

SPECIFICATION NO. 207

Model 207 Automatic GTAW Welding System

1.0 Introduction

The Model 207 is a completely self-contained Gas Tungsten Arc Welding (GTAW) System requiring only input power, inert gas and AMI Welding Head (or manual torch) for operation. Its small size makes it especially useful in field applications where portability is required. It is intended for (but not limited to) totally automatic fusion (Autogenous) welding of tube, pipe fittings using AMI Model 9 Tube Welding Heads.

The M-207 employs a constant-current Line Inverter as the Weld Current Power source and a 16-bit microprocessor with memory for control of all system functions. All functions are accurate and repeatable to better than +/- 1% providing that line voltage fluctuations and ambient temperature are within the stated limits.

All welding function parameters (weld schedules) are entered via the computer keypad and display. All steps for entering these values are prompted by the display in plain language, no computer language or codes are needed. Weld parameters for each specific application are only entered one time and are then retained within the system memory (by schedule number).

The M-207 is built in a rugged housing that is designed to be portable. Operating AC power is supplied by line cord and gas is supplied by flexible hosing, so permanent connections are not required. The system requires an inert gas source with pressure regulator and flow meter (not supplied).

The chassis and power source are air-cooled. Torches and weld heads requiring liquid-cooling must use the Model 207-CW Cooling Unit which attaches to the M-207 to retain system portability.

Multi-level pulsed current, torch rotation speed and timing controls allow the establishment of optimum welding procedures on a large variety of materials, sizes and wall thicknesses.

This specification details operating ranges, construction and general use. For specific information about operation, consult the Model 207 Operation Manual.

2.0 Features and System Configuration

2.1 Standard Features: The following are general features described in this specification.

1. All functions microprocessor-controlled.
2. Memory storage for up to 100 weld procedures.
3. Ability to create, copy and modify schedules.
4. 100/150 Amperes of straight polarity GTAW current.
5. Pulsed current controls from 0.05 to 50 PPS.
6. Multi-Levels of pulsed current values.
7. Continuous or stepped arc rotation controls.

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2.0 Features and System Configuration (continued)

8. Operates all AMI Model 9 Fusion Weld Heads.
9. Operates Manual Welding Torch.
10. Complete automatic operation and timing controls including pre-purge, post-purge, upslope, downslope, function start, and rotation delays and level times.
11. Built-in fault checks for system status and common operation errors (gas check, coolant check, etc.)
12. Multi-lingual display instructions in English, French or German (other languages will be available at later dates).
13. Built-in printer for recording weld procedures.

2.2 System Configuration:

1. Main Power Supply console including:
 1. 25-foot input power cord.
 2. 150 Ampere inverter power source.
 3. Computer memory module.
 4. Main computer electronics (weld functions)
 5. Input gas panel (two port).
 6. Weld head connect panel including ground, electrode, weld head electrical connectors, gas output connectors, remote pendant connector and auxiliary connector.
 7. 2 line by 40 character display (2 each).
 8. Membrane key panel including numeric keys and all set up, start/stop keys (jog, purge, etc.) and program selection keys.
 9. Printer.
2. 15-Foot Weld Head Adapter Cable including
 1. Weld head arc gas hose.
 2. Electrode cable.
 3. Ground cable.
 4. Weld head electrical cable.

2.3 Enclosure Physical Construction

1. Material: Aluminum
2. Height: 10.9" (276.9 mm) cover closed
 9.3" (236.2 mm) cover removed

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2.0 Features and System Configuration (continued)

- 3. Width: 22.75" (577.9 mm)
- 4. Depth: 19.25" (489.0 mm) including handle
- 5. Weight: 78 lb. (35.4 kg)

3.0 Input Power, Inert Gas and Temperature Requirements

- 3.1 Input Power: The M-207, as standard, can operate on a variety of single phase AC input power as follows:

- 100 VAC + 32%, -10%, 50/60 Hz, 30 ampere service
- 110 VAC + 20%, -18%, 50/60 Hz, 30 ampere service
- 115 VAC + 15%, -22%, 50/60 Hz, 30 ampere service
- 120 VAC + 10%, -25%, 50/60 Hz, 30 ampere service
- 200 VAC + 32%, -10%, 50/60 Hz, 20 ampere service
- 208 VAC + 27%, -13%, 50/60 Hz, 20 ampere service
- 220 VAC + 20%, -18%, 50/60 Hz, 20 ampere service
- 230 VAC + 15%, -22%, 50/60 Hz, 20 ampere service
- 240 VAC + 10%, -25%, 50/60 Hz, 20 ampere service

+/- % indicates the allowable input voltage fluctuation to maintain performance as specified. "Ampere service" rating is based on maximum welding current output (100 or 150 Ampere) with maximum Arc Voltage (20 VDC).

- 3.2 Inert Gas: The M-207 is a Gas Tungsten Arc Welding (GTAW) Power Source only and as such requires Inert or Inert/Active Mixed Gas for operation. The Arc Gas Line is provided with an Automatic/Manual Solenoid which controls the pre-weld, weld and post-weld purging of the weld zone.

Input gas pressure must be regulated, by the user, to a maximum of 50 PSI +/- 5 PSI (3.4 +/- 0.3 bar).

Connection to the gas source is via color-coded impermeable hosing (to prevent oxygen and water diffusion) and standard 5/8-16 NPT Gas fittings.

- 3.3 Temperature: The M-207 is designed to operate in an ambient temperature range between 0°C (32°F) and 45°C (110°F).

4.0 Weld Current Source and Controls

- 4.1 Output current: 3 to 100 Amperes using 100 to 120 VAC. 3 to 150 Amperes using 200 to 240 VAC.
- 4.2 Voltage: 20 to 30 VDC open circuit (no current) depending on input VAC value. 5 (min.) to 20 (max.) VDC at 150 Amperes.
- 4.3 Regulation: Constant current, straight polarity. +/- 1% of program setting or 0.5 Ampere (whichever is greater) with input power fluctuations of +/- 10%.

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4.0 Weld Current Source and Controls (continued)

- 4.4 Regulation type: Line inverter using 35 KHz switching frequency, microprocessor closed loop, real-time monitoring with solid-state, high-speed switching regulation devices.
- 4.5 Duty cycle: 100% at specified operating temperature and specified input VAC.
- 4.6 Current controls: The system provides two (2) methods of current operation. Continuous (Cont.) mode or Pulsed mode. The Cont. mode sets the system to regulate a single desired value of current. In the Pulsed mode, the system will automatically pulse between one desired current and another to perform pulsed arc-welding.

In addition, the system provides (in either mode) the ability to automatically program changes in the current value. These changes are called "Levels" and the system can provide up to 100 Level changes per automatic weld sequence.

The desired current values, current mode, desired pulsation rate (pulse times) and current Level values are entered into the microprocessor memory (via keypad) and filed by weld number/type/description.

5.0 Pulsed Arc Current

If desired, two (2) current values can be selected. The "high" current is designated the Primary current and the "low" current is designated the Background current. The frequency or pulse rate of switching between these currents is controlled by the Primary and Background Pulse time function with the following range:

Primary Pulse Time: 0.01 to 10.00 seconds, +/- 0.001

Background Pulse Time: 0.01 to 10.00 seconds, +/- 0.001

This equates to a pulse frequency range of 0.05 to 50.00 pulses per second. Pulse width adjustment is a function of the Primary time versus the Background time.

6.0 Fixture Rotation Servo and Controls

The M-207 is intended to (but not limited to) operate AMI Model 9 Fusion Tube Welding Heads. These heads encapsulate the weld zone (with inert gas) and the welding arc (electrode) is rotated around the stationary tube, pipe or fitting to be welded. The M-207 is equipped standard with a Rotation Servo and controls to drive the Weld Head Rotation Motor.

- 6.1 Rotation Speed: 0.10 to 20.00 RPM

There are over 23 versions of Model 9 Weld Heads and not all heads have the same rotation speed ranges.

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6.0 Fixture Rotation Servo and Controls (continued)

- 6.2 Rotation Regulation: Closed-loop servo using tachometer feedback with regulation to +/- 1%.

NOTE: The Servo is rated to +/- 1% over its specified range, however, some M-9 Weld Heads have low speed minimums greater than 1%. Consult the individual head specification for details.

- 6.3 Rotation Controls: The system provides two (2) methods of rotation control. Continuous (Cont.) mode and Stepped mode. The Cont. mode sets the system to regulate a single desired value of speed. In the Stepped mode, the system will automatically pulse between a desired Primary speed and a desired Background speed to perform Stepped arc-welding. The Stepping is synchronized to the Current Pulsation's.

The desired speed value and speed mode are entered into the microprocessor memory (via keypad) and filed by weld number/type/description.

7.0 Arc Start System

A High Frequency (HF) Arc Starter is provided, with a booster that momentarily increases the open circuit voltage during Arc Start. The HF starter will reliably start the arc at current levels of 5 amps in Argon and 10 amps in Helium using a suitably prepared thoriated or ceriated tungsten electrode with an arc gap of 0.080 inch or less, with weld head cables of 100 feet or less.

Protective devices are installed in the HF starter and at suitable points in the system to prevent HF feed through the power lines or to internal, sensitive components.

The Starting Frequency is approximately 10 MHz and will vary with components and cables.

8.0 Metering

During the weld sequence, one of the displays provides sliding scale indicators which display Amperes, Arc Volts and Rotation Speed.

The meters are intended as an information and trouble-shooting guide and are not intended to be used for Quality Control or calibration purposes.

9.0 Microprocessor

The M-207 contains a 16-bit microprocessor with BATRAM memory. The microprocessor has operating software which supplies all of the standard functions of this Specification. All standard commands are inputted into the microprocessor via the display panel keys. All steps of operation and programming are prompted by the displays (in English, French or German) contained in the display panel.

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10.0 EMI Suppression

The M-207 is 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 M-207. All-metal enclosures and internal shields prevent radiated EMI.

11.0 Operation, Modes

The M-207 has three (3) basic modes of operation. The modes are selected via a 3-way keylock mode switch. The key can be removed to lock the system into any of its three modes as described below:

11.1 Operate Mode: The operate mode is really two-fold: Non-welding Functions and Automatic Weld Sequence. The following describes these two Operate Modes:

Non-Welding

1. Operator selection of any one of the possible 100 weld schedules contained in the system memory.
2. Operator "override" control for Current and Rotation Speed. Limits to "override" can be pre-programmed (see programming).
3. Weld set-up controls for joggling the weld head electrode to the desired start position.
4. Manual purge control for pre-setting of desired gas flow rates.
5. Manual sequence stop for operator interruption of the weld sequence with normal stopping functions.
6. "All Stop" function for operator interruption of normal weld sequence without normal stopping sequence (post-purge only).
7. Automatic fault detection for gas flow, coolant flow, overheating, etc. Engages "All Stop" automatically.

Automatic Weld Sequence: Sequence Start is initiated by the operator and the following events occur automatically in the sequence described below:

8. Pre-purge Time: 0 to 999 seconds with automatic initiation of arc gas solenoid at beginning of sequence.
9. Arc Initiation (after pre-purge): Via impulse HF Starter.
10. Arc Detection: After Arc Initiation, the M-207 will detect if there is an arc. If arc start is not successful, it will notify the operator to start over; if successful, the following will all start at the same time:

Current Upslope Time: 0.0 to 99.9 seconds. The current will rise during this time to its maximum programmed value.

Rotation Start Delay Time: 0.0 to 99.9 seconds. Arc rotation will be delayed for the programmed time to achieve penetration before moving.

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11.0 Operation, Modes (continued)

Pulsation Timers: 0.01 to 9.99 Primary, 0.01 to 9.99 Background (if pulse mode is programmed, the current will start to pulse at the programmed rate).

Level 1 Time: 000 to 999 seconds. This programmed function sets the period of time that the level 1 primary current value will be used before switching to level 2 or end of sequence.

11. Levels: After upslope the Primary current will be at its full programmed value and will remain at that value until the level 1 time is over. Up to 99 levels of Primary current and Time for each can be programmed and the system will advance from level to level as each level time is completed. All levels do not have to be programmed.

When the last level time (1, 2, 3, 8, 12, etc.) is complete, the system will "Sequence Stop" automatically.

12. Sequence Stop: When the last programmed level time is over, the system will do the following:

Downslope Time: 0 to 99.9 seconds. The current will progress to 0 Amperes during this time. When the current is less than 3 Amperes, the Arc will go off.

Rotation Delay: The arc will continue to rotate for the same time as the downslope and stop rotating when the arc goes out.

13. Post-purge Time: 0 to 999 seconds. When the arc goes out the gas will continue to flow until this programmed time is complete.
14. Return-to-Home and Reset: When the post-purge time is complete, the arc gas solenoid will turn off and Model 9 rotors will automatically return to the "open" position for Head removal. The system will reset to be able to repeat the sequence on the next weld.

11.2 Operate Lock Mode

When the three-way keylock is in this position, the selected weld schedule cannot be changed. If the key is removed, this will prevent anyone from changing the set-up of the system.

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11.0 Operation, Modes (continued)

11.3 Weld Programming

The programming mode is engaged by the operating mode keylock switch which can be locked in the programming position. When engaged in the programming mode, the M-207 will perform the following.

1. The display will ask if the user wants to Create a new weld schedule, Copy an existing schedule, Modify an existing schedule, Transfer the weld schedule memory to another M-207 or Delete a weld schedule.
2. When the above choice is made the display will prompt the programmer for each step.
3. See the M-207 operation manual for further programming details.

11.4 Printer

The M-207 is supplied standard with a printer and print select key. The printer can issue a copy of the following items:

1. A complete list of all weld schedules in memory including day and date of print.
2. A complete copy of all program parameters for any particular weld schedule including day and date of print. The system can be set up to issue a copy of this automatically after every weld.
3. A complete copy of all actual function values during a weld including day and date of print and a statement as to whether or not the functions performed as programmed.
4. A complete copy of all weld numbers contained in the optional M-207-EMM (External Memory Module).

12.0 Additional Standard Features

- 12.1 Weld Count: The system will keep track of how many times a particular weld schedule has been used.
- 12.2 Tenth Increments: The system can be set up to be able to program amperes and weld level time in increments of 0.1 instead of the standard 1 amp or 1 second.
- 12.3 External Sensor Fault: In addition to the built-in faults (gas, coolant, voltage, etc.) the system can be set up to accept fault information from other sources such as an Oxygen Analyzer or Temperature Monitor.

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12.0 Additional Standard Features (continued)

- 12.4 Speed Math Function: M-9 Heads rotation is entered in RPM. Since the actual welding speed (surface speed) for any given RPM value changes as the weld diameter changes, the system can calculate the required RPM setting for any given weld diameter. By entering the weld O.D. and the desired welding speed, the system will automatically calculate and display the correct RPM setting.
- 12.5 Tungsten Length Math Function: Allows the system to calculate required tungsten length.
- 12.6 Rotation Calibration: Weld Head contain tachometers and they must be calibrated to the M-207 they are being run on. A built-in Automatic Calibration feature is included in the M-207.
- 12.7 Remote Equipment Start/Stop: The M-207 has input and output connectors to allow for the connection of external devices such as lathes or mills that may need to turn on during the welding sequence.

13.0 Options

The M-207 can operate a variety of options as follows:

- 13.1 Remote Operators Pendant: This option allows the operator to set-up, select weld schedule from a remote location.
- 13.2 M-207-CW Optional Cooling Package: An add-on liquid-cooling unit for weld heads with duty cycles and weld currents requiring liquid-cooling of the weld head or manual torch.
- 13.3 M-207-EMM External Memory Module: Used to store, transfer or back-up copies of the M-207 memory.
- 13.4 Chart Recorder: The M-207 is supplied standard with a Chart Recorder Output Port. When the optional chart recorder is connected, the user can record the Amperes, Voltage and Travel Speed in continuous "real time" information.
- 13.5 Manual Welding Foot Controller: Provides sequence start/stop and variable current. This option is required for manual welding.
- 13.6 Manual Welding Torch
- 13.7 Extension Cables: For operation of weld heads or manual torches up to 100 feet from the M-207.

THIS SPECIFICATION IS SUBJECT TO CHANGE WITHOUT NOTICE