MODEL 81 WELD HEAD
OPERATION MANUAL
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WARNING

The nature of the GTAW process creates some POTENTIAL HAZARDS. In accordance with international safety regulations the EXCLAMATION SYMBOL indicates that this equipment is considered HAZARDOUS until an operator has been made aware of these POTENTIAL HAZARDS by READING THIS MANUAL. The LIGHTNING FLASH SYMBOL indicates that there are potential electrical hazards. The use and display of these symbols make it the OPERATOR’S RESPONSIBILITY TO INSURE THAT THEY HAVE READ AND/OR BEEN MADE AWARE OF ALL OF THE SAFETY-RELATED ITEMS CONTAINED IN THIS MANUAL.

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SECTION I - INTRODUCTION

1.0 INTRODUCTION

This manual is intended to assist users of this equipment in set up and basic operation. Automatic Gas Tungsten Arc Welding (GTAW) welding with filler requires a good deal of operator/welder expertise which requires AMI supplied training. THIS MANUAL IS NOT INTENDED AS A SUBSTITUTE FOR THAT TRAINING.

The M-81 Weld Head can be configured in many versions. However, all M-81 Weld Head versions have a common design and are used essentially the same. This Manual is intended to cover the entire M-81 Product Line and not just one version. Version specific performance specifications can be found in the appropriate AMI Weld Head Specification. Version specific wiring and parts information can be found in the appropriate Illustrated Parts Breakdown Manual (IPB) supplied with each Weld Head.

The Model 81 Welding Head is part of a complete welding system intended for the welding of metal tubes, pipes and fittings. The complete system consists of an appropriate AMI Power Supply, Adapter Cable, Gas Lines and the M-81 Weld Head.

The standard AMI power supply provides GTAW current with pulsation controls, high frequency or touch arc starting, purge gas controls, weld head arc rotation, cold wire feed, Arc Voltage Control, Torch Weave/Steering (Oscillation) and automatic timing functions. Users need only to supply input AC power, regulated torch shielding gas source with flow meter and the M-81 Weld Head.

NOTE

A complete understanding of Orbital Welding techniques and the use of an AMI pipe welding Power Supply is required before installation or operation of a M-81 is attempted. Detailed descriptions of Power Supply general system operation, modes or functions mentioned in this manual can be found in the appropriate pipe welding power supply Operation Manuals and are not covered in this document.

In-depth weld development instructions, weld head set-up, maintenance and troubleshooting are contained in other manuals, documents and training classes and are not included in this manual. Contact your AMI representative for more information about these items.

1.1 SAFETY PRECAUTIONS

This section contains cautions and warnings concerning the operation of this equipment and welding equipment in general. However, in addition to reading this manual and before operating this or any welding equipment, users should reference and be familiar with "ANSI 49.1 Safety in Welding and Cutting". This standard is published by the American National Standards Institute and the American Welding Society.

WARNING: Touching energized electrical parts can cause a fatal shock or burns. When in weld sequence the electrode and work are electrically energized. Incorrectly installed or improperly grounded equipment is a hazard.
### 1.1 SAFETY PRECAUTIONS (continued)

**1.1**

**WARNING:** This equipment is authorized to use a type of arc starter that produces a High Frequency Radio Wave (sometimes called HF and/or RF Starting). It can cause interference and sometimes even damage to nearby electronic equipment (such as computers) that are un-protected or poorly protected against such interference.

**1.2**

**WARNING:** Magnetic Fields from High Currents can affect pacemakers. PACEMAKER WEARERS KEEP AWAY UNTIL CONSULTING YOUR DOCTOR.

**1.3**

**WARNING:** Disconnect the input power to the machine before opening or servicing. Discharge all circuits that store high voltage such as capacitor packs. Only QUALIFIED service personnel should open this equipment.

**2**

**WARNING:** Welding can cause fires or explosions. Do not weld near FLAMMABLE or EXPLOSIVE MATERIALS. Watch for fire. Have proper type of extinguisher in work area.

**2.1**

**WARNING:** Welding Operators should wear non-flammable protective clothing, footwear and head gear.

**2.2**

**WARNING:** Never weld on sealed containers or pipes. This may result in an EXPLOSION.

**2.3**

**WARNING:** Welding produces high temperatures in both the welded components and the welding equipment. Both can cause severe burns. Do not touch recently welded components. Avoid touching internal components of the welding system soon after use. Avoid touching torch components and welding fixtures soon after welding.

**3**

**WARNING:** The welding arc emits ultra-violet (UV) radiation and the molten weld gives off infra-red. Both can burn eyes and skin if unprotected. Suitable eye and skin protection must be worn.
### SECTION I - INTRODUCTION

**1.1 SAFETY PRECAUTIONS (continued)**

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<th>Description</th>
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<td>4</td>
<td><strong>WARNING</strong>: Weld materials can emit toxic fumes during welding. <strong>WELD ONLY IN AREAS WITH ADEQUATE VENTILATION.</strong></td>
</tr>
<tr>
<td>4.1</td>
<td><strong>WARNING</strong>: Most GTAW gases like Argon are non-toxic, however, Argon is heavier than air and will displace the normal atmosphere in enclosed areas. <strong>DO NOT WELD IN ENCLOSED AREAS WITHOUT PROPER VENTILATION OR RESPIRATORS.</strong></td>
</tr>
<tr>
<td>5</td>
<td><strong>WARNING</strong>: AMI factory training is essential for all Welding Operators and Maintenance Technicians who operate AMI equipment.</td>
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<tr>
<td></td>
<td><strong>WARNING</strong>: Before operating, storing or handling, always make sure that the Power Supply, Pendant, weld heads and cables are not exposed to rain or standing water. <strong>SYSTEM COMPONENTS ARE NOT WEATHER-PROOF.</strong></td>
</tr>
<tr>
<td>6.1</td>
<td><strong>WARNING</strong>: Keep hands and fingers clear from moving parts such as fans, gears, rotors, Wire Feed, Rotation, OSC and AVC Mechanisms.</td>
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**1.2 OPERATIONAL PRECAUTIONS**

The following is a basic check list for operating personnel to follow to insure minimum system down-time due to improper operation and handling:

1. **TOO AVOID** severe equipment damage **VERIFY** that the Power Supply is connected to the correct Input AC power before turning power on.
2. Before operating, check all fittings and connectors for proper seating and that all protective boots are in place. If not properly seated or protected, short circuits, poor connections or inert gas leaks could occur.
3. The M-81 is intended for typical GTAW gases ONLY. **NEVER CONNECT OXYGEN OR ACETYLENE TO THE M-81.**
4. Before operating, insure that all cables are routed or protected in such a way that they will not be subject to heat, equipment and/or personnel traffic. Insure that the cables DO NOT come in contact with HOT PIPE.
1.2 OPERATIONAL PRECAUTIONS (continued)

5. When storing or handling cables, always keep the protective boots and dust caps on all connectors and fittings until ready to install. A major cause of downtime in any automatic welding system is improper care and use of cables.

6. Before operating, insure that the Power Supply has adequate air flow. Do not restrict the intakes or exhaust vents of the power supply.

7. Before operating, always insure that there is bare metal contact between the weld head components which connect to GROUND (clamps, etc.) and the tube or pipe to be welded.

8. When storing or handling weld heads, always keep them in the protective containers they are shipped in, until ready to install.

9. When storing or handling, insure that the M-81 is protected against dirt, dust, etc. NEVER GRIND NEAR AN EXPOSED WELD HEAD or POWER SUPPLY.

10. Do not use acid, corrosives, liquid “Easy Out” or any liquid substance on the M-81. When cleaning, use only a light solution of Isopropyl alcohol on a soft cloth.

11. When handling, take extreme care to avoid dropping the power supply, weld heads, cables or any accessories.

12. Do not attempt to move the tube end into position using the weld head as a lever.

13. Do not add any lubrication like graphite, oil or grease to the weld heads or power supply unless it is specified in the operation or maintenance manual for that equipment.

14. Never use a M-81 or any AMI Power Source for the purposes of pipe thawing.

15. Proper operation of the wire feeder (and acceptable welds) depends on the spools being filled properly without contaminating the wire and also winding properly to insure the wire comes off the spool smoothly and consistently.

16. Do not use the Guide Rings on pipe that is larger than the intended range of the Guide ring. Over clamping will stretch the Insert and affect its performance.

1.3 SHOCK HAZARD WARNING

The ELECTRODE (tungsten) is an “exposed terminal” and by its nature the GTAW process requires electrical potential to be present on the electrode during arc starting and of course during welding.

All AMI Power Supplies contain a “bleeder” circuit to ground any residual potential after welding or after an aborted or bad “arc start” attempt. However, these circuits take a few seconds to operate or COULD FAIL.

“THE ELECTRODE SHOULD ALWAYS BE CONSIDERED A POSSIBLE SHOCK HAZARD”. This is especially true when ever the system is in “weld sequence” ready to weld, is welding or has just finished welding. However, equipment/component failure, system abuse, or improper maintenance could result in electrical potential at the weld head “even when not in weld sequence".
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1.3 SHOCK HAZARD WARNING (continued)

The users/operators of this equipment must take all precautions necessary to avoid contact with the ELECTRODE at "ALL TIMES". The only exception is when actually replacing or adjusting the electrode and this should be done "WITH THE POWER TURNED OFF".

If performed with the power "ON" the system must be in test mode out of weld sequence and the USER MUST OBSERVE COMMON SAFETY PRACTICES such as grounding the electrode to insure discharge before actually touching it.

REMEMBER, there is a "POSSIBLE" shock hazard in all welding power supplies at "ALL" times.

Most AMI Power Supplies feature High Frequency (HF) Arc Starting. This is a High Voltage/High Frequency electrical transmission process. To eliminate any HF shock possibility "AVOID ALL CONTACT" with the Welding WORK (ground), the ELECTRODE or the M-81 during arc start.

1.4 RF AND EMI EMISSIONS

1. WHY RF?

"It has long been recognized that in the practice of welding and cutting, there are circumstances where it is required to assist the process using radio frequency voltage. In order to arc weld an electric arc must be created, because of safety and economic concerns, the no load voltage of arc power sources is kept as low as practical. Thus, a source of high voltage with a high safety factor must be utilized. Radio Frequency voltage is the best method of meeting these criteria for many reasons." (quoted from CISPR/B/63).

2. RF REGULATION

The FCC regulates the RF emission limitations for welding equipment by the use of an IEC (international) regulation created by the Special Committee on Radio Interference (known as CISPR) subcommittee B. The regulation of record is:

CISPR/B/63

"CODE OF PRACTICE FOR THE USE OF WELDING AND CUTTING POWER SOURCES UTILIZING RADIO FREQUENCY VOLTAGE FOR STARTING OR STABILIZING THE ARC."

The regulation states that due to the variety of work requirements and conditions it is virtually impossible to establish fixed, normalized and predictable tests and test setups for RF limits that would actually mean something. Instead of limits they state the following:

"The manufacturer must design and produce equipment that is functional but at the same time, design this equipment to keep electromagnetic radiation at a minimum."

"The user has the responsibility to install and use the power source per the instructions of the manufacturer. Through this practice, it is reasonable to assume that the probability of electromagnetic disturbances will be significantly reduced. However, if some electromagnetic disturbances are felt, then it is the responsibility of the USER of the equipment to resolve the situation."
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1.4 RF AND EMI EMISSIONS (continued)

3. RF PROTECTION

AMI policy is to comply with the IEC (and thus FCC) regulations. Our design rules and procedures include testing and observing this area. We can assure our customers that every effort has been made to reduce RF emissions to the absolute minimum from our power sources.

However, this does not mean that a user will not have occasional problems with RF interference with other equipment due to the use of our equipment. This is the nature of RF starting.

Most RF noise interference problems are going to be either set-up related or caused by poor or no filtering on the behalf of the equipment that is being interfered with. Most problems are easily correctable but each one must be looked at on a “case by case basis.”

4. EMI SUPPRESSION

AMI Power Supplies are equipped with a heavy-duty Pi-Network filter, connected to the input power line, to prevent propagation of EMI either into or out of the Power Supply. The all-metal enclosures and internal shields prevent radiated EMI.

1.5 BASIC COMPONENTS

For the purposes of description, the Model 81 consists of five (5) basic assemblies. A brief description of each is as follows (reference Figure 1):

1. **Main Weld Head Housing** (Figure 1, Item 1A, B & C)

   1. This housing is made up of three (3) sections that are permanently hinged together. These sections contain all of the weld head motor servo assemblies.

      - **Section I - AVC and Torch Oscillator Assembly** (Figure 1, Item 1A).
      - **Section II - Rotation (travel) Drive Assembly** (Figure 1, Item 1B).
      - **Section III - Wire Feed Drive Assembly** (Figure 1, Item 1C).

   2. The Main Housing wraps around the pipe to be welded and is held in a rigid circle by the Model 81 Clamp Assembly (see 1.5.5).

2. **Torch and Wire Manipulator Assembly** (Figure 1, Item 2)

   1. The Torch Assembly contains a GTAW liquid cooled Torch that has a rigidly mounted Wire Manipulator Assembly affixed to it. The Torch also contains a Gas Lens, Gas Cup and Electrode Collet Assembly.
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1.5 BASIC COMPONENTS (continued)

2. (continued)

2. All Torch movement adjustments (tilt in/out and lead/lag adjustments) also move the Wire Manipulator in the same plane. The Wire Manipulator has Wire Entry Angle and Wire Cross Seam adjustments that are moved independently from the Torch movement.

3. Cabling and Connector Assembly (Figure 1, Item 3)

1. This Assembly supplies the previous two Assemblies with cooling liquid, electrode power, welding gas, and electrical control wiring for the motor and sensing functions.

4. Wire Spool Holder/Tension Arm Assembly (Figure 1, Items 4A to 4F)

1. There are three types of Wire Spool Holder Assemblies:

   1. Small Spool (standard) (Figure 1, Item 4A)
   2. Medium Spool (option) (Figure 1, Item 4B)
   3. Large Spool (option) (Figure 1, Item 4C)

2. The Small Spool Holder can be used in any application. The Medium Spool Holder is for larger Model 81 diameter ranges or any application where radial clearance is not a factor. The Large Spool Holder is for application where radial clearance is not a factor and the user wishes to use industry standard two (2) lbs. (4 inch) spools.

3. There are four (4) Tension Arm Assemblies supplied as standard equipment. Figure 1, Items 4E, 4D and 4F represent three of these Tension Arm Assemblies. Each is used for specific size pipe diameters; see the Installation Section of this Manual for details.

5. Clamp Assembly (Figure 1, Item 8)

1. The Model 81 requires a Clamp assembly for each size tube or pipe to be welded. The Clamp Assembly is of a split ring (clam-shell) design. The two halves of the Clamp Assembly are connected by a lockable hinge on one side and a open/close clamp on the other side.

2. The Clamp Assembly is mounted to the rear of the Model 81 Main Housing and provides the means to rapidly mount the Weld Head without the use of tools (except during initial set up). In addition to clamping the Weld Head the Clamp Assembly also provides the stationary gear for the positive drive of the Weld Head during rotation.
MODEL 81 MAJOR ASSEMBLIES

FIGURE 1
MODEL 81 WELD HEAD
OPERATION MANUAL

SECTION II - SPECIFICATION

2.0 INTRODUCTION

The M-81 and M-81C are identical Weld Heads except that the M-81C version has a liquid-cooled housing which increases its ambient temperature range and also increases its axial clearance requirements. The M81-415 and M81C-415 are also identical except they are designated for Operation on the M-415 Power Supply. For clarity, this specification will only reference the M-81 and unless otherwise noted, all ranges and parameters apply to all versions.

This specification is intended to outline the standard range and capabilities of the standard M-81 Weld Head and some of its versions.

2.1 WELDING RANGE

1. Minimum Outside Diameter (O.D.) ... = 1.900" (48.3 mm)
2. Maximum O.D. ........................................ = 5.563" (141.3 mm)
3. Maximum Wall Thickness ....................... = 0.375" (9.5 mm)

**NOTE:** Ranges are for standard M-81 Weld Heads, smaller diameters and larger wall thickness can be welded by the use of certain options. However, changes in clearances can and will occur with certain options (see Section 9.0 and 10.0). Conventional use on greater than 5.563" is not possible.

2.2 CLEARANCE ENVELOPE

The following is based on a M-81 with a standard Single Entry Torch with no Options.

1. Radial Clearance .................................... = 1.75" (44.5 mm)
2. Axial Clearances
   1. Electrode to Rear M-81 .......... = 5.503" (139.7 mm)
      M-81C ............. = 5.827" (148.0 mm)

**NOTE:** The above is based on the Cross-Seam Manual and Motorized Adjustments at Maximum IN position. **Nominal** would be 6.063" (154.0 mm) and 6.38" (162.2 mm) respectively. The Electrode to rear dimension is also the minimum straight length of pipe required for mounting.

2. Axial Clearance (continued)

2. Electrode to Bulkhead .......... = 0.56" (14.2 mm)
3. Reference **AMI Outline Drawings 40810002 or 40810008** for additional dimensions.

2.3 STANDARD FUNCTIONS AND RANGES

**NOTE:** Regulation methods and tolerances given are actually controlled by the Power Supply/Controller Unit. They are given here only as assurance that the devices used in the M-81 to perform these functions can meet these criteria.
2.3 STANDARD FUNCTIONS AND RANGES (continued)

1. Mounting and Rotation

   1. The M-81 employs a multi-segment wrap around style that allows the head to
      maintain the same clearances for all weld diameters within its specified range.

   2. Mounting is via an integral Guide Ring that is user installed onto the Weld Head
      (for each size) prior to Head mounting (See Section 5.0). Rotation is then produced
      by using a permanent magnet motor with positive gear drive.

   3. Maximum Speed ........... = 10.0 IPM (254 mm/min.)
      Optional ........... = 20.0 IPM (508 mm/min) See Section 10.0

   4. Minimum Speed ........... = 0.02 RPM (5.1 mm/min.)

   **NOTE**: Travel Speed is measured in Inches Per Minute on the outside surface of the
   Guide Ring and not on the Weld Diameter or surface of the pipe.

5. Intended Regulation is by Closed Loop Servo in IPM using 5 VDC Tachometer
   Feedback

6. Regulation Tolerance is +/- 1 % or 0.1 IPM (2.5 mm/min.) whichever is greater.

2. Wire Feed

   1. Wire Feed features an Integral on-board (built-in) puller wire feeder using a
      permanent magnet D.C. motor and small “miniature” wire spool.

   2. Maximum Speed ........... = 100 IPM (2.5 m/min.)

   3. Minimum Speed ........... = 5 IPM (0.13 m/min.)

4. Intended Regulation is Closed Loop Servo in IPM using 5 VDC Tachometer
   Feedback

5. Regulation Tolerance is +/- 2% or 1.0 IPM (25.4 mm/min.) whichever is greater.

6. Wire Size, Standard ...... = 0.030" (.76 mm)
   Optional ...... = 0.035" (.89 mm)

7. Standard Roller Type = Gripping V Groove
   Optional = Smooth U Groove for .020", .025", .035" (0.5, 0.64, 0.89 mm)
2.3 STANDARD FUNCTIONS AND RANGES (continued)

2. Wire Feed (continued)

8. The Wire Feeder, related Wire Liners and Wire Feed Nozzles are intended primarily for mild carbon steels and most Austenitic Stainless Steel wires not exceeding .035 inch in diameter.

Harder wires such as high chrome or Stellite may require special roller, liner, nozzle and motor options. Larger wire sizes are not recommended and would also require special roller, liner and nozzle Options.

The standard “V” groove serrated rollers can, depending on usage, nick or mark the wire. In cases of aluminum, this is not desirable and the use of size specific “U” groove smooth rollers may be necessary. Standard Wire Liners use Teflon inner sleeves. In the cases of Aluminum welding or in radiation environments, this is not recommended and in most cases should be replaced with a Nylon based liner.

9. Wire Feed Capacity

1. Standard Small Spool ............. = 0.50 lb. (0.23 kg) Max.

**NOTE:** The standard M-81 spool is a small “miniature” wire spool that fits into the main housing and maintains the stated radial and axial clearance. Weights can change due to wire type and size.

AMI supplies the spools empty, or can drop ship them to your wire supplier to be filled or AMI can supply, by special order, the spools with your particular wire filled on them. In all cases, proper operation of the wire feeder (and acceptable welds) depends on the spools being filled properly without contaminating the wire and also winding properly to insure the wire comes off the spool smoothly and consistently.

2. Optional Large (4”) Spool .......... = 2.00 lb. (0.9 kg) Max.

Use of this spool option will exceed the stated radial and axial clearances of the M-81 (see Section 10.0).

3. Optional Medium Spool ............ = 1.00 lb. (0.45 kg) Max.

Use of this spool option will exceed the stated radial and axial clearances of the M-81 (see Section 10.0).

3. Torch Oscillator (OSC) and Cross-Seam Adjust

1. The Torch Osc. provides both Cross-Seam adjustment (steering) for weld alignment and it also provides the electro-mechanical ability to oscillate (weave) across the weld seam during a weld sequence.
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SECTION II - SPECIFICATION

2.3 STANDARD FUNCTIONS AND RANGES (continued)

3. Torch Oscillator (continued)

2. Total Mechanical Movement .............. =  +/- 0.56" (14.2 mm) (1.12" total)
Consisting of:
   1. Motorized Oscillation (weave) ...... =  +/- 0.31" (7.9 mm) (0.62" total)
   2. Manual Cross-seam Adjustment .... =  +/- 0.25" (6.3 mm) (0.50" total)

3. Regulation Type .......................... = Thousands of an Inch
Closed Loop Position feedback using Precision Rotary Potentiometer to maintain
desired position to +/- 2% or 0.010" whichever is greater.

NOTE: The above are design maximums. The amount of Osc weave (amplitude)
and motorized cross-seam adjustment can vary depending on the Power
Supply/Controller Unit being used.

4. A worst case acceleration and deceleration time is 50 milliseconds (The time
required to go from zero to full speed or from full speed down to zero)

5. Maximum Speed – 120 IPM (3.0m/min)

NOTE: Operating speed is determined by movement time (called Excursion) versus
the distance traveled (called Amplitude). An Amplitude and Excursion time that
would require a greater speed than this is possible to program in most AMI Power
Supplies.

4. Arc Voltage Control (AVC)

1. The AVC provides a means of maintaining a uniform Arc Length as the Weld Head
rotates around the weld. The AVC mechanism provides motorized torch travel in a
plane which is radial to the pipe centerline. The AVC mechanism is built into and
attached to the moving portion of the oscillator mechanism.

2. The AVC features Direct Drive from a single pivot point using a permanent magnet
D.C. motor.

3. AVC Mechanical Stroke ............... =  0.75" (19.1 mm)

4. Intended Regualation is Closed Loop Position Servo measuring the Arc Voltage
(in VDC) at the Torch for position reference.

5. Regulation Tolerance is +/- 1% of desired voltage or 0.10 VDC whichever is greater.

5. Arc Starting Method ...................... =  High Frequency (RF) or Touch Starting

6. Weight ...................................... =  6 LBS (2.72 kg) without Cable and Wire Spool.
                                          11 LBS (4.99 kg) with Cable and Standard Spool.

NOTE: Weights are approximate and may vary with configuration
MODEL 81 WELD HEAD
OPERATION MANUAL

SECTION II - SPECIFICATION

2.4 GUIDE RINGS (Clamp Assemblies)

1. The M-81 requires a Guide Ring for mounting. Each Guide Ring must be sized for the specific mounting O.D. Please specify desired sizes when ordering.

2. All Guide Rings are made from 6061 Aluminum. In most cases they will be nickel plated.

3. The Guide Ring consists of two clam-shelled halves, the radius of each half is sized specifically for the mounting O.D. Each half has a Clamp Insert that is also sized for the specific mounting O.D. The Clamp Insert provides a flexible but firm grasp for adapting to pipe diameter deviations while still providing the M-81 with a stable rotation platform.

4. The Clamp Insert mounting tolerance varies slightly for each Insert Size but the design range is from 0.020” (0.5 mm) under nominal to 0.040” (1.0 mm) over nominal pipe O.D. If the Inserts are ever “stretched” by mounting on greater than 0.040” over nominal the insert performance may be affected on nominal pipe. Standard ASA pipe does frequently run over-sized (out of tolerance), in those cases, special Inserts for the larger O.D. need to be ordered.

5. The Mounting Tension Arm Provides Weld Head support essentially on the opposite side of the pipe from the Torch to prevent the M-81 from wobbling on the pipe. Four (4) different Mounting Tension Arms are provided as standard. The correct one must be installed for proper operation. There are many Mounting Arm Options that can or must be used with other Options. See Section 10.0 for more details.

6. The Guide Ring Assembly and appropriate Mounting Tension Arm are mounted onto the Weld Head before installation onto the pipe to be welded.

2.5 TORCH FUNCTIONS AND RANGES

As stated previously, there are several Torch Options available for the M-81 Weld Head. The following describes the basic features of the standard Single Wire Entry Torch. Reference AMI Outline Drawing 40810002 for more information. Also see Section 9.0 for other Torch Options,

1. The Standard M-81 Torch is a miniature, Liquid Cooled, Torch and Wire Manipulation Assembly designed especially for the extremely tight Radial and Axial clearances of the M-81 and M-81-C.

2. Current Rating .................. = 200 Amperes continuous

   300 Amperes Max. Pulsed

3. Torch Configurations

   1. Electrode, Standard ...... = 0.093” (2.4 mm)
      Optional ...... = 0.125” (3.2 mm)

   NOTE: AMI recommends the use of 2% ceriated-type tungsten electrodes only. Electrode tips should be precision-ground to a uniform and repeatable tip dimension.

   2. Gas Cup, Standard ...... = HW-20 #6 Modified

   3. Collet, Standard .......... = 0.093” (2.4 mm)
      Optional .......... = 0.125” (3.2 mm)
2.5 TORCH FUNCTIONS AND RANGES (continued)

3. Torch Configurations (continued)

4. Gas Lens, Standard = HW-20 0.093” (2.4 mm) Modified
   Optional = HW-20 0.125” (3.2 mm) Modified

   **NOTE:** Gas lenses supplied by Arc Machines, Inc under AMI’s Part Number are specially designed for optimum gas coverage. Use of other gas lenses is at the risk of the operator or user and may result in poor equipment performance.

4. IN/OUT Torch Tilt = +/- 15 degrees

5. LEAD/LAG Torch Adjust = +/- 5 degrees

6. Wire Cross-Seam Adjust = +/- 0.125” (3.2 mm)

7. Wire Entry Angle = 15 to 35 degrees, Manually Adjusted.

8. Wire Nozzle Diameter, Standard = 0.030” (0.76 mm)
   Optional = 0.025” and 0.035” (0.64 and 0.89 mm)

   **NOTE:** Wire Sizes larger than .035” diameter are not recommended

9. Standard Wire Liner is an Armored type with 0.062” (1.6 mm) I.D. Teflon inner sleeve. Other liner types are available.

10. Optional Gas Lens/Gas Cup/Manipulator Extenders can allow welding on greater wall thicknesses but will increase Weld Head overall Radial Clearance.

2.6 CABLES

1. The M-81 has a 10’ (3.05 m) Integral Control and Service Cable Assembly. The use of Adapter and Extension Cables will allow operation to be up to 200’ (61 m) from the Power Supply.

2. The Control Cable is a connector type (no hard wire) and can be easily removed for service or repair.

3. The Standard Service Cable Assembly also features a manifold style connector and can be easily removed for Service or Repair. The M-81-C and other option cables require some direct wiring for replacement or repair.

4. The entire Cable Assembly is jacketed in a rugged high temperature insulated sleeve. However, in pre-heat applications it is the users responsibility to keep the cable away from the hot pipe.

5. Cable Wrap (management) = 1 pre-wrap prior to welding. The Weld Head is intended to un-wrap the cable during welding. The cable should never be wrapped backwards against its mounting bracket and strain relief.
2.7 TEMPERATURE RANGE/PREHEAT CONDITIONS

1. No minimum or maximum preheat or ambient temperature range is given. Actual working conditions, head type, welding duty cycle, weld parameters and other conditions vary too much to state a rigid temperature.

2. All temperature range assessments are based upon the maximum allowable Motor Winding Temperature that can be tolerated by the internal Permanent Magnet D.C. motors of the Weld Head.

3. Winding temperature depends on pipe temperature, ambient air temperature, mounted duty cycle and Motor Torque (how hard are the motors being run?).

4. As a guideline, we state that the M-81 Weld Head Housing temperature should not exceed 140°F (50°C) at any time. The standard M-81 can be installed on short duration pre-heated welds in excess of 250°F (121°C) and not exceed this. On the other hand, this number can be exceeded in non-preheated applications with high duty cycles and high welding currents. It all depends on the application.

5. The M-81C uses a liquid-cooled housing. When used with an efficient cooling unit, it can easily maintain the Weld Head Housing temperatures under 120°F (49°C) and thus can be used in almost all preheat and non-preheat applications. It is highly recommended that the M-81C version be used on ANY application involving preheat or high duty cycle, high current welding.

2.8 TORCH OPTIONS

The following is a list of Torch Options available as of this specification revision. For Torch details reference individual specifications for each torch and the AMI M-81 Outline drawing noted for each configuration:

<table>
<thead>
<tr>
<th>Torch Description</th>
<th>Outline Drawing No.</th>
<th>Specification No.</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Wire Entry</td>
<td>40150008 and 40810002</td>
<td>See Section 2.5 of this Manual</td>
<td>Standard Torch</td>
</tr>
<tr>
<td>Tilt Manifold</td>
<td>40810007 or 40810015 or 40810013</td>
<td>No. 81-TILT</td>
<td>Standard Tilt Torch</td>
</tr>
<tr>
<td>Tilt Variable Leg</td>
<td>None</td>
<td>No. 81-TILT</td>
<td>Special Tilt Torch</td>
</tr>
<tr>
<td>Tilt Sparger</td>
<td>40810009</td>
<td>No. 81-TILT</td>
<td>Special Tilt Torch</td>
</tr>
<tr>
<td>Dual Wire Entry</td>
<td>40810012</td>
<td>No. 81-DUAL</td>
<td>For Double Up Welds</td>
</tr>
<tr>
<td>300 Ampere</td>
<td>40810014</td>
<td>No. 81-300</td>
<td>High Amp Welding</td>
</tr>
<tr>
<td>M81-DV Vision</td>
<td>40810016</td>
<td>No. 81-DV</td>
<td>For Remote Welding</td>
</tr>
<tr>
<td>Tilt Single Optic</td>
<td>41810147</td>
<td>No. 81-DV</td>
<td>Special Vision Torch</td>
</tr>
</tbody>
</table>
MODEL 81 WELD HEAD
OPERATION MANUAL

SECTION II - SPECIFICATION

2.9 OPTIONS

1. **M-81-AVC TILT Manifold Style** - Intended for stub welding variable legs where extremely small radial clearance is needed in the torch area but more room is available towards the rear of the head. Allows the torch to be tilted from 0 to 45 degrees (cannot tilt in). See *Specification No. 81-TILT* and *AMI Outline Drawing 40810007* for more details.

2. **M-81 DUAL ENTRY** - A M-81 using a torch that features Wire Manipulator Assemblies on both sides of the torch. This version allows for Filler welding in either direction of travel and allows double-up or double-down weld techniques to be used. Radial clearances increases to 2.5" (63.5 mm) with this version. See *Specification No. 81-DUAL* and *AMI Outline Drawing 40810012* for more details.

3. **M81-DV** - Features a torch using a single CCD camera which provides vision of both the leading and trailing edges of the weld puddle. See *Specification No. 81-DV* and *AMI Outline Drawing 40810016* for more details.

4. **M81 AVC/TILT with AVC/OSC Interchange** - Same features as the AVC tilt (above) but also allows the AVC to become the Oscillator and the Oscillator to become the AVC. Required for applications where the torch needs to be perpendicular to its normal position. See *Specification No. 81-AVC/OSC* and *AMI Outline Drawing 40810015* for more details.

5. **Guide Ring Adapter Kits** - The smallest standard Guide Ring Assembly is 1.900" O.D. (48.26 mm). An Adapter Kit must be used for any diameter down to 0.840" (21.3 mm). Kits consist of a 1.900" O.D. Guide Ring with Clamp Inserts for the Kit Size, and 1.875" and Smaller Mounting Tension Arm. Kit may also contain Front Roller Wheel Extenders and Extended Torch Mounting Brackets (depending on size).

**NOTE:** Because all Adapter Kits use the same size Guide Ring the Weld Head Radial clearance increases as the pipe size gets smaller.

6. **Stub Mounting Mandrels** - Many M-81 applications involve welding of short Stubs that are not long enough to mount the Weld Head on. In many of these cases a mounting Mandrel can be used to provide a mounting platform.

The Mandrel consists of a 14.5” (368.3 mm) long by 2.00” (50.8 mm) O.D. mounting surface and a 4.625” (117.5 mm) long Expanding I.D. Mandrel Assembly. Each Mandrel Assembly has a range of about 0.050” (1.3 mm) and needs to be sized for the exact Stub I.D. The Stub I.D. must also remain the same diameter (from the mounting end) for at least 4.75” (120.6 mm) to allow full penetration of the Mandrel into the stub I.D..

The Mandrel is expanded and collapsed manually (with a wrench) using a nut and plate Assembly on the end of the Mandrel. See *AMI Drawing 41810941* for further details and available sizes.
MODEL 81 WELD HEAD
OPERATION MANUAL

SECTION III – INSTALLATION

3.0 INSTALLATION INSPECTION

1. Before installing the Model 81 Weld Head, perform a general inspection of the head as follows:

   1. Check the Coolant and Gas hoses for damage (cracks, holes, wear, etc.).

   2. Check the Coolant and Gas quick disconnect fittings for clean tight connections (Figure 2).

   3. Check the Weld Head Control Cable for frays and the Connector for tightness and good thread condition (Figure 7).

   4. Insure that all Assemblies are connected and that no hardware, brackets or pieces are loose or obviously missing.

3.1 WELD HEAD CONNECTION

1. Connect the M-81 Coolant Return, Gas and Electrode quick disconnects to the 40 foot Weld Head Service Adapter Cable supplied with the welding Power Supply/Controller unit. Install the protective rubber boots on all connections. The rubber boots have a cut out allowing the retaining clips to be recessed and locked. Reference Figure 2 and 3 for details and also consult the Installation Section of your Power Supply/controller Operation and Maintenance Manual.

2. Connect the M-81 Weld Head Control Cable Connector (multi pin electrical connector) to the 40 foot Weld Head Control Adapter Cable. The connectors are keyed and should screw together easily, DO NOT FORCE. If it is difficult to connect, check the keyway and condition of the threads.

3. Connect the Adapter Service and control cables to the Power Supply/Controller or Extension cable per the Power Supply/Controller Operation and Maintenance Manual. Reference Figure 4, 5, 6 and 7 for assistance.

   NOTE: All Weld Head and Power Supply/Controller electrical connectors are equipped with threaded Dust Covers. Insure that these are in place when connectors are not in use and that they are connected to their mating Dust Cover when connectors are in use.

3.2 WELD HEAD CLAMP ASSEMBLY INSTALLATION

WARNING

The following steps should allow the Clamp Assembly to be installed smoothly and easily. NO FORCE should be required. If it does not go on easily please read the instructions again or check the Weld Head or Clamp for defects. Although the installation is not difficult, it does involve several steps and some amount of practice. Please READ all the steps of this Section before actually performing.

1. Prepare the M-81 Weld Head for the Clamp Assembly by performing the following steps.

   1. Set the Drag Clutch Release Lever to the dis-engaged position (toward the torch, see figure 8, Item 1).
MODEL 81 WELD HEAD
OPERATION MANUAL

MODEL 81 CABLE CONNECTIONS

FIGURE 2

FIGURE 3

FIGURE 4

FIGURE 5

FIGURE 6

FIGURE 7
MODEL 81 WELD HEAD
OPERATION MANUAL

SECTION III - INSTALLATION

3.2 WELD HEAD CLAMP ASSEMBLY INSTALLATION (continued)

1. (continued)

2. Press the Wire Feed Section Hinge Locking Button and unlock the Hinge allowing the Wire Feed Section to swing freely (see Figure 8, Item 2).

3. Loosen the Wire Spool/Tension Arm Assembly locking screw allowing the Wire Spool/Tension Arm to move freely (see Figure 8, Item 3).

4. Loosen the Oscillator Assembly Hinge screws (figure 8, Item 7).

5. Locate the Drive Gear Release Button and be prepared to engage this button any time the Clamp Assembly is moved over the Main Drive Gear (see Figure 8, Item 4).

2. Select the proper Clamp Assembly for the size pipe/tube to be welded and perform the following steps:

1. Release the Clamp Arms on both sides of the Clamp assembly and open the Clamp Assembly (see Figure 9).

2. Hold the M-81 Weld Head with one hand and depress and hold the Drive Gear Clutch Release Button with the same hand (see Figure 8, Item 4 and Figure 10, Item 1).

3. With the other hand grasp the open Clamp Assembly on the right hand side (see Figure 9, Item 1) and slide the open mounting end onto the Weld Head rear Roller Bearing (see Figure 10, Item 2).

4. Continue to slide the Clamp Assembly up to and engage the Drive Gear Sprocket (Figure 10, Item 3). Be sure the Drive Gear Clutch release Button is depressed or it will not rotate for insertion. Rotate the Clamp Assembly until the inserted end of the Assembly is just past the Drive Gear. Release the Drive Gear Clutch Release Button.

3.3 INITIAL WELD HEAD MOUNTING

1. The following steps cover Weld Head mounting when a change of Clamp Assembly size has been performed. Similar pipe size to similar pipe size mounting is covered in Section 3.4.

1. Before mounting the Weld Head, it is essential that the area on the pipe where the Clamp Assembly will mount be clean, bare pipe. This area (1 inch wide, 6 inches from the weld joint) should be cleaned as illustrated in Figure 12.

2. Verify that the Clamp Assembly is properly installed on the Weld Head per Section 3.2. Insure that the Drag Clutch Release Lever is still in the dis-engaged position. Ensure that Wire Feed Section Hinge is dis-engaged and allowed to swing free (see figure 8, Item 1 and 2).
FIGURE 8
3.3 INITIAL WELD HEAD MOUNTING (continued)

1. (continued)

3. There are four (4) standard Tension Arms that can be used depending on pipe diameter (see Table 1 below). Install the selected Tension Arm on the Wire Spool/Tension Arm Assembly but do not tighten, allow the Wire Spool/Tension Arm Assembly to remain free to swing.

**TABLE 1**

<table>
<thead>
<tr>
<th>Tension Arm Size Ranges</th>
<th>Use PN#</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.900 to 2.250 inch O.D.</td>
<td>13810102-01</td>
</tr>
<tr>
<td>2.250 to 3.000 inch O.D.</td>
<td>13810102-02</td>
</tr>
<tr>
<td>3.000 to 4.000 inch O.D.</td>
<td>13810102-03</td>
</tr>
<tr>
<td>4.000 to 4.500 inch O.D.</td>
<td>13810102-04</td>
</tr>
</tbody>
</table>

**NOTE:** Many Options such as Medium and Large Wire Spool Holders, Adapter Kits, and Special Clamp Assemblies require different Tension Arms and those Arms will be supplied with the Option or Kit.

4. Lay the Weld Head on the pipe to be welded, wrapping it around the pipe. Position the Torch Electrode over the desired weld bead location.

5. Swing the loose Clamp end up to and engage the Drag Clutch Gear. Insure that the Drag Clutch Release Lever is still dis-engaged (see Figure 8, Item 1). Engage the Clamp arms on both sides of the Clamp Assembly (see figure 11).

6. After the Clamp Assembly is securely clamped rock the head toward the Wire Feed Section and ensure that the Wire Feed Section Hinge lock engages.

7. Tighten the Oscillator Hinge screws (Figure 8, Item 7).

8. Swing the Wire Spool/Tension Arm Assembly onto the pipe surface so the Wire Spool is within the radial clearance of the Head and that the Tension Arm is in contact with the pipe. Tighten the Tension Arm onto the Spool Holder. The Tension Arm and Spool Holder should now move together as one Assembly.

9. Apply downward pressure on the Spool Holder until the Tension Arm Spring is compressed about half way. Tighten the Spool Assembly locking screws to maintain the position of the spool holder assembly.

10. This completes Weld Head mounting, when a Change of Clamp Assemblies has been performed. The Weld Head should be securely mounted with no drooping, sagging or binding during rotation. Using the Travel Jog, rotate the Weld Head and insure that movement is smooth and secure.
MODEL 81 WELD HEAD
OPERATION MANUAL
MODEL 81 CLAMP ASSEMBLY

FIGURE 9
MODEL 81 WELD HEAD
OPERATION MANUAL

MODEL 81 CLAMP ASSEMBLY INSTALLATION

FIGURE 10
FIGURE 11
MODEL 81 WELD HEAD 
OPERATION MANUAL

SECTION III - INSTALLATION

3.4 WELD HEAD MOUNTING DURING NORMAL OPERATIONS

1. Most of the steps in Section 3.3 are not needed to be performed when the Weld Head is already set up for and has been used on the same size pipe. The following are steps for normal mounting.

   1. Before mounting the Weld Head, it is essential that the area on the pipe where the Clamp Assembly will mount be clean, bare pipe. This area (1 inch wide, 6 inches from the weld joint) should be cleaned as illustrated in Figure 12.

   2. Ensure that the Wire Feed Section Hinge is un-locked.

   3. Verify that the Clamp Assembly is properly installed and positioned per Section 3.2 (see Figure 11).

   4. Lay the Weld Head on the pipe to be welded, wrapping it around the pipe. Position the Torch Electrode over the desired weld bead location.

   5. Swing the clamp up to and engage the Drag Clutch Gear. Insure that the Drag Clutch Release Lever is in the dis-engaged position (see figure 8, Item 1). Engage the Clamp Arms on both sides of the Clamp Assembly (see Figure 11).

   6. After the Clamp Assembly is clamped, rock the head toward the Wire Feed Section and ensure that the Wire Feed Section Hinge Lock engages.

   7. There should be no need to adjust the Wire Spool/Tension Arm Assembly if the Weld Head has been set up properly for the size pipe being welded.

   8. This completes Weld Head mounting for a previously set up head on the same pipe. The Weld Head should be securely mounted with no drooping, sagging or binding during rotation. Using the Travel Jog Switch, jog the Weld Head and insure that rotation is smooth and secure.

3.5 WELD HEAD AND CLAMP ASSEMBLY DISMOUNTING

1. Weld Head Dismounting - Perform the following steps to remove the Weld Head from a pipe:

   1. The Model 81 Weld Head can ONLY BE REMOVED when the Weld Head Main Body is positioned properly to allow the Clamp Assembly to open fully. Travel Jog the Weld Head until the Red Dot on the Rear of the Wire Feed Section is aligned with the Matching Red Dot on the Clamp Assembly.

   2. Release the Wire Feed Section Hinge and dis-engage the Drag Clutch prior to Head removal. See Figure 8 Items 1 and 2 for locations of these items.

   3. Open the Clamp Arms on both sides of the assembly and dis-engage the Open/Close Clamp completely. This will allow the Clamp Assembly to open and the Head to be removed.

2. Clamp Assembly Removal

1. To remove the Weld Head Clamp Assembly perform the steps of Section 3.2 in reverse order.
3.6 WELDING WIRE INSTALLATION

1. Perform the following steps to install the welding wire.

   1. Remove the Wire Liner assembly from the Torch to the Wire Feed Section (see Figure 8, Item 5).

   **Alternative Method**
   In most cases it is only necessary to remove the Wire Liner at the Wire Feed assembly and not from the Torch. However, if problems are encountered during Step 3.6.7, then the entire Liner Assembly should be removed.

   **NOTE** Installation of the Wire into the Torch Liner Assembly is done by hand. Do not use the Wire Feed Motor to feed wire through the liner assembly during installation.

2. Holding the Wire Spool firmly, remove the end of the wire from the retaining hole on the Spool. Allow 4 to 6 inches of wire to unwind. Be sure to hold your thumb over the rest of the wire to keep it from unwinding.

3. Cut the bent or twisted end of the wire off, leaving undamaged, dull wire on the end. If your cutters are leaving a sharp end it may be required to file the end before insertion into the liner (see Figure 13 and 14).

4. Lift the end of the Spool to Wire Feeder Liner (see Figure 8, Item 6) and thread the wire into the liner until it engages with the Wire Feed Drive Rollers.

5. Jog the wire until the Drive Rollers grab the wire and feed about 10 inches of wire out the other side of the Wire Feed Assembly.

6. Slide the Spool and Wire Liner into the Spool Holder.

7. Thread the wire by hand into the Torch to Wire Feeder Liner assembly until the wire comes out of the Nozzle. The Wire Nozzles are not self feeding, sometimes it may be required to remove the Nozzle and thread the wire into the Nozzle by hand.

   **NOTE** If the Wire tip is sharp it will cut the inner Teflon Liner and reduce the life of the Liner and make the feeding of the wire harder. Dull the wire with a file before threading.

8. After the wire is threaded in the Liner, slide the Liner up the Wire Feeder and re-engage the Liner Fitting locking screw. Re-connect the Nozzle end to the Torch Manipulator. See the Operation Section IV for details of Torch components.
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OPERATION MANUAL

SECTION IV – CALIBRATION AND OPERATIONAL NOTES

4.0 SYSTEM OPERATION

When installed, the Model 81 Weld Head becomes an integral part of the Welding System consisting of the Weld Head and the Power Supply. Calibration and Operation involve both products. Consult the Operation Manual for the Power Supply before Calibrating or Operating the Model 81 Weld Head.

4.1 CALIBRATION, GENERAL

1. Most calibrating functions are contained in the Power Supply/Controller Unit, however all AMI Weld Heads must be calibrated (matched) for Wire Feed Speed and Travel Speed to the Power Supply/Controller that it is used on. ANYTIME a Weld Head is changed from one Power Supply to another it must be checked for calibration of these (2) functions.

2. Calibration of the Wire Feed for a Model 81 is the same as all other AMI Pipe Weld Heads. Follow the procedure given in the Operation and Maintenance Manual for the Power Supply/Controller Unit in use. See Figure 8, Item 8 for the location of the Model 81 Wire Feed calibration potentiometer.

3. Calibration of the Travel speed for a Model 81 is some what different than the standard procedure contained in the Power Supply/Controller Operation and Maintenance Manuals. Most AMI Weld Heads calibrate in IPM of Travel on the surface of the Guide Ring or in RPM around the pipe. The Model 81 Travel is calibrated in reference to the O.D. of the Gear on the inside of the Clamp Assembly. Follow the steps of Section 4.2 to calibrate the Travel speed of the Model 81.

4.2 TRAVEL CALIBRATION PROCEDURE

1. Perform the following steps to calibrate the Model 81 Travel speed:
   1. Mount the Model 81 on any diameter pipe.
   2. Align any reference point on the rear of the Weld Head to the Red Dot located on the Clamp Assembly.
   3. Prepare the Power Supply/Controller to run at a continuous travel speed of 8.0 IPM in the CCW direction.
   4. Refer to Table 1. The time required for the M-81 to complete one revolution depends on the Clamp Assembly size. Use this table to determine the specific time required.
   5. Prepare the Power Supply/Controller or stop watch to run for the amount of time tabulated in Table 1. Insure that the Travel Start and Stop Delays are set to 0.0 Sec.

NOTE: The use of a stop watch is dependent on what type of Power Supply/Controller Unit is being used. If the Power Supply has Sequence Timing (Model 115 or 215) then a stop watch is not used. Set the Sequence timing to run the Travel for 60 seconds.
4.2 TRAVEL CALIBRATION PROCEDURE (continued)

1. (continued)

6. Insure the System Mode is in TEST.

7. Press SEQUENCE START. If a stopwatch is used, start the watch at the moment the Weld Head begins to travel. For the Power Supplies with Auto timing the weld head will stop automatically in 60 seconds. For the stop watch users, press ALL STOP when 60 seconds has elapsed.

8. Check to see that one revolution was completed and the Weld Head reference point is lined up with the Clamp Assemblies Red Dot.

9. If out of tolerance, adjust the calibration point located at the front of the Weld Head (Figure 8, Item 9).

10. Repeat steps 7 through 9 until the Weld Head makes one complete revolution +/- 3.6 Deg. (+/- 1%).

11. Set the travel direction to the CW Mode. Re-align the reference points.

12. Press SEQUENCE START. For the stopwatch users, start the watch at the moment the Weld Head begins to travel.

13. When timing has ended (stopwatch users press ALL STOP when 60 seconds has elapsed), check to see that the reference marks are lined up.

14. If out of tolerance, adjust the CW calibration point TR4 located on the Travel Servo Module (PCB) at the Power Supply. Refer to the Travel Calibration Section of the Operation and Maintenance Manual of your Power Supply/Controller.

15. Re-align the reference points and repeat steps 11 through 15 until correct – one revolution +/- 3.6 Deg.

**NOTE:** If a travel speed other than 8.0 IPM is desired or a Guide Ring is being used is not listed in Table 1, use the following formula to determine total time for one complete revolution:

\[
\text{Time (One Rev.)} = \frac{3.1416 \times \text{Pitch Dia.}^* \times 60}{\text{Program Speed}}
\]

The Pitch Diameter\(^*\) size is etched on the O.D. of the Clamp Assembly.
MODEL 81 WELD HEAD
OPERATION MANUAL

SECTION IV – CALIBRATION AND OPERATIONAL NOTES

4.2 TRAVEL CALIBRATION PROCEDURE (continued)

1. (continued)

<table>
<thead>
<tr>
<th>Pipe/Clamp O.D.</th>
<th>Clamp Pitch Dia.</th>
<th>Time (sec.) One Rev. at 8 IPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.900&quot; (48.26 mm)</td>
<td>2.500&quot;</td>
<td>58.9</td>
</tr>
<tr>
<td>1.986&quot; (50.0 mm)</td>
<td>2.625&quot;</td>
<td>61.9</td>
</tr>
<tr>
<td>2.000&quot; (50.80 mm)</td>
<td>2.625&quot;</td>
<td>61.9</td>
</tr>
<tr>
<td>2.125&quot; (53.98 mm)</td>
<td>2.750&quot;</td>
<td>64.8</td>
</tr>
<tr>
<td>2.250&quot; (57.15 mm)</td>
<td>2.875&quot;</td>
<td>67.7</td>
</tr>
<tr>
<td>2.307&quot; (58.6 mm)</td>
<td>2.937&quot;</td>
<td>69.2</td>
</tr>
<tr>
<td>2.375&quot; (60.33 mm)</td>
<td>3.000&quot;</td>
<td>70.7</td>
</tr>
<tr>
<td>2.500&quot; (63.5 mm)</td>
<td>3.125&quot;</td>
<td>73.6</td>
</tr>
<tr>
<td>2.750&quot; (69.85 mm)</td>
<td>3.375&quot;</td>
<td>79.5</td>
</tr>
<tr>
<td>2.875&quot; (73.03 mm)</td>
<td>3.500&quot;</td>
<td>82.5</td>
</tr>
<tr>
<td>3.000&quot; (76.2 mm)</td>
<td>3.625&quot;</td>
<td>85.4</td>
</tr>
<tr>
<td>3.500&quot; (88.9 mm)</td>
<td>4.125&quot;</td>
<td>97.2</td>
</tr>
<tr>
<td>4.000&quot; (101.6 mm)</td>
<td>4.625&quot;</td>
<td>109.0</td>
</tr>
<tr>
<td>4.500&quot; (114.3 mm)</td>
<td>5.125&quot;</td>
<td>120.8</td>
</tr>
<tr>
<td>5.000&quot; (127.0 mm)</td>
<td>5.625&quot;</td>
<td>132.5</td>
</tr>
<tr>
<td>5.500&quot; (139.7 mm)</td>
<td>6.125&quot;</td>
<td>144.3</td>
</tr>
<tr>
<td>5.563&quot; (141.3 mm)</td>
<td>6.187&quot;</td>
<td>145.8</td>
</tr>
</tbody>
</table>

4.3 CALCULATING WELDING SPEED

1. The calibration procedure of Section 4.2 insures that the Model 81 Weld Head will travel on any size Clamp Assembly at the speed setting that is selected on the Power Supply. However, the speed programmed IS NOT the actual welding speed. Welding speed is based on the ratio between the actual O.D. of each welding pass and the Clamp assembly Gear O.D. The following steps describe how to figure weld speed of select Program Speed from a desired weld speed.

1. Determine the ratio between the Clamp Assembly and the welding surface by performing the following formula:

   \[ \text{Clamp ratio} = \frac{\text{Clamp Pitch Diameter}^*}{\text{Weld O.D.}} \]

   **NOTE:** The Pitch Diameter* (P.D.) is marked on the outside of the Clamp Assembly.

2. Determine the actual surface Travel Speed by performing the following formula:

   \[ \text{Surface Speed} = \frac{\text{Program Speed}}{\text{Clamp Ratio}} \]

3. Determine the Program Speed for a desired welding speed by performing the following formula:

   \[ \text{Program Speed} = \text{Desired Speed} \times \text{Clamp Ratio} \]
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4.4 WIRE FEED CALIBRATION PROCEDURE

To insure calibration accuracy over the entire range of Wire Speeds and direction, calibration of the Power Supply Wire Feed Servo Section is recommended. Refer to the Operational and Maintenance Manual - Calibration of your Power Supply.

1. Perform the following steps to calibrate the M-81 Wire Feed Speed:

   1. Mount the M-81 on any diameter pipe and tighten the tension on the Wire Feed Rollers until the wire can be jogged without slipping. Cut the wire off flush with the nozzle tip. Insure that the Wire ON/OFF key is in the ON position.

   2. Insure the System Mode is in TEST.

   3. Program the Power Supply/Controller to run wire for a total time of 30 seconds. A stopwatch is required for the Power supplies without Auto Sequential timing.

   4. Program a continuous travel speed of 40 IPM. Insure Wire Start and Stop Delays are set to 0.0 Sec. and that Wire Retract is set to 0.0 Sec.

   5. Press SEQUENCE START. If using a stopwatch, start the watch the moment the wire begins to feed. When 30 seconds has elapsed, Press ALL STOP if using a stopwatch.

   6. Cut the wire flush with the nozzle and measure its length. It should be 20.0 inches +/- 0.2 inch.

   7. If out of tolerance, adjust the Wire Feed Calibration point located on the front of the Wire Feed Drive Assembly (turn clock-wise to increase speed).

   8. Repeat steps 5 through 8 until correct length is achieved.

4.5 OPERATIONAL NOTES

1. Operational Precautions - The following items should be noted and care taken during operation to insure proper operation and longer Weld Head life expectancy. Most of these items are listed in Section I and are repeated here because of their importance.

   1. Extreme care should be taken to protect the Weld Head Cable Assembly.

      1. Never wrap the cables against their natural flow.
      2. Never allow the cables to sit on pre-heated pipes.
      3. Never run the cables in walkways or exposed areas.
      4. Never grind around cables.
      5. Always watch the cables during Weld Head movement and prevent binding or fraying against sharp objects.
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SECTION IV – CALIBRATION AND OPERATIONAL NOTES

4.5 OPERATIONAL NOTES (continued)

1. Operational Precautions (continued)

2. Never allow the Weld Head to sit on a hot pipe and bake. When welds are completed or delayed, remove the Head. See the specification Section 2.1 K for temperature information.

3. The Weld Head, during normal operations, will get very warm. Advise all welding personnel to take precautions to prevent burns when handling the HOT Weld Head.

2. Torch Set Up and Operation - The following steps indicate the various Torch components and their operation:

1. Torch Tilt In/Out - To tilt the Torch In or Out toward the pipe walls, loosen the four (4) Torch retaining screws on top of the Torch Body (see Figure 16 - Item 1). Tilt the Torch Ball (Gas Lens/Cup Assy.), (Figure 16, Item 2) to the desired amount and tighten the screws. This adjustment is the same as Torch LEAD/LAG angle - take care not to accidentally move it. Note the tilt indicator, in degrees, on the front of the Torch to show how much the Torch is tilted (Figure 16, Item 3).

2. Torch LEAD/LAG adjust - To set the LEAD/LAG angle, perform the same steps as TILT IN/OUT. Take care not to move the IN/OUT accidentally.

3. Wire Entry Angle Adjust - The Entry Angle can be set by loosening the Wire Nozzle bracket holding screw and physically moving the Wire Nozzle up or down (Figure 16, Item 6).

4. Wire UP/DOWN adjust - This adjustment is used to set the distance between the wire and electrode tip and also serves to set the desired arc gap. Adjustment is made by turning (with a hex head wrench) the UP/DOWN adjust screw (Figure 15, Item 5).

5. Wire Cross seam adjust - This adjustment is used to keep the wire entering the arc under the electrode tip. To adjust: turn the Wire Cross Seam adjust screw (Figure 16, Item 5).

6. Electrode Length and Stick-out - The electrode on a Model 81 must be cut to a length needed to fit in the Collet and have the correct amount of stick out from the Gas Cup. The electrode stick-out is adjusted by loosening the Gas Lens/Cup Assembly and physically moving the electrode to the desired position. Be sure to tighten the Gas Lens/Cup Assembly after adjustment. See Step 4.5 C for instructions on Gas Lens/Cup installation and removal.
FIGURE 15
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SECTION IV – CALIBRATION AND OPERATIONAL NOTES

4.5 OPERATIONAL NOTES (continued)

3. GAS LENS INSTALLATION AND REMOVAL

1. The Model 81 is supplied with a special Gas Lens Wrench (PN# 42470105) for the ease of installation and removal of the Gas Lens.

2. To remove or loosen the Gas Lens, unscrew and remove the Gas Cup. Using the Gas Lens Wrench turn the Gas Lens about a quarter of a turn or until loose enough to turn by hand. This should be enough to allow adjusting the electrode in the Collet or removing the Gas Lens and Collet completely.

3. To install a new Gas Lens, first insure that the Gas Lens has an “O” Ring seal on it. Install the Collet into the Gas Lens body and then thread it by hand into the torch until snug, but loose enough to install the electrode. After installing the electrode, use the Gas Lens Wrench to insure that the Gas Lens is threaded in securely. DO NOT USE FORCE, just insure it is snug and leak free.

4. Thread on the Gas Cup insuring that it is snug against the Torch Ball Mounting Bracket.
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SECTION V – DOCUMENTS ATTACHED

5.0 WELD HEAD WIRING DIAGRAM

CAUTION

All documents continued in this Section are informational only and are subject to change without notice. AMI reserves the right to make revisions to these documents at any time.

Detailed, up to date, revised copies of these documents are available from AMI upon request. Please contact the factory for further information.
NOTES:
1. (+) ON PB - V = FEED WIRE (41, BLUE).
2. (+) ON PB - E = OSC IN (42, PLUG, TORCH IN TOWARDS BODY).
3. (+) ON PB - G = TORCH IN (43, PLUS, TORCH AWAY FROM WORK).
4. (+) ON PB - K = TRAVEL CW (44, PLUS, ROTATION VIEWED FROM TORCH END).
NOTES:

1. (+) ON P8-E - TRAVEL CW (M4 PLUS, ROTATION - VIEWED FROM TORCH END).
2. (+) ON P8-E - TORCH UP (M3 RED, TORCH AWAY FROM WORK).
3. (+) ON P8-W - OSC IN (H2 PLUS, TORCH IN TOWARDS BODY)
4. (+) ON P8-F - FEED WIRE (ON BLUE).
5. REF. BOM 13810824-01.