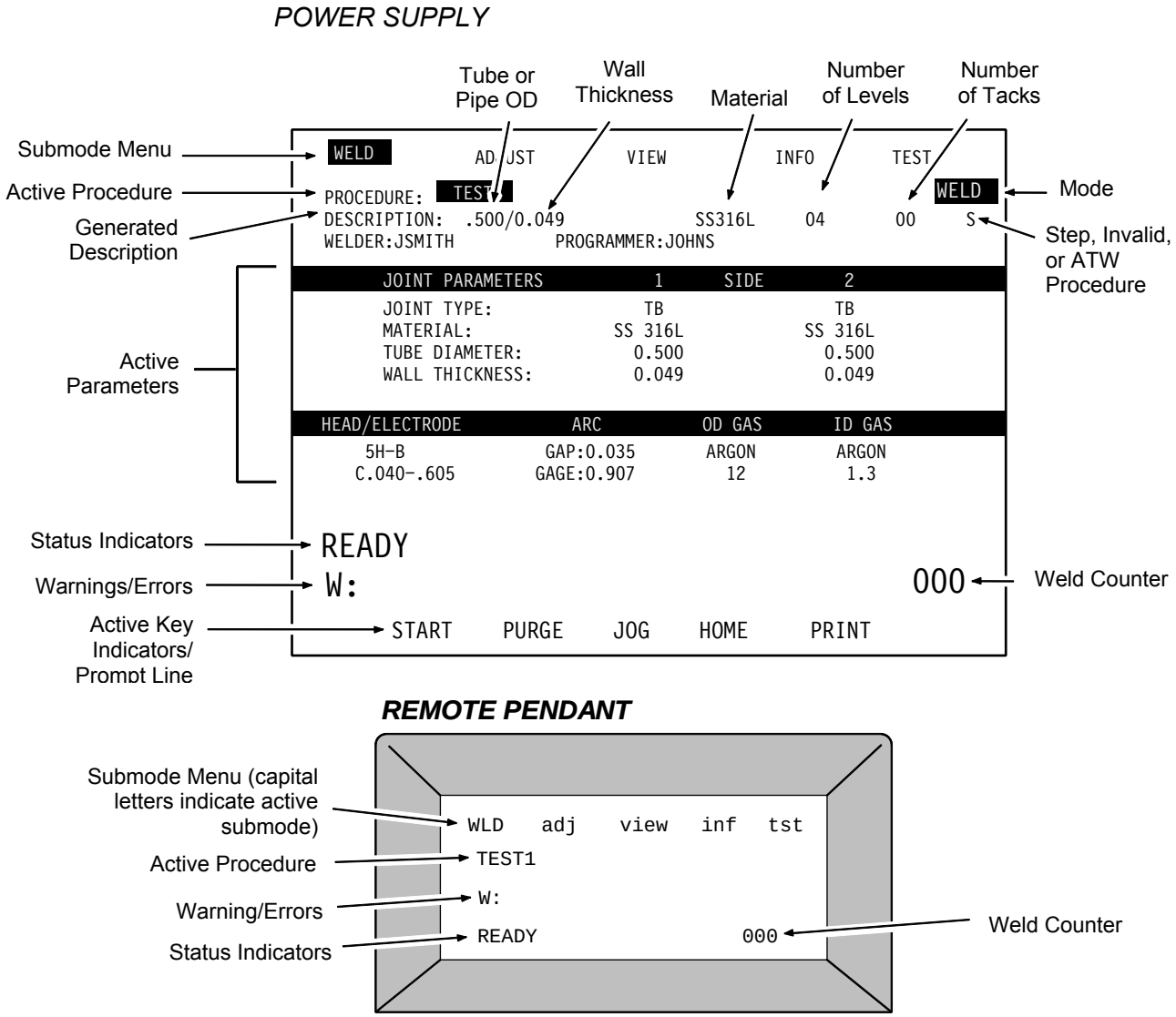


Figure 13 Operator Display

The operator display shows information about the current mode of operation. It also displays indicators, warnings, pop-up menus, and prompts when appropriate. The remote pendant displays a limited range of information.

In each mode, a series of submodes are displayed across the top of the screen. When a submode that has several functions is selected, those functions are listed in a pop-up menu below the heading.

In the WELD and PROG modes, the second line on the display shows the name of the active procedure and the current mode of operation. Below the name of the active procedure is a brief description of the procedure. On the next line, the welders and programmers names are listed. The first page of parameters for the active procedure is also displayed.

In all modes, the M100 power supply will display brief directions on how to make selections or continue a function in the bottom line of the display (Prompt Line).

Operator Keypad

The operator keypad has four types of keys:

- Mode keys
- Navigation and selection keys
- Weld function keys
- Alphanumeric keys

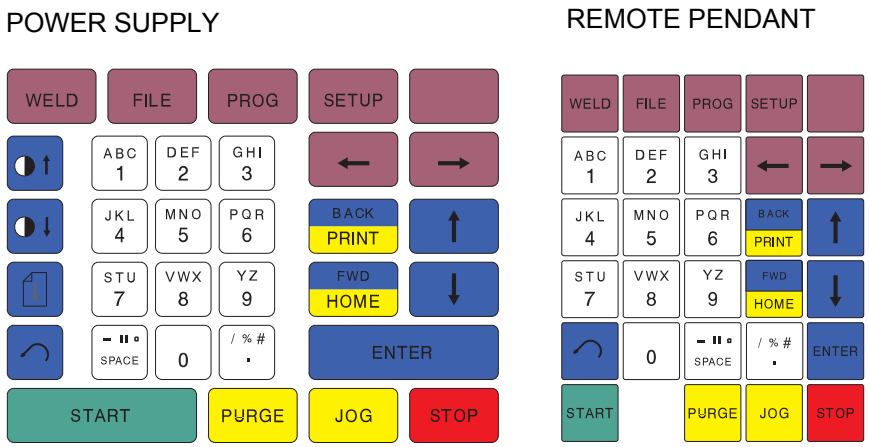


Figure 14 Operator Keypad

MODE KEYS

The four mode keys are located in the top row of the keypad. These keys are "hot," meaning you can press them at any time, except when a weld is being executed, to change the operation mode.

Whenever a mode key is pressed, the available series of submodes is displayed with the left most submode and the first active parameter of the submode highlighted (selected).

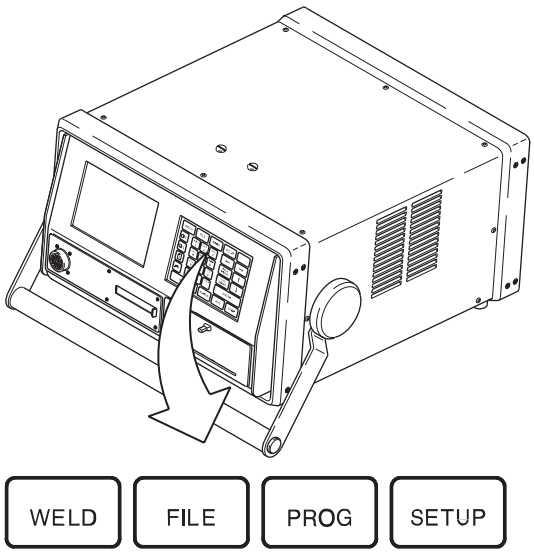


Figure 15 Mode Keys

WELD

Accesses the WELD mode.

In the WELD mode, you can execute a weld using the active procedure, make minor adjustments (ADJUST) to the procedure, or review the parameters of the procedure using the VIEW submode. In the WELD mode, the weld function keys are active. Pressing **START**, for example, would start a weld using the active weld procedure.

INFO Submode – Additional information may be added to data output by operator.

TEST Submode – Test of the active procedure is accomplished here.

WELD
Adjust
View
Info
Test

Note:
Though minor modifications to the active procedure are possible, most parameters must be set in the PROG (programming) mode.

POWER SUPPLY

```
WELD        ADJUST        VIEW          INFO        TEST

PROCEDURE:  TEST1                                   WELD
DESCRIPTION:  .500/0.049              SS316L   04    00    S
WELDER:JSMITH          PROGRAMMER:JOHNS

      JOINT PARAMETERS          1     SIDE       2
      JOINT TYPE:               TB              TB
      MATERIAL:              SS 316L         SS 316L
      TUBE DIAMETER:           0.500           0.500
      WALL THICKNESS:          0.049           0.049

HEAD/ELECTRODE          ARC          OD GAS      ID GAS
    5H-B            GAP:0.035         ARGON       ARGON
  C.040-.605        GAGE:0.907          12          1.3

READY
D:                                                  000
     START    PURGE    JOG    HOME     PRINT
```

REMOTE PENDANT

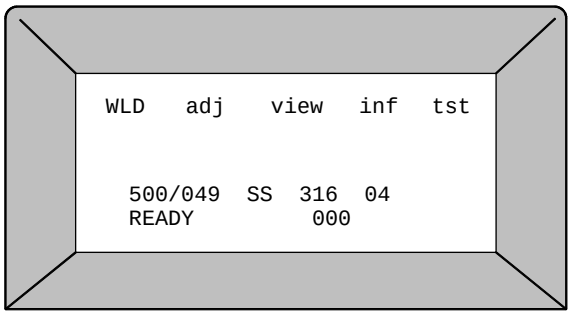


Figure 16 Weld Mode Display

FILE

Accesses the FILE mode.

In FILE mode, a saved weld procedure can be selected from memory, the active procedure can be saved, or stored procedures can be deleted or copied. Procedure files can be saved in either the internal memory or the PC memory card. Weld data log records are not accessed in the FILE mode. The records are located in SETUP/DATALOG.

FILE
- Load
- Save
- Delete
- Copy

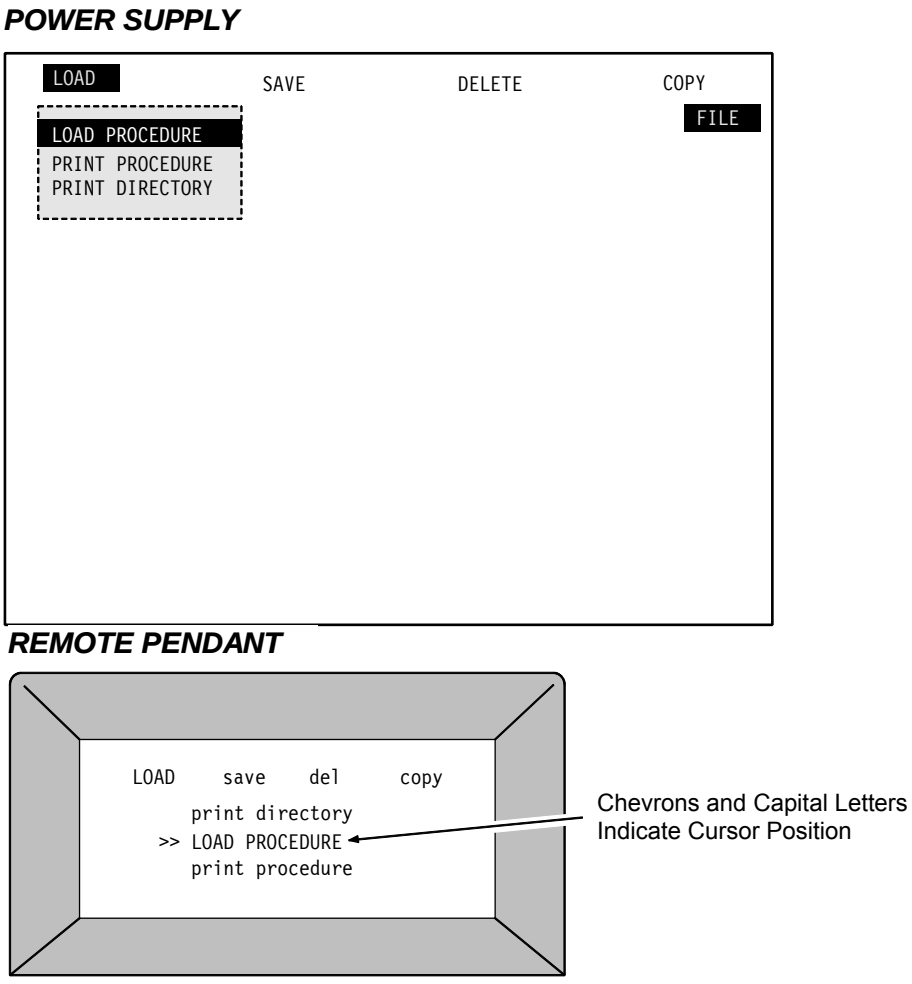


Figure 17 File Mode Display

File access can be limited by installing a programmer password.

FILE Mode – Limited Access: When a programmer password has been set, the user has limited access to the LOAD PROCEDURE functions. The procedure is read only which means no changes can be made. The user may also access PRINT COUPON and PRINT DIRECTORY. If any other function is requested, the unit will ask for the programmer password. The user cannot save weld changes, delete weld procedures, or transfer data to the PC memory card for weld procedures.

FILE Mode – Unlimited Access: When a programmer password has not been set, or it was entered at initial start up, the user has access to all the functions described later in this section under "File Mode."

PROG

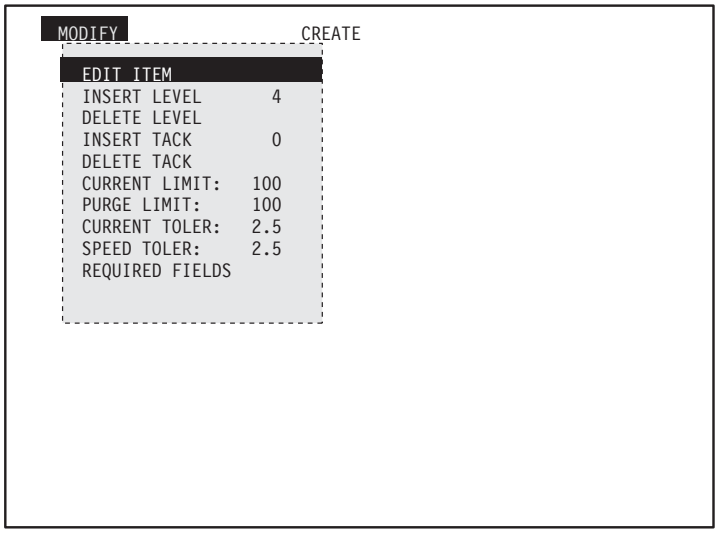
Accesses the PROG (programming) mode.

In the PROG mode, active procedures can be modified and new procedures can be developed. This mode can be password protected. Any information entered in PROG/CREATE or MODIFY is saved with the procedure.

PROG Mode – Access: Access to the programming mode is limited to users with programming privileges or higher. Programming privileges are obtained by entering the programmer password (if one has been set) at initial start up.

PROG
Modify
Create

POWER SUPPLY



REMOTE PENDANT

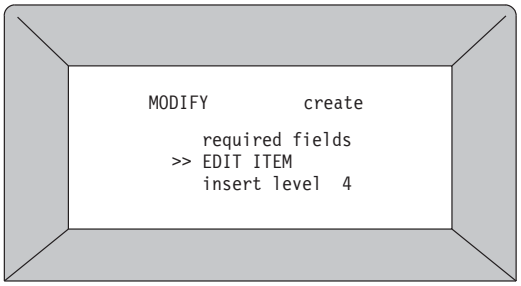


Figure 18 Programming Mode Display

SETUP

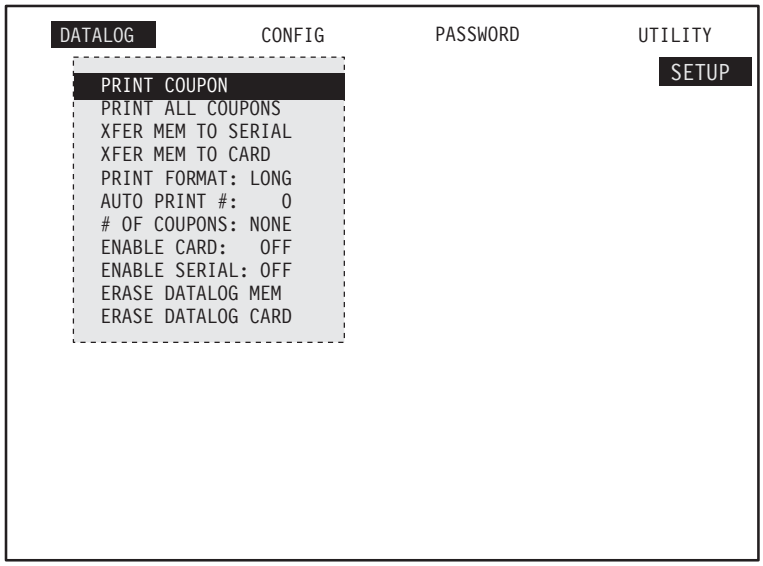
Accesses the SETUP mode.

This is a multi-purpose mode in which user preferences, options for data logging, and other parameters can be set. Any modifications made in SETUP mode are saved on the system and not in a specific procedure.

SETUP Mode – Access: Access to the setup mode is limited to users with programming privileges or higher. Programming privileges are obtained by entering the programmer password at initial start up (if one has been set).

SETUP
- Datalog
- Config
- Password
- Utility

POWER SUPPLY



REMOTE PENDANT

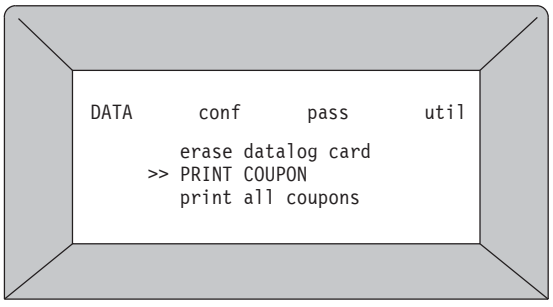
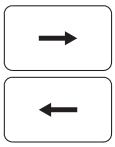


Figure 19 Setup Mode Display

Navigation and Selection Keys

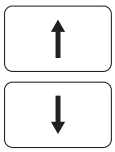
Two navigation keys are used to move through the menu of submodes in each mode. These keys are also “Hot” and will take you immediately to the next menu selection of the current mode, unless a weld is being executed.



Moves you forward in the submodes

Moves you backward in the submodes

The vertical arrow keys move you up and down through the pop-up lists or are used in the WELD/ADJUST submode to change the values.



The **UP/DOWN** keys can be used to select a function from the pop-up lists that appear below the menu of submodes.

Move up or down to highlight the function you wish to use, and press **ENTER** to select the highlighted option.

Sometimes, when you are modifying or selecting a value, there will be a list of options. The vertical arrow keys can also be used to select from these pick-lists. Highlight the option you want, and press **ENTER** to select it.

Highlighted values can also be changed by entering a number on the alphanumeric keypad.

The **FWD** and **BACK** keys can be used to scroll through screens of information.

In WELD/VIEW mode or in PROGRAM/MODIFY/EDIT ITEM mode, use **FWD** and **BACK** to scroll through the screens of procedure values. Pressing these keys moves the cursor through one group of values. For example, if you have a value in the joint parameters highlighted, pressing **FWD** once will move the cursor to highlight the weld head type, which is the first value in the next group. Pressing **FWD** again will move the cursor to the next screen of data.

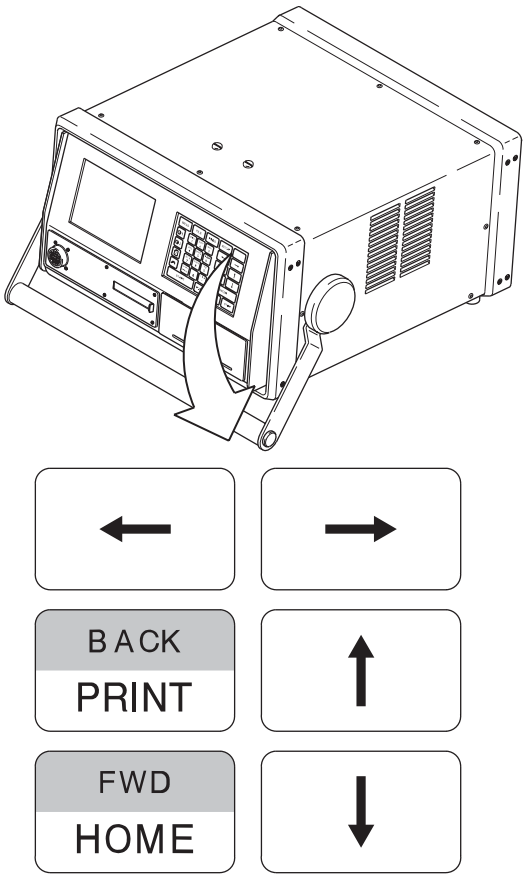


Figure 20 Navigation and Selection Keys

FWD and **BACK** can also be used to scroll through pop-up menus and pick-lists that are more than one screen long.

When entering a value using the alphanumeric keys, **BACK** can be used as a “backspace” key and **FWD** will move the cursor forward one space.

FWD and **BACK** appear on the same keys as **PRINT** and **HOME**, respectively. The PRINT and HOME functions are only available when the M100 power supply is in the WELD/WELD mode. **FWD** and **BACK** are available in other modes.

Weld Function Keys

The yellow, green, and red weld operation keys are used to control the welder. The keys are only active in the WELD/WELD mode.

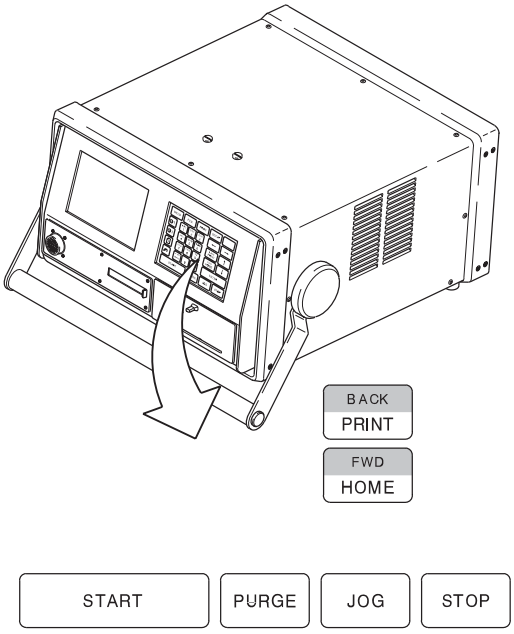
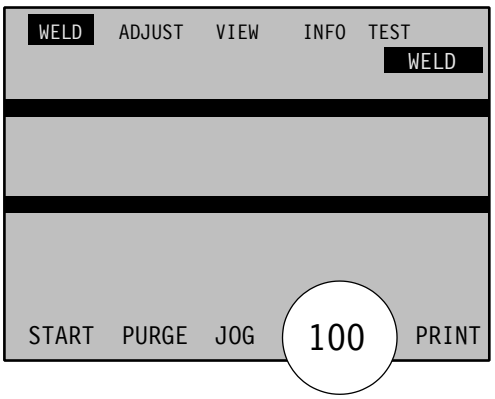


Figure 21 Weld Operation Keys

START Pressing this key will start the weld with the active weld procedure.

PURGE Pressing this key will toggle the weld head purge gas on and off. When the purge gas is on the word "PURGE" will flash on the screen and the remote to indicate the continuous purging. When "PURGE" is not flashing, the active weld procedure controls the flow of purge gas.

JOG Pressing this key will jog the rotor at the speed set in the SETUP/CONFIGURATION submode (see page 67). Press **JOG** and hold for rotor motion. The rotor will stop when **JOG** is released. An indicator in the bottom right corner of the screen gives the location of the rotor (in degrees) in relation to the home position (see Figure 22).



STOP Pressing **STOP** will stop the:

- Weld in progress immediately.
- Rotor homing in process.

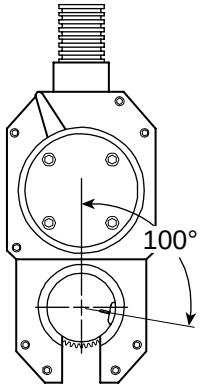


Figure 22 Rotor Position

BACK
PRINT

Pressing this key will print the information for the most recent weld performed. To obtain a printout of a weld prior to the most recent weld performed; you must go to SETUP/DATALOG (see page 62). The type of printout to be produced can be selected in the SETUP/DATALOG submode.

FWD
HOME

Pressing this key will move the rotor to the home position. The rotor will always move at full speed when **HOME** is pressed.

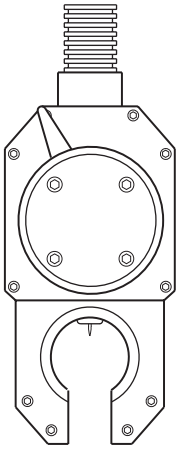


Figure 23 Rotor Home Position

Alphanumeric Keys

The white alphanumeric keys are used to enter information into a field, where direct field entry is possible.

Each key has up to four characters. To select the desired symbol, do the following:

- Press the key once to select the large bottom symbol, which is a number or a commonly used character such as a space or a period.
- Press the key twice quickly to select the first character on the top line of the key.
- Press the number three times quickly to select the second character on the top line of the key.
- Press the number four times quickly to select the third character on the top line of the key.
- Press a different key or wait approximately half of a second without pressing the same key to enter the selected symbol.
- Use the ← → arrows to scroll to any errors that may have been made.
- After the desired string or value has been completed, press **ENTER** to confirm the selection.

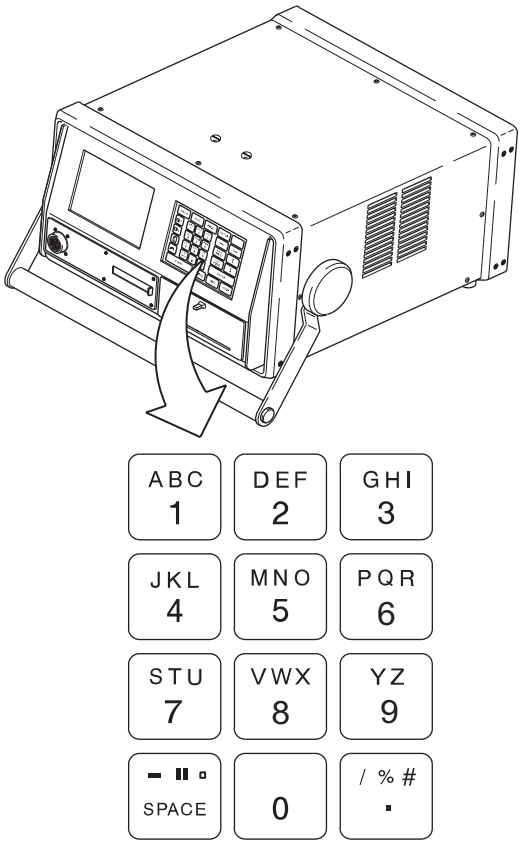


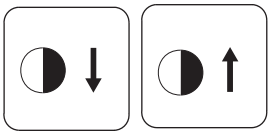
Figure 24 Alphanumeric Keys

CANCEL Key

Pressing **CANCEL** will cancel the last entry and revert to the previous submode selected. If you press **CANCEL** while in a direct data entry field, it will revert to the previous value.

Contrast Keys

Use these keys to adjust the display contrast. To change the screen color from white background with black letters to black background with white letters, press the Contrast Keys several times.



Data Recording Printer Feed Key

Press this key to advance the paper through the data recording printer.

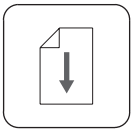


Figure 25 Contrast Keys and Data Recording Printer Feed Key

M100 Modes of Operation

The M100 has four modes to perform different types of functions:

- WELD Page 30
- FILE Page 45
- PROG Page 52
- SETUP Page 61

WELD Mode

WELD

The WELD mode includes most of the functions needed to execute a weld. Pressing **WELD** in the top left corner of the keypad at any time accesses this mode. Quick adjustments to the current setting can be made in this mode, in addition to performing welding operations.

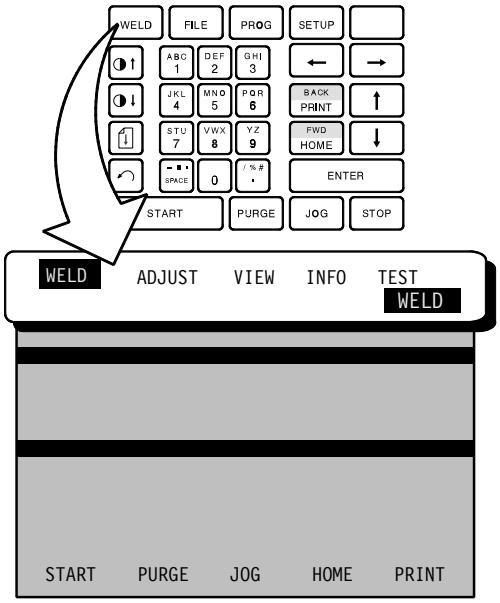


Figure 26 Menu Access to WELD Mode

Weld Mode Directory

Submode	Activity	Onscreen Display	Page
WELD	Ready state	READY	33
	Executing a weld	Current, voltage, level number currently executing, and time remaining in each step is displayed	33
	Error indicators	DISABLED	35
ADJUST	Clear adjustments	CLEAR ADJUSTMENTS	38
	Average current per level	LEV 1 CURR 36.0	38
	Prepurge, postpurge	PREPURGE, POSTPURGE	39
VIEW	View settings in active weld procedure	Joint parameters, start parameters, tacks, levels, and other settings are displayed	40
INFO	Select welder name	WELDER	41
	Weld head serial number	HEAD SN:	42
	Set heat number	HEAT 1:, HEAT 2	43
	Set certification number or Dewar serial number	OD GAS:, ID GAS:	43
	Open 1 and 2 available for additional information up to 10 characters	OPEN 1:, OPEN 2:	43
	Set project name or drawing name	PROJECT:, DRAWING:	44
TEST	Check or demonstrate weld program	TEST	44

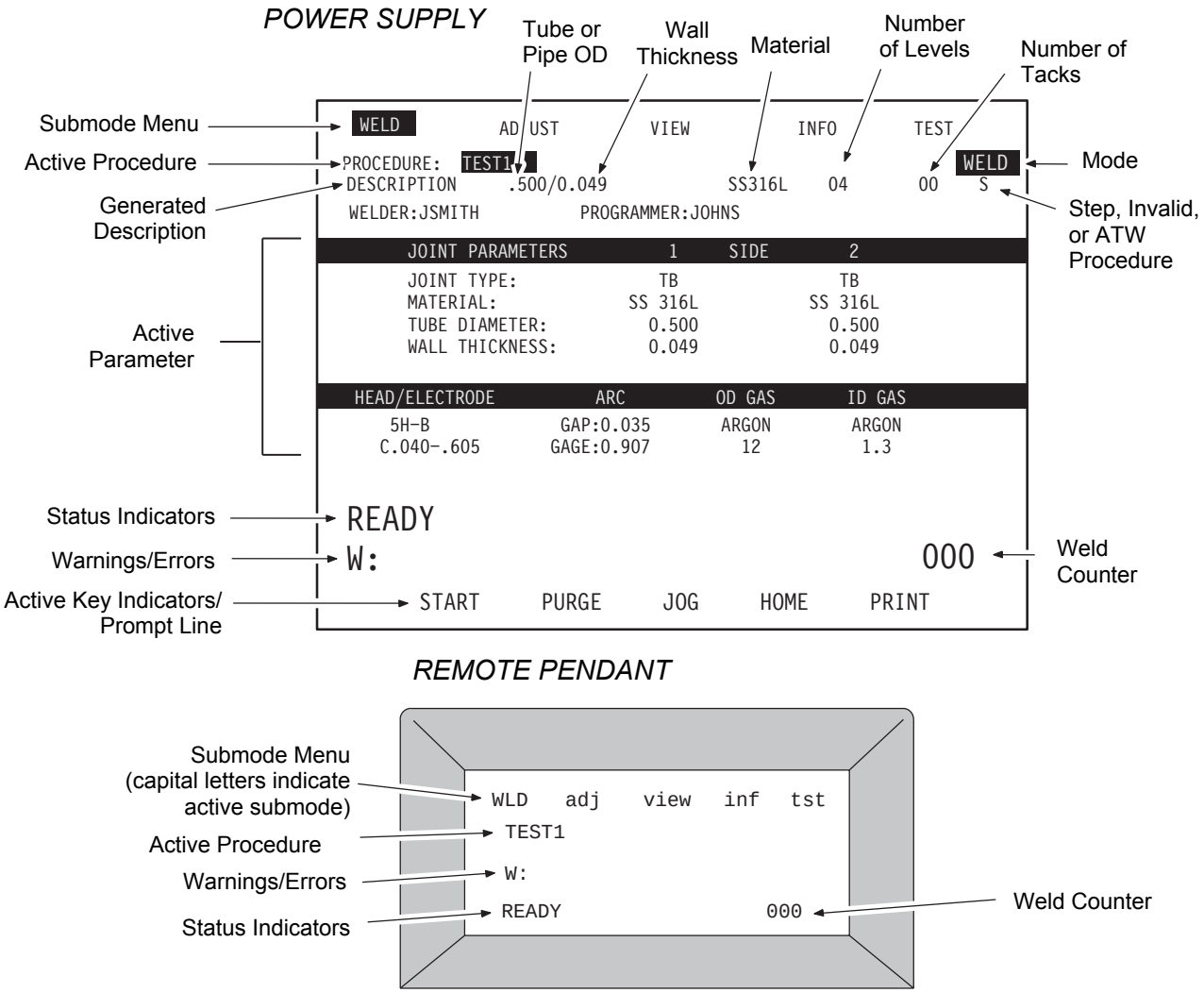
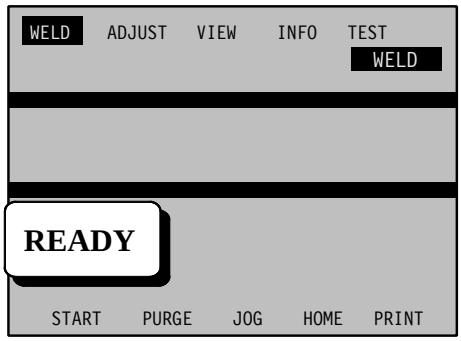


Figure 27 WELD Mode Display

WELD – READY

When the M100 power supply is in the WELD/WELD mode, it indicates that it is ready to weld by "READY" on the screen and "READY" on the remote. This means that if **START** is pressed, the weld cycle will begin as programmed in the active weld procedure. In this submode, **PURGE, JOG, HOME, PRINT** and **STOP** are active.



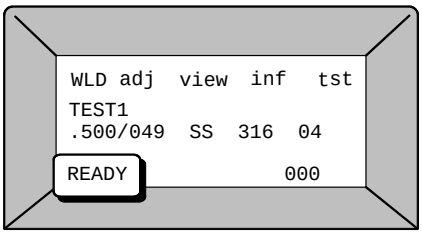
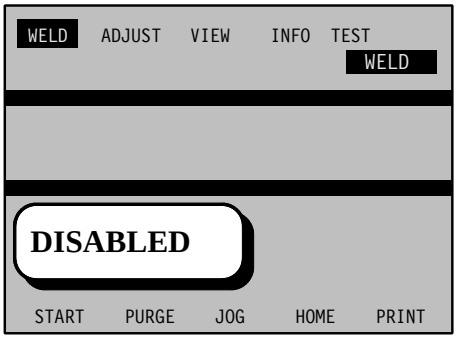


Figure 28 READY Display

If the M100 power supply is not ready to weld, the word "DISABLED" will be displayed and an error indicator will call attention to an error in the active procedure. Correct the error, or select a different program file, and the unit will be able to proceed with the weld. See page 35 for more information on error indicators.



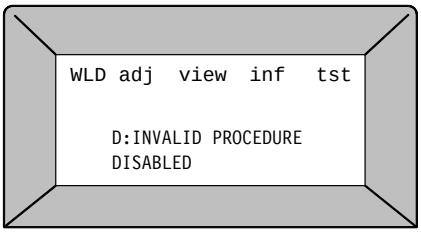


Figure 29 DISABLED Display

WELD – Executing a Weld

When **START** is pressed, the M100 power supply begins executing a weld according to the active weld procedure.

During the weld, the status line on the display and the remote will indicate the current, voltage, level number being executed and time remaining in each step. If tacks are part of the selected weld procedure they are executed before the level(s). As the tacks and levels are executed the data for each is highlighted.

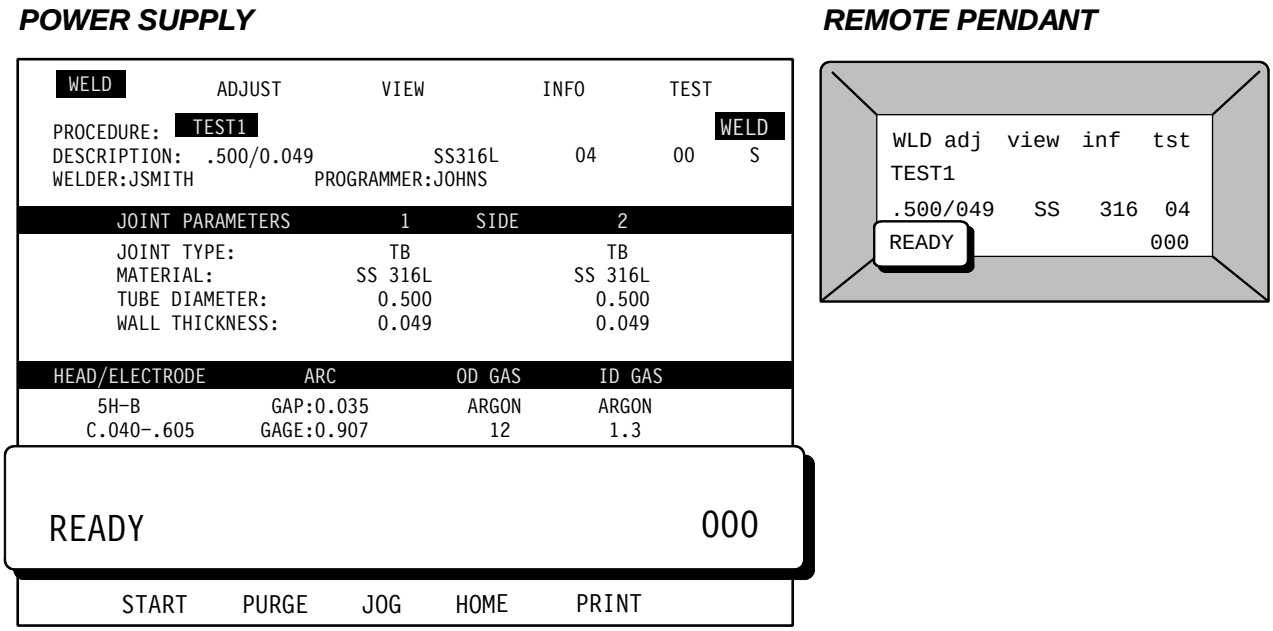


Figure 30 WELD Mode Display

After the weld is completed properly, the unit returns to the "READY" state. If error conditions occurred during the weld, the error will be displayed and **ENTER** will have to be pressed for confirmation. For more information on error indicators see page 35.

WELD – Disable, Warnings, and Weld Errors

Disable

When the word “DISABLED” is on the status line, a condition exists that must be corrected before a weld can be executed. The line below DISABLED describes the condition. Disabling conditions are preceded by **D:**. Warning conditions are preceded by **W:**. These both may be displayed but only the disabling (**D:**) conditions must be cleared before welding.

Warning

A warning (**W:**) condition should be noted by the operator but welding may proceed with discretion.

WELD ERRORS

The M100 has been programmed to monitor conditions during the weld cycle. If the M100 detects an error, the status line will indicate Weld Completed or Weld Not Completed, the line below will describe the error, and the audio alarm will sound if SETUP/CONFIGURATION/ALARM is on. The condition must be acknowledged by pressing **ENTER** before the next weld may be accomplished. All weld errors are recorded in the weld data.

Information Message Box

The Information Message Box may appear in any mode or submode. The box may require a corrective action by the operator or may contain information only.

Caution!

Information message boxes may contain actions that should not be taken by the operator.

Table 3 Status Conditions

Disable	Description
High-Temperature	The power supply is over its rated temperature. This condition will automatically reset when the power supply has cooled to within its limits.
No Weld Head	There is no weld head attached to the power supply.
No Proc. Selected	There is no procedure selected. You must select a program from FILE or create one from PROGRAM/CREATE.
Invalid Procedure	The procedure selected is not executable. The program weld field must be reset within tolerance using PROGRAM/MODIFY/ EDIT ITEM.
Update Weld Info	A field that has been designated as requiring data and the information has not been entered in the WELD/INFO mode.
Req. Memory Card	When SETUP/DATALOG/CARD ENABLE/ON is active a PC memory card must be installed to receive data. The card write protect must be off.
Memory Card Full	The PC memory card installed does not have memory space available.
System Memory Full	The number of saved procedures has exceeded the amount of available memory. You must delete unused programs or delete data log records. You may want to SAVE the procedure to a PC memory card.
High Rotor Speed	The weld head connected to the power supply cannot provide the rotor speed programmed in the active procedure. You must adjust the program rotor speed or change to the correct weld head.
Card Write Protect	When SETUP/DATALOG/CARD ENABLED/ON is active, the PC memory card is inserted but the write protect is on.
Card Uninitialized	When SETUP/DATALOG/CARD ENABLED/ON is active, the PC memory card is inserted, and the write protect is on but the card is not initialized and data cannot be written to the card. To initialize card go to SETUP/UTILITY/INITIALIZE CARD.

Warnings	Description
Wrong Weld Head	The active procedure calls for a different weld head than the weld head connected to the power supply.
Printer Paper Out	The printer is out of paper.
Printer Head Up	The printer head is up for loading.
Printer Overtemp	The printer temperature is over its rated temperature. You will not be able to print until the warning is removed.
Short Prepurge	The prepurge time is set for less than 5 seconds. If the parameters of the weld include continuous purge, this warning will not be displayed.
Test Mode	The M100 power supply is in test mode and will not execute a weld.
Weld Errors	**Description**
Rotor Jammed	The rotor has stopped turning during the weld program.
Misfire	The arc was not established.
Arc Failed	The arc failed during the weld.
Tack Not Complete	The tack failed to be completed as programmed.
High-Temperature	The power supply has exceeded its rated temperature.
Low Arc Voltage	The electrode has touched the weld puddle.
Stop Pressed	The operator has pressed the Stop Key to abort the weld in progress.
Speed Tolerance	The weld did not perform within the specified speed tolerance. The tolerance is set in PROGRAM/MODIFY/SPEED TOLERANCE.
Current Tolerance	The weld did not perform within the specified tolerance. The tolerance is set in PROGRAM/MODIFY/CURRENT TOLERANCE.
Information Box	**Description**
System Clean-Up	System Clean-up is an automatic Clean-up function that the M100 power supply will perform when internal memory is nearing capacity. The M100 power supply rearranges files to open up additional internal memory. If the System Clean-up Information box occurs often or takes excessive time to perform, weld data logs may need to be deleted in SETUP/DATALOG/ERASE DATALOG MEMORY OR CARD.

ADJUST – CLEAR ADJUSTMENTS

When a procedure has been adjusted by one of the displayed selections it is noted by adding "-ADJUSTED" to the procedure name displayed on the screen. Selecting CLEAR ADJUSTMENTS returns to the initial procedure values, and the appended notation is removed. Saving the Adjusted Active Procedure will also clear the appended notation.

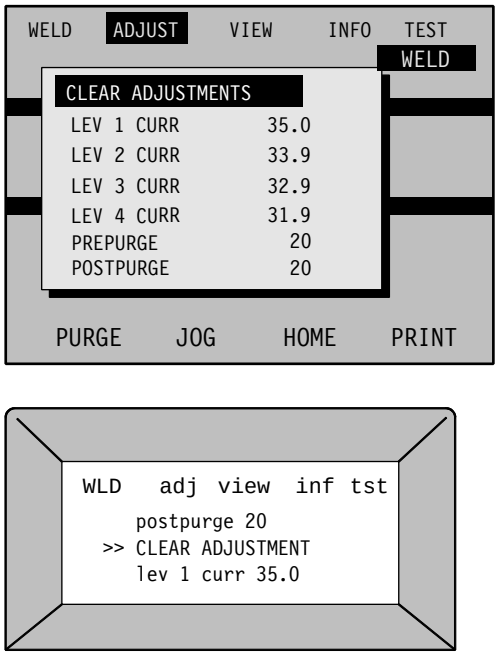


Figure 31 Clear Adjustments

ADJUST – AVERAGE CURRENT PER LEVEL

This selection allows you to make a quick adjustment to the current for a level. The value that can be adjusted is the average current, which is the average of the impulse, maintenance, and impulse width values for the level. You are allowed an adjustment range within the limits set in PROGRAM/MODIFY/CURRENT LIMIT (see page 56). The limit is usually about 10 % of the initial average for that level. The M100 power supply adjusts the average current by following the appropriate weld procedure guideline.

1. **Select the level** – Use the **UP/DOWN** keys to highlight the level you wish to adjust on the selection list then press **ENTER**. For example, to adjust the current for level 1, select and press **ENTER** on **LEV 1 CURR** line.
2. **Adjust the current setting** – The average current value for the selected level is then highlighted and can be adjusted using the UP/DOWN keys. The adjusted value will be automatically constrained by the current limits.

The M100 power supply can be returned to the Ready state by pressing WELD or highlighting the WELD submode with the menu arrows.

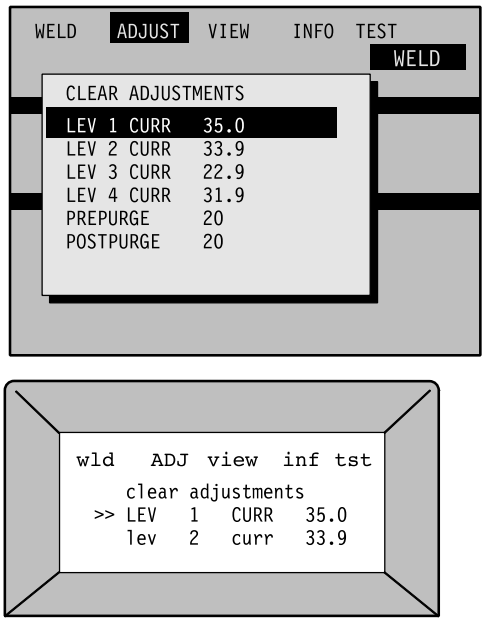


Figure 32 Current Level Adjustment

ADJUST – Prepurge and Postpurge

The prepurge and postpurge times of the weld procedure selected can be adjusted the same way as the average current settings. Select PREPURGE or POSTPURGE on the selection list and change the time. The range of adjustment can be set in PROGRAM/MODIFY/PURGE LIMIT.

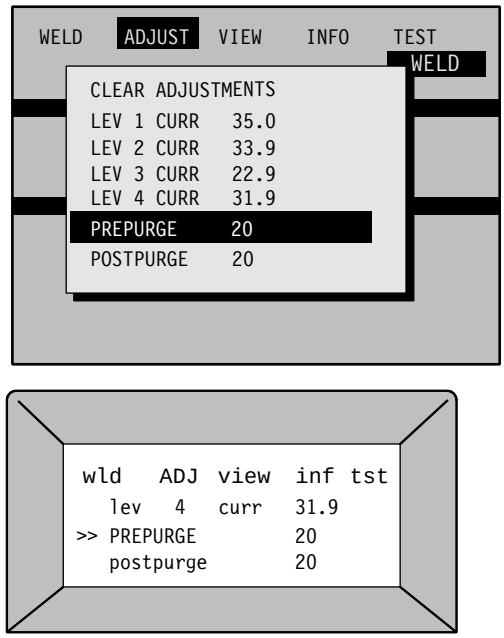
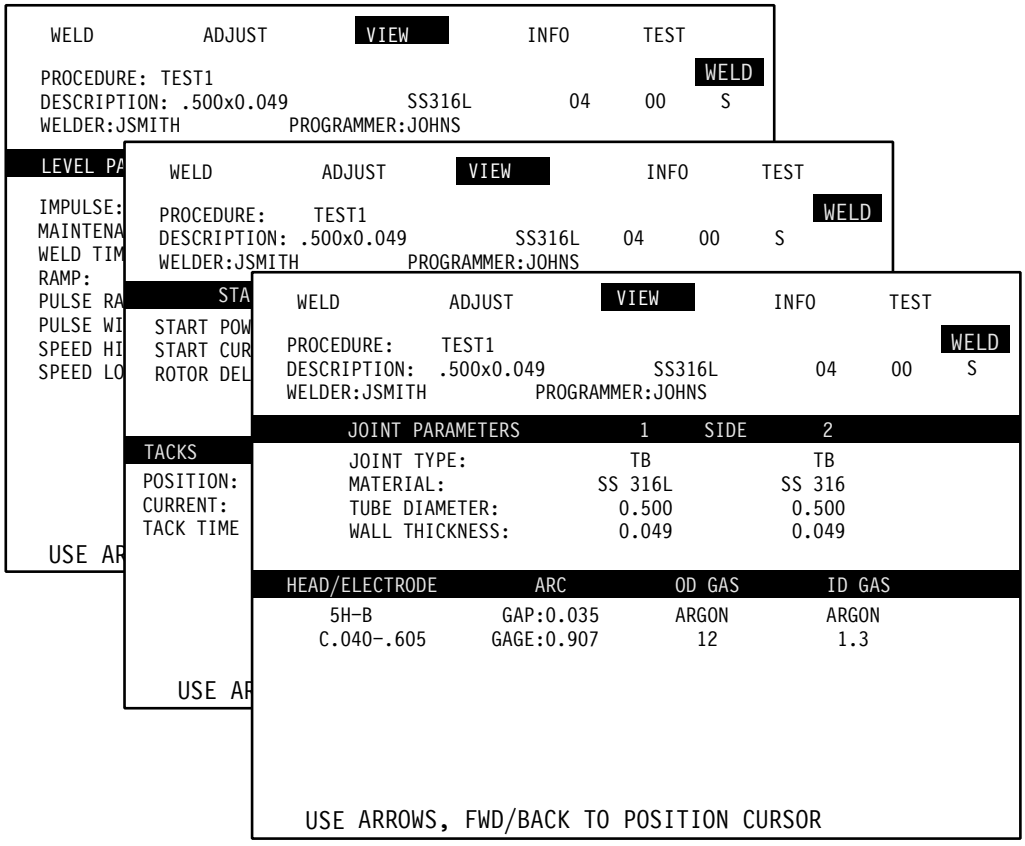


Figure 33 Prepurge and Postpurge Adjustment

VIEW

This submode allows you to review the settings in the active weld procedure. Joint parameters, start parameters, tacks, and levels as well as other settings are displayed. You cannot change any information in the VIEW submode.

POWER SUPPLY



REMOTE PENDANT

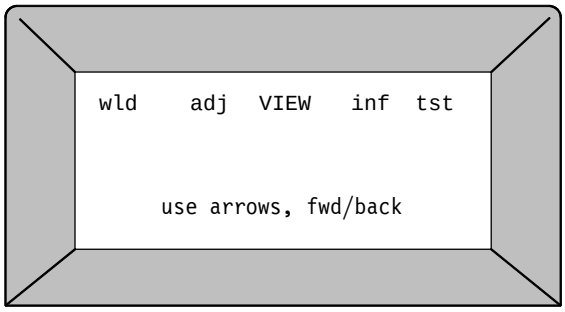


Figure 34 Review Active Weld Settings

INFO

This submode allows the equipment operator to enter data to the DATALOG record output. Data must be entered in a field displaying an asterisk (*required field) prefix. Information entered here will be displayed on the printout and in the Weld Datalog Record.

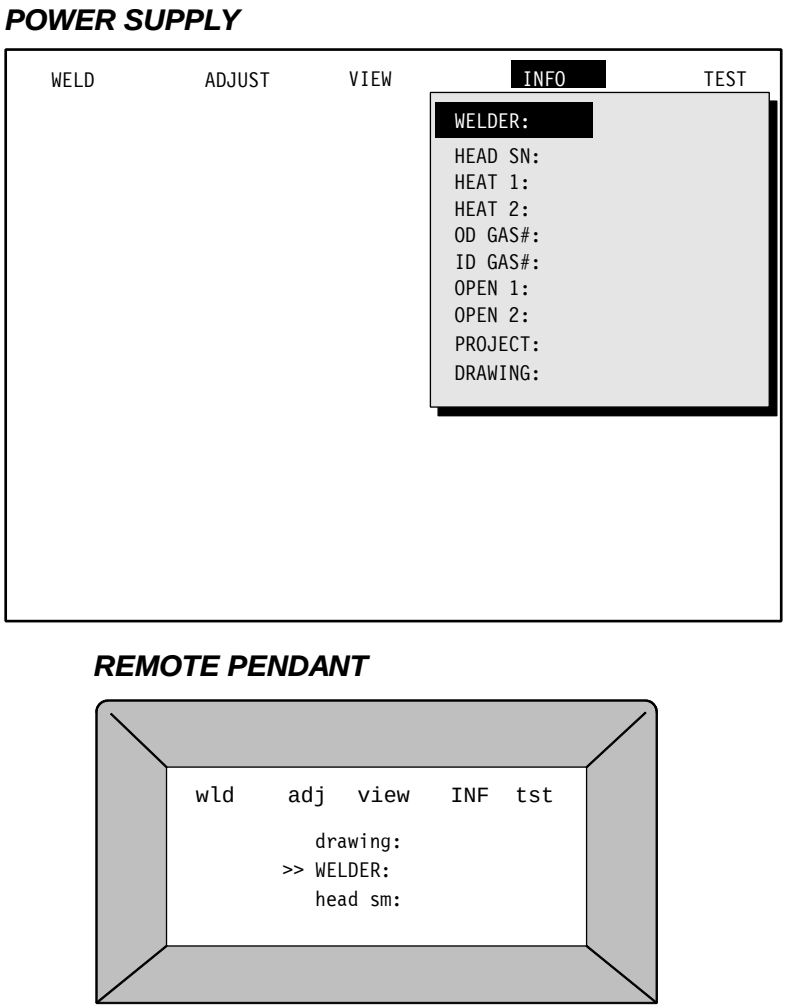


Figure 35 INFO Submode Display

INFO

The selection is cleared when the unit is powered down.

INFO – WELDERS

The welder name or ID may be entered here by using the alphanumeric keypad. This entry field is cleared on unit power down.

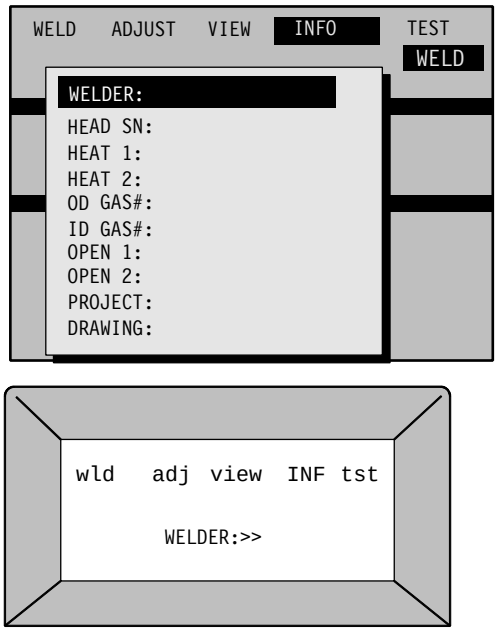


Figure 36 Welder Name Selection

INFO – HEAD SN

The serial number of the weld head being used may be entered here. The model number of the weld head is entered during creating of the procedure. This entry field is cleared on unit power down.

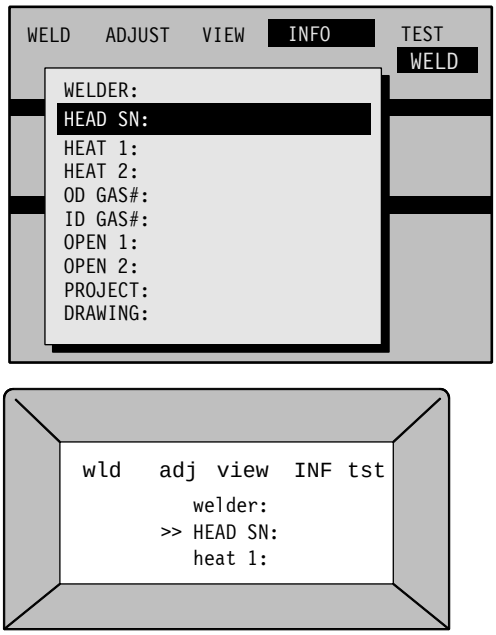


Figure 37 Weld Head Serial Number

INFO – HEAT 1 and HEAT 2

The heat number or lot number of the materials being welded may be entered in these locations. The entry field will clear on unit power down.

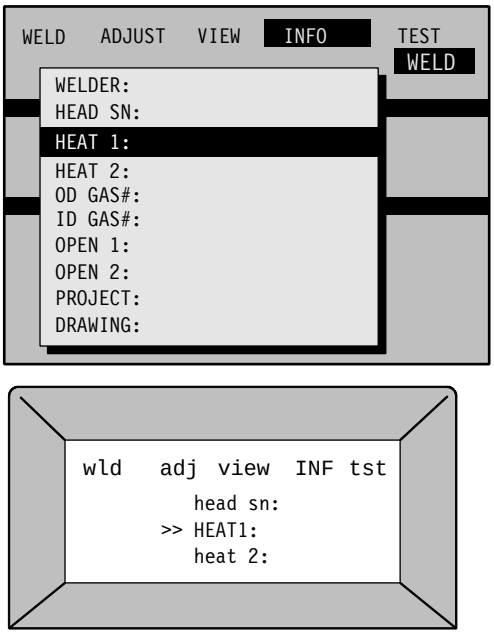


Figure 38 Heat or Lot Number

INFO – Shield Gas and Purge Gas Certification Numbers

The certification number or Dewar serial number may be entered in these locations. These entry fields will clear on unit power down.

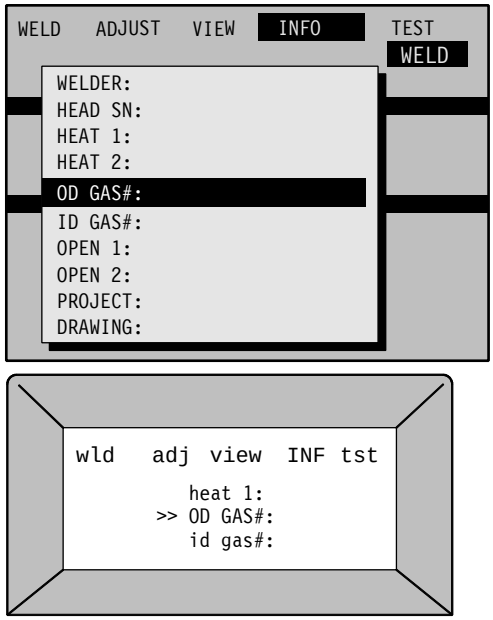


Figure 39 Shield Gas and Purge Gas Certification Numbers

INFO – Open 1 and Open 2

These two lines are available for any additional information up to 10 characters. These entry fields will clear on unit power down.

INFO – PROJECT

The project name and the drawing name or number may be entered in these locations. These entry fields will clear on unit power down.

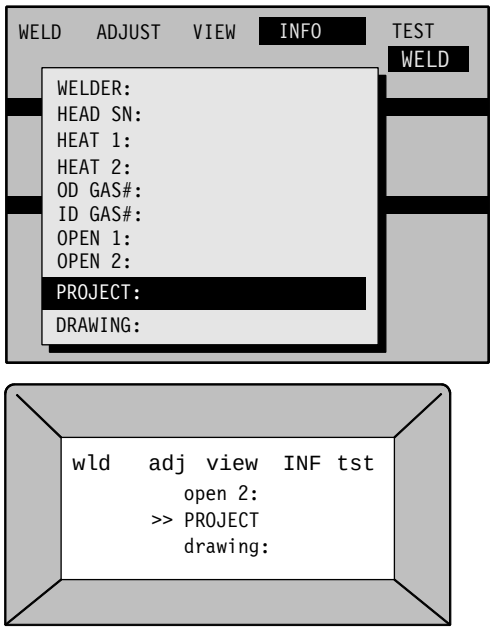


Figure 40 Project Name/Drawing Name Entry Fields

TEST

The TEST submode of the WELD mode is used to check or demonstrate a weld procedure. WELD/TEST is similar to WELD/WELD except that no current is applied to the electrode and the weld head does not have to be installed into the fixture block. The weld count will not advance in the TEST submode. To use the TEST submode: Select and install a weld procedure; press **START**. The M100 power supply will ask you to check that the rotor is clear to rotate; press **ENTER** to begin the TEST.

FILE MODE

FILE mode is used to access and edit weld procedure files in memory and on the PC memory card.

File Mode Directory

Submode	Activity	Onscreen Display	Page
LOAD	Load procedure	LOAD PROC followed by a list of procedures	46
	Print procedure	PRINT PROCEDURE followed by a list of procedures	47
	Print directory	PRINT DIRECTORY	48
SAVE	Store to memory	STORE TO MEMORY	49
	Store to card	STORE TO CARD	49
DELETE	Delete procedure	DELETE PROCEDURE	50
	Erase memory	ERASE MEMORY	50
	Erase card	ERASE CARD	50
COPY	One procedure from card to memory	1 CARD TO MEM	51
	One procedure from memory to card	1 MEM TO CARD	51
	All procedures from card to memory	ALL CARD TO MEM	51
	All procedures from memory to card	ALL MEM TO CARD	51

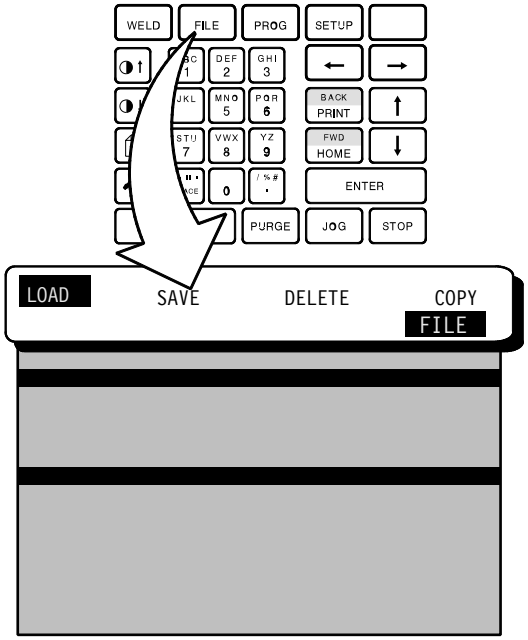
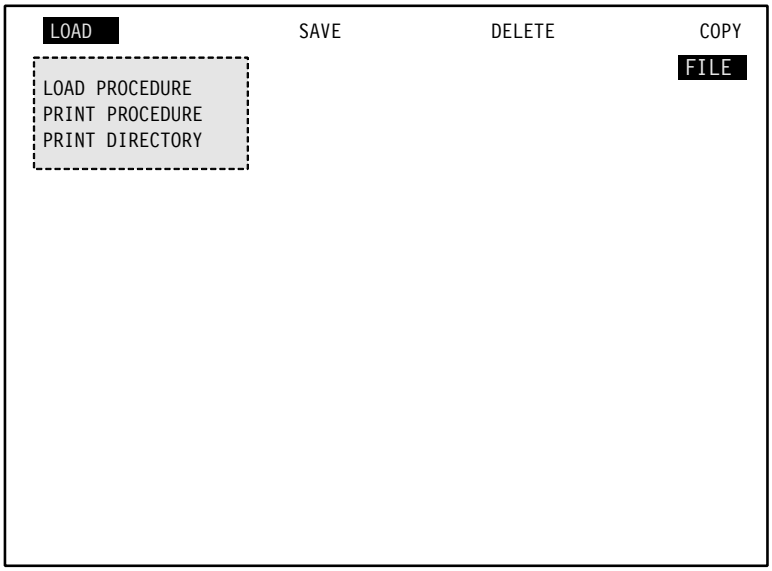


Figure 41 File Mode

POWER SUPPLY



REMOTE PENDANT

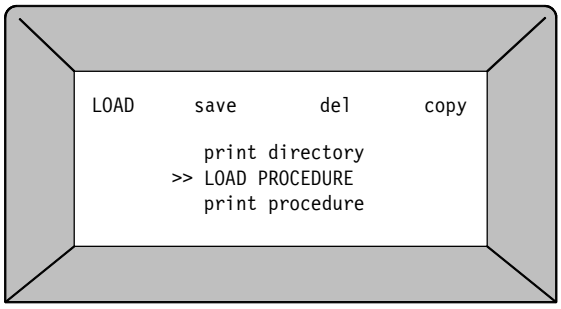


Figure 42 File Mode Display

LOAD – LOAD PROCEDURE

This function allows you to select a procedure stored in memory or the PC memory card. Select LOAD PROCEDURE and press **ENTER** to bring up the list of stored procedures. Scroll through the list to highlight the procedure you would like to load, then press **ENTER**. The selected procedure is copied from memory to the work area as the active procedure and the M100 changes to the Weld mode. If no weld procedure files are stored in memory, a "NO PROCEDURES FOUND" message is displayed.

Load Procedure also allows you to load procedures from the PC memory card. Install a PC memory card with weld procedures. The weld procedures from the memory card will be displayed first, with the letter C preceding the file name. Weld procedures from internal memory will have the letter S preceding the name.

Arrows

The arrows indicate more procedures above or below in the display. The procedures may be reached by scrolling with the **UP/DOWN** or **FWD/BACK** keys.

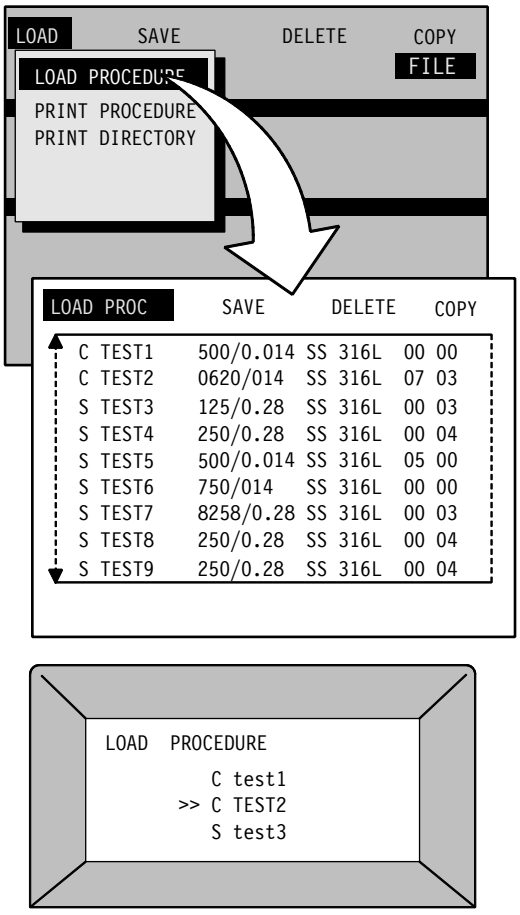


Figure 43 Load a Procedure Display

LOAD – PRINT PROCEDURE

This function allows you to print a weld procedure. No datalog information is available here. To print procedure:

1. Select Print Procedure, then press **ENTER**.
2. Highlight the desired weld procedure using the **UP/DOWN** keys. The **FWD/BACK** keys move the highlighted area 1/2 page at a time making scrolling easier. Press **ENTER**.

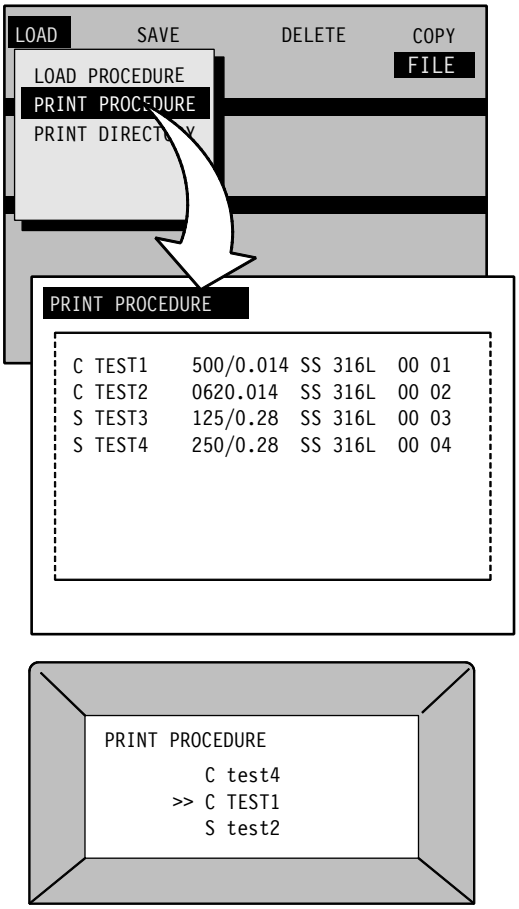


Figure 44 Print a Procedure Display

Note:
Card files will be listed first preceded by the letter C. System memory files will be preceded by the letter S.

LOAD – PRINT DIRECTORY

To print a directory of the weld procedures select PRINT DIRECTORY, then press **ENTER**.

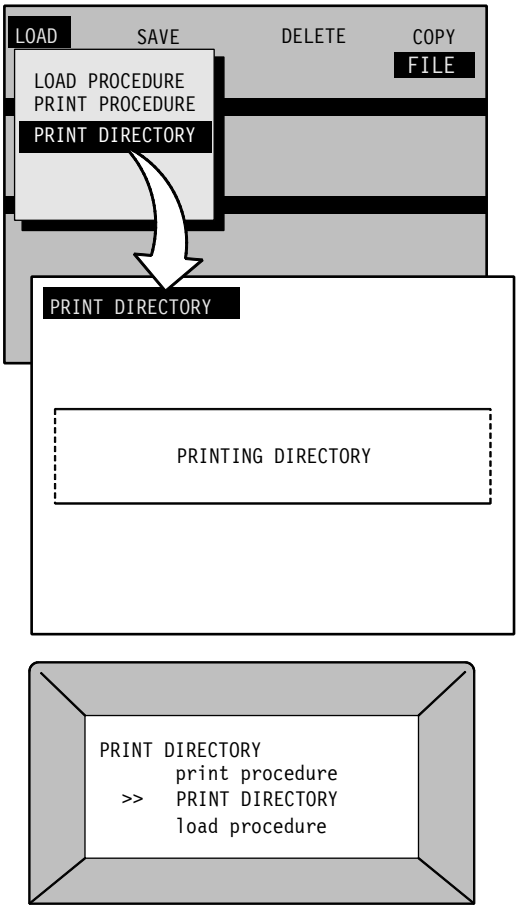


Figure 45 Print the Directory Display

Note:
Card files will be listed first preceded by the letter C. System memory files will be preceded by the letter S.

SAVE – STORE TO MEMORY

This function stores the active procedure in memory. If a procedure has been edited or adjusted, you may overwrite the procedure or create a new procedure with a new name.

SAVE – STORE TO CARD

This function stores the active procedure on the PC memory card.

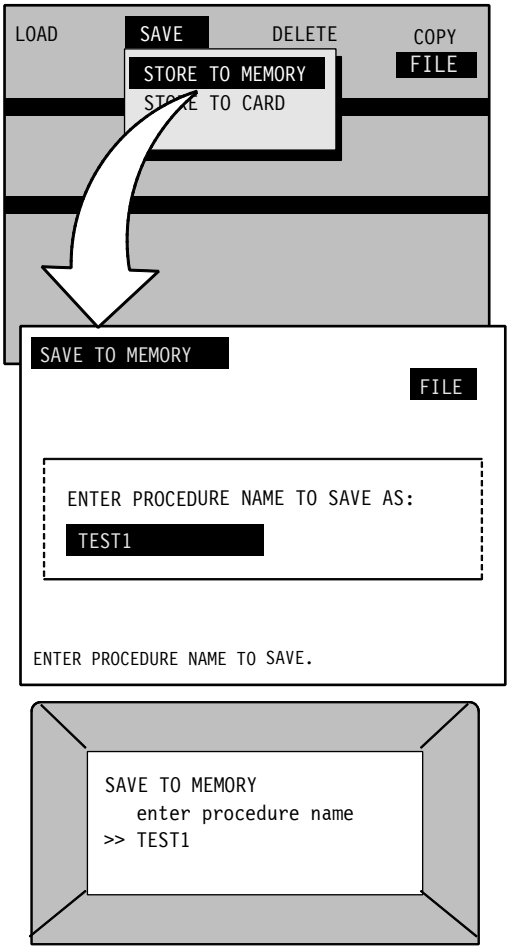


Figure 46 Store Procedure to Memory Display

DELETE – DELETE PROCEDURE

This function allows you to delete an unwanted weld procedure file from memory or card. Select the procedure from the list presented and press **ENTER.**

DELETE – ERASE MEMORY

The erase memory selection will erase all procedures from memory but will not delete the datalog records.

DELETE – ERASE CARD

The erase card selection will erase all procedures from the PC memory card but will not delete the datalog records. The M100 will ask for confirmation that you want to erase the card. Using the **UP/DOWN** keys to highlight your selection, **ENTER** "yes" to proceed or "no" to cancel.

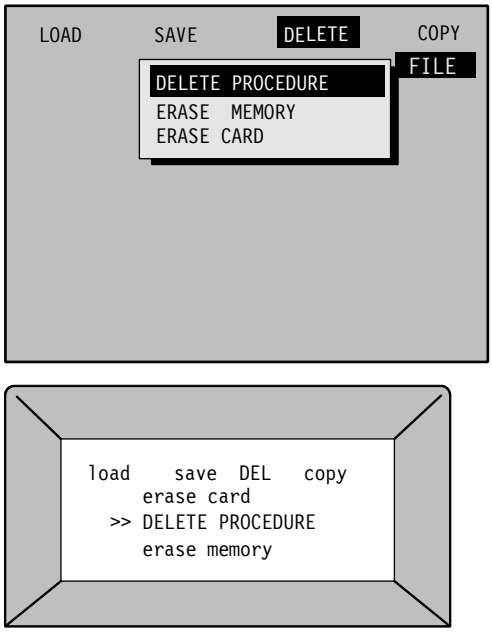


Figure 47 Delete Procedure from Memory Display

COPY – Copy Procedure Files

1 MEM TO CARD
ALL CARD TO MEM

These functions allow you to download one file or all files in memory to a PC memory card for storage or subsequent upload to another M100 power supply. The unit will ask if you want to overwrite PC memory card files with memory files of the same name. Select “yes” or “no” using the **UP/DOWN** keys. The default answer is “no.” When storing is done, press a mode key to continue.

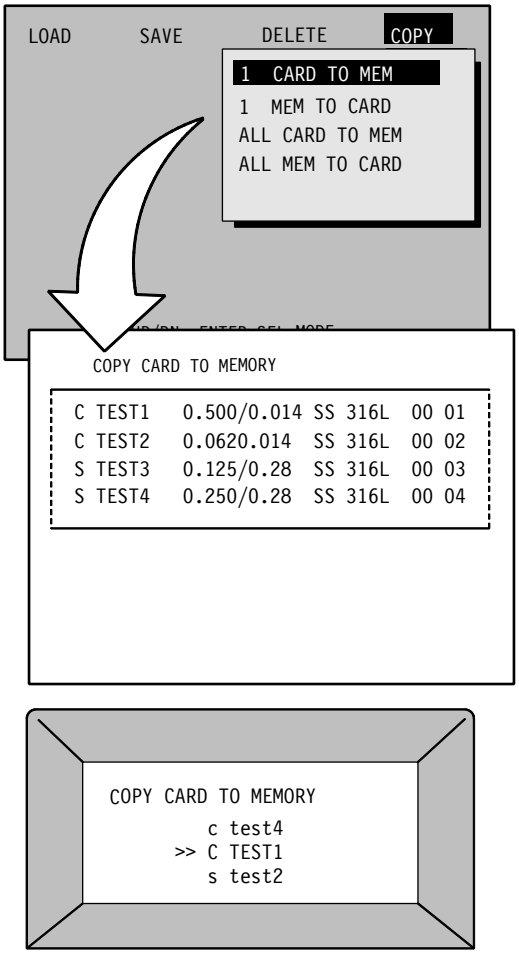


Figure 48 Copy Procedure Display

1 CARD TO MEM
ALL CARD TO MEM

These functions allow you to download one file or all files from a PC memory card to memory. The M100 power supply will ask you if you wish to overwrite files with the same name in memory. Select “yes” or “no” using the **UP/DOWN** keys. The default answer is “no.” When storing is done, press a mode key to continue.

PROG MODE

The PROG mode allows a programmer to modify and create weld procedures. To ensure that only authorized programmers create procedures, a password can be required to enter this mode.

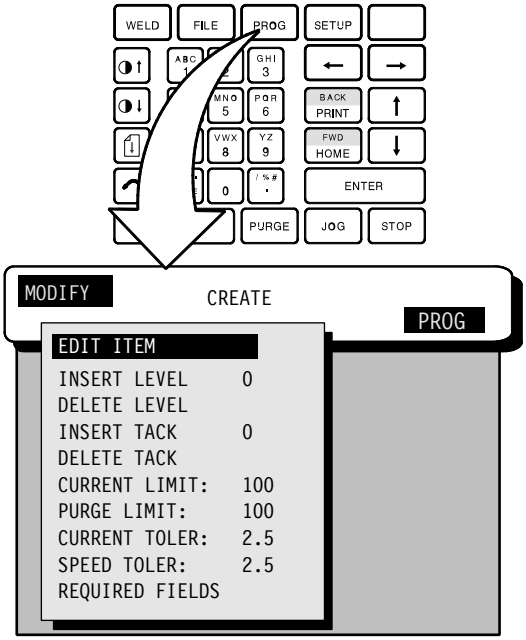
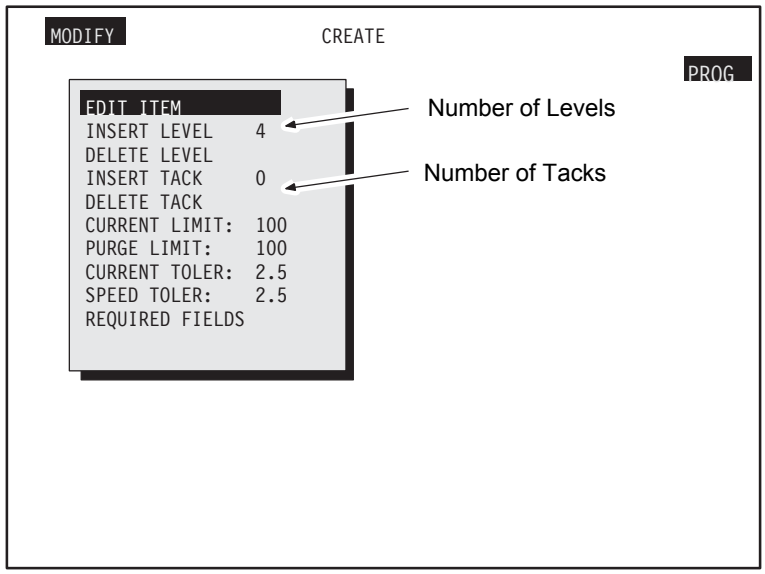


Figure 49 Program Mode

Program Mode Directory

Submode	Activity	Onscreen Display	Page
MODIFY Procedure	Edit item	EDIT ITEM	53
	Insert level	INSERT LEVEL	55
	Delete level	DELETE LEVEL	55
	Insert tack	INSERT TACK	55
	Delete tack	DELETE TACK	56
	Change current limits	CURRENT LIMIT: 100	56
	Purge time limits	PURGE LIMIT: 100	56
	Current performance tolerance	CURRENT TOLER: 2.5	56
	Rotor speed performance tolerance	SPEED TOLER: 2.5	56
	Designate required fields	REQUIRED FIELDS	57
CREATE Procedure	Auto entry	AUTO ENTRY	57
	Manual entry	MANUAL ENTRY	60
	Load and edit	LOAD AND EDIT	60

POWER SUPPLY



REMOTE PENDANT

Figure 50 Program Mode Display

MODIFY PROCEDURE – EDIT ITEM

This function allows you to edit the active weld procedure. Use the **FWD/BACK** keys to move between fields of information and the **UP/DOWN** keys to highlight information to be changed.

Page one: This page is primarily composed of textual information, which is important for identifying the procedure, and is displayed in the WELD/WELD mode. All fields of a procedure are directly modifiable in the EDIT mode except for three: Procedure Name, Welder Name, and Description.

Procedure name: This can only be modified in the FILE mode.

Welder Name: This can only be changed in WELD/INFO mode.

Description: Is automatically generated and updated by the M100 power supply. It cannot be directly modified. It is composed of 6 individual fields that help identify the procedure. These fields are:

DDDDD/WWW MMMMMM LL TTC

D: 5 characters for Side 1 Tube Outside diameter.

W: 3 characters for Side 1 Tube Wall thickness.

M: First 6 characters of Side 1 Material.

L: Number of Levels in procedure.

T: Number of Tacks in procedure.

C: Is blank for most procedures. An “S” indicates a step procedure; an “I” indicates an invalid procedure, and an “A” indicates an ATW procedure.

Page two: This page contains the Start Parameters and Tacks sections. The Start Parameters are values that are executed once in the procedure (as opposed to level type information which is repeated for every level). The tacks section can display 4 tacks at a time. The M100 power supply allows up to 10 tacks/procedure. If more then 4 tacks are present, they can be displayed by using the **FWD/BACK** keys that will scroll a tack at a time.

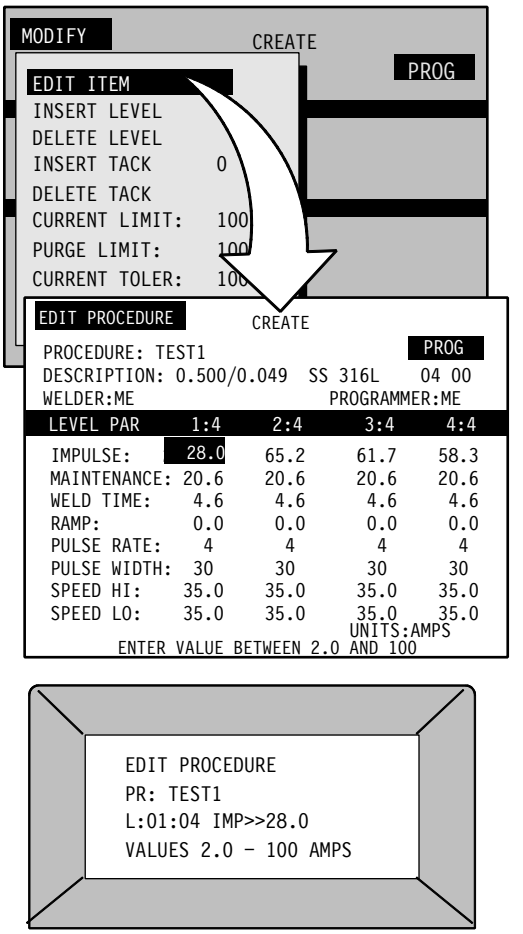


Figure 51 Adjusting the Floating-point Numbers

Page Three: This page contains the level sections. The M100 power supply allows from 1 – 99 levels but only 4 levels may be displayed at one time. If a procedure has more than 4 levels, the remaining levels can be displayed by using the **FWD/BACK** keys that will scroll a level at a time.

To use EDIT ITEM:

1. Select MODIFY/EDIT ITEM, press **ENTER.**
2. Using the alphanumeric keys, make the desired changes on all three pages of the weld procedure. If the value entered is outside the limits allowed for that parameter, a warning will appear. If you elect to leave an invalid entry, the program will not run.
3. Press any mode key to exit. If any of the procedure fields are invalid, you will be prompted with the number of errors and ask to save or correct errors.

   Correct Errors – If Correct Errors is chosen, the cursor will be located on the first error.

   Save – If Save with Errors is chosen the procedure will be invalid.
4. You will be asked if you wish to rename the procedure. If you don't rename the M100 power supply will default to the original file name. If you then enter **ENTER** with the original file name it will be overwritten without a warning message. If you enter a new name, both files will be saved. To delete one of the files, go to FILE/DELETE.

MODIFY PROCEDURE – INSERT LEVEL

The number of levels in a procedure is displayed next to the INSERT LEVEL function on the menu list. The programmer can create up to 99 levels in a weld procedure. When INSERT LEVEL is selected, the levels are displayed and you can use **FWD/BACK** to select the point of insertion in the procedure. The new level will be added immediately before the selected level. The new level will make a copy of the selected level. You must then go to EDIT ITEM to modify the values.

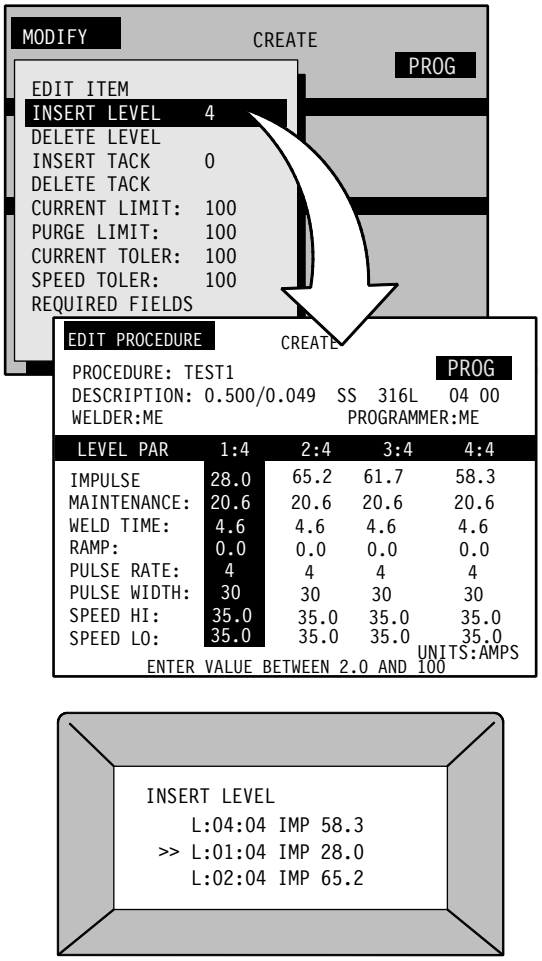


Figure 52 Inserting a Level

MODIFY PROCEDURE – DELETE LEVEL

The DELETE LEVEL function is used to remove a level from the procedure. Highlight the level to be deleted, and then press **ENTER**. The M100 power supply will ask for confirmation before deleting a level.

MODIFY PROCEDURE – INSERT TACK

The number of tacks in a procedure is displayed next to the INSERT TACK function on the menu list. The maximum number of tacks that can be used in a procedure is 10. When INSERT TACK is selected, the tacks are displayed and you can use **FWD/BACK** to select the point of insertion in the procedure. The new tack will be added immediately before the selected tack. You must go to EDIT ITEM to modify the values.

MODIFY PROCEDURE – DELETE TACK

The DELETE TACK function is used to remove a tack from the procedure. Highlight the tack to be deleted and then press **ENTER**. The M100 power supply will ask for confirmation before deleting the tack.

MODIFY PROCEDURE – CURRENT LIMIT

If you wish to limit the amount of average current adjustment allowed in the Adjust/Average Current Per Level function on page 38, this setting allows such modification. The value is expressed as a percentage and can be set to any value between +/- 0 and 100 %. The default value is 100 %. You must have programmer privilege to access this function.

MODIFY PROCEDURE – PURGE LIMIT

If you wish to limit the amount of purge time adjustment allowed in the ADJUST/PREPURGE, POSTPURGE function on page 39, this setting allows such modification. The value is expressed as a percentage and can be set to any value between +/- 0 and 100 %. The default value is 100 %. You must have programmer privilege to access this function.

MODIFY PROCEDURE – CURRENT TOLER

If you wish to adjust the tolerance for the acceptable performance or check calculations for average current, this setting allows selection of a new tolerance. It can be set to any value between +/- 0.0 and 9.9 %. The default value is +/- 2.5 %.

MODIFY PROCEDURE – SPEED TOLER

If you wish to adjust the tolerance for the acceptable rotor speed performance, this setting allows selection of a new tolerance. It can be set to any value between 0.0 and 9.9 %. The default value is +/- 2.5 %.

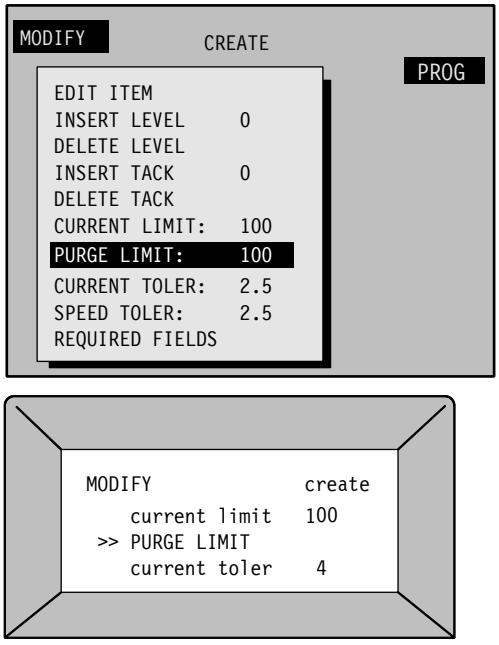


Figure 53 Adjust Limits

MODIFY PROCEDURE – REQUIRED FIELDS

If you wish to require some or all the fields in WELD/INFO to be filled in by the welder before welding, this setting is available. Three configurations are available.

- NO (the field is not required)
- REQ (the field must be entered before welding begins and will be cleared with power off)
- CHG (the field must be entered before welding begins and must be re-entered for every weld).

An asterisk (*) will appear before each field requiring data in the WELD/INFO mode.

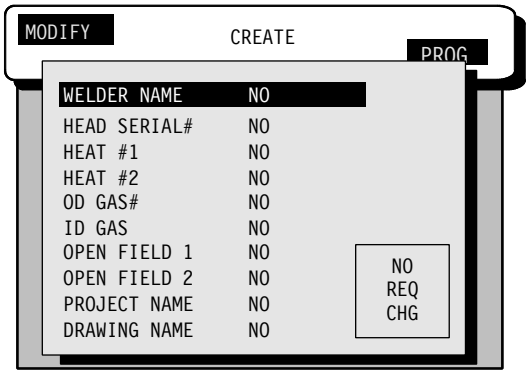


Figure 54 Designating the Required Fields

CREATE PROCEDURE – AUTO ENTRY

The AUTO ENTRY is a quick and easy way to create a weld procedure. You are prompted to select the weld parameters from a series of pick-lists and the M100 power supply calculates the initial values for tacks, levels, and other data. You must complete all the steps listed below, or your work will not be saved.

1. **Select Programmer –** Enter your name or ID with the alphanumeric keypad.
2. **Select joint type –** Select the joint type. The list presented gives the type of tube for each side of the joint. Some of the options include:

   - TB-TB (side 1 Tube Butt Weld to side 2 Tube Butt Weld)
   - TB-ATW (side 1 Tube Butt Weld to side 2 Auto Tube Weld)

   The side 2 ATW defaults to a normal cuff thickness. However, if desired, you may adjust thickness setting.

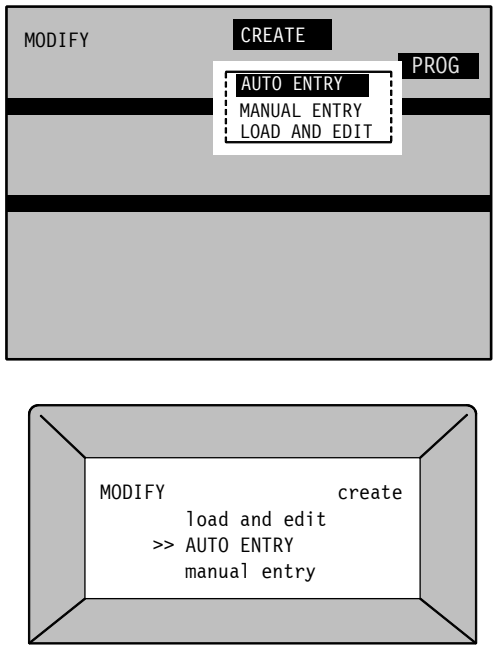


Figure 55 Creating an Auto Entry Procedure

3. **Select side 1 material –** Select the material for side 1 from the pick-list. The M100 power supply assumes that both sides of the weld are the same material and duplicates side 1 information in side 2. If necessary, changes can be made in MODIFY/EDIT ITEM.
4. **Select units –** Select the dimensional units desired for the weld procedure. Options include inches, millimeters, and OD in inches/wall thickness in mm.
5. **Select side 1 diameter –** Select the OD for the tube for side 1. The M100 power supply assumes that both sides of the weld are the same material and duplicates side 1 information in side 2. If necessary, changes can be made in MODIFY/EDIT ITEM.
6. **Select wall thickness –** Select the wall thickness for side 1. The M100 power supply assumes that both sides of the weld are the same material and duplicates side 1 information in side 2. If necessary, changes can be made in MODIFY/EDIT ITEM.
7. **Select weld head –** Select the weld head to be used. Since each weld head series is compatible with specific ranges of OD, only the compatible weld heads are presented for selection.

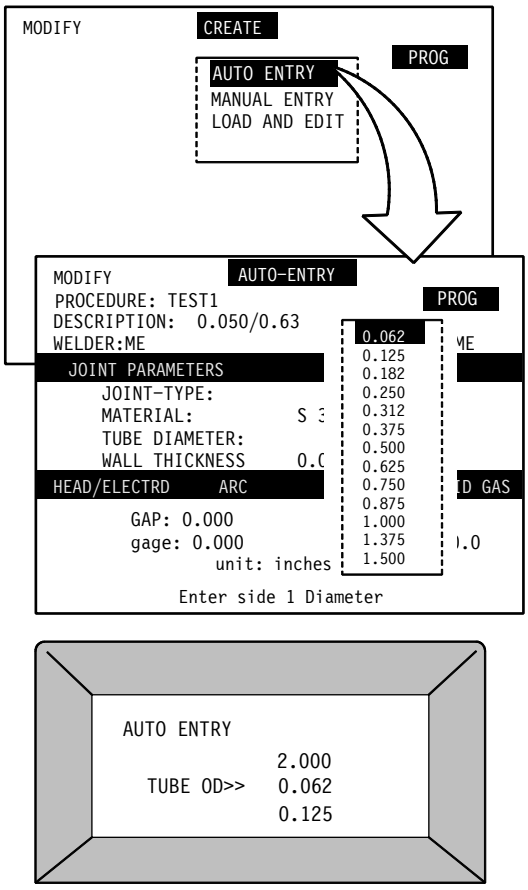


Figure 56 OD Pick List

8. **Select number of passes** – If the tube diameter is 1/4 in. or less, the M100 power supply prompts you to select whether a single-level multiple-pass procedure or multiple-level single-pass procedure is to be calculated.
9. **Select tacks, levels, or both** – After the weld head and number of passes are selected, the M100 power supply presents a list for you to select tacks, levels, or both for the unit to calculate.
10. **Select tacks** – M100 power supply prompts for the number of tacks desired.

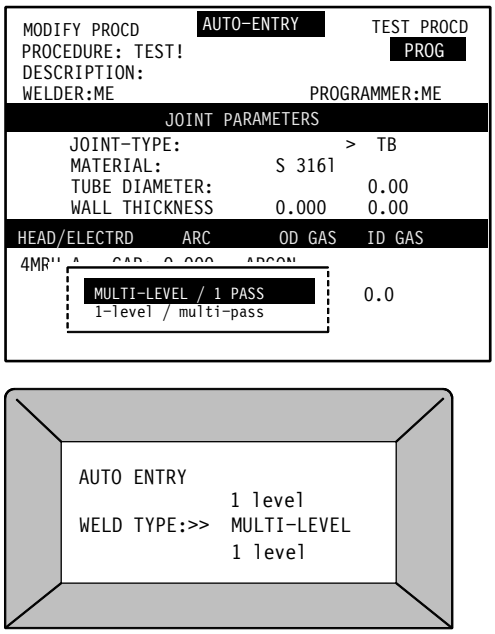


Figure 57 Number of Passes List

11. **Select levels –** M100 power supply prompts for the number of levels desired.

    At this point, the M100 power supply calculates the remainder of the data for the weld procedure.

    - The electrode is selected based on the weld head and tube diameter entered.
    - The arc gap is selected based on the weld head wall thickness and OD.
    - The start power is selected based on wall thickness.
    - The tube purge pressure is selected based on the diameter.
    - The shield purge rate is selected based on the weld head type.
    - The prepurge and postpurge times are selected based on the weld head.
    - The level data is calculated based on a set of factors ("A," "B," "C," "thickness speed," and "OD speed") taken from the latest table developed for Weld Guideline Preparation.
    - If tacks were selected, the tack current is calculated from the first level data. All tacks are evenly spaced starting at 10 degrees.
    - The start current is calculated from first level data.
    - The downslope time is calculated as a percentage of the total weld time.
    - The arc gap gauge setting is calculated based on weld head, diameter, and arc gap value.
    - After all work specifications are entered, the M100 power supply will create the description. If tacks or levels are added or deleted, the description will be updated.

12. **Store/Save –** You have the option of saving the newly created procedure to memory or to the PC memory card. The other option is Active (No Save), which allows the weld procedure to be the active procedure, but it is not saved.

13. **Name Procedure –** If you chose to save, you will be prompted to enter the procedure name.

14. **Screen Revert to PROGRAM/CREATE –** The M100 power supply defaults back to the auto entry screen ready to program another weld procedure.

CREATE PROCEDURE – MANUAL ENTRY

This submode is used when the programmer wishes to enter all values. The M100 power supply will only check if the values are valid not if they are appropriate for the weld procedure desired.

To use manual entry:

1. Select MANUAL ENTRY, then press **ENTER**.
2. Enter the number of tacks desired (0 – 10) and press **ENTER**.
3. Enter the number of levels desired (0 – 99) and press **ENTER.**
4. A zero or a minimum value is placed by the M100 power supply in all fields and places you in PROGRAM/EDIT ITEM.
5. Enter appropriate values in all available fields. The M100 will generate the description from the entered information.
6. To exit, press any Mode key.
7. M100 power supply will recognize any invalid fields. See Step 3 on page 54.
8. Save to one of the following:
   - Save to memory
   - Save to PC memory card
   - Active (no save)
9. Press **ENTER.**
10. Enter a procedure name and press **ENTER**. The procedure is complete.

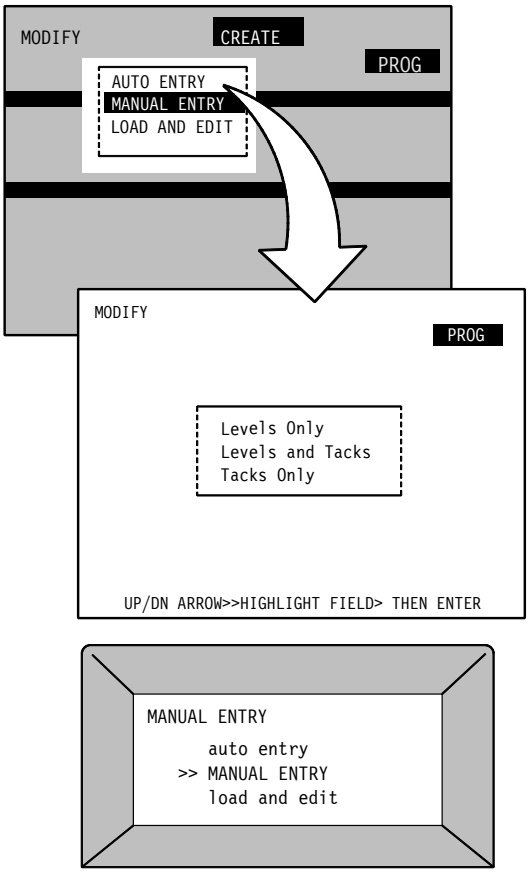


Figure 58 Manual Create Input

CREATE PROCEDURE – LOAD AND EDIT

This submode is used to copy a weld procedure that is similar to the one you want to create and it places you directly into EDIT ITEM so you can make changes. The default name will be untitled to remind you a new name is needed. You cannot overwrite an existing procedure from this function.

SETUP MODE

The SETUP Mode handles a number of auxiliary functions of the M100 power supply. User preferences can also be changed in this mode (See page 24).

Setup Mode Directory

Submode	Activity	Onscreen Display	Page
DATALOG	Print coupons	PRINT COUPON	62
	Transfer memory	XFER MEM TO SERIAL, XFER MEM TO CARD	62
	Modify print format	PRINT FORMAT:	62
	Auto print option	AUTO PRINT #:	66
	Number of coupons	# OF COUPONS:	66
	Enable card or serial port	ENABLE CARD:, ENABLE SERIAL:	66
	Erase datalog memory or card	ERASE DATALOG MEM, ERASE DATALOG CARD	66
CONFIGURE	Jog speed	JOG SPEED:	67
	Dimensional units	DIM UNITS:	67
	Purge rate units	PURGE UNITS:	68
	Set date format	DATE FMT:	68
	Remote backlight	REMOTE LIGHT:	68
	Remote keyclick	REMOTE KEYCLICK:	68
	Panel light	PANEL LIGHT:	68
	Panel keyclick	PANEL KEYCLICK:	68
	Monitor polarity	MON POLARITY:	68
	Alarm	ALARM:	68
	Modify minimum volts	MINIMUM VOLT:	68
	Count Misfires	COUNT MISFIRES:	69
PASSWORD	Change owner password	CHANGE OWNER	69
	Change programmer password	CHANGE PROGRAMMER	69
	Change security	CHANGE SECURITY	69
UTILITY	Reset weld counter	RESET WELD COUNTER	71
	Set date and time	SET DATE/TIME	71
	Initialize card	INITIALIZE CARD	71
	Clear application	CLEAR APPLICATION	72
	Executor Version	EXECUTOR VER:	72
	F. Panel Version	F. PANEL VER:	72
	Loader Lo Version Loader Hi Version	LOADER LO VER:, LOADER HI VER:	72

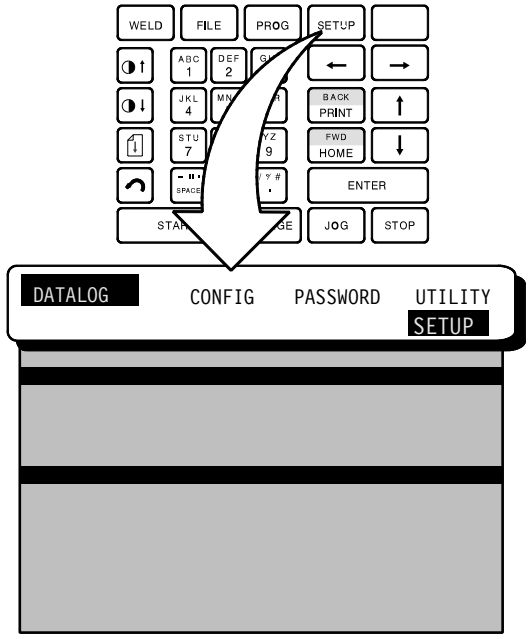
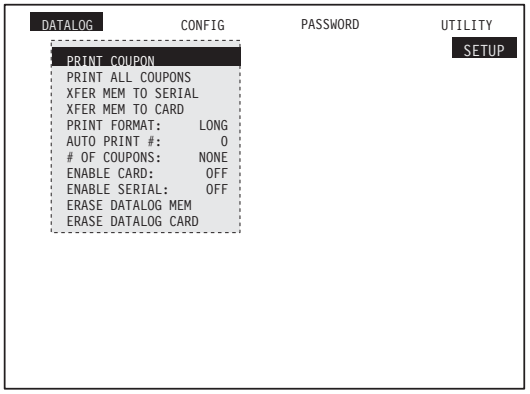


Figure 59 Setup Mode



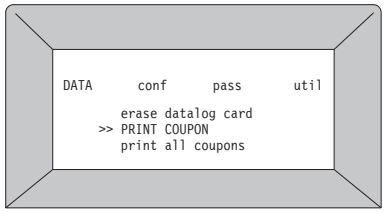


Figure 60 Setup Mode Display

DATALOG – PRINT COUPON

When this function is selected: the M100 power supply lists all Data records from memory or an installed PC memory card. Select the desired file using the **UP/DOWN** and **FWD/BACK** keys. The highlighted record will be printed when **ENTER** is pressed.

DATALOG – PRINT ALL COUPONS

When this submode is selected and the **ENTER** key is pressed, the M100 power supply will print all the data records in memory.

DATALOG – XFER MEM TO SERIAL

This submode allows you to transfer all the system datalog records to the serial port. This function does not transfer weld procedures. The port is active in this function even if the DATALOG/ENABLE SERIAL is in the OFF position.

DATALOG – XFER MEM TO CARD

This submode allows you to transfer the system datalog records to the PC memory card. This function does not transfer weld procedures. The port is active in this function even if the DATALOG/ENABLE CARD is in the OFF position.

DATALOG – PRINT FORMAT

This function allows you to specify a preferred format for printed output from three choices. The choices are: long, short, and medium and each provides more or less information. See Figure 62 through Figure 64.

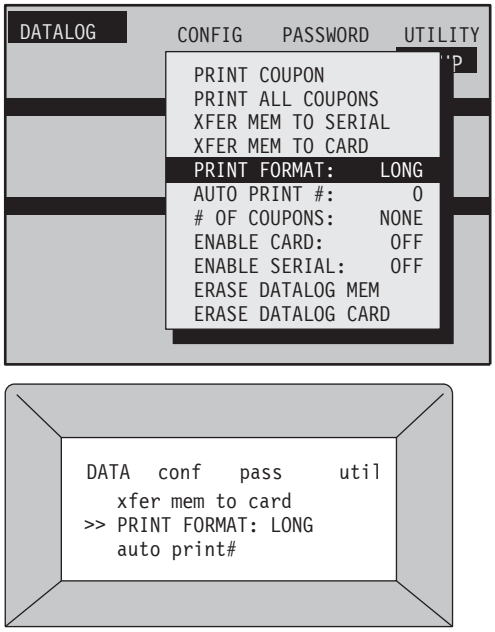


Figure 61 Print Format

Weld Data Record Examples

The **Short** printout shown in Figure 62 contains only the header information, description, outputs, and performance confirmation.

SWAGELOK WELDING SYSTEM
DATA RECORD SHORT

MODEL M100-1 VER: 1.01 5.05
SERIAL# 1050
DATE JUL 13, 1999 TIME 03:42p
WELD# 12

DESCRIPTION

PROCEDURE: WPS TEST 1A
DESCRIPTION: 0.500/049 SS 316 04 03
PROGRAMMER: XXXXXXXXX
WELDER: XXXXXXXXX

OUTPUTS

AVERAGE

LVL	AMPS	VOLT	RPM	TIME	KJ
1	34.9	6.7	35.51	4.6	1.0
2	33.8	6.6	35.51	4.6	1.0
3	32.8	6.6	35.51	4.6	0.9
4	31.8	6.6	35.51	4.6	0.9
D/S	15.5	6.6	35.51	3.6	0.3

PERFORMANCE CONFIRMATION

WELD COMPLETE
PERFORMANCE ACCEPTABLE

QA/QC: _____

NOTES: _____

Figure 62 Short Printout

The **Medium** printout shown in Figure 63 contains the output information most commonly requested. This printout gives header information, description, inputs, outputs, and performance confirmation.

SWAGELOK WELDING SYSTEM
DATA RECORD MEDIUM

MODEL M100-1 VER: 1.01 5.05
SERIAL# 1050
DATE JUL 13, 1999 TIME 03:42p
WELD# 12

DESCRIPTION

PROCEDURE: WPS TEST 1A
DESCRIPTION: 0.500/049 SS 316 04 03
PROGRAMMER: XXXXXXXXX
WELDER: XXXXXXXXX
LAST CAL: JUN 15, 1999
MIN VOLTS: 4.0
CUR TOL: 2.5%
SPEED TOL: 2.5%
CUR LIMIT: 100%
PURGE LIMIT: 100%

INPUTS

LVL	AMPS	RPM	TIME
1	35.0	35.50	4.6
2	33.9	35.50	4.6
3	32.9	35.50	4.6
4	31.9	35.50	4.60

OUTPUTS

AVERAGE

LVL	AMPS	VOLT	RPM	TIME	KJ
1	34.9	6.7	35.51	4.6	1.0
2	33.8	6.6	35.51	4.6	1.0
3	32.8	6.6	35.51	4.6	0.9
4	31.8	6.6	35.51	4.6	0.9
D/S	15.5	6.6	35.51	3.6	0.3

PERFORMANCE CONFIRMATION

WELD COMPLETE
PERFORMANCE ACCEPTABLE

QA/QC: _____

NOTES: _____

Figure 63 Medium Printout

The **Long** printout shown in Figure 64 contains all information on inputs and outputs. This printout lists the entire weld procedure as well as the results.

SWAGELOK WELDING SYSTEM
DATA RECORD LONG

MODEL M100-1 VER: 1.01 5.05
SERIAL# 1050
DATE JUL 13, 1999 TIME 03:42p
WELD# 12

DESCRIPTION

PROCEDURE:	WPS TEST 1A	
DESCRIPTION:	0.500/049 SS 316 04 03	
PROGRAMMER:	XXXXXXXXX	
WELDER:	XXXXXXXXX	
JOINT TYPE:	TUBE	TUBE
MATERIAL:	SS 316L	SS316L
HEAT #:	A123456789	A123456789
DIAMETER:	0.500 IN	0.500 IN
WALL THICK:	0.049 IN	0.049 IN
PROJECT:	MANUAL 123	
DRAWING:	AIR 12-456	
WELD HEAD:	5H	60801
ELECTRODE:	C.040-.555	
ARC GAP/SET:	0.035 IN	0.907 IN
OD GAS:	ARGON	AA98765432
OD FLOW:	12 CFH	
ID GAS:	ARGON	BB98765432
ID PRESSURE:	1.3 IWC	
OPEN 1:	1 2 3 4 5	
OPEN 2:	6 7 8 9 0	
LAST CAL:	JUN 15, 1999	
MIN VOLTS:	4.0	
CUR TOL:	2.5%	
SPEED TOL:	2.5%	
CUR LIMIT:	100%	
PURGE LIMIT:	100%	

INPUTS

START POWER:	NORM	
START CUR:	35.0	AMPS
ROTOR DELAY:	1.1	SECONDS
DOWNSLOPE:	3.6	SECONDS
PREPURGE:	20	SECONDS
POSTPURGE	20	SECONDS

TACKS:	DEGREES	AMP	SECONDS
1	0	35.0	1.0
2	120	35.0	1.0
3	240	35.0	0.9

			-IMPULSE-		AVG
LEV	IMPULSE	MAINT	RATE	WIDTH	CURR.
1	68.6	20.6	4	30	35.0
2	65.2	20.6	4	30	33.9
3	61.7	20.6	4	30	32.9
4	58.3	20.6	4	30	31.9

			----------RPM----------		
LEV	TIME	RAMP	HI	LOW	AVG
1	4.6	0.0	3.50	3.50	35.0
2	4.6	0.0	3.50	3.50	35.0
3	4.6	0.0	3.50	3.50	35.0
4	4.6	0.0	3.50	3.50	35.0

OUTPUTS

AVERAGE

LVL	AMPS	VOLT	RPM	TIME	KJ
1	34.9	6.7	35.51	4.6	1.0
2	33.8	6.6	35.51	4.6	1.0
3	32.8	6.6	35.51	4.6	0.9
4	31.8	6.6	35.51	4.6	0.9
D/S	15.5	6.6	35.51	3.6	0.3

PERFORMANCE CONFIRMATION

WELD COMPLETE
PERFORMANCE ACCEPTABLE

QA/QC: _____

NOTES: _____

Figure 64 Long Printout

DATALOG – AUTO PRINT

This function allows you to specify whether the print is to be output only when requested or automatically every “nth” weld.

DATALOG – # OF COUPONS

This function allows you to specify how many weld data logs the unit will store in internal memory. Selection of (NONE) will command the unit to store no weld data logs. Selection of a number will command the unit to store that number of logs then roll off the oldest log as new logs are added. Selection of (ALL) will command the unit to store all logs until the files are erased or the memory is full.

DATALOG – ENABLE CARD

When this function is turned ON, the unit will transmit the weld data, as welds are made, to the data card port. The Weld Mode Error function MEMORY CARD FULL or REQ. MEMORY CARD will be active.

DATALOG – ENABLE SERIAL

When this function is turned ON, the unit will transmit the datalog records as welds are made to the serial port in comma delimited format.

DATALOG – ERASE DATALOG MEM

Erases all datalog records from memory.

DATALOG – ERASE DATALOG CARD

Erases all datalog records from PC memory card.

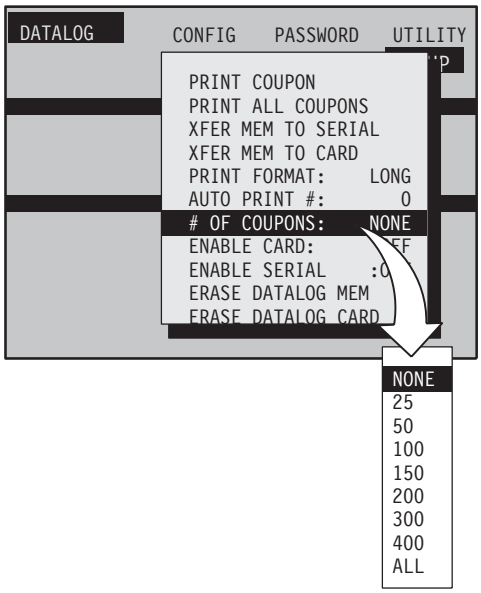


Figure 65 Number of Coupons

CONFIG – JOG SPEED

This function allows you to specify manual jog speed as a percentage of the maximum rotor RPM.

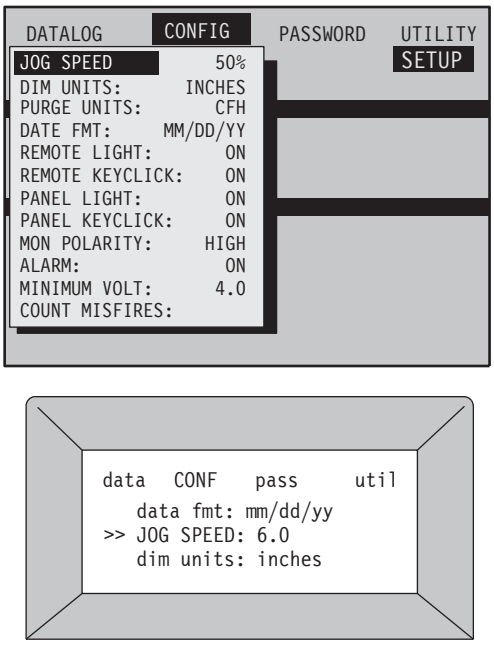


Figure 66 Jog Speed

CONFIG – DIM UNITS

This function allows you to change the linear measurement units between Metric and English measurement systems. Select inches, millimeters, or inches for OD and inches or millimeters for wall thickness.

The dimensional units displayed are defaulted from the last auto-generated program.

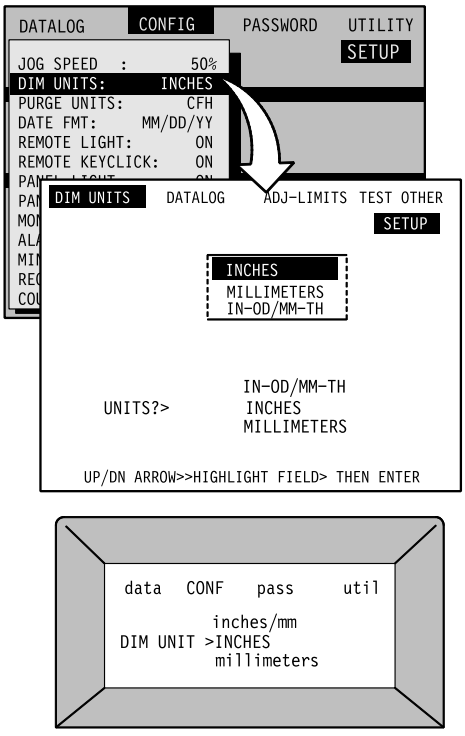


Figure 67 Dimensional Units

CONFIG – PURGE UNITS

This preference allows you to either measure purge gas flows in std ft^3/hr or std L/min.

CONFIG – DATE FMT

This submode allows you to set the date format to:

- Month/Day/Year
- Day/Month/Year
- Year/Month/Day

CONFIG – REMOTE LIGHT

Allows you to turn ON/OFF the remote pendant backlight. Backlighting makes the remote pendant display readable in low ambient lighting.

CONFIG – REMOTE KEYCLICK

Allows you to turn ON/OFF the remote pendant key panel audible tone.

CONFIG – PANEL LIGHT

Allows you to turn ON/OFF the main screen backlight. This is desirable when the ambient temperature is at or above 40°C (104°F) (normal operating range of the screen). The main screen backlight should be on except when operating above 40°C.

CONFIG – PANEL KEYCLICK

Allows you to turn ON/OFF the main key panel audible tone when pressing keys.

CONFIG – MON POLARITY

Allows you to change the output polarity of the recorded output enable port (located on the rear panel) + on to - on.

CONFIG – ALARM

If this function is on and a weld error occurs the audio alarm is activated. The status line displays the error. Reset by pressing **ENTER**.

CONFIG – MINIMUM VOLT

Allows you to change the voltage that the M100 power supply senses for low arc voltage error. The voltage will default to 4 volts. The value may have to be adjusted up when using a weld head extension cable. Refer to *Weld Errors* on page 35.

CONFIG – COUNT MISFIRES

Allows you to specify whether misfires will be counted on the reset table weld counter.

PASSWORD – CHANGE SECURITY, PROGRAMMER, OWNER

Allows an authorized user to change or set passwords for a particular privilege level. If the password field for that privilege level is left blank, no password is required to access those functions.

There are three password privilege levels available with the M100 power supply. In ascending order of privilege:

- **Security Password**
  The security password is used to secure the M100 power supply during periods that it is unattended. If a Security password is entered, it must be entered to access any function of the equipment. Owner password and Programmer password can override.
- **Programmer Password**
  Programmer privilege allows you to change the programmer password and is required for full use of the equipment. This privilege level has full WELD mode and FILE mode privileges. If a Programmer password has been set, users without it will only have WELD mode and limited FILE mode privileges. Owner password can override.
- **Owner Password**
  A privileged password is one that only the person responsible for the welder should know. This level accesses all privileges and can override the programmer and security level passwords if necessary. Think of this password as a master key and protect it as such.

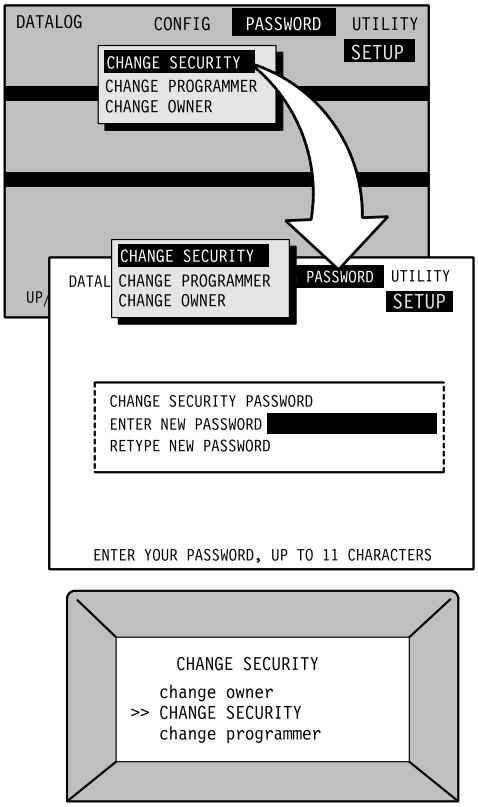


Figure 68 Change Password

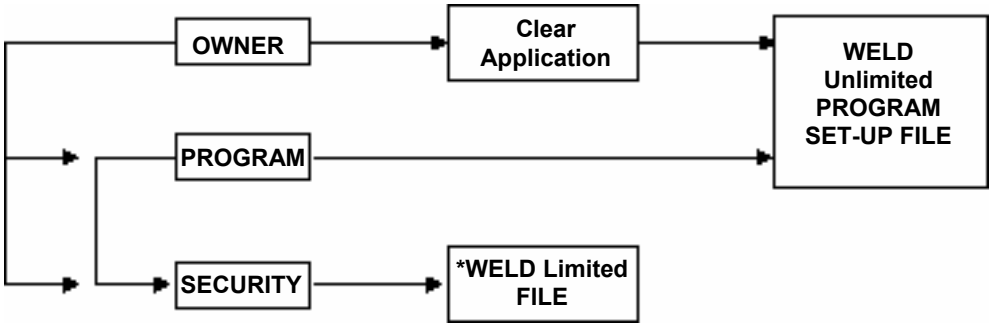
Note:
If the owner password does not work, contact your Swagelok representative for instructions.

Note:
If no programmer password is used, all users will have programmer priveleges with full File mode activities.

Note:
The M100 power supply must be turned off to activate security.

To change a Password

1. **Select the function** – Select the password level you want to change (Security, Programmer, Owner).
   a. **Security** – The programmer password or the owner password must be entered. Enter the new security password, and verify the new password by retyping it in the confirmation field.
   b. **Programmer** – The old programmer password or the owner password must be entered. Enter the new programmer password, and verify the new password by retyping it in the confirmation field.
   c. **Owner** – The existing owner password must be entered. Enter the new password, and verify the new password by retyping it in the confirmation field.



*** If a Program password is not entered the security will allow the user to access all Programmer functions.**

Figure 69 Password

UTILITY – RESET WELD COUNTER

The Weld Counter that appears on the main or remote screen and in data log, can be reset or changed. Key in the new counter number and press **ENTER**.

Note:
The M100 advances the Weld Count each time a new weld is started.

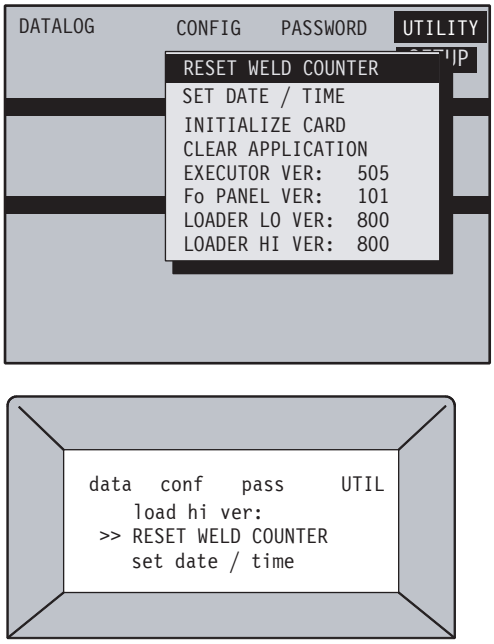


Figure 70 Reset Weld Counter

UTILITY – SET DATE\TIME

If the date or time displayed is incorrect you can enter a new date and time. SAVE TIME NOW option must be pressed after changes are made.

UTILITY – INITIALIZE CARD

If the PC memory card data or formatting becomes corrupt, the card can be cleared and initialized.

Caution!

All data will be cleared from the PC memory card when the PC memory card is initialized.

UTILITY – CLEAR APPLICATION

This is an owner-password-protected function used when updating the application software installed in the unit. The new application software on a PC memory card should be on hand before the current software is cleared.
SEE EXTREME CAUTION!

Extreme Caution!

If the unit software is cleared without the new software update the unit will be DISABLED.

Procedure to clear and load update software:

1. Select CLEAR APPLICATION and press **ENTER.**
2. Key in Owner Password and select **ENTER.**
3. Verify/Confirmation to Continue (YES/NO).
4. **SEE EXTREME CAUTION!**
5. Press **ENTER**.
6. Turn Power OFF upon prompt.
7. Insert the PC memory card with the new software into the card port.
8. Turn power ON.
9. Remove the PC memory card upon prompt.
10. Turn power OFF upon prompt.
11. Turn power ON and the installation is complete.

UTILITY – EXECUTOR VER: XXX

The Executor Software interfaces the Application or Front Panel Software with the welding section of the power supply.

Note:
The only software version that is updateable in the field is the Front Panel Version.

UTILITY – F. PANEL VER: XXX

F. Panel software, often called the application software, controls the user's communication with the M100 power supply.

UTILITY – LOADER LO VER: XXX
UTILITY – LOADER HI VER: XXX

Loader software controls the loading of Front Panel software.

Effect of Weld Parameters

The following text briefly discusses how the weld parameters relate to the current waveform and the effects of any parameter changes.

Weld Parameters Affect the Output Waveform

The shape and duration of the output current waveform created during the weld cycle is determined by the weld parameter settings entered on the M100 front panel. The values from the weld procedure guideline in Section 5 create a current waveform as shown in Figure 71 and Figure 72.

During a typical weld, the power supply pulses between high amp current (Impulse) and low amp current (Maintenance). In Figure 72, the current control settings are:

IMPULSE	56.4 A	Level 1
	53.6 A	Level 2
	50.9 A	Level 3
	48.4 A	Level 4
MAINTENANCE	15.8 A	
IMPULSE RATE	3 pulses per second	
IMPULSE WIDTH	30 %	

In this case, the current pulses between the high and the low levels 3 times per second. The current is at the high level 30 % of the time and at the low level 70 % of the time.

Effects of Weld Parameter Changes

Impulse current and rotor speed affect the depth of penetration of the weld.

Impulse width also affects weld penetration. The control allows fine-tuning of the weld penetration level.

Pulse rate is typically set so that each weld spot overlaps the previous one by at least 70 %.

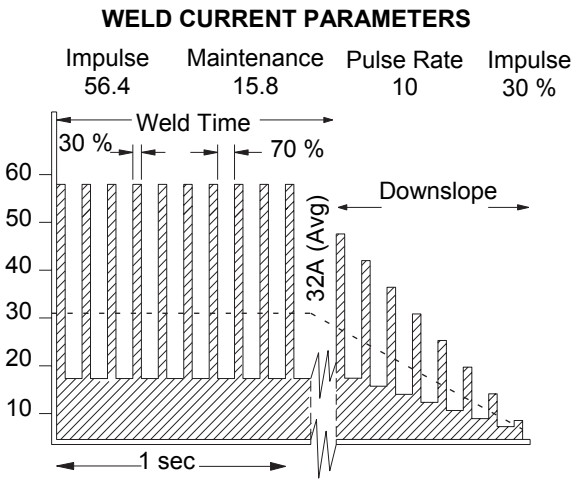


Figure 71 Single Level Weld Current Waveform

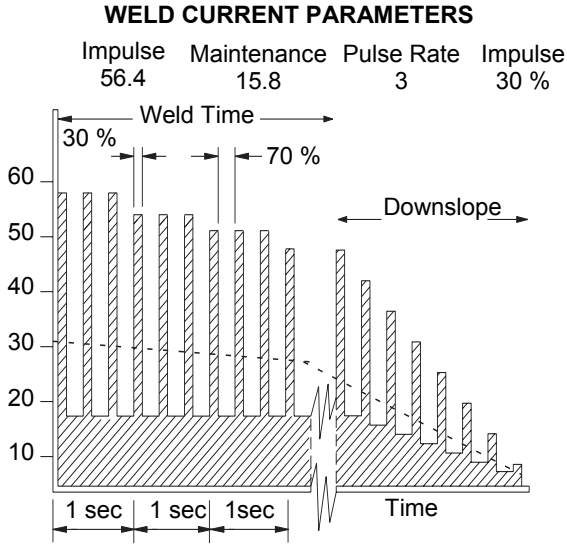


Figure 72 Multiple Level Weld Current Waveform

Setting the Shield Gas Flow

1. Verify the shielding and purge gas connections to the work pieces.
2. Set the shielding gas flow meter to the proper setting. Refer to Table 4.

Table 4 Shield Gas Flow Rates (Argon)

Weld Head Series	std ft^3/h	L/min
5H	10 to 15	4.7 to 7.1
10H	10 to 20①	4.7 to 9.4
20H-A	10 to 20①	4.7 to 9.4
20H-B/C	20 to 40①	9.4 to 18.8
40H	25 to 50①	12 to 24
4MH	8 to 10	4 to 4.7
8MH	15 to 20	7.1 to 9.4

① Set the flow to the higher rates when welding at high current levels.

3. Press PURGE to operate the shielding gas solenoid valve and to start the shielding gas flow. Allow the system to purge for several minutes on initial setup to clear the shielding gas system of oxygen. Refer to Table 5.
4. Press **PURGE** again to close the shield gas solenoid valve.

Caution!

Excessive or insufficient flow rates may affect arc start and arc stability.

Table 5 Purge Rate and Pressure Tables

Tube Size	Wall Thickness	Minimum ID Purge Rate	Pressure①②	Swagelok Weld Head Purge Rates③④	Restrictor Size⑤
1/16 in. n/a	0.015 in. n/a	0.2 std ft^3/hr 0.1 L/min	13 to 16.8 torr 7 to 9 iwc 175 to 230 mmwc 17.4 to 22.4 mb	10 to 20 std ft^3/hr 5 to 10 std L/min	n/a
1/8 in. 3 mm	0.028 in. 0.8 mm	1 std ft^3/hr 0.5 L/min	9.3 to 16.8 torr 5 to 9 iwc 130 to 230 mmwc 12.4 to 22.4 mb	10 to 20 std ft^3/hr 5 to 10 std L/min	1/16 in.
1/4 in. 6 mm	0.035 in. 1 mm	6 std ft^3/hr 3 std L/min	5.2 to 6.3 torr 2.8 to 3.4 iwc 71 to 86 mmwc 7.0 to 8.5 mb	10 to 20 std ft^3/hr 5 to 10 std L/min	1/8 in. 3 mm
3/8 in. 10 mm	0.035 in. 1 mm	10 std ft^3/hr 5 L/min	2.8 to 4.7 torr 1.5 to 2.5 iwc 38 to 64 mmwc 3.7 to 6.2 mb	10 to 20 std ft^3/hr 5 to 10 std L/min	1/8 in. 3 mm
1/2 in. 12 mm	0.049 in. 1 mm	15 std ft^3/hr 7 std L/min	1.9 to 2.8 torr 1.0 to 1.5 iwc 25 to 38 mmwc 2.5 to 3.7 mb	10 to 40 std ft^3/hr 5 to 12 std L/min	1/4 in. 6 mm
3/4 in. 20 mm	0.065 in. 1.5 mm	20 std ft^3/hr 10 std L/min	1 to 2 torr 0.5 to 1.1 iwc 13 to 28 mmwc 1.2 to 2.7 mb	15 to 40 std ft^3/hr 7 to 14 std L/min	1/4 in. 6 mm
1 in. 25 mm	0.065 in. 1.5 mm	40 std ft^3/hr 20 std L/min	1 to 1.3 torr 0.5 to 0.7 iwc 13 to 18 mmwc 1.2 to 2.5 mb	15 to 40 std ft^3/hr 7 to 14 std L/min	1/4 in. 6 mm
1 1/2 in. 38 mm	0.065 in. 1.5 mm	90 std ft^3/hr 43 L/min	1 to 1.3 torr 0.5 to 0.7 iwc 13 to 18 mmwc 1.2 to 1.7 mb	15 to 50 std ft^3/hr 7 to 12 std L/min	1/4 in. 6 mm
2 in. 50 mm	0.065 in. 1.5 mm	170 std ft^3/hr 80 L/min	0.7 to 1.3 torr 0.4 to 0.7 iwc 13 to 18 mmwc 1.0 to 1.7 mb	15 to 50 std ft^3/hr 7 to 12 std L/min	3/8 in. 10 mm
3 in. 75 mm	0.065 in. 1.5 mm	400 std ft^3/hr 190 L/min	0.4 to 0.9 torr 0.2 to 0.5 iwc 5 to 13 mmwc 0.5 to 1.2 mb	30 to 50 std ft^3/hr	1/2 in. 12 mm
4 in. 100 mm	0.083 in. 2 mm	720 std ft^3/hr 340 L/min	0.4 to 0.7 torr 0.2 to 0.4 iwc 5 to 13 mmwc 0.5 to 1.0 mb	30 to 50 std ft^3/hr	3/4 in. 20 mm
6 in 150 mm	0.083 in. 2 mm	1670 std ft^3/hr 790 L/min	0.4 to 0.9 torr 0.2 to 0.5 iwc 5 to 13 mmwc 0.5 to 1.2 mb		1 in. 25 mm

Note:
These weld tables are for use on butt welds only. If Weld Head Purge Rates exceed Swagelok recommendations, be cautious of arc wander. For best results, use constant weld head purge between welding cycles.

① ATW welds and Weld Ring welds typically will require approximately 15 % more purge pressure.
② Pressures must be adjusted for ID encroachment of 0 to +10 % of wall thickness at the bottom of the weld.
③ Indicated purge rates are for minimum color line.
④ ID purge rates shall be adjusted to the desired ID color line.
⑤ Restrictor sizes are approximate; purge rate and pressure are critical parameters.

Starting and Completing the Weld

1. Check the following before starting the weld
   - All rear panel connections are complete.
   - Shielding and purge gas lines are properly connected.
   - The inert gas source is on.
   - Correct gas flow rates are set.
   - Weld pieces are properly aligned and clamped in the fixture block.
   - The proper arc gap is set.
   - The weld head is connected to the fixture block.
   - The proper weld procedure program has been selected and entered.
   - WELD mode display shows **READY**.
   - The internal purge gas is flowing.
2. Press **START**.
   Total time for the process is the sum of the following times:
   - Prepurge
   - Rotor delay
   - Weld time (all levels)
   - Downslope
   - Postpurge

Note:
Although the power supply welds in any orientation, it is recommended that it be placed in the upright position before welding.

WARNING!

DO NOT TOUCH THE CABLE CONNECTORS DURING ARC START. IF THE CABLES HAVE BEEN DAMAGED, THE POTENTIAL FOR AN ELECTRICAL SHOCK EXISTS.

Display Indications During Welding

During welding, the status messages are displayed on the screen in the following sequence:

- **Loading**
- **Prepurge**
- **Arc Start**
- **Tacks**
- **Rotor DLY (delay)**
- **Ramp**
- **Levels (time remaining)**
- **Downslope (time remaining)**
- **Postpurge.**

Note:
If the arc fails to start, the power supply status becomes **MISFIRE**. *See the Troubleshooting section for possible causes and corrective actions.*

After the Weld is Complete

1. Wait for the M100 power supply to return to "Ready" state. If a weld error occurs refer to page 35.
2. Check if the fixture block has cooled enough to be safely handled. Allow additional cooling time if necessary before handling. If necessary, increase postpurge time to aid cooling.
3. Release the locking lever on the weld head housing.
4. Remove the weld head from the fixture block. If it is difficult to remove the weld head, release one of the side plate levers.
5. Remove the internal purge gas lines from the welded assembly.
6. Release the levers on the fixture block.
7. Open the side plates of the fixture block.
8. Remove the welded assembly.

WARNING!

USE GLOVES OR OTHER PROTECTIVE DEVICES IF YOU MUST HANDLE PARTS IMMEDIATELY AFTER WELDING. THE PARTS CAN BE EXTREMELY HOT AND MAY CAUSE BURNS.

Caution!

Do not immerse the hot fixture block in water after welding. If using only one fixture block, allow it to cool before performing the next weld. More than one fixture block can be used for repetitive welding.

Note:
Inspect the electrode after each weld. Look for oxidation, wear, or weld material on the tip.

Operation Summary

1. Install the electrode.
2. Set the arc gap using the arc gap gauge.
3. Prepare the work pieces.
4. Select the correct fixture block and collets.
5. Install the collets in the fixture block.
6. Align the work pieces in the fixture block.
7. Connect the internal purge gas line to the work piece to be welded, and set the flow meter.
8. Press **PURGE**, and set the shield gas flow.
9. Press **PURGE** to stop the shielding gas flow prior to starting the weld.
10. Connect the weld head to the fixture block.
11. Program the welder.
12. Press **START** and complete the weld.
13. Remove the weld head from the tube fixture block.

Data Recording Printer

The SWS Data Recording Printer is a small size thermal printer housed inside the M100 power supply case. See Figure 73.

The data recording printer is covered under the same warranty as the M100 power supply.

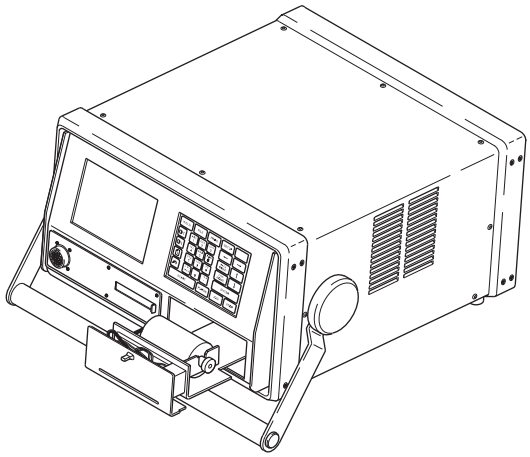


Figure 73 Data Recording Printer

Load the Paper

1. Turn the latch counter-clockwise to release the printer body from the case. Remove the printer body from the case by pulling it forward. See Figure 74.

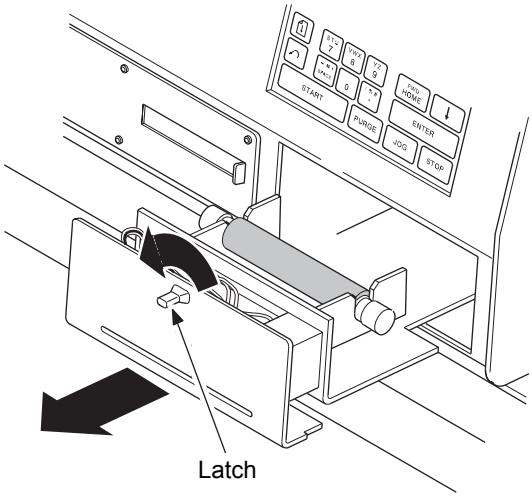


Figure 74 Opening the Data Recording Printer Drawer

2. Lift the printer head fully by raising the lift arm located with the manual paper feed wheel next to the printer cover panel.

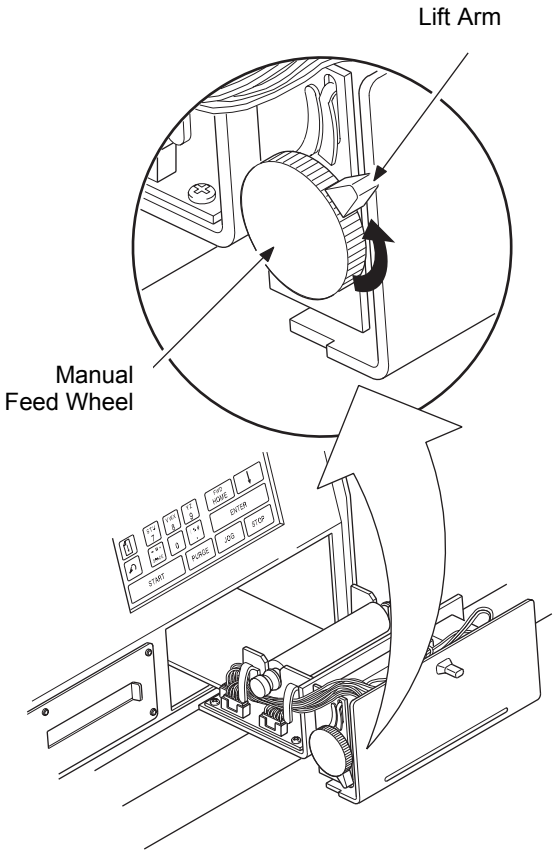


Figure 75 Lift the Printer Head

3. Press the ends of the spindle and lift to remove the paper roll spindle pin and used paper spindle.

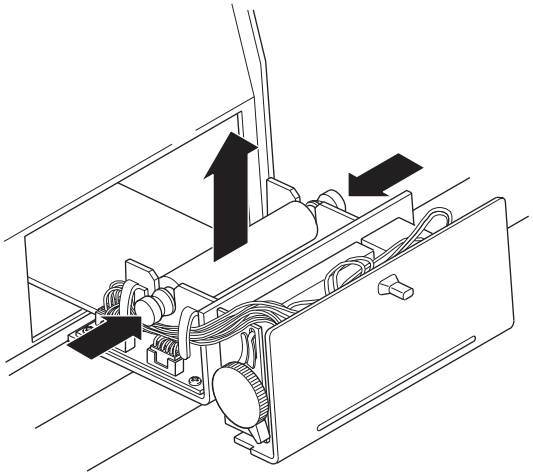


Figure 76 Press the Ends of the Spindle and Lift

4. Install the new roll of thermal paper and load the paper into the feed mechanism. See Figure 77.

   a. Lift the printer head fully by raising the lift arm located with the manual paper feed wheel next to the printer cover panel. The lift arm has three positions. Full down for printing and full up to load the paper. The center position is not used.

   b. Before you place the paper into the support bracket, feed the paper through the printer. The paper enters the printer between the support brackets above the white plastic bar. Feed the paper completely through the printer until it comes out the front panel slot. The paper feeds from the top of the roll.

   c. Insert the spindle through the paper roll. Press both ends of the spindle and insert into the slots. Release ends and check spindle seating.

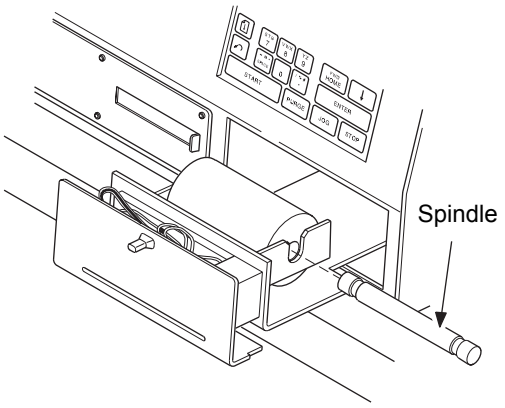


Figure 77 Install Paper

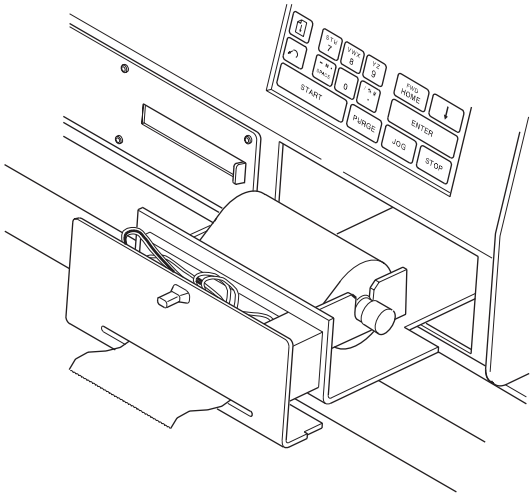


Figure 78 Advancing the Paper

d. Lower the printer head fully by lowering the lift arm.

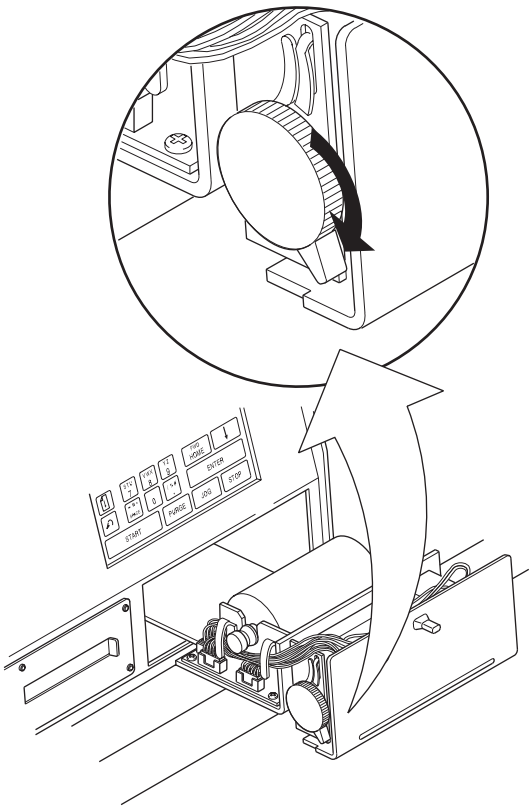


Figure 79 Lower the Printer Head

5. Slide the data recording printer back into the unit case.
6. Turn the latch clockwise to secure the data recording printer to the case.

Caution!

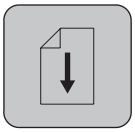
Once the paper enters the feed mechanism, do not pull it back in the direction of the paper roll. Feed the paper with the Advance Paper Button.

Operating the Data Recording Printer

The controls used to operate the data recording printer have been kept to a minimum.

Using the Data Recording Printer

Activate the data recording printer from the power supply by one of the following methods.

- Press **PRINT** on the power supply front panel.
- Establish an automatic print cycle by setting the automatic print counter from the SETUP/ DATALOG function.
- Press  to advance the paper.

The data recording printer will always print the last valid weld data record. If no valid data exists, no data record will be printed.

Data Recording Printer Options

- Select FILE/LOAD/PRINT PROCEDURE. This function is printed on the data recording printer. (See FILE/LOAD/PRINT PROCEDURE on page 47.)
- Select FILE/LOAD/PRINT DIRECTORY. This function is printed on the data recording printer. (See FILE/LOAD/PRINT DIRECTORY on page 48.)
- Select the Print Format (short, medium or long) from the SETUP/DATALOG/PRINT FORMAT. (See SETUP/DATALOG/PRINT FORMAT on page 62.)
- Select SETUP/DATALOG/PRINT COUPON. This function is printed on the data recording printer. (See SETUP/DATALOG/PRINT COUPON on page 62.)
- Select SETUP/DATALOG/PRINT ALL COUPONS. This function is printed on the data recording printer. (See SETUP/DATALOG/PRINT ALL COUPONS on page 62.)

Caution!

Do not operate the data recording printer without paper. (Refer to section on paper loading.)

Figure 80 Print Key and Data Recording Printer Feed Key

Maintenance

The SWS data recording printer is designed to require a minimum of maintenance and service. Contact your Swagelok representative for any electrical or mechanical repairs that must be performed.

Clearing Paper Jams

In the event of a paper jam do not force paper into the unit or try to pry the paper out of the unit. This may damage the thermal print mechanism. Instead:

1. Turn off the power supply.
2. Turn the latch counter-clockwise to release the data recording printer body from the case. Extend the data recording printer body from the power supply by pulling it forward. See Figure 81.
3. Lift the printer head fully by raising the lift arm located with the manual paper feed wheel next to the printer cover panel. See Figure 82.

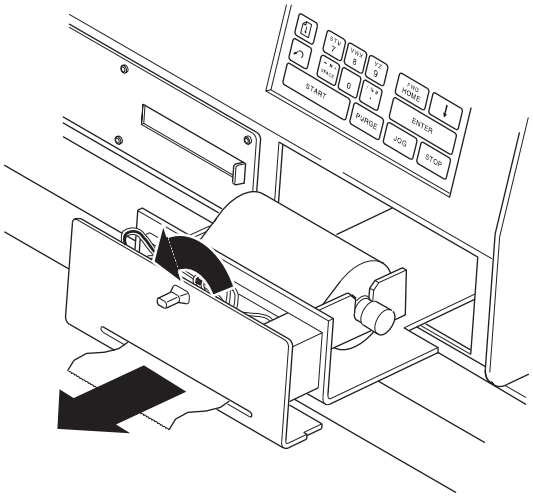


Figure 81 Opening the Data Recording Printer Drawer

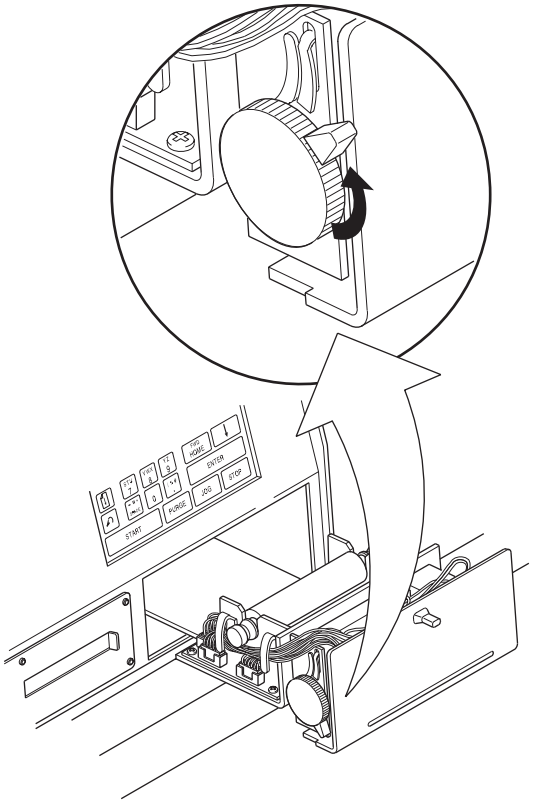


Figure 82 Lift the Printer Head

4. Cut the paper off at the roll. Carefully remove the paper in the data recording printer mechanism by advancing the Manual Feed Wheel or using tweezers or small needle nose pliers. Remove the paper through the front panel. See Figure 83.
5. If the paper cannot be cleared, the front panel cover may be removed by removing two screws located on the underside of the front panel cover. Clear the paper jam and replace the front panel cover.
6. Reload the paper after the jam has been cleared.
7. Slide the data recording printer back into the power supply and tighten the latch.

Caution!

Do not pull the paper backwards toward the paper roll. This can damage the print head mechanism.

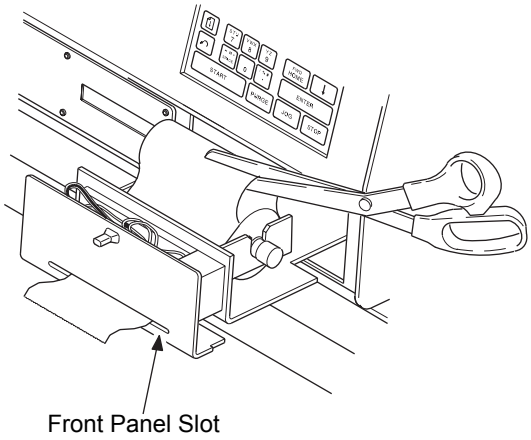


Figure 83 Clearing a Paper Jam

Optional Equipment

The optional equipment available for your Swagelok Welding System (SWS) is listed below. Contact your Swagelok representative for additional information on any listed option.

Optional equipment includes:

- SWS remote pendant
- remote pendant extension cables
- weld head extension cables
- data logging/monitoring
- PC interface cable.

SWS Remote Pendant

See Figure 84. The remote pendant allows you to access all the controls and functions of the M100 power supply. The screen on the remote pendant is not as large as on the main screen. Therefore only data highlighted on the main screen will be displayed on the remote screen.

The unit is attached to the power supply via a cable and the connector labeled Remote on the front panel.
See Figure 85.

Remote Pendant Extension Cable

The remote pendant extension cable is 35 feet long. This allows the remote pendant to reach the weld head when the weld head extension cable is used.

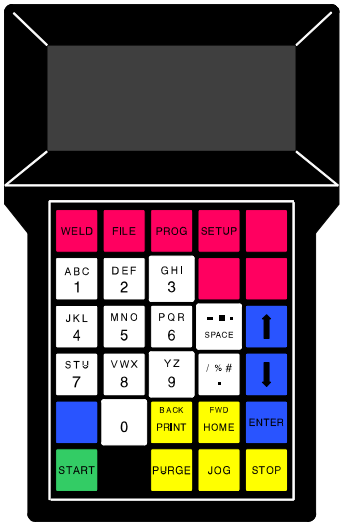


Figure 84 Remote Pendant

Note:
The SWS remote pendant for the D-Series power supply will not work on the M-Series power supply.

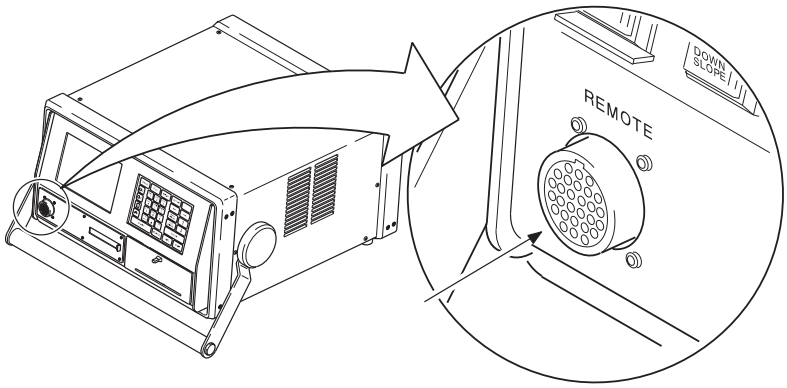


Figure 85 Remote Pendant Connector

Weld Head Extension Cables

The weld head extension cables allow the user to position the weld head up to 50 feet away from the power supply. The extension cable is placed between the power supply and weld head.

Install the extension cable as follows:

1. Turn off the power supply circuit breaker.
2. Disconnect the weld head from the power supply. Plug the appropriate weld head connectors into the end of the extension cable.
3. Insert the connectors at the other end of the extension cable into the appropriate sockets on the power supply rear panel.
4. Turn on the power supply.
5. Locate the **HOME** and **PURGE** pushbuttons on the front panel. See Figure 86.
6. Press **HOME** and check for rotor rotation. Press **HOME** again if the rotor is not at the home position.
7. Press **PURGE** and check for gas flow through the weld head. Allow the shielding gas to flow for at least 60 seconds to clear the gas lines of oxygen. Press **PURGE** again to stop the gas flow.

Note:
When using an extension cable, increase the prepurge time by 1 second for each foot of extension cable.

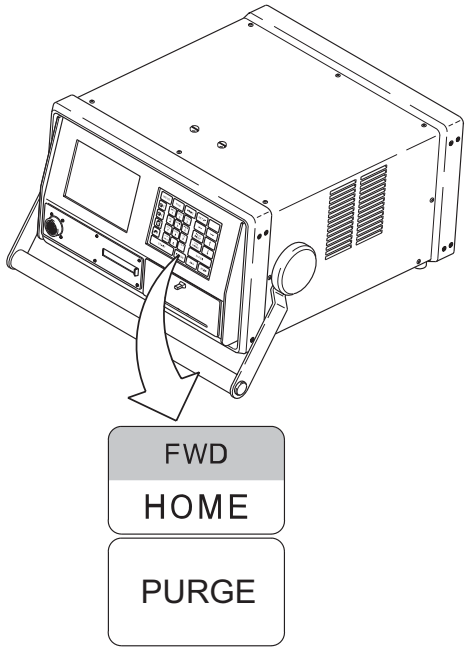


Figure 86 Pushbutton Locations

Analog Data Logging/Monitoring

The power supply has four Bayonetted-N Style connectors (BNC) on the lower portion of the rear panel to provide analog data outputs. The data outputs have a signal range from 0 V (dc) to 4 V (dc). See Table 6.

Connect a chart recorder or other recording device to these outputs to monitor the SWS during welding. The data outputs include:

- current
- voltage
- rotor travel speed
- enable.

The current, voltage, and rotor speed outputs are used to monitor the performance of the SWS.

Table 6 Data Output References

Output Function	0 V Reference	4 V Reference
Current	0 A	100 A
Voltage	0 V	20 V
Travel Speed	0 % of max RPM	100 % of max RPM

Enable is a control signal for the external recorder. Equipment with the capability to start and stop data recording can use this signal as the trigger to control the recording function.

The polarity of the enable signal is selectable. Refer to SETUP/CONF/MON POLARITY on page 68.

The data from these outputs does not indicate whether the weld is acceptable, but instead provides a record of the equipment performance during the welding process. The data can be compared to the weld procedure guideline as a method of quality control.

Visual, mechanical, and other testing must also be done to verify the weld integrity. As with any connection, proper leak testing should be performed once the weld is completed.

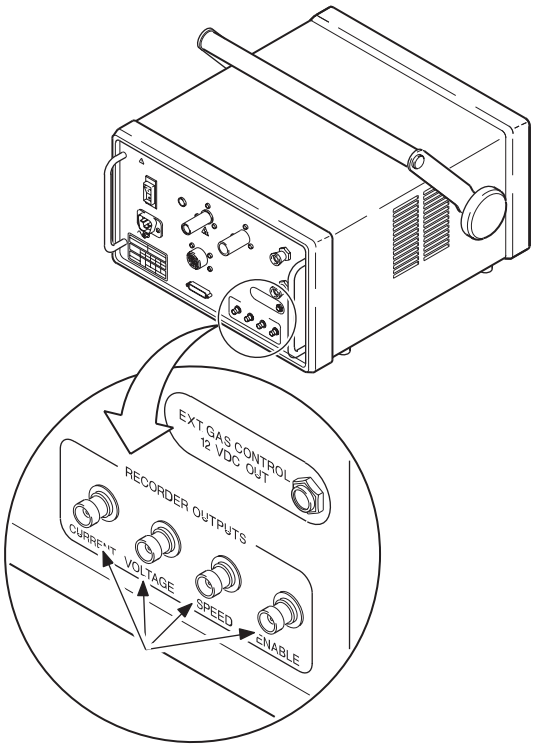


Figure 87 Data Logging Outputs

Note:
The data recorder must have high impedance inputs (greater than 1 MΩ).

Note:
Variables such as material chemistry, weld end preparation, electrode condition, and shielding gas may also affect the weld quality. The user must decide how to use the information provided by this feature.

Swagelok neither sells nor recommends a specific type or brand of recording equipment. However, when selecting data recording equipment remember that the frequency response (sampling rate) of the equipment will determine how accurately a data printout will reflect the actual welding process.

A data-collecting device should have a sampling rate at least ten times faster than the maximum weld impulse rate (99 pulses per second). Thus a sampling rate of 1000 samples per second will help ensure accurate recording of the data. The equipment should also be capable of gathering data over the longest programmed weld time.

When an analog strip chart recorder is used, the 0 V (dc) to 4 V (dc) signals drive the strip chart pens. This type of recorder generally has limited memory and does not store data for future retrieval.

When the data must be captured and stored for future reference, digital recording equipment is used. This equipment converts the analog signals to data patterns that are stored to some device, such as a memory unit or a hard disk. The data can be recalled as needed and can be used for later analysis of the welding process.

Remember that data recording is just a method used to monitor the welding process and does not guarantee the quality of the weld.

PC Memory Card

A Swagelok PC memory card is a flash memory device designed for use with the M100 power supply. No other memory card may be used in its place.

The PC memory card has a Write Protect Switch. When the switch is on, the card will read only. The M100 power supply will prompt you if the switch is on and you attempt to write or delete.

The PC memory card has three (3) basic functions:

1. Weld procedures may be stored outside the internal memory of the unit on the PC memory card. The procedures may be re-installed into the internal memory of any M100 or used directly from the card.
   - File/SAVE – STORE TO CARD (page 49)
   - File/COPY – Copy Procedures Files (page 51)
2. Weld data logs may be stored on the PC memory card as they are made or downloaded from the internal memory to the card for transfer to a PC.
   - Setup Mode/DATALOG – ENABLE CARD (page 66)
   - Setup Mode/DATALOG – XFER MEM TO CARD (page 62)
3. Front Panel application software may be loaded into the M100 power supply using the PC memory card.
   - Setup Mode/ UTILITY – CLEAR APPLICATION (Page 72)

PC Interface Cable

The M100 power supply may be connected directly to your personal computer. The data sent to the computer is in comma delimited format.

The computer needs communications software included with Windows 3.1 or above, but not normally with DOS operating systems. DOS systems must have communications software installed such as Telex or Procom. Please check with your computer supplier. The communication set up is:

- baud 9600
- parity none
- 1 stop bit
- 8 bit.

The storage requirements will be approximately 1.5 K per each data log file (weld file). Please check that you have adequate memory space available. This is a very small usage of memory and should not be a problem.

Your application requirements for handling the information after your computer receives the data should be considered when purchasing a software program. Therefore, consult your software supplier before purchasing a program.

A PC Interface Cable (SWS-PC-CABLE) is shipped with each M100 power supply. One end of the cable is connected to the printer port on the back of the M100 power supply. See Figure 88.

Table 7 M100 Printer Port Pin Outputs

Pin No.	Signal Name from SWS M100 Power Supply
2	Transmit
3	Receive
5	Clear to Send (CTS)
7	Signal Ground
9	+15 V (dc)
20	Data Transmit Ready (DTR)
24	Ground

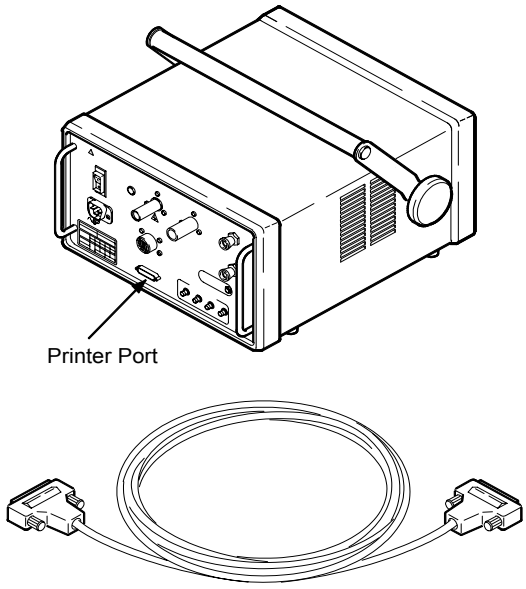


Figure 88 PC Interface Cable

Weld Parameter Development

This section describes the procedures necessary for developing weld parameters to create welds that meet required specifications. This section includes

- developing a weld procedure guideline
- evaluating the weld
- adjusting software settings for weld quality.

Developing a Weld Procedure Guideline

Note:
This procedure assumes you are fusion butt welding austenitic stainless steel tubing.

Note:
This procedure is only a guideline. The final weld quality depends on the operator's welding experience and on the proper use of welding techniques.

In order to create a weld that meets the required specifications, you may need to adjust the welding parameters. You start with the Example Weld Procedure Guideline Worksheet on page 107. Each of the following steps on pages 92 through 106 correspond to the steps on the example worksheet. After completing each step, verify the recorded value on the example worksheet.

The "Worksheet entry" values in the procedure correspond to the steps in the Example Weld Procedure Guideline Worksheet found. The example is based on 1/2 in. OD, 0.049 in. wall thickness 316L stainless steel tubing using the Series 5 Weld Head. However, the procedure applies for all weld heads.

A blank worksheet is included on page 109 for you to use when creating your own weld procedure guidelines. The steps in the worksheet show you how to develop the speed, current, and timing for the SWS.

Determining the Work Specifications

1. Record the programmer's name.
2. Record the joint type.

TB – TB	Tube Butt Weld to Tube Butt Weld
TB – ATW	Tube Butt Weld to Auto Tube Weld

Worksheet entry: **TB – TB**

3. Record the material being welded for each side.

316L	316 SS Low Carbon
316LV	316 SS Low Carbon Controlled Sulfur
304L	304 SS Low Carbon

Worksheet entry: **316LV-316LV**

4. Record the tube or pipe outside diameter.

Worksheet Entry: **0.5 in.**

5. Record the wall thickness.

Worksheet Entry: **0.049 in.**

6. Record the weld head model. See weld head manuals for selection.

Worksheet Entry: **CWS-5H-B**

7. Record the proper electrode. Refer to the Electrode Selection Table in the appropriate weld head manual.

Worksheet Entry: **C.040-.605**

8. Record the arc gap for the weld head being used. Refer to the Arc Gap Gauge Setting Table in the appropriate weld head manual.

Worksheet Entry: **0.035 in.**

9. Record the ID purge gas flow rate and the type of purge gas. Refer to Table 4 *Shield Gas Flow Rates (Argon)* on Page 74.

Worksheet Entry: **15 SCFH Argon**

10. Record the shield gas flow rate and the type of shielding purge gas. Refer to Table 4 *Shield Gas Flow Rates (Argon)* on Page 74.

Worksheet Entry: **13 SCFH Argon**

11. Record the purge gas pressure from the ID purge pressure. Refer to Table 5 *Purge Rate and Pressure Tables* on Page 75.

Worksheet Entry: **1.2 iwc**

Setting Single or Multi-Level Program Parameters

1. Calculate the Travel Speed:

   a. Determine the travel speeds by locating the wall thickness (0.049) and the OD size (1/2 in.) in the appropriate table (Table 8 or Table 9) then reading the corresponding travel speeds.

Table 8 Travel Speed Setting Chart – Fractional

Wall Thickness (in.)	OD Size (in.)		Travel Speed (in. per min)
	Tube	Pipe	
0.010 to 0.020	1/16		10
0.021 to 0.034	1/8		8
0.035 to 0.046	1/4		7
0.047 to 0.055	3/8	1/8	6
0.056 to 0.065	1/2	1/4	5
0.066 to 0.070	5/8	3/8	4.5
0.071 to 0.075	3/4		4
0.076 to 0.080	7/8	1/2	3.6
0.081 to 0.085	1	3/4	3.3
0.086 to 0.090	1 1/4	1	3
0.091 to 0.095	1 1/2	1 1/4	2.6
0.096 to 0.109	1 3/4	1 1/2	2.3
0.110 to 0.154	2 - 4		2

Table 9 Travel Speed Setting Chart – Metric

Wall Thickness (mm)	OD Size		Travel Speed (mm per min)
	Japan (in.)	Europe (mm)	
0.20 to 0.50	1/16	2	4.2
0.51 to 0.86	1/8	3	3.4
0.87 to 1.17	1/4	6	3.0
1.18 to 1.40	3/8	10	2.5
1.41 to 1.65	1/2	12	2.1
1.66 to 1.78	5/8	16	1.9
1.79 to 1.90	3/4	20	1.7
1.91 to 2.03	7/8	22	1.5
2.04 to 2.16	1	25	1.4
2.17 to 2.29	1 1/4	32	1.3
2.30 to 2.41	1 1/2	38	1.1
2.42 to 2.77	1 3/4	46	1.0
2.78 to 4.0	2 – 4	50	0.8

b. Calculate and record the corrected travel speed using the following formula:

Average Travel Speeds:
[(OD Speed + Wall Thickness Speed) ÷ 2] =
Corrected Travel Speed

For example: for a 1/2 in. x 0.049 in. wall thickness
(6 + 5) ÷ 2 = 11 ÷ 2 = 5.5

Worksheet Entry: **5.5**

Note:
A travel speed of 3 in./min to 15 in./min is a general range for GTAW welding.

2. Calculate the Rotor Speed in rpm:

a. Calculate the circumference using the formula:

Tube OD x π = Circumference

For example:

0.5 x 3.1416 = 1.5708 inches circumference

b. Use the travel speed from step 1.b. and the circumference from step 2.a. to calculate and record the rpm:

(Travel Speed ÷ Circumference) = rpm

For example:

5.5 ÷ 1.5708 = 3.5014 = 3.5 rpm

Worksheet Entry: **3.5**

3. Calculate the Impulse Level 1:

a. Determine the wall thickness (0.049 in.)

ATW Fitting

To determine the wall thickness used for an ATW fitting, add 40 % of the ATW cuff thickness to the fitting wall thickness.

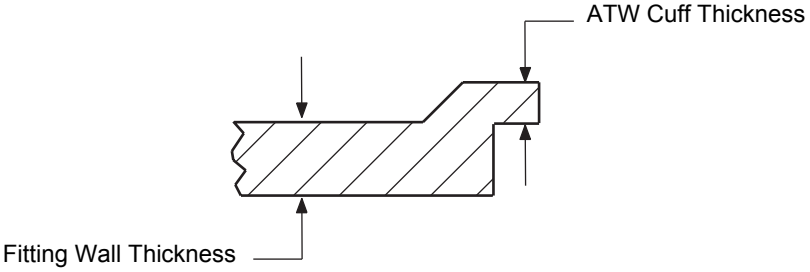


Figure 89 ATW Fitting wall Thickness

The new ATW wall is then used in Table 10 for the "A" factor.

b. Locate the wall thickness (0.049 in.) and then read the corresponding "A" factor in Table 10.

Table 10 Wall Thickness and "A" Factor

Wall Thickness Range		"A" Factor
In.	mm	
0.020	0.5	0.75
0.021 to 0.034	0.51 to 0.86	1.1
0.035 to 0.046	0.87 to 1.17	1.4
0.047 to 0.055	1.18 to 1.40	1.4
0.056 to 0.065	1.41 to 1.65	1.4
0.066 to 0.070	1.66 to 1.78	1.41
0.071 to 0.075	1.79 to 1.90	1.33
0.076 to 0.080	1.91 to 2.03	1.25
0.081 to 0.085	2.04 to 2.16	1.17
0.086 to 0.090	2.17 to 2.28	1.11
0.091 to 0.095	2.29 to 2.41	1.05
0.096 to 0.109	2.42 to 2.77	0.90
0.110 to 0.118	2.78 to 3.0	0.84
0.119 to 0.154	3.1 to 4.0	0.65

c. Calculate and record the Impulse Level 1 using the following formula:

"A" x Wall Thickness x 1000 = Impulse Value Level 1

For example, for a wall thickness of 0.049 in.:
1.4 x 0.049 in. x 1000 = 68.6 A

Worksheet entry: **68.6**

Note:
Because the **IMPULSE** *setting accepts values to only one decimal place, you may need to round off the number.*

4. Calculate the Maintenance Amps:

a. Locate the wall thickness (0.049 in.) and then read the corresponding "B" factor in Table 11.

Table 11 Wall Thickness and "B" Factor

Wall Thickness Range		"B" Factor
In.	mm	
0.010 to 0.020	0.2 to 0.5	0.15
0.021 to 0.034	0.51 to 0.86	0.20
0.035 to 0.046	0.87 to 1.17	0.30
0.047 to 0.055	1.18 to 1.40	0.30
0.056 to 0.065	1.41 to 1.65	0.30
0.066 to 0.070	1.66 to 1.78	0.31
0.071 to 0.075	1.79 to 1.90	0.32
0.076 to 0.080	1.91 to 2.03	0.33
0.081 to 0.085	2.04 to 2.16	0.36
0.086 to 0.090	2.17 to 2.29	0.39
0.091 to 0.095	2.30 to 2.41	0.40
0.096 to 0.109	2.42 to 2.77	0.43
0.110 to 0.154	2.78 to 4.0	0.45

b. Calculate and record the Maintenance Amps using the following formula:

Impulse Current level 1 x "B" = Maintenance Value all levels

For example, for a wall thickness of 0.049 in.:

68.6 A x 0.30 = 20.58 = 20.6 A

Worksheet entry: **20.6**

Note:
Because the **MAINTENANCE** *setting accepts values to only one decimal place, you may need to round off the number. For example, 16.92 is rounded off to 16.9.*

5. Determine and record the Start Power (U-Low/Low/Norm) for the weld head and wall thickness being used. Refer to the appropriate weld head manual.

Worksheet entry: **norm**

Note:
Impulse Width *is determined and recorded in step 13 on page 98 and entered as percentage in the formula.*

6. Calculate and record the Start Current using the following formula:

(Impulse x % Impulse Width) + [Maint x (1 - % Impulse Width)] = Arc Start

For example:

(68.6 x 0.30) + [20.6 x (1-0.30)] = 35.00 = 35 A

Worksheet Entry: **35**

7. Calculate the Total Weld Time Single Pass in seconds using the following formulas:

a. First, calculate the Seconds per Revolution

60 ÷ rpm = Seconds per Revolution

For example:

60 ÷ 3.5 = 17.1429 seconds = 17.1 seconds

b. Next, calculate the weld overlap time using the following formula:

(Wall Thickness x 2) ÷ Travel Speed In seconds
= Weld Overlap Time

For example:

(0.049 x 2) ÷ (5.5 ÷ 60) = 0.098 ÷ 0.0917 = 1.1 seconds

c. Next, calculate and record the Total Weld Time Single Pass using the following formula:

Seconds per Revolution + Weld Overlap = Total Weld Time Single Pass

For example:

17.1 + 1.1 = Total Weld Time Single Pass

18.2 = Total Weld Time Single Pass

Worksheet entry: **18.2**

d. Determine the total WELD TIME setting. The total Weld Time setting depends on the number of passes needed to complete the weld diameter. If the outside diameter is:

- less than 1/4 in. (multiple pass technique)*, multiply the total weld time for a single pass by two and set WELD TIME according to that result.
- 1/4 in. or greater (single pass technique) use the total weld time for a single pass.

  For example, since the tubing in this example has an outside diameter of 1/2 in., the Weld Time is 18.2 sec.

8. Determine and record the Rotor Delay by calculating the weld overlap time in 7.b on page 96.

   Worksheet entry: **1.1**

9. Record a Prepurge Time of 20 seconds.
   Use a continuous purge when using the micro weld head by pressing the PURGE pushbutton.

   Worksheet entry: **20**

***Note:**
Experience suggests that tubing with an outside diameter of less than or equal to 1/2 in. typically requires two revolutions (two passes). Tubing with a larger outside diameter requires one revolution (one pass).

Caution!

When welding 1/2 in. or 12 mm outside diameter with the 8 MRH Weld Head, use a single pass (one revolution) weld procedure only.

Note:
The suggested minimum Prepurge time is 10 seconds for all weld heads. Higher Prepurge times may be necessary for certain applications.

10. Record a Postpurge Time of 20 seconds.

Worksheet entry: **20**

11. Calculate and record the Downslope using the following formula:

Weld Time x 0.2 = Downslope setting

For example, using the Weld Time of 18.2 seconds from step 7.d.:

18.2 x 0.2 = 3.64

Worksheet entry: **3.6**

12. Calculate and record the Pulse Rate for 80% overlap using the following formula:

Travel speed ÷ (30 x wall thickness) = Pulse Rate

For example, for a wall thickness of 0.049 in.:

5.5 ÷ (30 x .049) = 5.5 ÷ 1.47 = 3.74 = 4

Worksheet entry: **4**

13. Determine and record the Impulse Width by locating the wall thickness and then reading the corresponding "C" factor in Table 12.

Table 12 Wall Thickness and "C" Factor

Wall Thickness Range		"C" Factor
in.	mm	
0.010 to 0.020	0.20 to 0.50	15
0.021 to 0.034	0.51 to 0.86	15
0.035 to 0.046	0.87 to 1.17	25
0.047 to 0.055	1.18 to 1.40	30
0.056 to 0.065	1.41 to 1.65	33
0.066 to 0.070	1.66 to 1.78	35
0.071 to 0.075	1.79 to 1.90	36
0.076 to 0.080	1.91 to 2.03	37
0.081 to 0.085	2.04 to 2.16	38
0.086 to 0.090	2.17 to 2.29	40
0.091 to 0.095	2.30 to 2.41	45
0.096 to 0.109	2.42 to 2.77	50
0.110 to 0.154	2.78 to 4.0	50

For example, a wall thickness of 0.049 in. has a "C" factor of 30.

Worksheet entry: **30**

Note:
The suggested minimum Postpurge Time is 20 seconds. This time allows for sufficient cooling of the electrode and weld zone.

Note:
Additional Postpurge time may be necessary for a weld made with a high average current setting.

14. When developing a multi-level program, the level times are calculated using the following formulas:

    a. Calculate and record the Weld Time for Each Level by choosing the number of levels desired and using the following formula:

Total Weld Time ÷ Number of Levels = Weld Time for Each Level

For example:

18.2 ÷ 4 = 4.55 = 4.6 Seconds per Level

Worksheet entry: **4.6**

    b. Calculate and record the Level Factor using the following formula:

(Impulse Amps Level 1 x .15) ÷ (Number of Levels - 1) = Level Factor

For example:

(68.6 x .15) ÷ (4-1) = 10.29 ÷ 3 = 3.43 = 3.4 Amps

Worksheet entry: **3.4**

    c. Calculate and record the Impulse Amps for all levels after level one using the following formula:

Impulse Amps for the Previous Level – Level Factor = Impulse Amps for this Level

For example:

For level 2: 68.6 – 3.4 = 65.2 Amps

Worksheet entry: **65.2**

For level 3: 65.2 – 3.4 = 61.8 Amps

Worksheet entry: **61.8**

For level 4: 61.8 – 3.4 = 58.4 Amps

Worksheet entry: **58.4**

Note:
Always round the weld time for each level up to the next tenth of a second.

Note:
The Level Factor is used to calculate the Impulse Amps for all three levels after level one.

Step Programs Multi-Level

A Step Program should be used when the rotor speed differs between the Impulse (high) pulse period and the Maintenance (low) pulse period. The rotor speed may vary from zero to maximum rotor rpm of the weld head being used. Decreasing rotor rpm will increase heat input and increasing rotor rpm will decrease heat input.

1. Calculate the average seconds per revolution before the weld overlap and total weld time.

(Impulse rpm x Impulse Width) + [Maintenance rpm x (1 - Impulse Width)] = Average rpm

Example: We want to stop the rotor (0 rpm) during the impulse period.

(0 x 0.30) + [3.5 x (1 - 0.30)] = 0 + [3.5 x 0.70] = 2.45 average rpm

2. Calculate the seconds per revolution using this rpm.

   60 ÷ Average rpm = Seconds per Revolution

   For example:

   60 ÷ 2.45 = 24.49 = 24.5 seconds

3. Calculate the average travel speed to find the weld overlap time.

   a. Calculate the circumference.

   Tube OD x π = Circumference

   For example:
   0.5 x 3.1416 = 1.5708

   b. Calculate the average travel speed using the average rpm and the circumference.

   Average rpm x Circumference = Average Travel Speed

   For example, using the average rpm from step 2 and the circumference from step 3.3:

   2.45 x 1.5708 = 3.84846 = 3.8 IPM

Note:
The Impulse Rate must be less than or equal to 10 cycles per second for step programs.

Note:
Do not use the Impulse Width for heat (penetration) adjustments in a step program. Program timing problems may result. Make heat adjustments with the Impulse Amps or the Maintenance Amps.

Caution!

Step Programs are not used with Series 4 or Series 8 Micro Weld Heads.

Note:
Step Programs do not produce speed data for the data log record.

c. Calculate the weld overlap using the wall thickness and the average travel speed.

(Wall Thickness x 2) ¸ (Average IPM ÷ 60) = Weld Overlap Time

For example, using 0.049 wall thickness and the average travel speed from step 3.b:

(0.049 x 2) ÷ (3.8 ÷ 60) = 0.098 ÷ 0.063 = 1.555
= 1.6 seconds

4. Calculate the total weld time.

Weld Time per Revolution + Weld Overlap Time = Total Weld Time

For example, using the weld time per revolution from step 2. and the weld overlap time from 3.c.:

24.5 + 1.6 = 26.1 seconds

5. Calculate the weld time per level.

Total Weld Time ÷ Number of Levels = Weld Time per Level

For example, using the weld time from step 4 and 4 levels:

26.1÷ 4 = 6.525 = 6.5 seconds per level

Socket Welds

Because socket welds are not full penetration welds, a modified concept is used to calculate the weld procedure guideline. Refer to the Automatic Socket Weld Procedure Guideline Worksheet located on page 113.

The modification is to the High/Low current value and the % Impulse value. Adjusting the electrode offset will change the profile of the weld. Adjusting the weld level heat will change the profile of individual levels.

All socket welds use a single pass technique. The arc gap will be 0.010 in. (0.25 mm) for all sizes and offset 0.015 in. (0.35 mm) as shown in Figure 90. The welding diameter is based on the socket OD.

Note:
Start all socket welds between 11 and 12 o'clock positions to assist the formation of a weld pool.

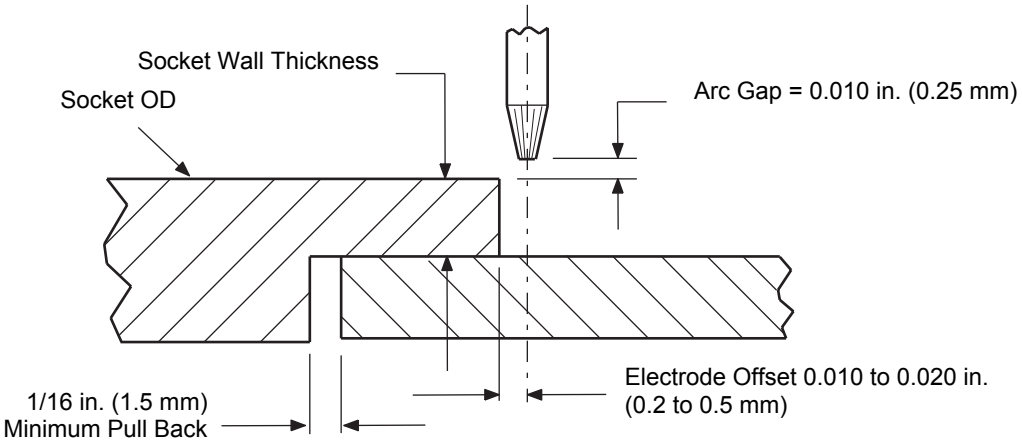


Figure 90 Socket Weld Arc Gap

Tacks

Tacks are used for various reasons. They are used by themselves and the weld is made at a later time or tacks are used with the weld following immediately. The M100 power supply will automatically generate up to 10 tacks during Programming/Auto Generate or you may add tacks to any program in PROG/MODIFY/INSERT TACK. Choose the location of the tack in degrees, use the Start Current of the program, and start with 80 % of the Rotor Delay time for each tack to be added. If the tacks break during welding, increase the time by 1/2 (0.5) seconds for each tack. If the tacks are not fully consumed by the weld, decrease the time by 1/2 (0.5) seconds for each tack. Several cautions are important when using tacks:

- If the tacks are to be welded at a later time, they must be brushed before they are welded. The oxidation will cause weld meander if it is not removed. This is not necessary if the weld follows immediately.
- All tacks should be consumed completely by the weld. (Decrease tack size or the number of tacks.)
- Tacks should not break during the welding. (Increase tack size or the number of tacks.)

Caution!

Tack programs or programs that include tack should not be used with the micro weld heads.

Weld Program with Ramp Time

Ramping is used in two applications. The first and most commonly used is ramping between levels. Its main purpose is to spread over a set period of time the change of amperage between levels. The second is to Ramp-up slowly when starting a weld. Its main purpose is to apply heat to the material in a controlled manner, which is necessary with some materials. The ramp time is applied to the beginning of the level it is entered.

Ramping between levels – If you desire to ramp the heat down from level one to level two, you apply the desired ramp time to level two, see Figure 91.

Note:
Ramp Time will affect the collection of data logs if the weld time is not at least one second longer than the Ramp Time.

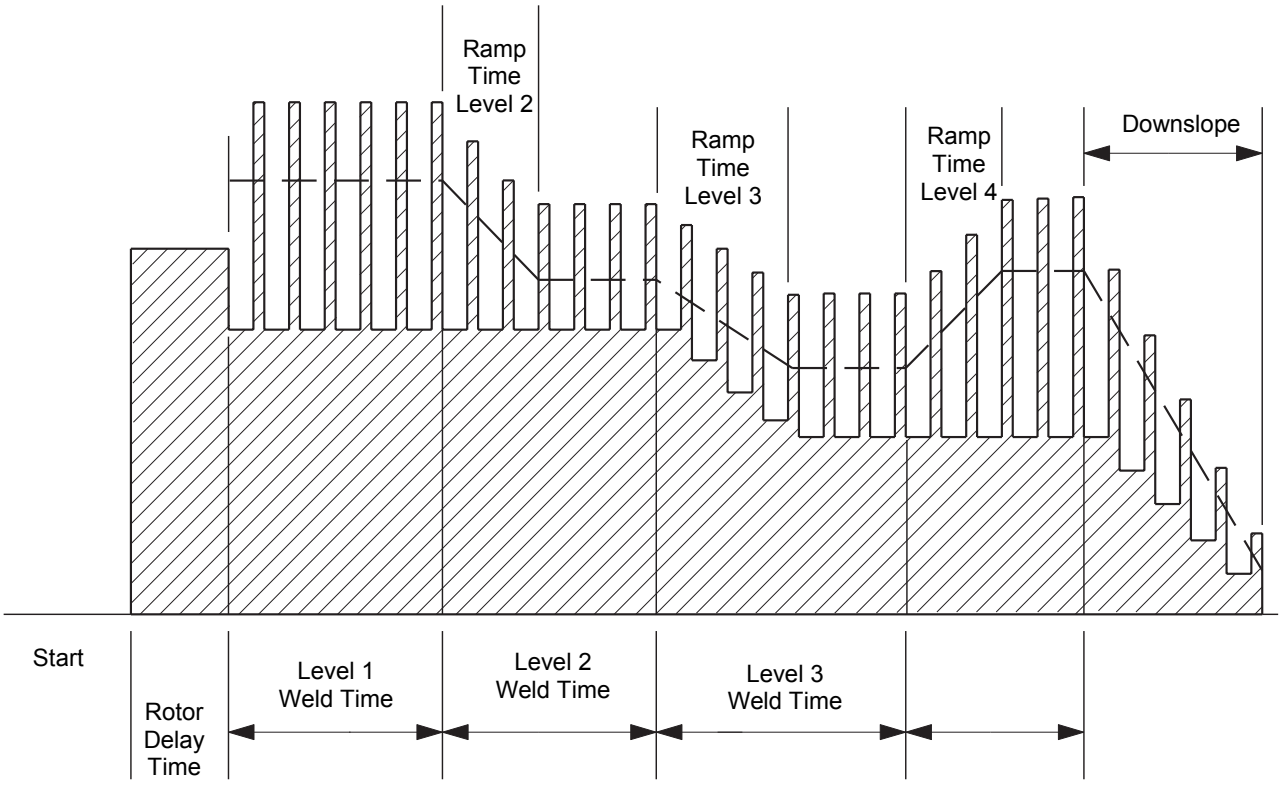


Figure 91 Ramp Between Levels

Ramping up in level one – If you desire to ramp the heat up from a minimum value to welding temperature over a set period of time, two procedures may be used:

1. The weld does not penetrate immediately, see Figure 92. The following is accomplished in PROG/MODIFY/ EDIT ITEM:
   a. Set the Start Current to an acceptable level minimum (5 Amps) or greater.
   b. Set the Start time to 0.1 seconds.
   c. Enter the ramp-up time in level one Ramp (time).
   d. Add the ramp-up time to level one Weld (time).
   e. Adjust the procedure weld time to overlap the start of the weld for an even ID bead width.

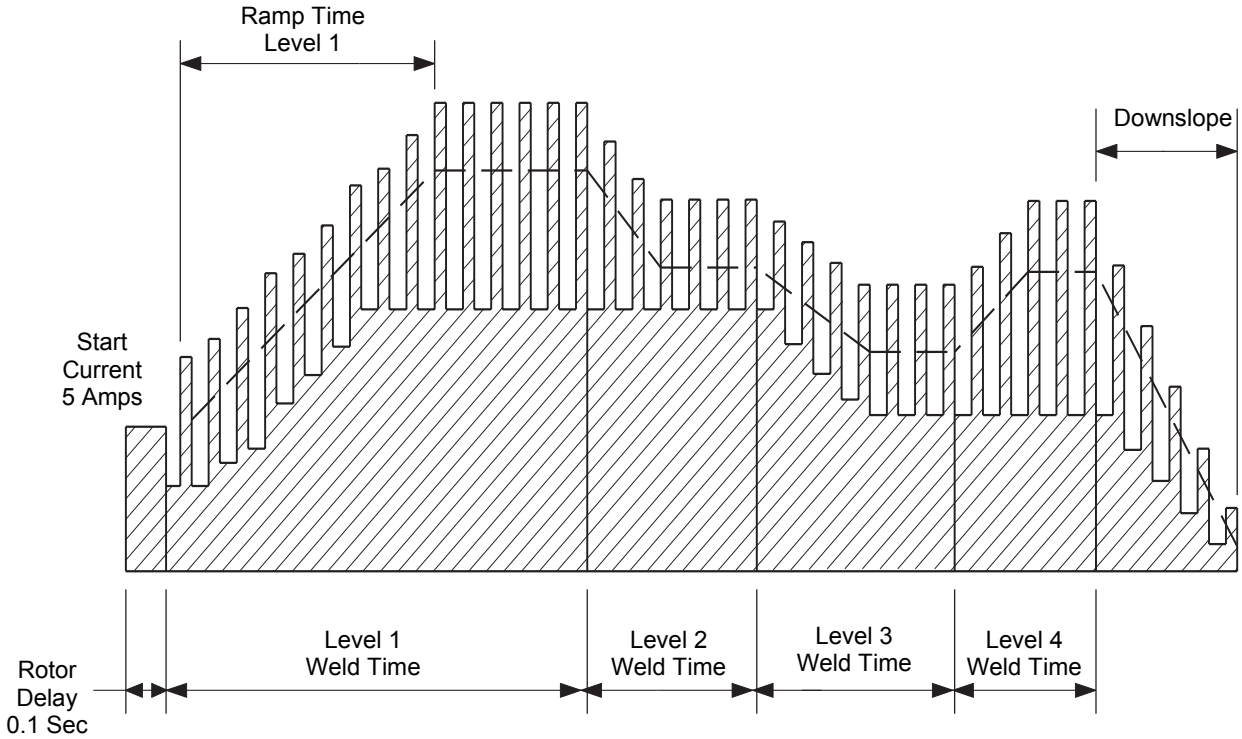


Figure 92 Ramp Time: Weld Does Not Penetrate Immediately

2. The weld must penetrate completely before the rotor begins to move, see Figure 93. After the basic weld program is developed, duplicate level one by using PROG/MODIFY/INSERT LEVEL. The following is accomplished in PROG/MODIFY/EDIT ITEM:
   a. Set the Start Current to an acceptable level minimum (5 Amps) or greater.
   b. Set the Start time to 0.1 seconds.
   c. Change the Weld (time) of level one to the desired ramp-up time plus any rotor delay time needed for penetration.
   d. Enter the ramp-up time in level one Ramp (time).
   e. Change the Speed High RPM and the Speed Low RPM to Zero RPM.
   f. Increase the start penetration by increasing the weld time of level one or by increasing the weld input amperage.
   g. Decrease the start penetration by decreasing the weld input amperage.
   h. Level one is now a Ramp-up time and Rotor Delay Level. The first weld level will be level two. Make heat changes to weld accordingly using either WELD/ADJUST or PROG/MODIFY/ EDIT ITEM.

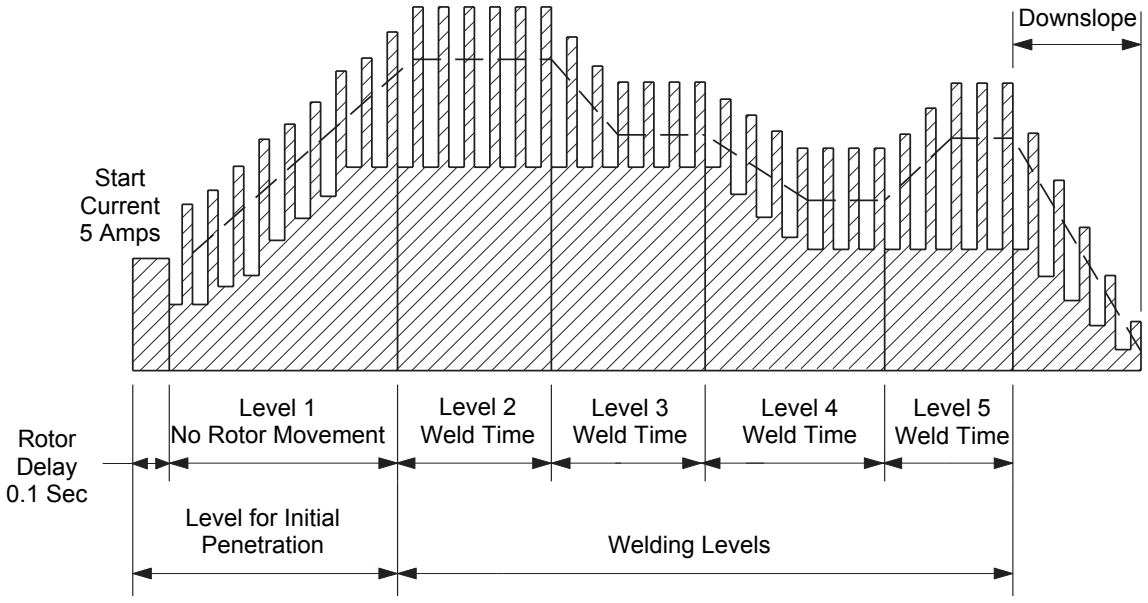


Figure 93 Ramp Time: Weld Penetrates Completely Before Rotor Moves

Example Weld Procedure Guideline Worksheet

Determine the Work Specifications

Step	Parameter	Setting
1	Programmer's Name	John J Jones
2	Joint Type	TB – TB
3	Material Type (Side 1 – Side 2)	316LV - 316LV
4	Weld Diameter in Inches	0.5 Inches
5	Wall Thickness in Inches (Side 1 – Side 2)	0.049 – 0.049
6	Weld Head Model No.	CWS-5H-B
7	Electrode Part No.	C.040 –.605
8	Arc Gap in Inches	0.035 Inches
	Arc Gap Gauge Setting	0.907 Inches
9	ID Purge Gas Flow in SCFH Gas Type Ar	15 SCFH
10	Shielding Gas Flow in SCFH Gas Type Ar	13 SCFH
11	ID Purge Gas Pressure in IWC	1.2 IWC

*For ATW fittings, use the corrected wall thickness. To determine the wall thickness for an ATW fitting, add 40 % of the ATW cuff thickness to the fitting wall thickness. Refer to Figure 89 on page 94.

Calculating Weld Parameters – Example

Step	Parameter	Setting
1	Travel speed (in. per min.) (Table 8)	5.5 in. per min.
2	Rotor speed in rpm for all levels *Travel Speed ÷ Circumference = rpm* *Tube OD x π = Circumference* .5 x 3.1416 = 1.5708 5.5 ÷ 1.5708 = 3.5014 = 3.5	3.5 rpm
3	Impulse amps for level 1 (Table 10) *"A" x Wall Thickness (in thousands of an inch) x 1000 = Impulse Amps* 1.4 x .049 x 1000 = 68.6	68.6 Amps
4	Maintenance amps for all levels (Table 11) *"B" x Impulse Level 1 = Maintenance Amps* 0.30 x 68.6 = 20.58 = 20.6	20.6 Amps
5	Start power (u-low/low/norm)	Norm
6	Impulse width ("C" Table 12)	30 %
7	Start current *(Imp. Level 1 x % Imp. Width) + [Maint. X (1-% Imp. Width)] = Arc Start* (68.6 x .30) + [20.6 x (1 – 0.30)] = 20.58 + [20.6 x 0.70] = 20.58 + 14.42 = 35.00	35 Amps

Calculating Weld Parameters – Example Continued

Step	Parameter	Setting
8	Total weld time single pass in seconds *Seconds per Revolution + Weld Overlap = Total Time Single Pass* *60 ÷ rpm = Seconds per Revolution* 60 ÷ 3.5 = 17.1429 = 17.1 *(Wall Thickness x 2) ÷ (Travel Speed ÷ 60) = Weld Overlap* (.049 x 2) ÷ (5.5 ÷ 60) = 0.098 ÷ 0.0917 = 1.1 *Seconds per Revolution + Weld Overlap = Total Time Single Pass* 17.1 + 1.1 = 18.2	18.2 Seconds
9	Rotor delay time use the weld overlap time from step 7.	1.1 Seconds
10	Prepurge time in seconds	20 Seconds
11	Postpurge time in seconds	20 Seconds
12	Downslope *Total Weld Time x 0.2 = Downslope* 18.2 x 0.2 = 3.64 = 3.6	3.6 Seconds
13	Pulse rate *Travel Speed ÷ (30 x Wall Thickness) = Impulse Rate* 5.5 ÷ (30 x 0.049) = 5.5 ÷ 1.47 = 3.74 = 4	4 cycles per sec.
14	Weld time for each level *Total Weld Time ÷ Number of Levels = Weld Time for each Level* 18.2 ÷ 4 = 4.55 = 4.6	4.6 Seconds
15	Level factor *(Impulse Amps Level 1 x .15)÷ (Number of Levels – 1) = Level Factor* (68.6 x 0.15) ÷ (4-1) = 10.29 ÷ 3 = 3.43 = 3.4	3.4 Amps
16	Impulse amps for level 2 *Impulse Amps Level 1 – Level Factor = Impulse Amps for Level 2* 68.6 - 3.4 = 65.2	65.2 Amps
17	Impulse amps for level 3 *Impulse Amps Level 2 – Level Factor = Impulse Amps for Level 3* 65.2 - 3.4 = 61.8	61.8 Amps
18	Impulse amps for level 4 *Impulse Amps Level 3 – Level Factor = Impulse Amps for Level 4* 61.8 - 3.4 = 58.4	58.4 Amps
19	Impulse amps for level 5 *Impulse Amps Level 4 – Level Factor = Impulse Amps for Level 5* ___ - ____ =	
20	Impulse amps for level 6 *Impulse Amps Level 5 – Level Factor = Impulse Amps for Level 6* __ - ____ =	
21	Impulse amps for level 7 *Impulse Amps Level 6 – Level F=actor = Impulse Amps for Level 7* __ - ____ =	
22	Impulse amps for level 8 *Impulse Amps Level 7 – Level Factor = Impulse Amps for Level 8* __ - ____ =	

Weld Procedure Guideline Worksheet
US Customary Standard (inches)

Determine the Work Specifications

Step	Parameter	Setting
1	Programmer's Name	
2	Joint Type	
3	Material Type	
4	Weld Diameter in Inches	
5	Wall Thickness in Inches	
6	Weld Head Model No.	
7	Electrode Part No.	
8	Arc Gap in Inches	
	Arc Gap Gauge Setting	
9	ID Purge Gas Flow in SCFH Gas Type	
10	Shielding Gas Flow in SCFH Gas Type	
11	ID Purge Gas Pressure in IWC	

Calculating Weld Parameters

Step	Parameter	Setting
1	Travel speed (in. per min.) (Table 8)	
2	Rotor speed in rpm for all levels (*Travel Speed ÷ Circumference) x 60 = rpm* *Tube OD x π = Circumference* ____ x 3.1416 = _____	
3	Impulse amps for level 1 (Table 10) *"A" x Wall Thickness (in thousands of an inch) x 1000 = Impulse Amps* ____ x ____ x 1000 = ____	
4	Maintenance amps for all levels (Table 11) *"B" x Impulse Level 1 = Maintenance Amps* ____ x ____ x = ____	
5	Start power (u-low/low/norm)	
6	Impulse width ("C" Table 12)	
7	Start current *(Imp. Level 1 x % Imp. Width**) + [Maint. x (1 - % Imp. Width)] = Arc Start* (_____ x _____) + [_____ x (1- ____)] = _____ + [_____ x _____] = _____ + _____ = _____	

Calculating Weld Parameters (Inches) Continued

Step	Parameter	Setting
8	Total weld time single pass in seconds *Seconds per Revolution + Weld Overlap = Total Time Single Pass* *60 ÷ rpm = Seconds per Revolution* 60 ÷ ___= _____ *(Wall Thickness x 2) ÷ (Travel Speed ÷ 60) = Weld Overlap* (___ x 2) ÷ (___ ÷ 60) = ____ *Seconds per Revolution + Weld Overlap = Total Time Single Pass* _____ + _____ = _____	
9	Rotor delay time use the weld overlap time from step 7.	
10	Prepurge time in seconds	
11	Postpurge time in seconds	
12	Downslope *Total Weld Time x 0.2 = Downslope* ___x 0.2 = ____	
13	Pulse rate x 2.364 *Travel Speed ÷ (30 x Wall Thickness) = Impulse Rate* ____÷ (1.182 x ____) = ____ ÷ ____ = ____	
14	Weld time for each level *Total Weld Time ÷ Number of Levels = Weld Time for each Level* ____ ÷ ____ = ____	
15	Level factor *(Impulse Amps Level 1 x .15)÷ (Number of Levels – 1) = Level Factor* (___ x 0.15) ÷ (__-1) = ____ ÷ ____ = ____	
16	Impulse amps for level 2 *Impulse Amps Level 1 – Level Factor = Impulse Amps for Level 2* _____ - _____ = _____	
17	Impulse amps for level 3 *Impulse Amps Level 2 – Level Factor = Impulse Amps for Level 3* _____ - _____ = _____	
18	Impulse amps for level 4 *Impulse Amps Level 3 – Level Factor = Impulse Amps for Level 4* _____ - _____ = _____	
19	Impulse amps for level 5 *Impulse Amps Level 4 – Level Factor = Impulse Amps for Level 5* ___ - ____ =	
20	Impulse amps for level 6 *Impulse Amps Level 5 – Level Factor = Impulse Amps for Level 6* __ - ____ =	
21	Impulse amps for level 7 *Impulse Amps Level 6 – Level F=actor = Impulse Amps for Level 7* __ - ____ =	
22	Impulse amps for level 8 *Impulse Amps Level 7 – Level Factor = Impulse Amps for Level 8* __ - ____ =	

Weld Procedure Guideline Worksheet – Metric Standard

Determine the Work Specifications

Step	Parameter	Setting
1	Programmer's Name	
2	Joint Type	
3	Material Type	
4	Weld Diameter in Millimeters	
5	Wall Thickness in Millimeters	
6	Weld Head Model No.	
7	Electrode Part No.	
8	Arc Gap in Millimeters	
	Arc Gap Gauge Setting	
9	ID Purge Gas Flow in L/min Gas Type	
10	Shielding Gas Flow in L/min Gas Type	
11	ID Purge Gas Pressure in mm/wc	

Calculating Weld Parameters

Step	Parameter	Setting
1	Travel speed (mm. per sec.) (Table 8)	
2	Rotor speed in rpm for all levels (*Travel Speed ÷ Circumference) x 60 = rpm* *Tube OD x π = Circumference* ____ x 3.1416 = _____ (_____ ÷ _____) x 60 = _____	
3	Impulse amps for level 1 (Table 10) *"A" x Wall Thickness (in mm) x 39.4 = Impulse Amps* ____ x ____ x 39.4 = ____	
4	Maintenance amps for all levels (Table 11) *"B" x Impulse Level 1 = Maintenance Amps* ____ x ____ x = ____	
5	Start power (u-low/low/norm)	
6	Impulse width ("C" Table 12)	
7	Start current *(Imp. Level 1 x % Imp. Width**) + [Maint. x (1 – % Imp. Width)] = Arc Start* (_____ x _____) + [_____ x (1- ____)] = _____ + [_____ x _____] = _____ + _____ = _____	

Calculating Weld Parameters (Metric) Continued

Step	Parameter	Setting
8	Total weld time single pass in seconds *Seconds per Revolution + Weld Overlap = Total Time Single Pass* *60 ÷ rpm = Seconds per Revolution* 60 ÷ ___= _____ *(Wall Thickness x 2) ÷ Travel Speed = Weld Overlap* (___ x 2) ÷ ___ = ____ *Seconds per Revolution + Weld Overlap = Total Time Single Pass* _____ + _____ = _____	
9	Rotor delay time use the weld overlap time from step 7.	
10	Prepurge time in seconds	
11	Postpurge time in seconds	
12	Downslope *Total Weld Time x 0.2 = Downslope* ___x 0.2 = ____	
13	Pulse rate (*Travel Speed x 2.364) ÷ (1.182 x Wall Thickness) = Impulse Rate* (____ x 2.364) ÷ (1.182 x ____) = ____ ÷ ____ = _____	
14	Weld time for each level *Total Weld Time ÷ Number of Levels = Weld Time for each Level* ____ ÷ ____ = ____	
15	Level factor *(Impulse Amps Level 1 x 0.15)÷ (Number of Levels – 1) = Level Factor* (___ x 0.15) ÷ (__-1) = ____ ÷ ____ = ____	
16	Impulse amps for level 2 *Impulse Amps Level 1 – Level Factor = Impulse Amps for Level 2* _____ - _____ = _____	
17	Impulse amps for level 3 *Impulse Amps Level 2 – Level Factor = Impulse Amps for Level 3* _____ - _____ = _____	
18	Impulse amps for level 4 *Impulse Amps Level 3 – Level Factor = Impulse Amps for Level 4* _____ - _____ = _____	
19	Impulse amps for level 5 *Impulse Amps Level 4 – Level Factor = Impulse Amps for Level 5* ___ - ____ =	
20	Impulse amps for level 6 *Impulse Amps Level 5 – Level Factor = Impulse Amps for Level 6* __ - ____ =	
21	Impulse amps for level 7 *Impulse Amps Level 6 – Level F=actor = Impulse Amps for Level 7* __ - ____ =	
22	Impulse amps for level 8 *Impulse Amps Level 7 – Level Factor = Impulse Amps for Level 8* __ - ____ =	

Automatic Socket Weld Procedure Guideline Worksheet US Customary Standard (Inches)

Determine the Work Specifications

Step	Parameter	Setting
1	Programmer's Name	
2	Joint Type	
3	Material Type	
4	Weld Diameter in Inches	
5	Wall Thickness in Inches	
6	Weld Head Model No.	
7	Electrode Part No.	
8	Arc Gap in Inches	
	Arc Gap Gauge Setting	
9	ID Purge Gas Flow in SCFH	
10	Shielding Gas Flow in SCFH	

Calculating Weld Parameters

Step	Parameter	Setting
1	Travel speed (in. per min.) Use 5 in. per min.	
2	Rotor speed in rpm for all levels *Travel Speed ÷ Circumference = rpm* *Socket OD x π = Circumference* ____ x 3.1416 = _____ *Travel Speed ÷ Circumference = rpm* _____ ÷ _____ = _____	
3	Impulse amps for level 1 (Table 10) *1.2 x Socket Wall Thickness (in thousands of an inch) x 100 = Amps* 1.2 x ____ x 1000 = ____	
4	Maintenance amps for all levels (Table 11) *.33 x Impulse Amps = Maintenance Amps* .33 x ____ = ____	
5	Start power (u-low/low/norm)	Norm
6	Impulse width = 50 %	
7	Start current *(Imp. Level 1 x % Imp. Width**) + [Maint. x (1 - % Imp. Width)] = Arc Start* (_____ x _____) + [_____ x (1- ____)] = _____ + [_____ x _____] = _____ + _____ = _____	

Calculating Socket Weld Parameters (Inches) Continued

Step	Parameter	Setting
8	Total weld time single pass in seconds *Seconds per Revolution + Weld Overlap = Total Time Single Pass* *60 ÷ rpm = Seconds per Revolution* 60 ÷ ___= _____ *(Wall Thickness x 2) ÷ (Travel Speed ÷ 60) = Weld Overlap* (___ x 2) ÷ (___ ÷ 60) = ____ *Seconds per Revolution + Weld Overlap = Total Time Single Pass* _____ + _____ = _____	
9	Rotor delay time use the weld overlap time from step 7.	
10	Prepurge time in seconds	
11	Postpurge time in seconds	
12	Downslope *Total Weld Time x 0.2 = Downslope* ___x 0.2 = ____	
13	Pulse rate *Travel Speed ÷ (30 x Wall Thickness) = Impulse Rate* ____÷ (30 x_____) = ____ ÷ ____ = _____	
14	Weld time for each level *Total Weld Time ÷ Number of Levels = Weld Time for each Level* ____ ÷ ____ = ____	
15	Level factor *(Impulse Amps Level 1 x 0.15)÷ (Number of Levels – 1) = Level Factor* (___ x 0.15) ÷ (__-1) = ____ ÷ ____ = ____	
16	Impulse amps for level 2 *Impulse Amps Level 1 – Level Factor = Impulse Amps for Level 2* _____- _____ = _____	
17	Impulse amps for level 3 *Impulse Amps Level 2 – Level Factor = Impulse Amps for Level 3* _____ - _____ = _____	
18	Impulse amps for level 4 *Impulse Amps Level 3 – Level Factor = Impulse Amps for Level 4* ___ - _____ = _____	

Evaluating the Weld

A completed weld must meet structural and metallurgical requirements. The weld must be uniform, and free of cracks, porosity, and undercuts. It must not have excessive oxidation. And, if it is a butt weld, it must have full penetration from the outside diameter to the inside diameter. See Figure 94.

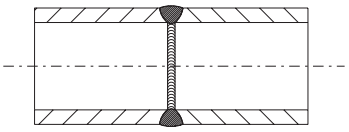


Figure 94 Acceptable Weld

Identifying Typical Weld Discontinuities

Figure 95 shows typical weld discontinuities.

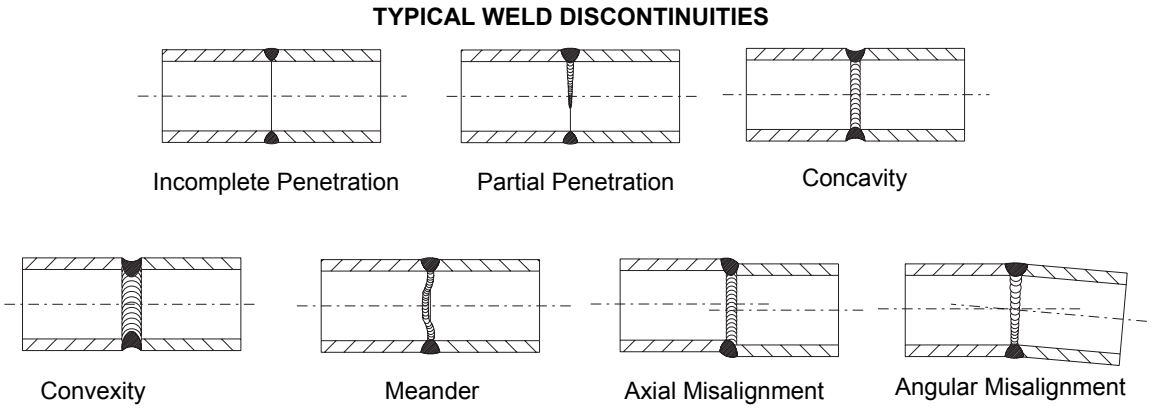


Figure 95 Typical Weld Discontinuities

Identifying Proper Welds

The cross-sectional welds in Figure 96 through Figure 107 on pages 116 through 121 show how changing various parameters affects the shape of the weld.

To check the weld, follow these steps:

1. Inspect the weld on the outside of the tube. Check for:
   - uniformity
   - cracks
   - undercuts
   - excessive oxide.

2. Inspect the weld on the inside of the tube. Check for:
   - uniformity, cracks, undercuts, and excessive oxidation
   - full penetration
   - excessive weld bead width variations
   - excessive weld-spot overlap.

Reference Weld

Figure 96 shows a cross-section of a proper weld. The weld shows full penetration from the outside diameter to the inside diameter, a crown on the outside diameter, and minimal weld bead convexity on the inside diameter.

Table 13 lists the parameters used to create the weld. Compare welds with Figure 96.

Table 13 Reference Weld Parameters

Parameter	Setting
Impulse (Amperes)	58.8
Maintenance (Amperes)	17.6
Pulse Rate (cycles/s)	10
Impulse Width (%)	35
Speed (rpm)	3
Arc Gap (in.)	0.035
Avg. Current Display (Amperes)	32

The following examples show how changes in various parameters can affect the weld shape.

Note:
The welds are made with a 316L stainless steel tube with the following dimensions: 1/2 in. OD, 0.049 in. wall thickness.

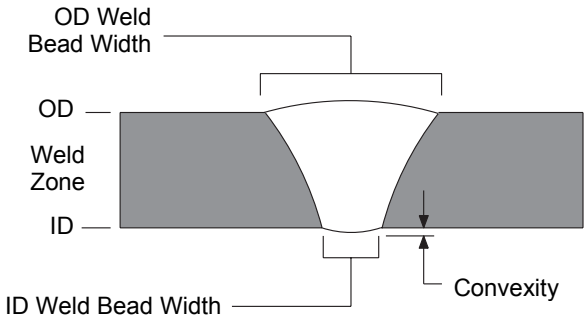


Figure 96 Reference Weld Illustration

Weld Example No. 1

Table 14 lists the parameter change used to create the weld shown in Figure 97.

Table 14 Weld Example No. 1

Parameter	Reference Setting	This Setting
Impulse (Amperes)	58.8	49.8
Average Current (Amperes)	32	28.87

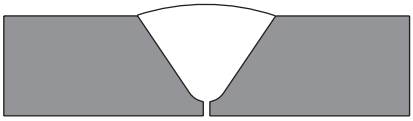


Figure 97 Improper Weld Example No. 1

Lowering the Impulse current lowers the average current. This decreases the heat input per unit of electrode travel resulting in no inside diameter penetration.

Weld Example No. 2

Table 15 lists the parameter change used to create the weld shown in Figure 98.

Table 15 Weld Example No. 2

Parameter	Reference Setting	This Setting
Impulse (Amperes)	58.8	67.9
Average Current (Amperes)	32	35.2

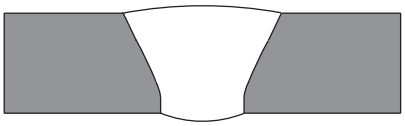
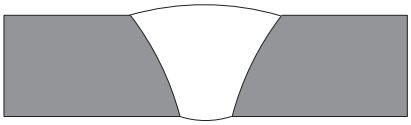


Figure 98 Improper Weld Example No. 2

Raising the Impulse current raises the average current. This increases the heat input per unit of electrode travel resulting in increased inside diameter convexity and weld bead width.



Reference Illustration of Proper Weld

Weld Example No. 3

Table 16 lists the parameter change used to create the weld shown in Figure 99.

Table 16 Weld Example No. 3

Parameter	Reference Setting	This Setting
Maintenance (Amperes)	17.8	14.8
Average Current (Amperes)	32	30.2

Lowering the Maintenance current lowers the average current. This decreases the heat input per unit of electrode travel resulting in no inside diameter penetration.

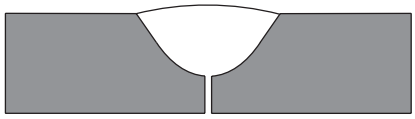


Figure 99 Improper Weld Example No. 3

Weld Example No. 4

Table 17 lists the parameter change used to create the weld shown in Figure 100.

Table 17 Weld Example No. 4

Parameter	Reference Setting	This Setting
Maintenance (Amperes)	17.8	20.8
Average Current (Amperes)	32	34.12

Raising the Maintenance current raises the average current. This increases the heat input per unit of electrode travel resulting in increased inside diameter convexity and weld bead width.

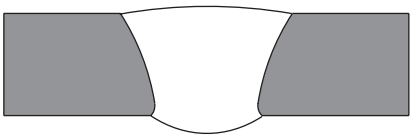
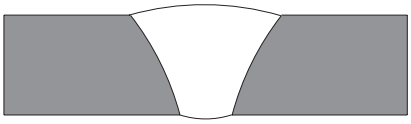


Figure 100 Improper Weld Example No. 4



Reference Illustration of Proper Weld

Weld Example No. 5

Table 18 lists the parameter change used to create the weld shown in Figure 101.

Table 18 Weld Example No. 5

Parameter	Reference Setting	This Setting
Impulse Width (%)	35	30
Average Current (Amperes)	32	30

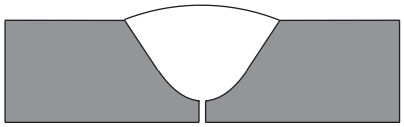


Figure 101 Improper Weld Example No.5

Shortening the Impulse Width lowers the average current. This decreases the heat input per unit of electrode travel resulting in no inside diameter penetration.

Weld Example No. 6

Table 19 lists the parameter change used to create the weld shown in Figure 102.

Table 19 Weld Example No. 6

Parameter	Reference Setting	This Setting
Impulse Width (%)	35	40
Average Current (Amperes)	32	34

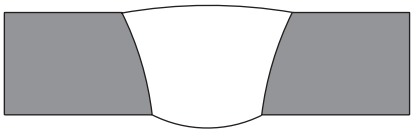
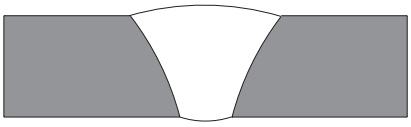


Figure 102 Improper Weld Example No. 6

Lengthening the Impulse Width raises the average current. This increases the heat input per unit of electrode travel resulting in increased inside diameter convexity and weld bead width.



Reference Illustration of Proper Weld

Weld Example No. 7

Table 20 lists the parameter change used to create the weld shown in Figure 103.

Table 20 Weld Example No. 7

Parameter	Reference Setting	This Setting
Speed (rpm)	3 (19)	4 (15)

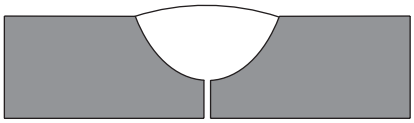


Figure 103 Improper Weld Example No. 7

Raising the Rotor Speed decreases the heat input per unit of electrode travel resulting in no inside diameter penetration.

Weld Example No. 8

Table 21 lists the parameter change used to create the weld shown in Figure 104.

Table 21 Weld Example No. 8

Parameter	Reference Setting	This Setting
Speed (rpm)	3 (19)	2 (26)

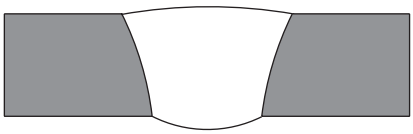
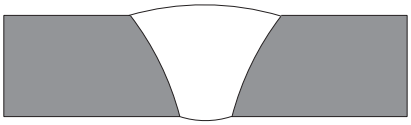


Figure 104 Improper Weld Example No. 8

Lowering the Rotor Speed increases the heat input per unit of electrode travel resulting in increased inside diameter convexity and weld bead width.



Reference Illustration of Proper Weld

Pulse Rate Reference Weld

Table 22 lists the parameter used to create the reference weld shown in Figure 105.

Table 22 Pulse Rate Reference Weld

Parameter	Reference Setting	This Setting
Pulse Rate (cycles/s)	10	10

Figure 105 Pulse Rate Reference Weld

Pulse Rate Weld Example No. 1

Table 23 lists the parameter change used to create the weld shown in Figure 106.

Table 23 Weld Example No. 1

Parameter	Reference Setting	This Setting
Pulse Rate (cycles/s)	10	5

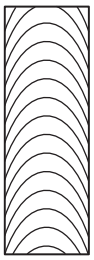


Figure 106 Pulse Rate Weld Example No.1

Lowering the pulse rate reduces weld-spot overlap.

Pulse Rate Weld Example No. 2

Table 24 lists the parameter change used to create the weld shown in Figure 107.

Table 24 Weld Example No. 2

Parameter	Reference Setting	This Setting
Pulse Rate (cycles/s)	10	25

Figure 107 Pulse Rate Weld Example No. 2

Raising the pulse rate increases weld-spot overlap.

At times, the welding parameters (as described on page 107) must be adjusted to create an acceptable weld.

Maintenance

The power supply has no internal serviceable parts and should not be disassembled.

Fuse Inspection and Replacement

A 20 A (110 V (ac) system) or a 10 A (220 V (ac) system) ceramic fuse is on the rear panel of the power supply. If the power is on but the arc fails to start, you may have a blown fuse.

To inspect the fuse:

1. Turn off the power supply. See Figure 108.
2. Unplug the power cord.

WARNING!

THE USER SHOULD NOT SERVICE THE POWER SUPPLY.

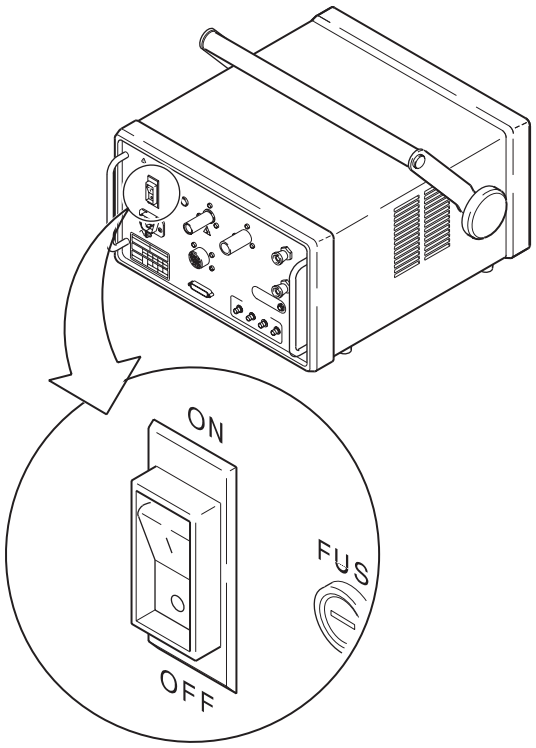


Figure 108 Power Supply Circuit Breaker in the OFF Position

3. Inspect the fuse and fuse cap:
   a. Unscrew the fuse cap using a flat blade screwdriver. See Figure 109.
   b. Inspect the fuse cap for damage (overheating, burning, etc.). Replace the cap if necessary.
   c. Using an ohmmeter, check the continuity of the fuse. If it is blown, replace it with a fuse of the same type and rating.
4. Turn on the power supply.

Note:
The fuse can be checked with an ohmmeter.

Caution!

Use only insulated pliers to remove fuse.

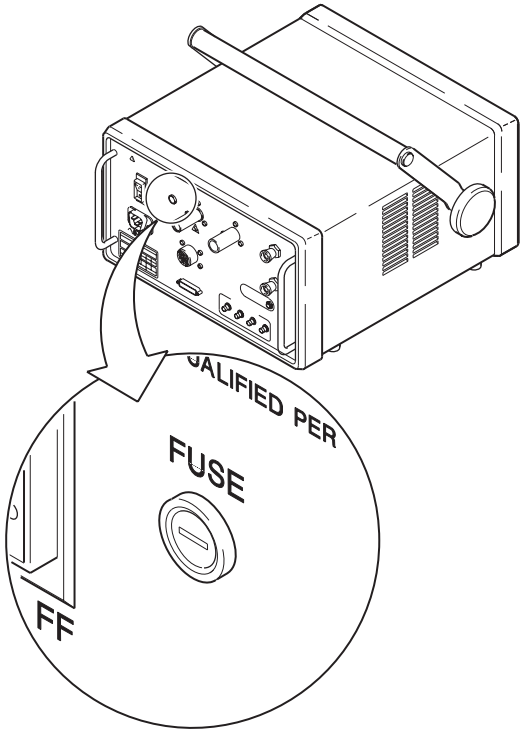


Figure 109 Ceramic Fuse Location

Use the following instructions to change the HEPA filter as necessary.

HEPA Filter Replacement

1. Turn off the power to the power supply unit prior to replacing the HEPA filter.
2. Place handle in position shown to open HEPA filter cover.
3. Using a small pointed tool, push the two latches to fully disengage them and release the HEPA filter cover. See Figure 110.
4. Push latches to disengage the filter.

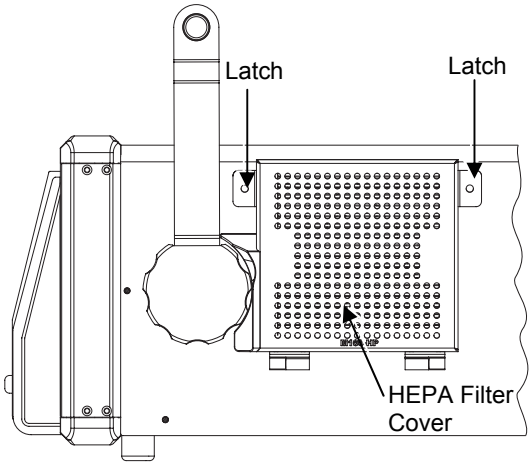


Figure 110 HEPA Filter Cover

5. Swing the HEPA filter cover open to reveal the HEPA filter. See Figure 111.

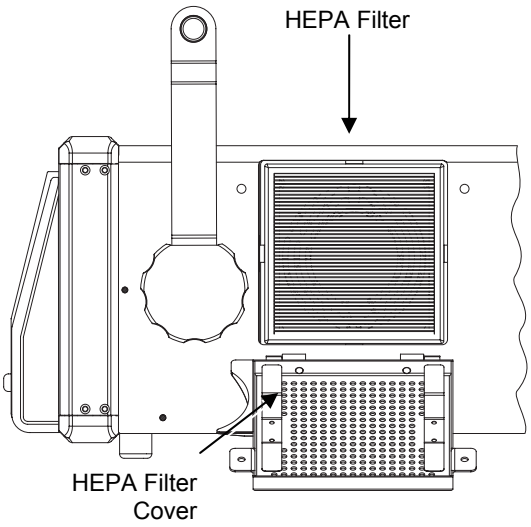


Figure 111 HEPA Filter Location

6. Remove the HEPA filter. Ensure the fan is not spinning. Clean the fan guard with an absorbent, non-abrasive, low-lint wipe and isopropyl alcohol prior to installing new filter. See Figure 112.
7. Install the new HEPA filter with gasket side towards fan guard.
8. Swing the HEPA filter cover closed. Use the tool from step 2 to press and engage the latches. The latches will lock into place when the HEPA filter cover is completely closed. See Figure 112.

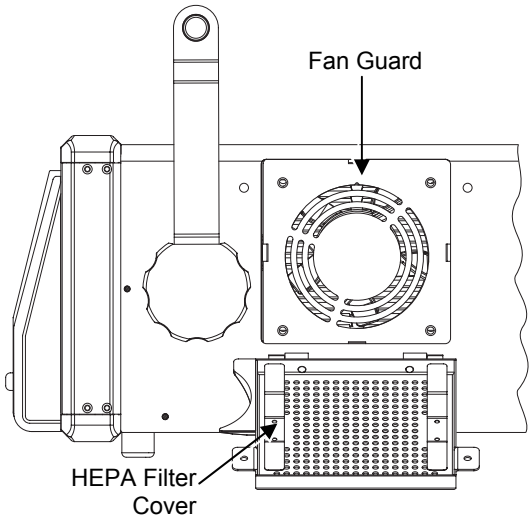


Figure 112 Fan Guard

9. The cabinet of the M100-HP power supply can be cleaned with a low-lint non-abrasive wipe and isopropyl alcohol.

Specifications

Table 25 Power Supply

Model	Supply Voltage ①	Service Amps	Output Current (dc)
SWS-M100-1 SWS-M100-HP-1	115 V (ac)	20	2 to 100 A
SWS-M100-1 SWS-M100-HP-1	115 V (ac)	15	2 to 70 A
SWS-M100-2 SWS-M100-HP-2	230 V (ac)	15	2 to 100 A

① 10% input voltage tolerance, frequency range 50 to 60 Hz

Table 26 M100 Duty Cycle

Model	6.25 %	60 %	100 %
SWS-M100-1	100 A 14 V	32.3 A 11.3 V	25 A 11 V
SWS-M100-2	100 A 14 V	32.3 A 11.3 V	25 A 11 V

Table 27 M100-HP Duty Cycle

Model	20 %	60 %	100 %
SWS-M100-HP-1	100 A 7 V	35 A 9 V	15 A 9 V
SWS-M100-HP-2	100 A 7 V	30 A 9 V	15 A 9 V

Welding systems may be operated at different power-output settings, prescribed by the appropriate Duty Cycle Rating (Table 26). The Duty Cycle Rating (expressed as %) refers to the maximum weld time allowed during a given period of time, with the balance of the cycle being required for cooling. The industry uses a 10-minute Duty Cycle as a standard.

Using the 10-minute Duty Cycle, the weld times and idle times for several Duty Cycle Ratings are presented in the following tables.

Table 28 M100 10 Minute Cycle Times

Duty Cycle Rating	Maximum Weld Time (minutes)	Required Idle Time (minutes)
30 %	3	7
60 %	6	4
100 %	10	0

Table 29 M100-HP 10 Minute Cycle Times

Duty Cycle Rating	Maximum Weld Time (minutes)	Required Idle Time (minutes)
20 %	2	8
60 %	6	4
100 %	10	0

Continually exceeding the duty cycle may activate an internal thermal protector that will disable the power supply and display a critical error message code on the operator interface screen.

Table 30 M100 Power Supply Dimensions and Weight

Model	Dimensions (overall)	Weight
SWS-M100-1	15.5 in. (39 cm wide) 19.4 in. (49 cm) deep 9 in. (23 cm) high (without handle)	42.5 lb (16.8 kg)
SWS-M100-2	15.5 in. (39 cm wide) 19.4 in. (49 cm) deep 9 in. (23 cm) high (without handle)	45.5 lb (20.6 kg)

Table 31 M100-HP Power Supply Dimensions and Weight

Model	Dimensions (overall)	Weight
SWS-M100-HP-1	16.375 in. (41.6 cm) wide 19.4 in. (49 cm) deep 9 in. (23 cm) high (without handle)	44.2 lb (20.1 kg)
SWS-M100-HP-2	16.375 in. (41.6 cm) wide 19.4 in. (49 cm) deep 9 in. (23 cm) high (without handle)	47.6 lb (21.6 kg)

Extension Cords

Model	Supply Voltage	Wire gauge 0 to 50 ft (0 to 15 m)	Wire gauge 50 to 100 ft (15 to 30 m)
SWS-M100-1 SWS-M100-HP-1	115 V (ac)	#12 AWG (2.5 mm)	#10 AWG (4.0 mm)
SWS-M100-2 SWS-M100-HP-2	230 V (ac)	#12 AWG (2.5 mm)	#10 AWG (4.0 mm)

Some power loss will occur, depending on the length of the extension cord. See table to determine the **minimum** wire size to use.

WARNING!

DO NOT USE EXTENSION CORDS THAT ARE IN POOR PHYSICAL CONDITION OR HAVE INSUFFICIENT CURRENT CAPACITY.

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TROUBLESHOOTING

USER'S MANUAL

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TROUBLESHOOTING

This section contains troubleshooting charts to assist you with problems. It contains troubleshooting guidelines for both hardware and weld process problems, including:

- power supply
- weld head
- electrode
- fixture block
- welding process.

Swagelok Welding System (SWS) Repair Procedure

In some cases, the stated remedy to a problem listed in the charts may be “Call for service.” If so, contact your Swagelok representative for over-the-phone troubleshooting.

Be prepared to give the following information to the Swagelok representative:

- serial and model number of the equipment
- complete description of the application
- detailed description of the symptom.

Provide complete details of any problem encountered to your Swagelok representative. Good information helps identify the exact problem and expedite the solution. This applies to problems that can be handled over the phone or those that require the unit to be returned for repair. The result is faster repair times and more assurance that the repair meets with your approval.

Make the Swagelok representative aware if backup equipment is needed to temporarily replace the equipment being returned for repair.

Repair/Replacement Instructions

Certain remedies require a component, such as a weld head, to be disassembled, cleaned, or replaced. For user maintenance procedures, refer to the **Maintenance** section of the appropriate manual. If in doubt about a procedure, call your Swagelok representative.

Power Supply

Symptom	Cause	Remedy
Front panel screen blank.	The circuit breaker is off.	Turn on circuit breaker.
	The power supply line cord is not plugged in.	Plug power cord into the wall outlet.
The replaced or new ceramic fuse fails immediately when power is turned on.	Internal component failure.	Call for service.
Power supply fan does not operate.	Internal component failure.	Call for service.
Cannot store procedures or weld data on the PC Memory Card.	PC Memory Card write protect switch is on.	Slide the write protect switch on the PC Memory Card to the OFF position.

Note:
The circuit breaker is of the type that must be reset if it trips. Reset the breaker by setting it to the OFF position before turning it on.

Weld Head

Symptom	Cause	Remedy
Rotor does not return to the home position.	Fixture connector is not fully engaged.	Check that the fixture connector is seated and its collar is tight.
	Rotor is not at the home position when the power supply is turned on.	Use **ROTOR JOG** to move the rotor to the home position, then cycle power off and on.
	Dirty home sensor.	Disassemble the weld head and check the home sensor for dirt. See the appropriate motor and power block assembly drawing in the *Power Supply* manual. Use compressed air to blow off debris.
	Rotor gear ring is misaligned with secondary gears.	Realign the rotor with the weld head opening. Refer to the **Maintenance** section of the appropriate weld head user manual.
	Fixture connector has broken or damaged pins/wires.	Call for service.
	Home sensor is damaged or misaligned.	Call for service.
Rotor squeaks when turning.	Dirty or worn weld head body halves.	Disassemble the weld head and clean or replace components.
	Gear bearings worn or dirty.	Clean or replace bearing assemblies as needed.
	Dirty ball bearings in rotor.	Disassemble rotor and clean or replace ball bearings as needed.
Rotor does not move or makes a clicking noise when turning.	Debris on gears.	Check for weld spatter or debris on gears.
	Loose drive clip in the micro weld head.	Check and replace drive clip if needed. See the appropriate micro weld head assembly drawing in the appropriate weld head user manual.
	Brush spring is installed incorrectly in micro weld head.	Install the brush spring in the correct orientation. Refer to the **Maintenance** section of the appropriate weld head user manual.
	Bent motor shaft.	Call for service.

Symptom	Cause	Remedy
Erratic rotor rotation/speed control.	Weld spatter on gears.	Inspect the rotor primary, secondary, and drive gear(s) for damage. Replace damaged gears.
	Arcing damage on rotor gear teeth.	Inspect rotor and replace if damaged.
	Dirty weld head, debris on encoder sensor or encoder wheel.	Disassemble the weld head and clean thoroughly.
	Encoder wheel slips on motor shaft.	Call for service.
	Fixture connector has broken wire.	Call for service.
Arc damage on rotor gear.	Arcing from rotor.	Clean gear, or replace if necessary.
Damage to weld head body halves.	Arcing	Disassemble the weld head. Clean or replace parts as needed. Follow the recommended maintenance schedule outlined in the **Maintenance** section of the appropriate weld head user manual.
	Excessive heat from welding.	Check weld procedure guideline. Use a larger weld head, allow a cooling period between welds, or allow continuous shielding gas flow when welding.
	Weld head was dropped	Check for damage and replace parts as necessary. Check rotor for smooth operation. Call for service if damage is severe.

Electrode

Symptom	Cause	Remedy
Material found on the electrode tip.	Electrode touched the weld puddle.	Replace electrode and check arc gap setting. Check work pieces for out of roundness.
	Weld puddle protrusion.	Check internal purge gas flow rate for excessive back pressure.
	Weld head is not properly attached to the fixture block.	Reattach the weld head to fixture block. Engage the weld head locking lever.
Oxidation film on the electrode.	Insufficient shielding gas.	Increase shielding gas flow rate.
	Insufficient post purge time.	Increase post purge time.
	Partially blocked or cut shielding gas line.	Check for leaks and/or blockages. Replace purge lines if needed.
	O-ring missing between the weld head and motor module. Micro Weld Head Only.	Check and install O-ring if necessary.
	Shielding gas line disconnected inside weld head.	Disassemble weld head and reconnect the line.
Bent or broken electrode.	Electrode was not secured in the rotor.	Replace the electrode. Tighten electrode clamping screws.
	Weld head not correctly attached to the fixture block.	Replace the electrode. Reattach the weld head to the fixture block. Engage the weld head locking lever.
	Incorrect arc gap setting.	Check the length of the electrode and replace it. Reset arc gap.
Melted electrode.	No shielding gas.	Check for shielding gas flow and set the proper flow rate.

Fixture Block

Symptom	Cause	Remedy
When closing the fixture block side plate, the latch does not lock.	The latch is not inserted into the fixture block side plate completely.	Reinsert the latch into the side plate until it rests against the latch pin.
	Bent latch.	Replace latch.
	Oversized tubing.	Replace fitting/tubing with the correct size.
	Wrong size collets.	Replace with the correct size collet.
	Hinge worn out.	Replace the hinge and dowel pins.
	Worn out latch cam.	Replace the latch cam.
The latch does not fit into the bottom part of the fixture block side plate.	A burr is in the slot or on the latch.	Use a fine file to remove burrs.
	The latch is bent or damaged.	Remove the hinge and replace all damaged parts.
The fixture block does not fit onto the weld head.	The arc gap is incorrect.	Reset arc gap according to the Weld Procedure Guideline.
	The locking ring tab is broken or damaged.	Replace the locking ring tab.
	The weld head is incorrectly assembled.	Reassemble using the instructions found in **Maintenance**.
	Arc damage on fixture.	Clean fixture. Remove and replace any damaged parts.

Welding Process

Symptom	Cause	Remedy
Arc fails to start.	Blown ceramic power supply fuse.	Replace the ceramic power supply fuse with one of the same type and rating.
	Fuse not seated in fuse holder properly or fuse spring is missing.	Insert fuse properly. Replace fuse spring if necessary.
	Incorrect arc gap setting.	Reset the arc gap with the arc gap gage.
	Excessive purge gas flow.	Reduce flow to the value shown on the weld procedure guideline.
	Insufficient shielding gas flow or contaminated shielding gas.	Check the shielding gas source for low pressure. Check gas lines for leaks. Change to a different gas source or change oxygen removal filter.
	Electrode in poor condition.	Replace electrode.
	Damaged electrical connections in the weld head.	Weld head needs repair. Call for service.
	Poor contact between locking ring tab and ground extension.	Inspect and clean all contact surfaces.
	Poor contact between rotor and brush.	Inspect and clean all contact surfaces.
	Poor contact between tubing, collet, and fixture block.	Inspect and clean all contact surfaces.
	Start power set to low.	Set start power to normal.

Note:
All fuses should be rated at 250 V (ac). 110 V (ac) power supplies use a 20 A fuse (1/4 x 1 1/4 in.), 220 V units use a 10 A fuse (5 x 20 mm).

Note:
The ceramic fuse is located on the rear panel of the power supply. See Figure 1.

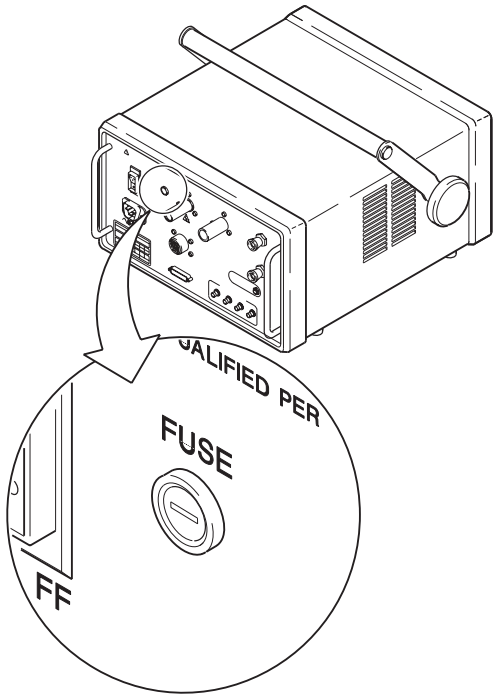

Figure 1 Ceramic Fuse Location

Symptom	Cause	Remedy
Voltage fluctuations during the weld cycle exceeding 2 V.	Weld head not seated properly into the fixture block.	Reattach the weld head to the fixture block. Engage the weld head locking lever.
	Work pieces are out of round.	Replace work pieces if out of standard specifications.
	Insufficient shielding gas flow or contaminated shielding gas.	Check the shielding gas source for low pressure. Check gas lines for leaks. Change to a different gas source or change oxygen removal filter.
Outside diameter discoloration.	Insufficient shielding gas flow.	Increase shielding gas flow rate and prepurge time.
	Impurities in the gas supply.	Check gas lines for leaks. Change to a different gas source or change oxygen removal filter.
	Wrong type of purge gas used.	Change to correct type of purge gas.
	Contamination on work pieces.	Clean the work pieces before welding.
	Contaminants in the weld head and purge lines.	Increase prepurge time. Check the gas source for low pressure.
	Shielding gas line disconnected from the power supply.	Reconnect gas line.
Inside diameter discoloration.	Insufficient internal purge gas.	Increase internal purge gas flow rate and prepurge time.
	Contaminants in the purge line.	Increase prepurge time. Check the gas source for low pressure.
	Migration of oxygen from the internal purge gas exit port of the work pieces to the weld joint.	Reduce exit port size with a purge restrictor. See Note.
	Wrong type of purge gas used.	Change to correct type of purge gas.
	Contamination on work pieces.	Clean the work pieces before welding.
	Nicks/cuts in the internal purge gas line.	Replace gas line.

Note:
The purge restrictor must be of adequate size to prevent excessive inside diameter back pressure.

Symptom	Cause	Remedy
Hole in the weld bead.	Incorrect arc gap.	Reset the arc gap with the arc gap gage.
	Excessive internal purge gas back pressure or surge.	Remove any obstruction of the internal purge gas flow or reduce the pressure.
	Improper tube preparation.	Inspect and reface tubing.
	Incorrect weld parameter setting (impulse).	Check and adjust the weld parameter settings.
	Loss of shield gas flow.	Check the shielding gas source for low pressure. Check gas lines for leaks. Change to a different gas source or change oxygen removal filter.
Concave weld puddle.	Excessive heat input.	Compare the material, wall thickness and outside diameter size of the components you are welding to the weld procedure guideline being used. Verify settings match the guideline and adjust if necessary.
	Insufficient inside diameter purge gas pressure.	Compare flow meter settings to the weld procedure guideline being used. Adjust if necessary.
Electrode touches the work.	Incorrect arc gap.	Reset the arc gap to the table setting in the appropriate weld head user manual.
	Insufficient arc gap for the material or the heat input.	Increase the arc gap by 0.005 in. (0, 13 mm) above the table settings.
	Work pieces are out of round.	Increase the arc gap or replace the work piece.

Symptom	Cause	Remedy
Incomplete inside diameter penetration.	Insufficient heat input.	Compare the power supply setting to the weld procedure guideline being used. Adjust weld parameters as necessary.
	Incorrect weld procedure guideline.	Compare the material wall thickness and outside diameter size of the work pieces being welded to the weld procedure guideline being used. Adjust weld parameters as necessary.
	Incorrect arc gap.	Reset the arc gap with the arc gap gage.
	Tip of electrode is worn or ground improperly.	Change the electrode.
	Inconsistent heats of materials or changes in material chemistry.	Verify consistency of material with material supplier. Adjust weld parameters as necessary.
	Weld joint is off-center or misaligned.	Inspect the entire weld joint n the fixture block prior to welding.
After welding, the tubing/fitting assembly is not straight.	The end surfaces of the work pieces being welded are not perpendicular to their center axis.	Prepare the work piece weld ends properly. Refer to the appropriate weld head user manual.
	The fixture block side plate screws are not tight.	Tighten screws as needed.
After welding, the fitting/tubing joint is still visible.	The fitting/tubing was not centered properly.	Center fitting/tubing.
	The electrode is bent or was not properly installed.	Inspect the electrode and replace if necessary. Reset the arc gap with the arc gap gage.

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GLOSSARY

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GLOSSARY

Active Procedure

The procedure (sometimes referred to as Weld Program or Weld Schedule) that is loaded for use in the M100. This is the program that will be used in WELD mode functions.

Arc

The flow of electrical current between an anode and cathode. In welding, the flow of current between an electrode and the work.

Arc Gap

The distance between the electrode and the work.

Arc Gap Gage

The gage used to set the arc gap in the weld head rotor.

Arc Radiant Energy

The ultra-violet light emitted from the welding arc.

Arc Start

The period of the welding cycle following prepurge. During this short period of time, approximately 0.01 second, high voltage is applied between the electrode and work piece, initiating the arc. The only control of this period is with start power.

Arc Welding

A type of welding process that uses an electrical arc as a source of heat to melt and join metals.

Arcing

A condition in welding where the arc follows a path other than from the electrode to the work. This can cause damage to the weld head and fixturing components.

Argon

An inert monatomic gas used as a shielding and purge gas for gas tungsten arc welding.

ATW (Automatic Tube Weld)

A type of weld that uses a cuff at the joint of the weld fitting to aid in alignment and supply extra material to the weld joint. This weld will require more Arc Gap and more heat than a comparable Butt Weld.

Autogenous

In orbital welding, autogenous describes the process of welding two parts together using the fusion process without the use of filler material.

Automatic Welding

A welding process in which all of the parameters are controlled by the welding machine during the weld cycle. The process may or may not perform the loading and unloading of the work pieces.

Average Current

In pulse welding, high current is maintained for some fraction of each output cycle and low current is maintained for the remainder of the cycle. The average current is the sum of these fractional components that occur during each cycle.

Backing Gas

The gas used at the back of a weld joint or within a tube or vessel to prevent oxidation and undercut.

Butt Weld

A weld joint where two work pieces are welded together with their long axes concentric and in-line. The joint can have various configurations, such as square groove, v-groove, j-groove, double v-groove, etc.

Centering Gage

Gage used to center the work pieces in the fixture block.

Ceramic Insert

A ceramic insulator used in the rotor to isolate the electrode from the weld head. The insert helps prevent arcing.

Collet

A device used to hold the work pieces in the fixture. Collets are made in different sizes and shapes to accommodate different size and shapes of work pieces.

Concavity

In welding, the condition where the weld profile extends below the outside surface of the work.

Data Log Record

This is the record of weld data such as the weld procedure used, the real time data output collected, information entered in WELD/INFO, and the acceptability performance of the weld.

Data Logging

Collecting welding parameter data regardless of faults or alarms.

Data Monitoring

Collecting data and comparing it to preset conditions. If the data is found to be outside normal limits, audio alarms may be triggered and a weld error message will be displayed. See the *Power Supply* module.

Dedicated Line

An electrical service line used for only one device. The device is isolated from interference created by other equipment and can utilize the full current capacity of the line breaker.

GTAW

An acronym for Gas Tungsten Arc Welding, the process used in the Swagelok Welding System (SWS).

Heat Input

The heat conducted into the weld during the weld cycle. It is generally expressed in joules or kilojoules (see Datalog Printout).

Impulse (High Amps)

The maximum current level generated during the weld cycle. Also referred to as high amps.

Inches of Water Column (IWC)

Unit of pressure measurement.

1 PSI= 2.31 ft. of water column= 27.72 in. of water column

Inclusion

A defect or discontinuity in the work material or weld that could become a site for stress or corrosion.

Internal Purge Gas

The backing gas used at the back of a weld joint or within a tube or vessel to prevent oxidation and encroachment.

Jog

The term used when positioning the rotor with the rotor JOG key before or after the weld cycle.

Joule

A unit of energy used to express heat input. One joule is equal to one ampere times one volt for one second. Also termed a watt-second.

Level Factor

A percentage of the level 1 impulse current used to calculate the impulse current drop in subsequent levels (Refer to **Setting Single or Multi-Level Program Parameters** in the *Power Supply* module).

Maintenance (Low Amps)

The minimum current level generated during the weld cycle. Also referred to as background current or low amps.

Meander

A welding condition in which the weld puddle is displaced to one side of the weld joint from the center line.

Misfire

An action that occurs when the arc fails to start or sustain itself.

mm of Water Column

Unit of pressure measurement.

Multiple Level

A welding technique in which more than one average current level is used during the weld time.

Multiple Pass

A welding technique in which the rotor moves more than one revolution during the weld time. The technique is most helpful when fusion welding small diameter parts.

Orbital Welding

A welding technique used for tubing, pipes, etc. in which the arc rotates around the weld joint circumference.

Oxidation

Heat discoloration or heat tint that occurs in the weld area caused by the presence of oxygen. It can vary in color and intensity based on the weld temperature and the amount of oxygen present. Oxidation can be detrimental to high purity systems and increase the chances of weld joint corrosion.

Ozone

A gas produced when the ultraviolet light emitted by the welding arc reacts with the oxygen in the surrounding atmosphere.

Penetration

The term used to describe the depth of the weld. The common usage to describe the correct level of penetration for tube and pipe welds is “full penetration weld.” This means the weld has penetrated completely from the outside diameter to the inside diameter of the weld joint. There are no portions of the weld joint that are visibly unfused.

Plenum

A fixture block component that separates the side plates, providing space for the weld head and forming a chamber for the shielding gas.

Postpurge

The amount of time that the O.D. shielding gas is on after the welding is complete to cool the work pieces.

Power Supply

The device that produces the electrical power for the welding process. The SWS power supply is a constant current power supply.

Prepurge

The amount of time that the O.D. shielding gas is applied before the arc start.

Pulse Rate

The rate at which the output current level is changed between the high (Impulse) and low (Maintenance) settings. The rate is expressed as pulses per second.

Pulse Weld

A weld current that varies between a high level and a low level at a specific rate. The technique reduces the heat input to the weld.

Pulse Width (% Impulse)

The percentage of time during one cycle that the weld current is at the Impulse (High Amps) level.

Purge Gas

The gas (backing or shielding) used at the weld joint or within a tube or vessel to prevent oxidation.

Ramp

Ramp is a time entered into a weld level that allows a gradual amperage change from the previous level or Arc start current.
(Refer to **Weld Program with Ramp Time** in the *Power Supply* module).

Re-enforcement

The excess metal on the outside of the weld extending above the surface of the work. Sometimes referred to as the “crown.”

Remote Pendant

A hand-held control device that allows remote operation of the SWS power supply.

Rotor

The device that holds the tungsten electrode and moves around the weld joint during orbital welding.

Rotor Delay

A time delay that is programmed into the weld procedure after arc start to allow the weld to penetrate the material by delaying the rotor movement. This should be carefully controlled in single pass welds.

SCFH

The acronym for standard cubic feet per hour. The unit used to measure the flow rate of shielding and purge gases.

Shielding Gas

The gas used to shield the tungsten electrode and work pieces during the welding cycle and cool the weld head.

Single Level

A welding technique in which a single average value of current is used during the weld cycle.

Single Pass

A welding technique in which the rotor moves one revolution during the weld time.

Socket

A basic lap type of weld joint. Refer to **Socket Welds** in the *Power Supply* module.

Solenoid Bypass

An option that bypasses the internal gas solenoid in favor of a secondary valve and is controlled by the power supply.

Speed Lo

This is the rotor speed in RPM during the Maintenance portion of the weld cycle. (Refer to **Step Programs Multi-Level** in the *Power Supply* module).

Speed Hi

This is the rotor speed in RPM during the Impulse portion of the weld cycle. (Refer to **Step Programs Multi-Level** in the *Power Supply* module).

Start Current

The DC current used during the rotor delay. Normally the average current of level one of the weld procedure.

Start Power

The high voltage that starts the weld arc. The M100 has three settings, U-LOW for use with wall thickness of 0.010 in. (0,25 mm) or less, LOW for use with thin materials and the series 5 and 8 weld heads, and NORMAL for all other applications.

Step Program

A type of weld program in which the rotor speed is different between the impulse (high) pulse time and the maintenance (low) pulse time. The rotor speed may vary from zero to the weld heads maximum rpm.
(Refer to **Step Programs Multi-Level** in the *Power Supply* module).

Straight Polarity

The electrical configuration that makes the electrode the negative lead and the work the positive lead.

Tacks

Small points of weld that do not penetrate the wall completely. Usually spaced at three or four places around the tube diameter. Used to hold the joint alignment and joint gap during welding.

Travel Speed

The speed of the electrode as it passes over the weld joint, usually expressed in inches per minute or millimeters per second. Travel speed is normally entered into the machine as RPM.

Tungsten

The material used to make the electrode. Tungsten is typically alloyed with rare earth metals to enhance its current-carrying capacity.

UCI

An acronym used for universal collet insert, the exchangeable component used in the fixture block to hold work pieces. The patented inserts come in various sizes to match the outside diameter of the work pieces.

Warning (W:)

A status line displayed on the M100 under the READY status line during the WELD/WELD mode. They do not disable the machine but are warnings to the M100 operator to an equipment condition that may affect the weld. (Refer to **Weld- Disable, Warnings, and Weld Errors** in the *Power Supply* module).

Watt

A unit of electrical power measurement. One ampere times one volt equals one watt.

Weld Coupon

A sample weld made for evaluation purposes. The weld is used for both visual and physical testing.

Weld Pool Shift

See meander.

Weld Procedure

The term used to describe a custom set of weld parameter values used to program the SWS for a particular welding job. The parameter settings are based on the characteristics of the work and the SWS configuration. It is sometimes called the “weld schedule.”

Weld Puddle

The portion of the weld that is molten.

Weld Time

The portion of the weld cycle in which the current is at the level needed to fully penetrate the weld joint. The current will pulse between Impulse and Maintenance levels.

Warranty Information

Swagelok products are backed by The Swagelok Limited Lifetime Warranty. For a copy, visit swagelok.com or contact your authorized Swagelok representative.

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