



D-2000 SERIES

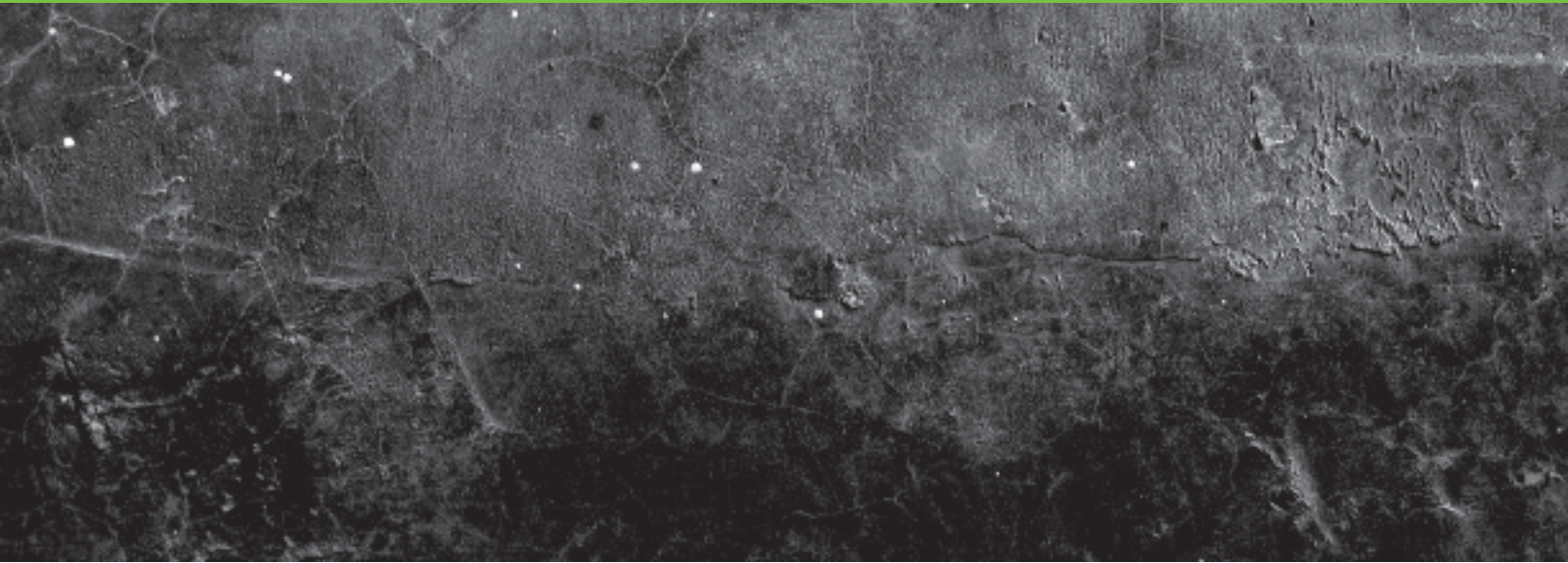


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GENERAL SAFETY INSTRUCTIONS

This manual provides information on how to install, operate, and maintain your Magnaflux magnetic particle inspection machine.

Read these instructions carefully before operating or servicing your machine.

- Only trained personnel should operate or service this machine. Be familiar with your facility and local procedures as well as Lock Out/Tag Out requirements before working with this machine.
- Read this entire manual *before* operating this machine.
- Wear safety glasses that conform to ANSI Standard Z87.1 while operating this machine.
- Do not wear loose clothing or jewelry while operating or servicing this machine.
- Inspect the machine daily for unsafe conditions; replace any worn or broken parts (see Section 4).
- Keep all unauthorized personnel away from the machine operating area.
- According to the American Conference of Governmental Industrial Hygienists (ACGIH) recommendations, inspectors with pacemakers should avoid exposure to D.C. fields over 10 gauss; or 60 cycle A.C. field over 1.0 gauss. There are a variety of pacemakers with different susceptibilities to magnetic fields. Wearers should discuss pacemaker limitations with their physicians and learn more exactly what they should avoid, and whether they should be exposed to magnetic fields before operating this equipment.
- When you are finished operating the machine, turn off all power.
- This machine was designed to help the end user comply with ASTM E-1444. Calibration frequency is dictated by this standard.

SECTION 1: EQUIPMENT SPECIFICATIONS

SCOPE OF THIS MANUAL

This manual provides essential information required for installation, operation, and maintenance of standard Magnaflux D-2000 Series Stationary Magnetic Particle Inspection Machines.

PURPOSE OF THE EQUIPMENT

The equipment is used to inspect ferromagnetic parts by means of the magnetic particle inspection method. Magnetic particle inspection (MPI) is a non-destructive method for revealing surface, and, under certain conditions, sub-surface discontinuities. It consists of three basic operations:

1. Application of magnetic particles.
2. Establishment of a suitable magnetic field.
3. Inspection and evaluation of particle accumulations.

Discontinuities may exist in raw material from which parts are made, or, they may occur during processing or fabrication of the parts, or, they may exist as cracks due to excessive service stresses. Discontinuities are considered defects if their existence is detrimental to the usefulness of the part. Magnetic particle inspection can readily and reliably locate discontinuities revealing manufacturing and/or service-induced defects.

EQUIPMENT CHARACTERISTICS

Stationary magnetic particle inspection units consist of a processing station and an integral power pack. The power pack provides low-voltage, high-amperage 3-phase full wave direct current for magnetization and reversing 3-phase full wave direct current for demagnetization.

The output current levels are governed by 2 separate current control potentiometers. Selection of Contacts or Coil operation is provided by push buttons on the Operator Control Panel. A push button on the Operator Control Panel, or a push bar, initiates the timed magnetizing current “shot.”

A digital ammeter provides a reading of the magnetizing current. The reading is held until the next current “shot” is initiated. The wet bath is contained in a tank that runs the full length of the machine. A pump re-circulates the particle in bath and provides flow to the spray nozzle or the Optional Autobath nozzles. Grilles cover the tank, provide a work surface, and prevent parts from falling into the tank.

The air-operated headstock and adjustable locking tailstock provide the necessary clamping force to assure good electrical contact with the part.

Parts clamped between the headstock and tailstock for circular magnetization may also be magnetized longitudinally with the coil while clamped in the headstock and tailstock.

The bath is filled with magnetic particles. An ultraviolet black light causes the coated particles to glow, revealing flaws in the part being tested.

Pertinent data (e.g., the unit's serial number, electrical specifications, and duty cycle rating) may be found on the **Magnaflux Data Plate**, located on the headstock end of the unit.

EQUIPMENT SPECIFICATIONS

| | |
|---|---|
| CONVENIENCE OUTLETS | 2 each 115 volts AC, 10 amperes (for Black Light) |
| COMPRESSED AIR (¹ / ₈ " NPT pipe connection) | 90-120 psig |

Input Specifications

The equipment can be fused based on less than the maximum amperage draw due to the duty cycle. Refer to NEC Code Section 630.31 Ampacity of Supply Conductors and Table 630.31(A) (2) Duty Cycle Multiplication Factors for Resistance Welders (NPF National Electric Code 2011).

| Table 1-1. Electrical Input | | | | | |
|---|----------------|-------|----------------|---------------------------------|-----------------------------|
| Model Series | Input Volts AC | Phase | Load (Amperes) | Recommended Line Fuse (Amperes) | Recommended Wire Size (AWG) |
| D-2060 (MOD 2.5 AC optional) | 208 | 3 | 160 | 125 | 2 |
| | 230 | 3 | 160 | 125 | 2 |
| | 380 | 3 | 100 | 80 | 6 |
| | 415 | 3 | 90 | 70 | 6 |
| | 460 | 3 | 80 | 60 | 6 |
| | 575 | 3 | 70 | 60 | 6 |
| D-2100 (MOD 4.0 AC optional) | 208 | 3 | 400 | 300 | 0 |
| | 230 | 3 | 400 | 300 | 0 |
| | 380 | 3 | 245 | 200 | 2 |
| | 415 | 3 | 220 | 175 | 2 |
| | 460 | 3 | 200 | 150 | 4 |
| | 575 | 3 | 160 | 125 | 4 |
| MOD6 AC (Optional for D-2060 and D-2100) | 208 | N/A | N/A | N/A | N/A |
| | 230 | 3 | 575 | 350 | 2/0 |
| | 380 | 3 | 350 | 200 | 0 |
| | 415 | 3 | 325 | 200 | 0 |
| | 460 | 3 | 300 | 150 | 2 |
| | 575 | 3 | 200 | 100 | 2 |

Output Specifications

***All contacts current ratings are based on the maximum current through a 2000 amp/100 mv shunt.**

*Some coils may be capable of handling more current but these levels are based on the duty cycle of the unit.

| Table 1-2. Magnetization and Demagnetization Output | | | | |
|--|-------------|-----------------------------------|--|--------------------------|
| Model Series | Mode | Maximum Current (Amperes)* | Current Control | Demag |
| | | Average (DC) | | |
| D-2060 | Contacts | 6000 | Continuously Variable In all cases | Reversing Decaying DC |
| | 12" Coil | 4600 | | |
| | 16" Coil | 4400 | | |
| | 20" Coil | 4200 | | |
| | 25" Coil | 4000 | | |
| | 30" Coil | 3000 | | |
| | 36" Coil | 3000 | | |
| D-2100 | Contacts | 10000 | Continuously Variable In all cases | Reversing Decaying DC |
| | 12" Coil | 5800 | | |
| | 16" Coil | 5200 | | |
| | 20" Coil | 5000 | | |
| | 25" Coil | 4700 | | |

| Table 1-3. Duty Cycle | | |
|------------------------------|---------------------|----------------------|
| Model Series | Seconds "On" | Seconds "Off" |
| D-2060 SERIES | | |
| At Maximum Output | 0.5 | 10 |
| At 1000 A. Output | 0.5 | 5 |
| D-2100 SERIES | | |
| At Maximum Output | 0.5 | 20 |
| At 1000 A. Output | 0.5 | 5 |

Dimensions and Capacities

| Table 1-4. Part Weight Capacity | | |
|---|---------------------|------------------|
| Description | Maximum Load | |
| | Pounds | Kilograms |
| Using contact pad mounted v-blocks to support part | 300 | 136 |
| Using contact pad mounted v-blocks to support part (with rotating heads) | 70 | 32 |
| Using rail mounted steady rests to support part | 1500 | 680 |
| Equipped with heavy duty frame option and rail mounted steady rests to support part | 4000 | 1814 |

| Table 1-5. Part Length Capacity | |
|--|---------------|
| Model No. | Length |
| D-2*** | 54" (137 cm) |
| D-2***L | 102" (259 cm) |
| D-2***XL | 146" (370 cm) |
| D-2100XL2 | 188" (478 cm) |

| Table 1-6. Recommended Bath Level | | |
|--|----------------|---------------|
| Model No. | Gallons | Liters |
| D-2060 (2 door) | 20 | 76 |
| D-2060L (3 door) | 34 | 129 |
| D-2060XL (4 door) | 46 | 174 |
| D-2060XL2 (5 door) | 58 | 220 |

| Table 1-7. Machine Weight | | | | |
|----------------------------------|---------------------------------|------------------|------------------------------------|------------------|
| Model No. | Approximate Weight (Dry) | | Approximate Weight (Crated) | |
| | Pounds | Kilograms | Pounds | Kilograms |
| D-2*** | 1600 | 726 | 1875 | 850 |
| D-2***L | 1825 | 828 | 2100 | 952 |
| D-2***XL | 1925 | 873 | 2200 | 998 |
| D-2100XL2 | | | 6600 | 3000 |

| Table 1-8. Overall Dimensions | | | | | |
|--------------------------------------|---------------|----------------|-----------------|------------------|------------------|
| Description | D-2*** | D-2***L | D-2***XL | D-2100XL4 | D-2100XL5 |
| <u>Basic Unit (No Hood)</u> | | | | | |
| Length | 84½(215cm) | 132½(336cm) | 176½(448cm) | 280½(712½cm) | 317½(806½cm) |
| Depth | 41(104cm) | 41(104cm) | 41(104cm) | 41(104cm) | 41(104cm) |
| Height | 60¼(153cm) | 60¼(153cm) | 60¼(153cm) | 60¼(153cm) | 60¼(153cm) |
| <u>Basic Unit (Optional Hood)</u> | | | | | |
| Length | 86(218cm) | 135(336cm) | 178(452cm) | N/A | N/A |
| Depth (Hood Opened) | 50(127cm) | 50(127cm) | 50(127cm) | | |
| Depth (Hood Closed) | 73(185cm) | 73(185cm) | 73(185cm) | | |
| Height (Hood Opened) | 120(305cm) | 120(305cm) | 120(305cm) | | |
| Height (Hood Closed) | 89½(227cm) | 89½(227cm) | 89½(227cm) | | |

EQUIPMENT WARRANTY

The Equipment Warranty Statement can be found on our Web site at the following link:
<https://www.magnaflux.com/Files/Corporate/Equipment-Warranty-Statement.pdf>

SECTION 2: INSTALLATION AND STORAGE

GENERAL

This section contains information required for unpacking, inspecting, and setting up the magnetic particle inspection unit. Information for preparing the inspection unit for shipment and storage is also included.

INSTALLATION

Location of Unit

Consider the following requirements before selecting a permanent location for the inspection unit:

1. A power source of the proper voltage, frequency and phase (as designated on the **Magnaflux Data Plate** located on headstock end of inspection unit) capable of providing current per the nameplate.
2. A compressed air supply capable of providing minimum 90-120 psig at 5 cubic feet per minute.
3. A minimum of two feet is required at both ends and the rear of the inspection unit to ensure adequate space for servicing and ventilation.
4. A firm, reasonably level floor capable of supporting the inspection unit and the materials awaiting inspection.
5. Adequate space to accommodate a black light inspection hood (Optional), material storage, material movement and access to the materials.

Unpacking

No special unpacking process is necessary. Observe normal precautions to prevent damage to inspection unit, and adhere to standard practices for the removal of crating material, protective barrier materials and preservatives.

Visually inspect the machine and Optional accessories for any apparent shipping damage, and to ascertain that all accessories ordered have been received. If shipping damage is found, please contact the freight company to report the damage before contacting Magnaflux Customer Service via phone at 847-657-5300, or via e-mail at CS@magnaflux.com.

Leveling

Check the tailstock rails for true level, shimming the legs as required. When the inspection unit is level, secure it to the floor with a bolt through each leg.

Electrical Connections

The inspection unit as supplied is internally wired for operation from a power source as designated on the Magnaflux Data Plate (located on headstock end of inspection unit). When connecting the unit all local codes should be followed. External wiring directions for operation on the designated voltage are as follows:

1. Open rear panel located on the headstock end, or Optional disconnect, to gain access to input power terminal block.

WARNING: Turn off and lock-out the external disconnect switch (not normally supplied) before opening the rear panel. Failure to disconnect incoming power could result in severe electrical shock or death.

2. Connect external power source to the terminal block on the rear of the inspection unit, or the top connectors in the Optional disconnect. Refer to Table 1-1 for recommended dual-element time delay fuse size and power source conductor size.

WARNING: Magnetic particle baths can carry electrical current. Since operators will come in contact with the bath during operation, proper grounding of the inspection unit is essential. Failure to ground the inspection unit properly may result in an electrical shock hazard. Check the ground connection with an ohmmeter. A reading of 0 ohms denotes an acceptable ground connection.

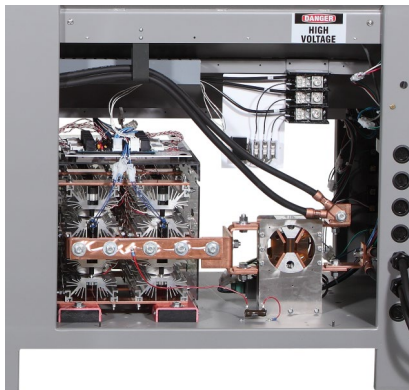


Figure 2-1

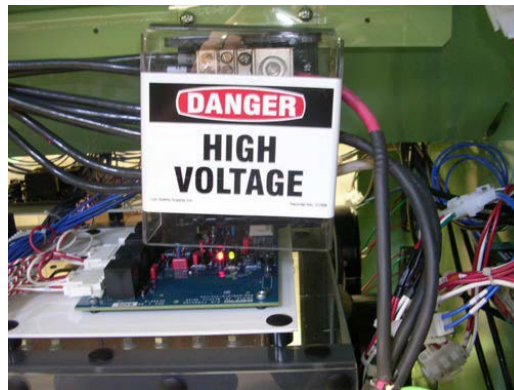


Figure 2-2



Figure 2-3

In Figure 2-1 above, the rear headstock side panel has been removed. This is the location for the electrical connection. Figure 2-2 above is a closer view of where the connection is located. The black wires on the right side of the High Voltage label in Figure 2-2 would be the wires that the customer installs.

In Figure 2-3 above, the copper lug shown is the ground lug. The top punch out hole in the frame is for the customer to run the wires through and connect to the terminal block located behind the High Voltage label.

Note: The equipment can be fused based on less than the maximum amperage draw due to the duty cycle. Refer to NEC Code Section 630.31 Ampacity of Supply Conductors and Table 630.31(A) (2) Duty Cycle Multiplication Factors for Resistance Welders (NPFPA National Electric Code 2011). Some areas refer to 2 phase instead of 1 phase. The incoming power goes directly to an isolation transformer so the unit will operate identically on 1 or 2 phase power.

Air Supply

Connect a 90-120 psig compressed air supply to the air filter. Adjust the pressure regulating knob until the air pressure gauge indicates 40 psi. Figure 2-4 and 2-5 below show this regulator on the headstock end of the machine.



Figure 2-4



Figure 2-5

The air connection is required to operate the pneumatic headstock and pneumatic contactor, which is shown below in Figure 2-6.

WARNING: If air is not connected to the machine, severe damage can occur.

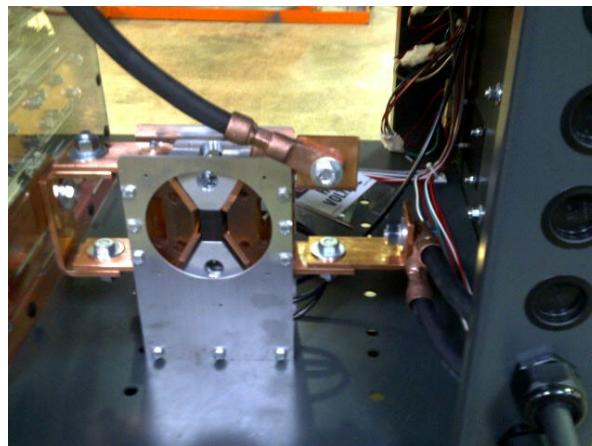


Figure 2-6

Pump Connection

WARNING: Pump should not be run dry. Be sure to fill the tank with oil or water bath prior to plugging in the pump.

WARNING: The unit has been tested at the manufacturing facility using Carrier II oil. Be sure all oil residue is removed if using a water bath.

After the tank is filled with oil or water bath, and the proper amount of magnetic particles, plug the pump in to the outlet located on the operator's end of machine. Figures 2-7 below shows the pump as it is shipped and normal operation. Figure 2-8 shows the housing removed which would be required to do any maintenance.



Figure 2-7



Figure 2-8

NOTE: The following procedure should be performed by a qualified maintenance technician.

Ammeter Accuracy Verification

1. With the unit electrically installed, the compressed air supply connected, and the inspection hood (optional) installed, connect the foot switch to the foot switch receptacle or the optional Dual Palm to the Dual Palm receptacle on the left side of unit. Refer to Figure 2-9 to locate both receptacles.

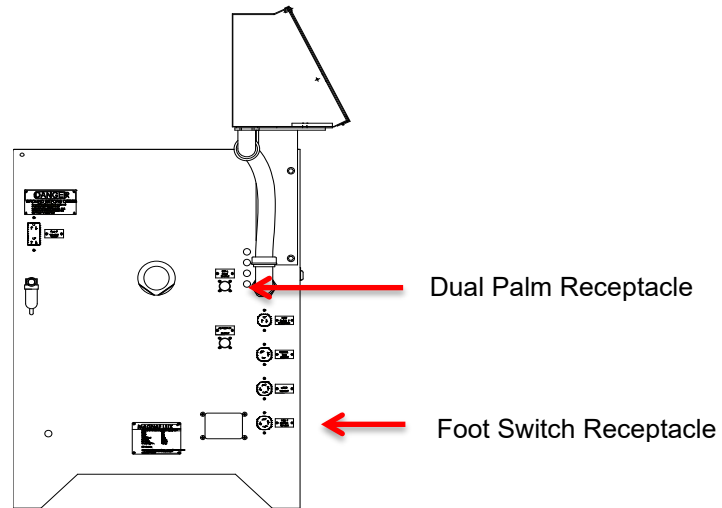


Figure 2-9

2. Unlock and position tailstock where the digital test meter kit shunt can be supported by the tailstock and headstock shelves. Lock tailstock.
3. Position the digital test meter kit shunt (Magnaflux Accessory Part #622350) as shown in Figures 2-10 and 2-11, and specified in Table 4-5, between the headstock and tailstock.



Figure 2-10

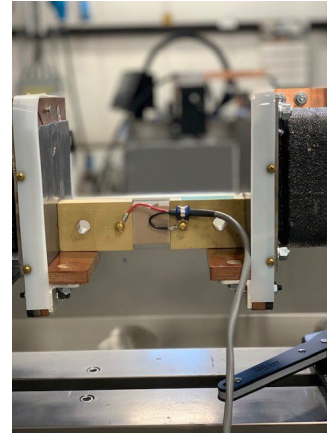


Figure 2-11

4. Connect the shunt cable to the test meter shunt input as directed in the test kit instructions.
5. Check that the pressure gauge indicates 40 psi.
6. Turn on disconnect switch; digital ammeter and power indicator will light.
7. If equipped with the AUTOBATH option, toggle AUTOBATH and PUMP buttons to off. If equipped with the AUTOMAG option, toggle AUTOMAG to off; item 12 change 13 to 11; under Preparation of Bath, item 4 needs to be line with the other numbers and first sentence "on the HMI.

8. Press the foot switch or the Optional Dual Palm to firmly clamp the shunt in position between the headstock and tailstock.
9. Press CONTACTS push-button to on.
10. Set the CONTACTS CURRENT CONTROL to 1/3 full scale and lock to prevent accidental change in setting.
11. Press AC and set digital test meter to AC.
12. Press MAG button. After the timed “shot,” both the unit’s digital ammeter and test kit ammeter should display within +/- 10% or 50 Amps.

Coil Ammeter Accuracy Verification

1. This unit is designed with one meter. The signal to the meter comes from the same source as the contacts. If the meter is accurate in the contact mode, the meter is considered calibrated for the all modes.

Preparation of Bath

WARNING: Never operate the pump without bath in the tank. Operation of the pump without bath may overheat the pump seal.

1. Be certain that the drain cock at the rear of the unit is closed.
2. Agitation system is checked for leaks prior to shipment with light oil. **If using water bath**, carefully clean the entire system with liquid detergent solution and re-circulate, followed by a thorough water rinse. **If using oil bath**, flush system with light oil (Specification MIL-L-15016) such as Magnaflux Carrier II.
3. Prepare bath according to the manufacturer’s recommendations and any applicable specifications. For proper particle agitation, **DO NOT EXCEED VOLUME RECOMMENDED IN TABLE 1-6.**
4. Press PUMP button on HMI. The button is dimly lit when off and brighter when on. Allow the bath to agitate and circulate through the system.

| Table 2-2. Recommended Bath Concentration | | | | | | |
|---|-----------|-----------|-----------|------------|--------------------|---------------------------|
| | Magnaglo® | | | Magnaflux® | Water Conditioners | |
| | 14A | MG-410 | 20B | 7C | WA-2B | WA-4 |
| Recommended Concentration | | | | | | |
| Ounces/Gallon | 1/6 | 1/10 | 1½ | 1¼ | 1 | 1 Part to 100 parts water |
| Grams/Liter | 1.25 | 0.75 | 11.25 | 9.4 | 10.0 | |
| Settling Volume (ml/100 ml bath) | 0.15-0.25 | 0.05-0.15 | 0.15-0.25 | 1.1-1.7 | N/A | N/A |
| Use Centrifuge Tube Part # | 8493 | 507923 | 8493 | 2461 | N/A | |

Checking Bath Concentration Using Settling Test

NOTE: The settling test applies to both oil and water suspensions. As water evaporates more quickly than oil, water baths generally require more frequent maintenance. Check applicable specifications for test frequency.

1. Allow the pump to thoroughly agitate the suspension for at least fifteen minutes to assure uniform particle distribution.
5. Run the suspension through a spray nozzle for at least one minute to assure the suspension in the hose is fresh and agitated.
3. Using the spray nozzle, fill the centrifuge tube with agitated solution to 100 ml.
4. Place the centrifuge tube in its stand (Magnaflux Accessory Part #1837A), and allow the suspension to settle for thirty minutes (water baths) or sixty minutes (oil baths) in a vibration-free location.
5. Observe the total level of settled particles. Graduations read directly in milliliters (ml). If a contaminant layer is present, subtract from the total level to obtain magnetic particle concentration.
6. Illuminate the centrifuge tube and suspension with a black light (Optional). Fluorescence in the liquid or presence of a non-fluorescent particle layer indicates a solution breakdown, and requires replacement of the tank solution.
7. If the solution concentration is outside the range of the manufacturer's recommendations or applicable specifications, adjust the amount of liquid or particles as required. Repeat steps 1 through 6 to verify concentration.
8. Return the contents of the centrifuge tube to the tank and clean the centrifuge tube prior to the next test.

PREPARATION FOR STORAGE OR SHIPMENT

Limited Storage

When the inspection unit will not be used for a period up to 30 days, it should be serviced as follows:

1. Open the Auto-bath valve (Optional).
2. Open the drain cock at the rear of the inspection unit, drain all bath solution into a suitable container and discard the used solution.
3. Remove and clean the grilles, agitator vee; then, replace these back on the unit, and close the drain cock. The tank and spray nozzle can be cleaned using compressed air.
4. Open the valve (turn counter clockwise) at the bottom of the regulator/gauge/filter bowl, and blow out. Then, shut off the air supply to the machine.
5. Place the CURRENT CONTROLS to the 0 positions. Disconnect power from the inspection unit by placing the external disconnect switch in the off position.
6. Disconnect the foot switch or Dual Palm (Optional), and the black light (Optional). Pack and store in a plastic bag or carton on the grilles.
7. Cover the tank with paper, cardboard or plastic to prevent the accumulation of dust, dirt or other contaminants. Close the hood (Optional) curtains for added protection.

Long Term Storage and/or Shipment

1. Open the Auto-bath valve (Optional).
2. Open the drain cock at the rear of the inspection unit, drain all bath solution into a suitable container and discard the used solution.
3. Remove and clean the grilles, agitator vee; then, replace these back on the unit, and close the drain cock. The tank and spray nozzle can be cleaned using compressed air.
4. Open the valve (turn counter clockwise) at the bottom of the regulator/gauge/filter bowl, and blow out. Then, shut off the air supply to the machine.
5. Lock the tailstock assembly close to the headstock.
6. Place the CURRENT CONTROLS to the 0 position.
7. Disconnect power from the inspection unit by placing the external disconnect switch in the off position. Disconnect the three conductors from the terminal block. Disconnect the ground conductor from the brass grounding screw.

8. Disconnect the foot switch or Dual Palm (Optional) and the black light (Optional). Pack and store in a plastic bag or carton on the grilles.
9. Support the hood (Optional) at both ends and then remove the hardware securing the hood to the inspection unit frame. Lower the hood and pack separately. Install the removed hardware back in the frame.
10. Remove the mounting screws and shims securing the inspection unit to the floor.
11. Use the original shipping materials if possible. If the original packaging is not available, fabricate a shipping container with sufficient blocking, bracing, and bolting to protect the contents during shipment and long term storage. For overseas shipping, the shipping crate must be lined with sealed case liners. For commercial level packing, fabricate a shipping container in accordance with Consolidated Freight Classification Rules that will ensure safe transportation to the point of delivery. Estimated shipping dimensions and weight are listed in Tables 1-7 and 1-8. Mark the crate(s) clearly to identify the contents and denote which side is to be up.

SECTION 3: OPERATING INSTRUCTIONS

OPERATING CONTROLS AND INDICATORS

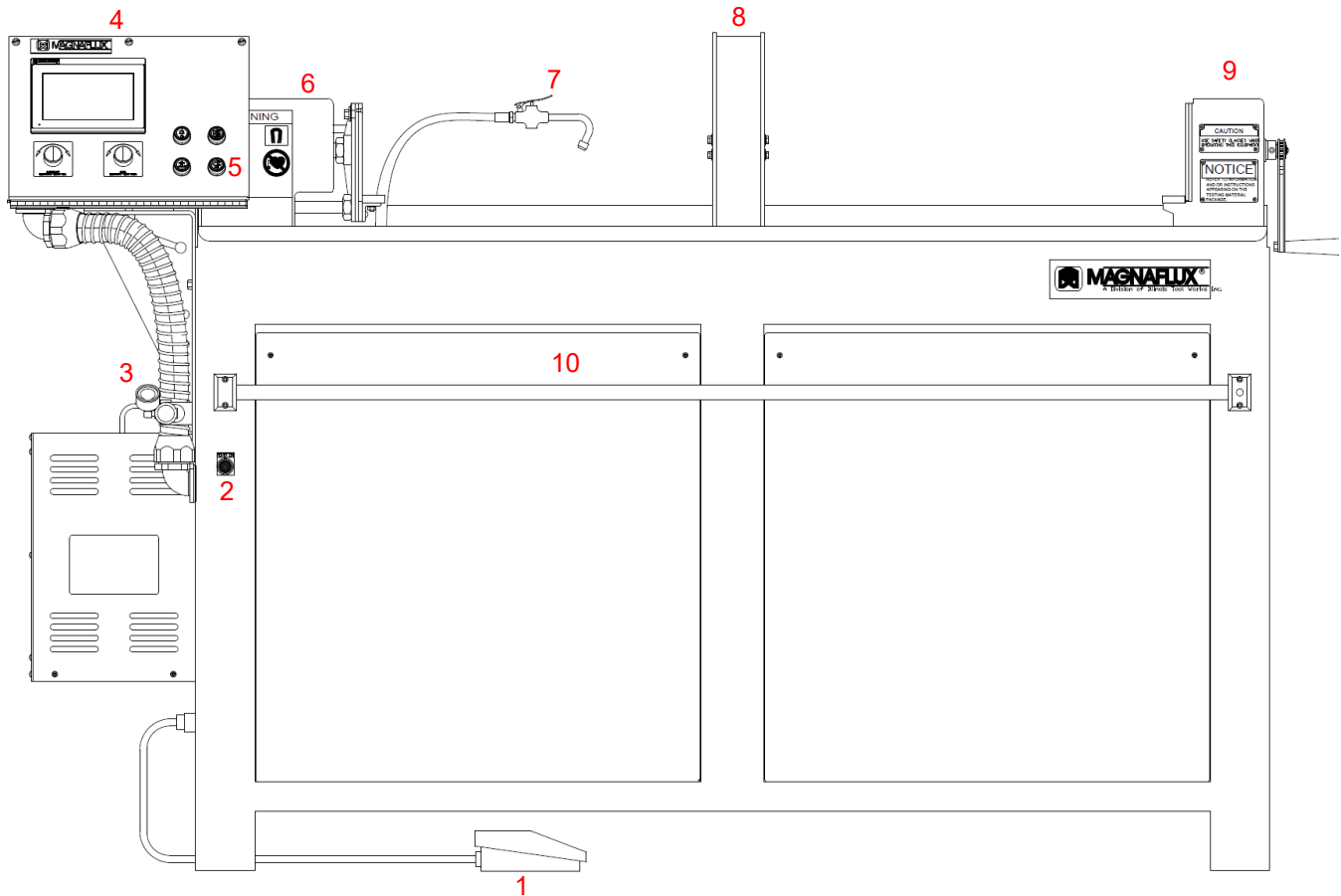


Figure 3-1

Table 3-1. General Bench Key for Figure 3-1

| | |
|---|----------------------|
| Item 1: Foot Switch | Item 6: Headstock |
| Item 2: Power Indicator | Item 7: Spray Nozzle |
| Item 3: Headstock Pressure Regulator/Gauge | Item 8: Coil |
| Item 4: Operator Control Cabinet (Figure 3-5) | Item 9: Tailstock |
| Item 5: Magnetic Current Push-button | Item 10: Push Bar |

NOTE: Adjustment of the pressure regulator for higher or lower pressures will also result in higher or lower clamping forces. Proper adjustment assures proper clamping force without distorting the test part. Too low of pressure can cause arcing on the part at high amperage.

Adjustment of Magnetizing Shot Duration

NOTE: The duration of the magnetizing shot is set at 0.5 seconds from the factory.

- 1) Select Item 4 in Figure 3-3 to the desired shot time. The range is from 0.5 to 2 seconds. A shot timer (Magnaflux Accessory Part Number 622646) should be used to provide the actual shot time that has been set.

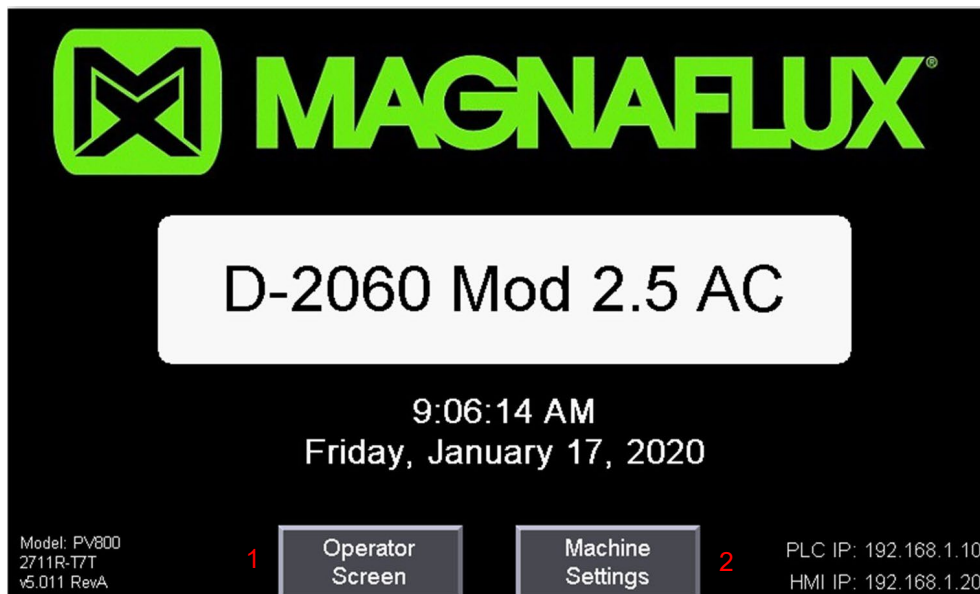


Figure 3-2 (MOD AC Option shown)

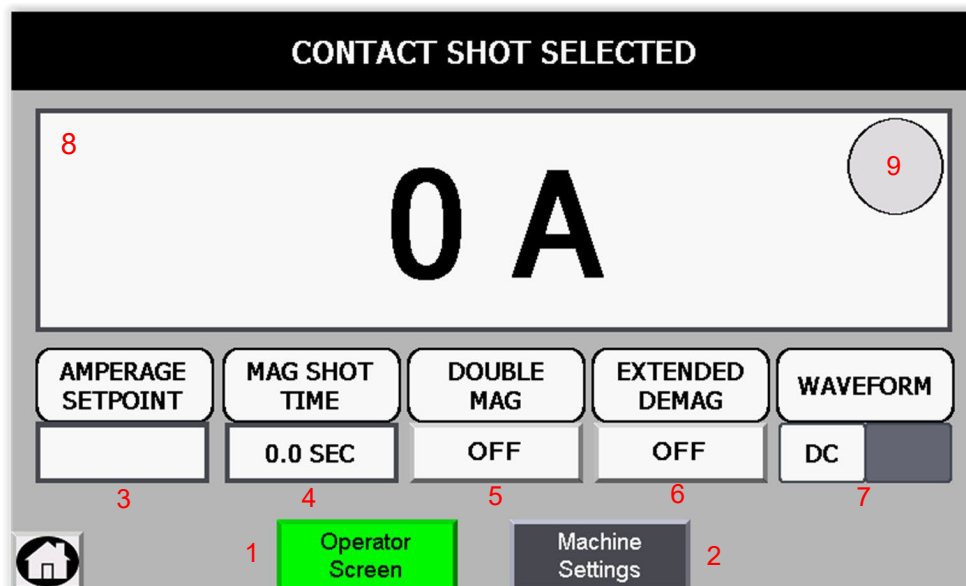


Figure 3-3

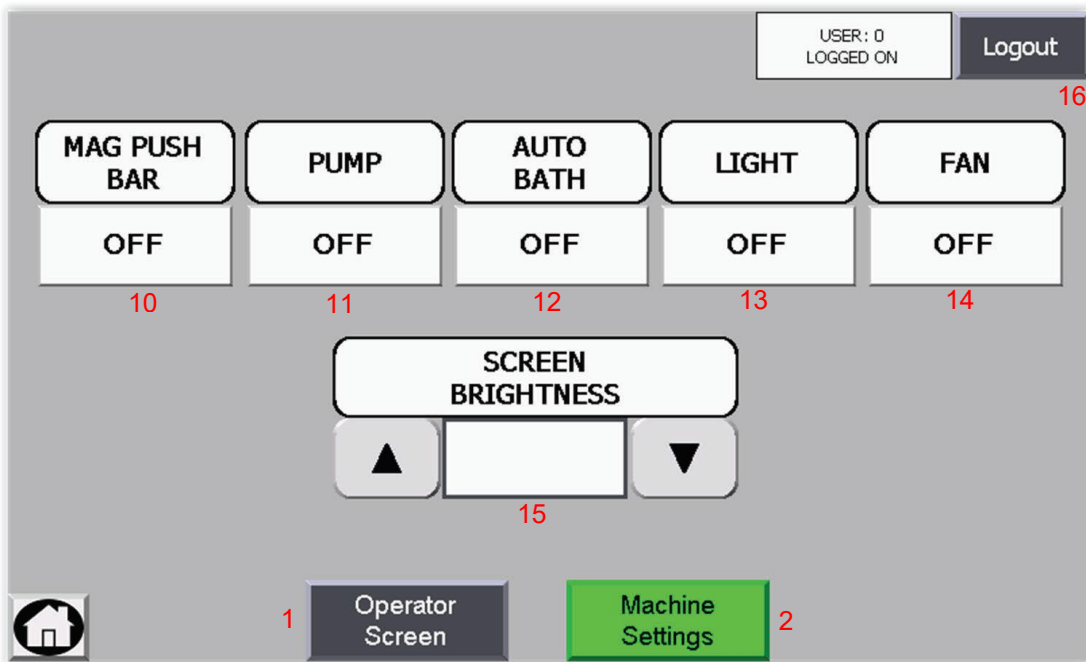


Figure 3-4

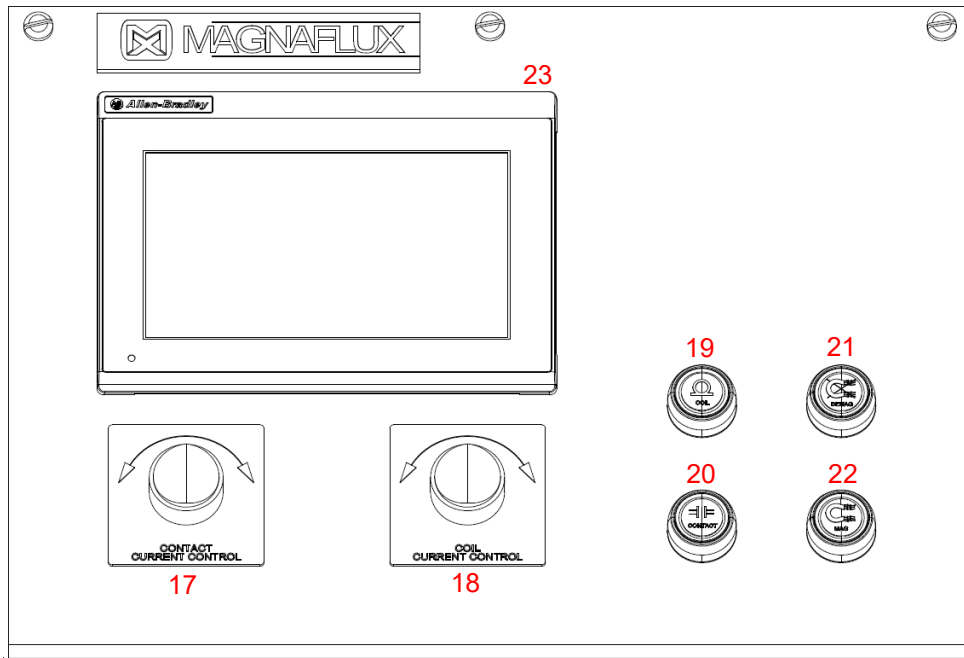


Figure 3-5

Table 3-2. Control Panel Key for Figure 3-2, 3-3, 3-4, and 3-5.

| | |
|--|-----------------------------------|
| Item 1: Pushbuttons (Operator Screen) | Item 14: Fan Light ON/OFF Button |
| Item 2: Pushbuttons (Machine Settings) | Item 15: Screen Brightness |
| Item 3: Amperage Setpoint | Item 16: Login/Logout Button |
| Item 4: Mag Shot Time | Item 17: Contact Current Control |
| Item 5: Double Mag | Item 18: Coil Current Control |
| Item 6: Extended Demag | Item 19: Coil Selection Button |
| Item 7: DC or AC (Optional) Waveform | Item 20: Contact Selection Button |
| Item 8: Ammeter Output | Item 21: Demag Select Button |
| Item 9: Current Assurance Indicator | Item 22: Mag Select Button |
| Item 10: Push Bar ON/OFF Button | Item 23: HMI Display Screen |
| Item 11: Pump ON/OFF Button | |
| Item 12: Auto Bath Selector (Optional) | |
| Item 13: Hood Light ON/OFF Button | |

All controls and indicators are illustrated in Figures 3-2, 3-3, 3-4, and 3-5.

WARNING: Do not operate this machine until you are familiar with all the electrical and mechanical controls. Check controls for proper functioning before operating machine.

NOTE: For a contact shot to be performed – the part must be clamped by pressing the foot switch or using the dual touch button optional feature.

See Figure 3-1:

1. a. **Foot Switch (Without Autobath):** Activates headstock clamping.
 - Press once and release; part is clamped.
 - Press again and release; part is released.
- b. **Foot Switch (With Autobath):** Activates headstock clamping, bath application, and mag current.
 - Press once, and release, part is clamped; bath cycle begins.
 - When bath cycle is finished, a mag shot is fired, then, the part is automatically unclamped.
 - If Auto-bath button is off (dimly lit), the foot switch will only activate the headstock clamping.
- c. **Foot Switch (With Auto-Mag):** Activates headstock clamping and mag shot.
 - Press once and release; part is clamped.
 - The part is “magnetized,” then unclamped.
2. **Power Indicator:** Light to indicate power to machine.
3. **Headstock Pressure Regulator/Gauge:** Controls amount of clamping force.

- Set at 40 psig for normal operation.
 - Reduce pressure to avoid damaging fragile parts but clamp firmly enough to assure good electrical contact.
4. **Operator Control Cabinet:** Contains all of the Operator Controls, Pushbuttons, and display.
 5. **Mag Current Push-button:** Initiates a magnetizing current “shot” each time push-button is pressed.
 6. **Headstock:** Provides clamping and unclamping mechanism for contacts.
 7. **Spray Nozzle:** Dispenses magnetic particle bath solution.
 8. **Coil:** Provides longitudinal magnetization, should be locked down to avoid injury or damage.
 9. **Tailstock:** Moves along the rail via upper ratchet arm, adjusted to accommodate part length. Once adjusted, the tailstock to be locked in place via lower ratchet, failing to do so may result in injury or damage.
 10. **Push Bar:** Enables/Disables the Push Bar
 - With PUSHBAR switch “on” (light on), pressing Push Bar (2) from any position, activates the mag shot. With PUSHBAR switch “off”, Push Bar (2) is inoperable.
 - On longer machines, a second Push Bar is provided on the tailstock end of the machine for operator convenience.

See Figures 3-2, 3-3, 3-4, and 3-5:

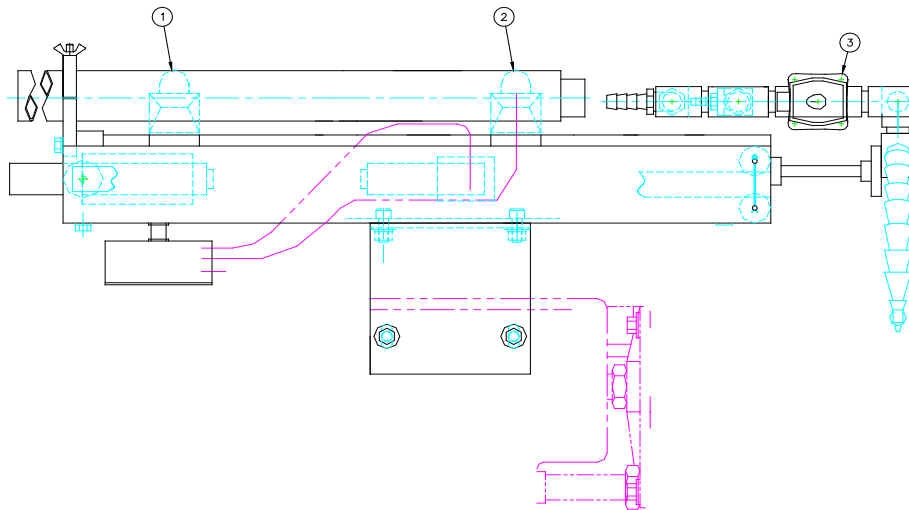
1. **Operator Screen:** Displays Operator Screen.
2. **Machine Settings:** Displays Machine Settings Screen.
3. **Amperage Setpoint:** Input desired amperage.
4. **Adjust Mag Shot Time Input:** Used in conjunction with item 14, when enabled allows user to set mag shot time between 0.50 and 2.00 seconds
5. **Double Mag Shot Indicator:** Lit when Double Mag Shot is enabled
6. **Extended Demag:** Lit when Extended Demag is enabled.
7. **Waveform:** Enables DC or AC (optional) waveform.
8. **Digital Ammeter:** Displays the amount of current passed through the circuit.
9. **Green Current Assurance Light:** Indicates current is flowing through circuit.
10. **Pushbar ON/OFF Button:** Enables pushbar(s) to initiate a mag shot.

11. **Pump ON/OFF Button:** Toggles the bath circulating pump motor ON/OFF.
12. **Auto-Bath Selector (Optional):** Enables Auto-Bath cycle.
13. **Hood White Light Button (Optional):** Turns ON/OFF the white light within the hood.
14. **Hood Fan Button (Optional):** Toggles the fan in the hood ON/OFF.
15. **Screen Brightness:** Toggles the brightness of the screen (0-100%).
16. **User Login:** only for Magnaflux Authorized Service Center use.
17. **Contacts Current Control:** Control amount of current for the Contact circuit.
18. **Coil Current Control:** Control amount of current for the Coil circuit.
19. **Coil Selection Button:** Selects Coil circuit.
20. **Contacts Select Button:** Selects Contact circuit.
21. **Demag Shot Button:** Selects a demag cycle. Button is bright when demagnetizing and returns to dim when the cycle is complete. The next demag or mag shot will be dictated by the duty cycle.
22. **Mag Shot Button:** Initiates a magnetizing current shot each time is pressed. The next mag or demag shot will be dictated by the duty cycle.
23. **HMI Display Screen:** Displays the Operator Screen and Machine Settings Screen. It also displays the amount of current passed through the circuit.

Options not Illustrated

1. **Tailstock Crank:** Moves tailstock back and forth along rails.
2. **Bath Applicator Pressure Regulator Valve:** Controls the speed of the bath applicator (with Auto-bath option). - Set at 40 psig for normal operation.
3. **Bath Applicator Ball Valve:** Controls the flow of bath to the bath applicator (with Auto-bath option).
4. **Dual Palm (Optional):** Used in place of foot switch, to activate headstock clamping, bath application (Auto-bath option), and Mag Current (Automag option).
 - a. Press both buttons simultaneously; part is clamped, and cycle begins
 - b. If Auto-bath (Optional) button is off, the Dual Palm will only activate the headstock clamping.
5. **Air Filter:** Air fixture on head stock end of unit for Air Supply Input.
6. **Speed Control Needle Valve:** Controls speed of clamping air cylinder in headstock. Has no effect on clamping force.

- a. Slower clamping speed allows operator greater flexibility in positioning large, heavy or awkwardly shaped parts.
- b. Faster clamping speed improves productivity for simple, repetitive parts.



Autobath Retracted Limit Switch (1): Initiates a magnetizing current “shot” when the bath applicator reaches the switch position, on its return stroke.

Autobath Extended Limit Switch (2): Controls the extended length of the bath applicator.
 · Loosen set screws and adjust position for length of part being inspected.

Bath Application Solenoid (3): Turns the bath on when applicator is extended, off when retracted.

DAILY START UP AND OPERATION CHECKLIST

All controls and indicators are illustrated in Figures 3-2, 3-3, 3-4, and 3-5.

1. Turn on external disconnect switch. Digital Ammeter and power indicator will light.
2. Check for proper volume of bath; see Table 1-6 in Section 1.
3. Press PUMP push-button to turn on and allow bath to circulate for a minimum of 15 minutes.
4. Check for proper magnetic particle concentration in bath; see Table 2-5 in Section 2.
5. Allow black light to warm up for approximately 5 minutes.

6. Check UV output of lamp using Magnaflux black light meter. Measure intensity 15" from the lens; clean lens or replace bulb if reading is less than $1000\mu\text{W}/\text{cm}^2$. **WARNING: Lens on the black light may be extremely hot. Let the unit cool before cleaning or replacing bulb.**
7. Set Pressure Regulator Valve to 40 psig. **WARNING: Lowering air pressure setting may be required for small part to prevent damage.**
8. If equipped with Auto-bath (Optional), toggle the Auto-bath button, and the PUMP button to off. If equipped with the Auto-Mag, toggle Auto-Mag to off by pressing the Auto-Mag button, then releasing.
9. Check operation of headstock clamping cylinder by pressing and releasing Foot Switch or Optional Dual Palm.
10. Adjust Speed Control Needle Valve on headstock for desired clamping speed.
11. Press CONTACT push-button.
12. Set the amperage using the CONTACT current control or use the AMPERAGE SETPOINT on the HMI to a desired value.
13. Check for magnetizing current between contacts.
 - a. Place a suitable part between headstock and tailstock contacts.
 - b. Place a piece of insulating material, such as a thick piece of cardboard, between headstock contact and the end of the part.
 - c. Press and release Foot Switch or Optional Dual Palm to clamp part.
 - d. Press MAG push-button while observing Digital Ammeter.
 - The current assurance light should not light.
 - f. If there is any indication of current on the ammeter, an electrical short exists. For corrective action, refer to Section 5 for Troubleshooting.
 - g. Place a minimum 1" diameter test bar between headstock and tailstock contacts.
 - h. Press and release foot switch or Optional Dual Palm to clamp test bar.
 - i. Press MAG Current push-button while observing ammeter.
 - The magnetizing current flowing through the test bar should appear on the Digital Ammeter.
 - The Green Current Assurance Light on the Ammeter (HMI) should light indicating current flow through the test bar.
 - For MOD AC (Optional), repeat Step 13.i with AC selected on the HMI.
14. Press and release foot switch or Optional Dual Palm to release the part.
15. If equipped with Auto-bath option, check as follows:
 - a. Press Auto-bath button and PUMP button to ON.
 - b. If equipped with foot switch, follow steps 13 and 14, keeping in mind that the foot switch is pressed, and released to clamp the part, then the bath applicator will extend to apply bath. When extend limit is reached, it will retract and the bath will turn off, and the mag shot will occur.
 - c. Part will then unclamp signifying that the Auto-bath cycle is complete.
 - d. If equipped with Optional Dual Palm, follow steps 13 and 14, keeping in mind that the Dual Palm are pressed to clamp the part and extend the bath applicator. After mag shot occurs, headstock

retracts to unclamp part.

16. If equipped with Auto-Mag, check as follows:
 - a. Toggle Auto-Mag to "ON" by pressing and releasing Auto-Mag button.
 - b. Place part between contacts and press foot switch. Part will be clamped.
 - c. When foot switch is released, a mag shot will be "fired", then headstock will unclamp.
 - d. To deselect Auto-Mag, press Auto-Mag button.

NOTE: To ensure reliable processing of parts, all above conditions must be met. For corrective action, refer to Section 5 Troubleshooting.

PIECE PART SETUP

WARNING: Heavy materials may cause severe damage or injury if dropped; always lock tailstock and/or coil in desired position before applying current.

WARNING: Use rail mounted steady rests to support heavier parts. See Table 1-4 for part weight capacities.

Normal Piece Setup

All controls and indicators are illustrated in Figures 3-2, 3-3, 3-4, and 3-5.

WARNING: Lower air pressure setting may be required to prevent damage to small parts.

1. If equipped with Auto-bath, adjust bath applicator ball valve for the desired bath flow.
2. If equipped with Auto-bath, adjust bath extend limit switch for the length of part being inspected.
3. Check that the Pressure Regulator Valves are properly set for the type of part being inspected.
4. Move and lock the coil against the headstock so it will not interfere.
5. Unlock and move tailstock to a position where part can be supported by tailstock and headstock shelves, or by Optional rail mounted steady rests. Lock tailstock.
6. Align part so that current will flow parallel to direction of expected flaw. This places magnetic field at right angles to flaw and provides best indications.
7. Move coil to desired position.
8. Position the part, press and release foot switch or Optional Dual Palm to clamp part in place. On units equipped with Auto-bath, the automatic cycle will begin if Auto-bath button is on.

Remote Operation Set-up

For remote operation, turn off bath applicator ball valve and Auto-bath button, clamp contact block between headstock and tailstock; then connect remote cables. Use Optional clamps, prods or cable wraps to magnetize parts for inspection.

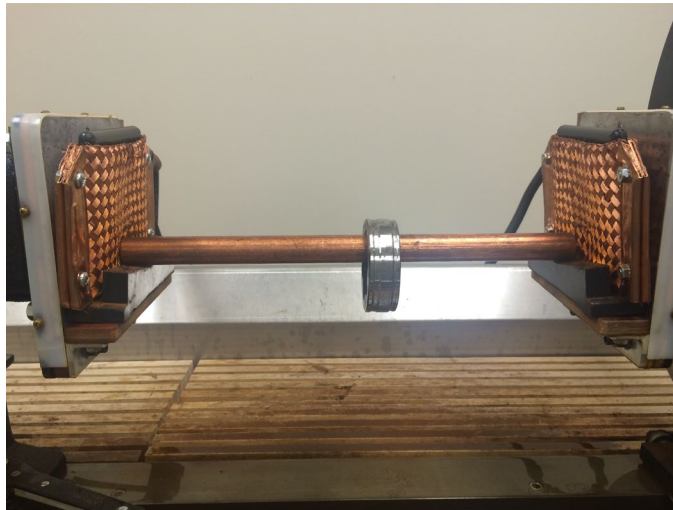


Figure 3-7 Central Conductor using a wet horizontal Magnaflux machine

Central Conductor Set-up

If parts are hollow, tubular, ring-like, or have holes, it is generally better to magnetize them using a central conductor rather than passing current directly through them. This method also reveals defects on the inside diameter of the part. The central conductor is placed through a part that is clamped between the headstock and tailstock. Circular Magnetization is accomplished by passing current through the central conductor. This is shown above in Figure 3-7.

MAGNETIZING PROCEDURES

Without Auto-Bath:

All controls and indicators are illustrated in 3-2, 3-3, 3-4, and 3-5.

1. Clamp the part as described in **PIECE PART SETUP**. **WARNING: Set current at the appropriate level for the part cross section to avoid overheating.**
2. Press the COIL or CONTACT push-button to input the desired magnetizing circuit.
3. Set the amperage using the appropriate current control or use the AMPERAGE SETPOINT on the HMI to a desired value.

4. If the spray nozzle has not been used in the last 10 minutes, allow bath to circulate through spray nozzle for 10-15 seconds to clear any settled bath.
5. If machine is equipped with an Optional black light hood, lower hood to darken work area. Allow time for your eyes to adjust to the dark (approximately 3 minutes).
6. Use spray nozzle to apply bath to the part.
7. As soon as the part (or part section) is thoroughly covered with bath, shut off the spray nozzle, and immediately apply magnetizing current by pressing and releasing MAG push-button or Push Bar.
 - a. Current assurance will light and remain lit for duration of magnetizing shot
 - b. Digital Ammeter will display and retain applied current.
 - c. **NOTE:** This technique is called the “wet continuous method.” For long parts, it may be necessary to inspect in sections, each with a separate bath application and current “shot.” The “wet residual method,” which applies bath after the current shot, is recommended only for parts with high magnetic retention.
8. Press and release foot switch to unclamp part.
9. Examine part for indications.

With Auto-Mag:

1. Clamp part as described in **PIECE PART SETUP**.
2. Press and release Auto-Mag button so light is bright.
3. Manually bathe the part, press and release the foot switch.
4. When foot switch is pressed, the part will be “magnetized” and released.

DEMAGNETIZATION

All controls and indicators are illustrated in 3-2, 3-3, 3-4, and 3-5.

Demagnetization is generally performed after inspection. A safety feature prevents accidental energizing of the magnetizing circuit during the demagnetization cycle.

1. If equipped with Auto-bath, press Auto-bath button to off. The button is dimly lit when off and brighter when on.
2. Clamp test part between headstock and tailstock in same manner as described in Piece Part Set-up.
3. Set the CURRENT CONTROL to the same or a value slightly higher than setting used to magnetize the part using AMPERAGE SETPOINT on the HMI.

4. Press and release DEMAG Push button to start demagnetization cycle. DEMAG light will remain lit during complete cycle.

NOTE: *If AC (MOD AC Optional) is selected, DEMAG will be AC demagnetization.*

5. After demagnetization of part is complete, DEMAG light will go out.
6. Press and release foot switch or Optional Dual Palm to unclamp part.

NOTE: *Foot switch is locked out during “demagnetization,” so arcing will not damage the machine and the part being processed.*

Demagnetization Using Optional Accessories

All controls and indicators are illustrated in 3-2, 3-3, 3-4, and 3-5.

When parts are magnetized for inspection using optional clamps, prods or cable wraps, they can be demagnetized in the same manner. Use a cable wrap whenever possible. Longitudinal demagnetization with a cable wrap generally can be accomplished successfully even if the part was magnetized for inspection using clamps or prods.

SHUTDOWN

All controls and indicators are illustrated in 3-2, 3-3, 3-4, and 3-5.

1. Toggle the PUMP button to off.
2. Open valve at bottom of the air filter bowl to blow out any contaminants or accumulated moisture. Close valve and then shut off air supply to machine.
3. If Optional hood is installed, close curtains.
4. Disconnect power from unit by turning external disconnect switch to OFF.

EMERGENCY SHUTDOWN

To shut off the machine in an emergency, disconnect the power by turning OFF the external disconnect switch. Lock Out unit as required.

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SECTION 4: MAINTENANCE

GENERAL

The following tables contain periodic visual and operational inspections designed to prevent or discover malfunctions and defective parts. Many of these checks are based on ASTM E-1444. Do not operate the inspection unit if it is found to be in need of repair or unsafe. Report problems to the designated authority. Do not remove any cover panels. Inspections or maintenance requiring removal of cover panels are to be performed by a qualified technician. A list of Authorized Magnaflux Service Centers is located at www.magnaflux.com

DAILY OPERATOR MAINTENANCE

| Table 4-1. Daily Operator Checks | |
|---|--|
| Item | Action |
| Bath level | See Table 1-6 for proper level. |
| Particle concentration | See Table 2-5 for proper concentration. |
| Cable and busbar connections | Check coil, headstock, and tailstock busbar and cable connections. Tighten as necessary. Check wires and cables for worn or frayed insulation. |
| Headstock clamping | Check headstock clamping action. |
| Locking devices | Check tailstock and coil lock. |
| Leaks (bath) | Check tank, hoses and nozzle for leakage. |
| Leaks (pneumatic) | Check air cylinder, fittings, hoses, air regulator and speed valve. |
| Power indicator | Check that indicator lights when power is supplied to inspection unit. |
| Push-buttons | Check push-buttons for proper operation. Push-buttons are dimly lit when off and turn brighter when on. |
| Digital ammeter and assurance current indicator | Check ammeter readout and assurance current indicator operations. |
| Black light assembly | Check for missing or broken filter or lamp. Check for damaged cord. |
| Curtain | Repair small cuts and tears with black plastic electrical tape. |
| Auto-bath and Auto-Mag (Optional) | Check Auto-bath function. Check Auto-Mag function. |

WEEKLY OPERATOR MAINTENANCE

| Table 4-2. Weekly Operator Checks | |
|-----------------------------------|---|
| Item | Action |
| Contact pads and contact plates | When water bath is used, remove oxidation from between the contact pad and contact plate. Use a wire brush. |
| Ground Fault Interrupt | Check for proper operation of Black Light. |
| Clean Tank Screen | See Instructions page 4-4 |

MONTHLY OPERATOR MAINTENANCE

| Table 4-3. Monthly Operator Checks | |
|------------------------------------|--|
| Item | Action |
| Tank and grilles | Clean if necessary. After cleaning, flush tank and grilles with appropriate bath solution. |
| Fans | Listen for fan operation and check air flow for restrictions. |
| Air filter | Clean air filter element and bowl. |
| Check Tank Seal | Look for leaks of fluid around/near the pump/motor shaft |

PERIODIC INTERNAL MAINTENANCE

NOTE: The following procedures should be performed by a qualified maintenance technician.

WARNING: Turn off and lock out the external disconnect switch before removing cover panels. Failure to disconnect incoming power could result in severe electrical shock or death.

WARNING: For cleaning, do not use compressed air greater than 30 psi. Wear eye protection. Use cleaning solvents only in well ventilated areas.

| Table 4-4. Periodic Checks | |
|----------------------------|---|
| Item | Action |
| Rectifier stack | Blow accumulated dirt from rectifier heat sinks and fan blades. Do not use cleaning solvents. Use dry air on PCB. |

| Table 4-4. Periodic Checks | |
|-----------------------------------|---|
| Item | Action |
| Control panel wiring | Check wiring for discoloration or burnt insulation, and that connectors are secure. |
| Lower unit wiring | Check wiring for discoloration or burnt insulation, and that connectors are secure. |
| Transformers | Check transformers for discoloration and pungent odor. |
| Connections | Check and tighten all connections, busbars, cables and wires. |
| Tank and plumbing | Check for leaks. |
| Fans | Check that the cooling fan(s) turn freely. |
| Ammeter and "Mag" shot time | Check for accuracy every 6 months. |
| Replace Pump Seal | See Supplemental pump Instructions. |

NOTE: Due to the nature of the material used in Magnetic Particle Inspection, periodic maintenance is required on the pump seal. Replacement is recommended every 3 months, based on using Magnaflux materials for an 8 hour day, 5 days a week work schedule. It is recommended to maintain a back-up pump that can be switched out when the seal needs to be changed in order to decrease the amount of downtime on the machine.

Screen Cleaning

To prevent loss of flow from the pump, the screen on the intake of the pump will need to be cleaned on a weekly basis. **NOTE:** Be sure the pump is turned off prior to removing the sump screen. To remove the screen, simply push in and twist the brass fitting one quarter turn and pull off along with a spring. In Figure 4-1 below, this shows the entire assembly assembled. Figure 4-2 shows the brass fitting removed.



Figure 4-1

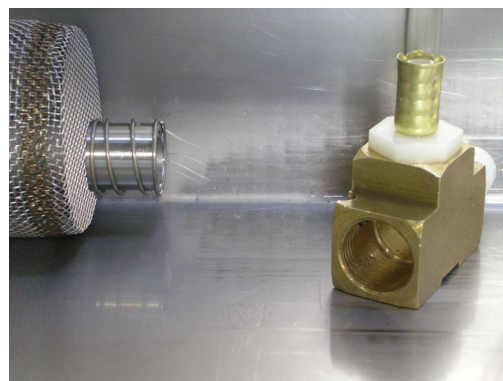


Figure 4-2

The spring is shown below in Figure 4-3, and the bib flow on spray nozzle is shown in Figure 4-4.



Figure 4-3



Figure 4-4

OPERATIONAL CHECKOUT PROCEDURES

The following paragraphs describe the operational checkout procedure for magnetic particle inspection units. Refer to schematic and wiring diagrams and any referenced illustrations for the location of components referenced in the procedures. At the conclusion of the operational checkout procedure, place the machine into service if it has met all the acceptance criteria. If any discrepancies are noted, refer to the troubleshooting section, and correct all discrepancies before placing the machine into service.

| Table 4-5. Test Equipment |
|---|
| Recommended Test Equipment |
| Tektronix TDS 2012B Two Channel Digital Storage Oscilloscope, 100 MHz, 1 GS/s |
| Magnaflux 622350 Digital Test Meter Kit with Matching Shunt |
| Steel Test Bar (1" diameter, 12"-18" long, 4140 H.T.) |

INITIAL SET-UP

WARNING: Turn off and lock-out the external disconnect switch before opening the rear panel. Failure to disconnect incoming power could result in severe electrical shock or death.

1. Check that the electrical connections have been made properly.
2. Adjust air supply to 40 psi.
3. Check that the pump drain cock is fully closed. Check bath level and concentration.
4. Turn the external disconnect switch on. The Digital Ammeter and the power indicator should light.

5. Press PUMP button to turn on the pump. The bath circulating pump motor should start. There should be no leakage of bath solution. Operate the spray nozzle(s) and check for bath discharge. Release the nozzle lever and check that the bath discharge stops. Press PUMP button to turn off the pump.
6. Connect the foot switch or Optional Dual Palm to the corresponding receptacle on the headstock end of the machine.
7. If an Optional hood has been installed, connect the line plug to the HOOD outlet on the headstock end of the machine.
8. Connect the black light to the convenience outlet on either end of the machine. The black light should come to full brilliance in about 5 minutes. To turn off the black light, the plug must be removed from the convenience outlet.
9. Press LIGHT button to turn on the hood white light. Press again to turn light off.

CIRCULAR (CONTACT) AND LONGITUDINAL (COIL) MAGNETIZATION CHECK

1. Move the coil against the headstock so it will not interfere. Lock in place.
2. Unlock and move tailstock to a position where the digital test meter kit shunt, noted in Table 4-5, can be supported by the tailstock and headstock shelves. Lock tailstock.
3. If equipped with Auto-bath, press the AUTO BATH button off. The button is dimly lit when off and bright when on.
4. Position the digital test meter kit shunt between the headstock and tailstock. The terminal with the red test lead should be closest to the headstock. Lock the tailstock in position. Connect the shunt cable to the test meter shunt input as directed in the test kit instructions.
5. Press the foot switch or Optional Dual Palm to firmly clamp the shunt in position between the headstock and tailstock.
6. Press CONTACTS button.
7. Set the CONTACTS CURRENT CONTROL to the lowest division.
8. Hold the digital test meter as far from the machine as the leads will permit. Press and release the MAG push-button (see test meter instructions). The green current assurance indicator should light during the "shot," and the current should be indicated on both the Digital Ammeter and the digital test meter. Each ammeter reading should correspond within $\pm 10\%$ or 50 amps of the machine rating. {MOD AC (Optional) repeat for AC}.
9. Continue repeating this procedure while increasing the CURRENT CONTROL to the next division after each "shot." At all settings, both ammeters should agree within $\pm 10\%$ or 50 amps of the machine rating.

10. Press the foot switch or Optional Dual Palm to unclamp and remove the shunt. Re-clamp with a non-conductive test bar (2x4 piece of wood).
11. Press and release the MAG push-button (see test meter instructions). The green LED on the Ammeter should not light and the meter should hold previous reading. If it does not do this, an electrical short exists. Refer to Section 5 for Troubleshooting.
12. Press the COIL push-button to on. The push-buttons are dimly lit when off and brighter when on.
13. Set the COIL CURRENT CONTROL to the first division.
14. Press and release the MAG push-button. The green current assurance indicator should light during the “shot,” and the current should be indicated on the Digital Ammeter. The data for the coil reading and the contact reading are from the same shunt, so if the Contact readings are accurate, then the coil meter readings will be accurate also {MOD AC (Optional) repeat for AC}.
15. Continue repeating this procedure while increasing the CURRENT CONTROL to the next higher division after each “shot.”
16. Check coil for “Quick Break” at 15,000 A/T (a 5 turn coil requires 3,000 Amps) per Quick Break instructions.
17. At the conclusion of the circular (contact) and longitudinal (coil) magnetization check, proceed with the circular (contact) and longitudinal (coil) demagnetization check performing only those steps not previously accomplished. If no further testing is to be done, disconnect the digital test meter and return it to its carrying case

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SECTION 5: TROUBLESHOOTING

Refer to the corresponding wiring diagram as a supplement to the troubleshooting chart when tracing an electrical problem. Check supplementary drawings for options you may have received with the unit.

DEMAGNETIZATION ADJUSTMENT

Demag Control: Theory of Operation

The PLC control provides 3 functions:

Timing of the demagnetization pulse

Alternation of the output current

Decay of output current (in conjunction with demagnetization capacitor)

1. When DEMAG is selected, the PLC enables the selected firing board(s) to fire a decreasing intensity and reversing polarity mag shot {(Reversing FWDC normally, Decreasing AC with MOD AC (Optional) selected)}.
2. Demag balance in the DC mode is adjusted by the lower of the two controls behind the communication door on the PLC. It is factory set for 30 msec of reverse pulse widths. Adjust this control very carefully in small increments and check parts residual magnetism often as you adjust.

Adjustment of Demagnetization

1. With the oscilloscope connected to the shunt, proceed to shoot a mag shot and adjust output current to 2000 amps as indicated on unit ammeter.
2. With scope set to 200 msec/div horiz, check demag pulse trains for equal width forward and reverse and adjust lower potentiometer on PLC until widths of forward and reverse pulse trains are equal. Check AC (MOD AC Optional) for decaying AC waveform.
3. Demag cycle time is factory set by PLC program to 16 seconds (approximately 32 switching cycles). Demag light will go OFF when cycle is finished. Check that pulses decay to zero before cycle is finished (time between pulses ending and Demag cycle finished depends on CURRENT CONTROL setting).

Troubleshooting Stack

1. Check that green "12V ON" LED is glowing. If not, check for 24VAC input to board through connection J5-1 and J5-2. If 24VAC is not present at connector, check 24 V transformer for OUTPUT. Check that red "PHASE LOSS" LED is off. If not, check for balanced 3 phase voltage input through connector J7-1, 3, and 5. **CAUTION: At power line potential.**
2. Check that red "INHIBIT" LED is glowing. Push MAG button, red LED should go out for duration of mag shot. If not, check thermal overload protectors, which connect J5-4 to J5-6. Check current command voltage between J5-8 and J5-10. It should read approximately 1.6VDC at minimum output current

setting and approximately 4.5VDC at maximum current setting. If no voltage is present, check that current command POT wiper is intact and that there is approximately 4VDC across POT winding. If there is no voltage across POT, check for 12VDC as follows: The 12VDC, +/-0.5V, should be connected to maximum 3POT, and wire #311 connected to minimum limit 4POT. If no voltage or low voltage, check for 12 volts across J5-6 to J5-8 of firing board.

Low Mag Current Output at Maximum Current Control Setting, Cannot Get Rated Output Current

1. Make sure that the 3 phase main input voltages are not sagging under load at full output. A 10% line voltage sag translates into approximately 10% less maximum output current. Also note that using higher resistance loads than what the unit was calibrated with, will give a lower maximum output.
2. Use scope to observe SCR peaks as in calibration procedure. Look for missing SCR peak(s). If you see one is missing, use a multi-meter clamp across each of the 6 SCR stack bus bars to see which SCR is missing. Then check gate pulses to that SCR with scope. If pulses are present, then SCR is bad. If pulses are not present, then master phase control or wiring from the phase control is bad.

Unit Does not Demag Properly

1. Check that PLC output 1 flashes at approximately 2 hertz rate during DEMAG.
2. Check that control voltage (Wire 310 to Wire 311) decreases gradually over DEMAG cycle. If not, check Capacitor 1Cap. on subpanel.
3. If demag passes these steps, then re-do demag adjustment.

Table 5-1 TROUBLESHOOTING GUIDE

| Issue | Probable Cause | Remedy |
|---|---|---|
| No line voltage at all. Green power indicator light not on. | <ol style="list-style-type: none"> 1. External fused disconnect switch off. 2. Fuse in external fused disconnect switch blown. 3. Fuse 1FU blown. 4. Green power indicator lamp burned out. | <ol style="list-style-type: none"> 1. Turn on external fused disconnect switch. 2. Replace fuse. Check for shorts if fuse continues to blow. 3. Replace fuse 1FU. Check for shorts if fuse continues to blow. 4. Replace lamp. |
| No convenience outlet power. Internal power on. | <ol style="list-style-type: none"> 1. Fuse 2FU blown. | <ol style="list-style-type: none"> 1. Replace fuse 2FU. Check for shorts if fuse continues to blow. |
| Pump motor does not operate. | <ol style="list-style-type: none"> 1. Fuse 4FU blown. 2. Relay 2CR not functioning. <p>NOTE: Pump is external.</p> | <ol style="list-style-type: none"> 1. Replace fuse 4FU. Check for shorts if fuse continues to blow. 2. Check 115v on wire 4. |
| Headstock does not extend to clamp part or retract to release part. | <ol style="list-style-type: none"> 1. Air supply not properly connected. 2. Defective foot switch/dual palm cable and/or plug. 3. Defective solenoid valve. 4. Fuse 6FU. | <ol style="list-style-type: none"> 1. Connect air supply to inlet. 2. Check Input 0 lamp on PLC. If it doesn't light when Footswitch pressed, replace foot switch cable and/or plug. 3. Check that Output lights 0 and 1 on PLC toggle with Footswitch. If so, replace solenoid valve. 4. Replace fuse. |
| Current Flow with nothing clamped. | <ol style="list-style-type: none"> 1. Insulators worn or missing. 2. SCR(s) shorted. | <ol style="list-style-type: none"> 1. Check headstock drawing for insulator locations and repair/replace as needed. 2. Check SCRs |
| Irregular clamping action at headstock. | <ol style="list-style-type: none"> 1. Dirty or defective pressure regulator. 2. Dirty air filter. | <ol style="list-style-type: none"> 1. Clean or replace pressure regulator. 2. Clean air filter. |
| No output current at Contacts, Coil. | <ol style="list-style-type: none"> 1. Thermo shutdown. | <ol style="list-style-type: none"> 1. Turn off disconnect, wait until unit cools. |
| Continuous mag shot on coil and/or contact. | <ol style="list-style-type: none"> 1. Shorted SCR. | <ol style="list-style-type: none"> 1. Call Authorized Service Center. |
| Main fuse to unit blown. | <ol style="list-style-type: none"> 1. Shorted SCR | <ol style="list-style-type: none"> 1. Call Authorized Service Center. |

Table 5-1 TROUBLESHOOTING GUIDE

| Issue | Probable Cause | Remedy |
|--|--|--|
| No output current or irregular current through contacts. | <ol style="list-style-type: none"> 1. Loose connection at bus bars or cable joints. 2. Fuse 5FU. 3. Defective relay if occurs on COIL only or CONTACTS only. 4. Defective harnesses. 5. Defective SCRs. | <ol style="list-style-type: none"> 1. Clean connections and tighten hardware. 2. Replace fuse 5FU. Check for shorts if fuse continues to blow. 3. Swap relays 5CR and 6CR. 4. Check outputs on PLC and see if Output 2 is off during COIL mag shot and Output 2 is on during CONTACTS shot. Check harnesses and replace or repair as necessary. 5. Call Authorized Service Center |
| No output current or irregular current through Coils. | <ol style="list-style-type: none"> 1. Loose connection at bus bars or cable joints. 2. Fuse 5FU blown. 3. Mod AC(option) NO AC 4. Defective relay 5CR 5. Defective harnesses. 6. Defective SCRs. | <ol style="list-style-type: none"> 1. Clean connections and tighten hardware. 2. Replace fuse 5FU. Check for shorts if fuse continues to blow. 3. AC firing board or relay 6CR. 4. Swap with 6CR and see if problem switches to CONTACTS. 5. Check harnesses and replace or repair as necessary. 6. Call Authorized Service Center |
| Low output current at higher current control settings. | <ol style="list-style-type: none"> 1. Impedance of part exceeds the equipment capabilities. 2. Low line voltage. 3. Loose connection at bus bars or cable joints. 4. Wrong voltage range on current controls 5. MOD AC(Optional) only | <ol style="list-style-type: none"> 1. Check equipment output with a central conductor (optional accessory). If equipment output is within specifications, part cannot be tested with this equipment. 2. Check line voltage. Correct if possible or try another line 3. Clean connections and tighten hardware 4. Adjust per instructions above in trouble shooting stack. 5. Check SPAN and BIAS adj. on AC firing board. |
| Maximum current output at all settings. | <ol style="list-style-type: none"> 1. Defective SCR firing board. 2. Defective harness. 3. Wrong voltage range on current controls 4. Shorted SCR. | <ol style="list-style-type: none"> 1. Check inhibit light operation. 2. Check harnesses and repair/replace as necessary. 3. Adjust per instructions above in trouble shooting stack. 4. Contact Authorized Magnaflux Service Center |

Table 5-1 TROUBLESHOOTING GUIDE

| Issue | Probable Cause | Remedy |
|---|---|--|
| Current assurance light defective. | 1. Defective Ammeter | 1. Replace Ammeter |
| Demag does not work or does not completely demag. | 1. SCR is not properly balanced. 2. Defective 1 Cap. | 1. Call Authorized Service Center 2. Change 1 cap. |
| Contacts push-button does not light at all. | 1. Lamp burned out. 2. Defective PB switch | 1. Replace lamp. 2. Replace Switch |
| Coil push-button does not light at all. | 1. Lamp burned out. 2. Defective PB switch. | 1. Replace lamp. 2. Replace Switch |
| No push-buttons light. | 1. Fuse 6FU blown. 2. No 115v control supply. | 1. Replace fuse 6FU. Check for shorts if fuse continues to blow. 2. Check 115Vac voltage between 1 and 2. |
| White light does not work. | 1. Bulb burned out. 2. Fuse 3FU blown. 3. Defective switch. 4. Defective relay 3CR | 1. Replace bulb. 2. Replace fuse 3FU. Check for shorts if fuse continues to blow. 3. Check white light switch and replace if defective. 4. Replace 3CR |
| Meter does not work. | 1. Meter not responding. 2. Meter got wet | 1. Connect oscilloscope to terminal 5 & 6 on meter, (AT 50MV/ DIV) At 2,000 amps, wave form should be approximately 2 divisions (0 to peak). If wave form is not there, check harness. 2. Replace Meter |
| Meter does not light. | 1. Fuse 6FU blown. 2. Defective harness. 3. Meter failure from surge. | 1. Replace fuse 6FU. Check for shorts if fuse continues to blow. 2. Check harnesses and replace or fix as necessary. 3. Check cables for worn indication. Replace meter if necessary. |
| MOD AC not firing. | 1. Inhibit lamp on AC firing board not OFF during mag shot. | 1. AC relay not energizing. AC switch not ON. AC firing board bad. |

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SECTION 6: DRAWINGS AND SPARE PARTS LIST

GENERAL

The drawings provided describe major equipment groups, assemblies, sub-assemblies, and detail parts of the Magnaflux Magnetic Particle Inspection Units. Depending on your options package, certain parts may have been substituted.

FIGURE AND INDEX NUMBER COLUMN

The first number identifies the corresponding drawing.

PART NUMBER COLUMN

On the first sheet of each drawing is a bill of material located in the lower right corner. Magnaflux part numbers are used to identify all parts except common commercial hardware. Commercial hardware is identified with a full identification in the DESCRIPTION column. Material and coating for commercial hardware is zinc plated steel except where noted.

DESCRIPTION COLUMN

A brief description is provided for each item. The descriptions to the right indicate assembly-sub-assembly-part relationship. The Magnaflux part number is included in the description.

UNITS PER ASSEMBLY COLUMN

The quantities listed are for that assembly only. The abbreviation "REF" is used to indicate that the quantity has been shown in a previous listing. The abbreviation "A/R" (as required) is used when a precise quantity cannot be specified.

HOW TO ORDER A PART

Contact your local Authorized Magnaflux Service Center or Distributor to order the part. Provide the model and serial number of the unit, and the part number requested.

SPARE PARTS LIST**D-2060**

| <u>Part Number</u> | <u>Description</u> |
|---------------------------|--|
| 631159 | Replacement Pump Kit, Standard,(2-Door,72in.) |
| 631098 | Replacement Pump Kit, Long,(3-Door,120in.) |
| 631098 | Replacement Pump Kit, Auto-bath, (2-Door or 3-Door) |
| 631111 | Replacement Pump Kit, Extra Long,(4-Door,164in.) |
| 521454 | DPDT Relay |
| 624779 | 4PDT Relay |
| 624758 | Ammeter |
| 623956 | Air Solenoid Valve |
| 621076 | Grille Assembly (Standard Frame Unit) |
| 621225 | Grille Assembly (Long Frame Unit) |
| 621347 | Grille Assembly (Extra Long Frame Unit) |
| 625309 | Rectifier Stack (Includes fans, firing board, SCR's) |
| 521432 | Fan only for Rectifier Stack |
| 622996 | Firing board only for Rectifier Stack |
| 521097 | SCR only for Rectifier Stack |
| 624715 | Maintained Assembly Pushbuttons |
| 624927 | Harness for 624715 |
| 624717 | Momentary Assembly Pushbuttons |
| 624928 | Harness for 624717 |

D-2100

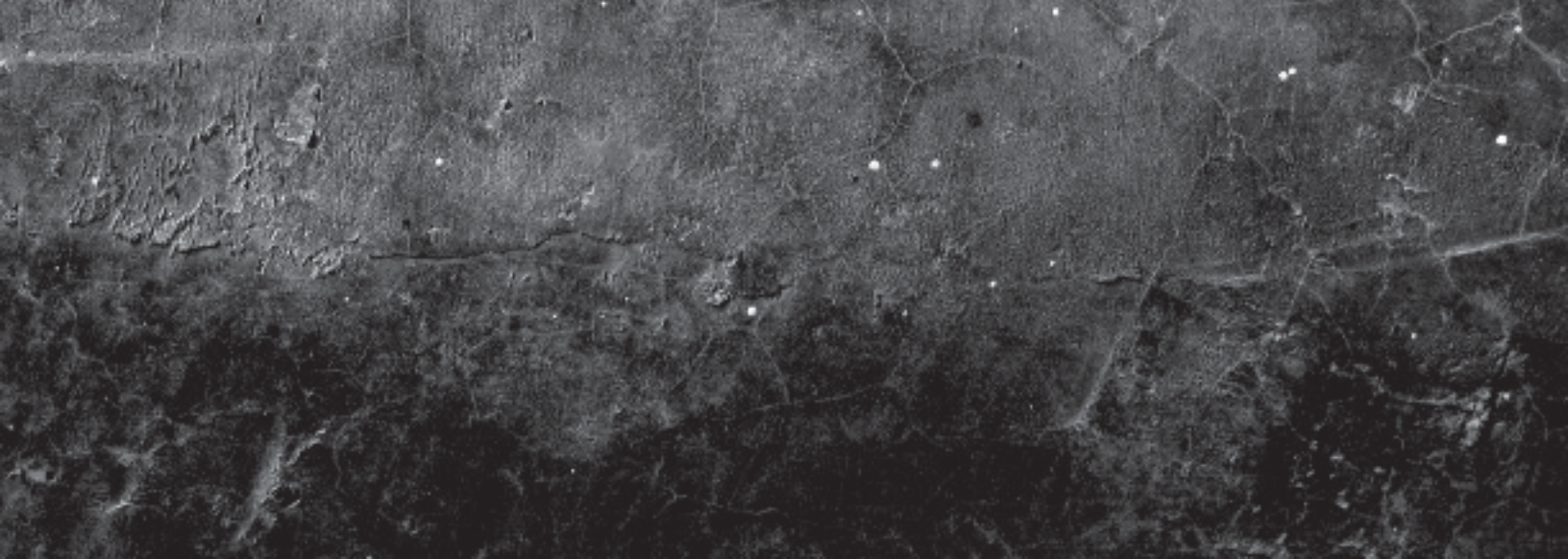
| <u>Part Number</u> | <u>Description</u> |
|---------------------------|---|
| 631159 | External Pump with hardware |
| 624570 | Seal for pump |
| 521454 | DPDT Relay |
| 624779 | 4PDT Relay |
| 624758 | Ammeter |
| 623956 | Air Solenoid Valve |
| 621076 | Grille Assembly (Standard Frame Unit) |
| 621225 | Grille Assembly (Long Frame Unit) |
| 621347 | Grille Assembly (Extra Long Frame Unit) |
| 625311 | Rectifier Stack(Includes fans, firing board, SCR's) |
| 521432 | Fan only for Rectifier Stack |
| 622996 | Firing board only for Rectifier Stack |
| 521095 | SCR only for Rectifier Stack |
| 624715 | Maintained Assembly Pushbuttons |
| 624927 | Harness for 624715 |
| 624717 | Momentary Assembly Pushbuttons |
| 624928 | Harness for 624717 |
| 114184 | Braided Lead Contact Pad |

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SECTION 7: HOOD & BLACK LIGHT INSTALLATION

HOOD INSTALLATION

1. The hood is wrapped in a protective plastic for shipping.
2. Carefully cut away the wrap without cutting the curtain material.
3. In a separate box the hood fan and white light are located.
4. Figure 7-1 below shows the separate fan and white light assembly. Figure 7-2 shows the hood assembly.



Figure 7-1



Figure 7-2



Figure 7-3

5. Place the Magnaflux machine on a solid surface and secure it based on Section 1 of this manual. Figure 7-3 above shows the unit.
6. Once it is secure, remove the accessory boxes containing the foot switch, and set aside in a safe place.
7. Verify the hood installation with the electrician prior to installing so as to not have any conduit interference with the hood.
8. Locate the mounting holes in the rear of the unit frame as shown in Figures 7-4 and 7-5 below.

NOTE: Grilles have been removed for clarity.



Figure 7-4



Figure 7-5



Figure 7-6

9. On a solid surface with the assistance of another person, stand on each side of the hood to support it.
10. Carefully open the hood frame as shown in Figure 7-6 below.
11. Side and rear curtains are folded on to the top curtain for convenience.
12. Be careful when doing this as the fan frame section and the swivel frame section are not mounted to each other.
13. With a person on either side of the hood, carefully lift it on to the unit and insert the frame into the mounting holes as shown in Figure 7-7 and Figure 7-8 below.

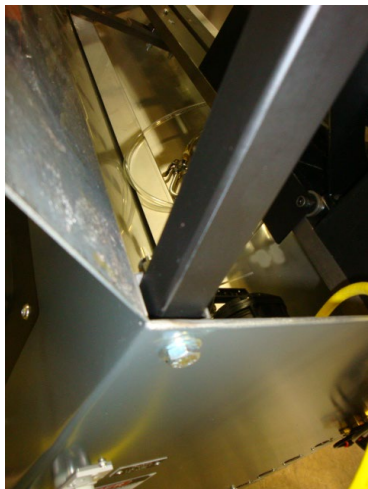


Figure 7-7



Figure 7-8

14. Verify the frame slides into the bottom of the space.
15. Insert bolt and lock nut supplied to secure to the frame (two places).

16. Next, locate shoulder bolt in the swivel frame of the hood (each side of the frame).
17. Remove the lock nut and one washer.
18. Place the shoulder bolt through the hole in the stationary part of the frame.
19. With one washer on the inside and outside, tighten the nut to secure the frames together as shown in Figures 7-9 through 7-12 below.

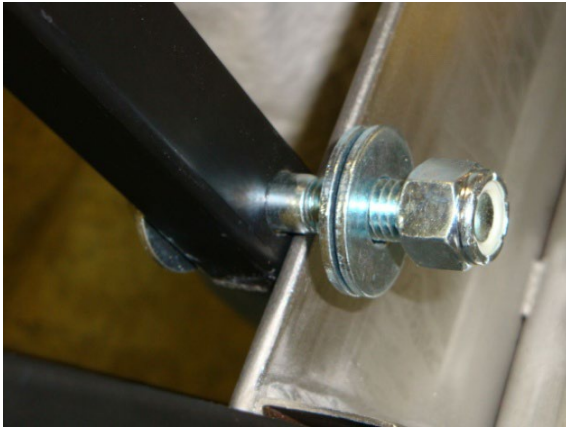


Figure 7-9

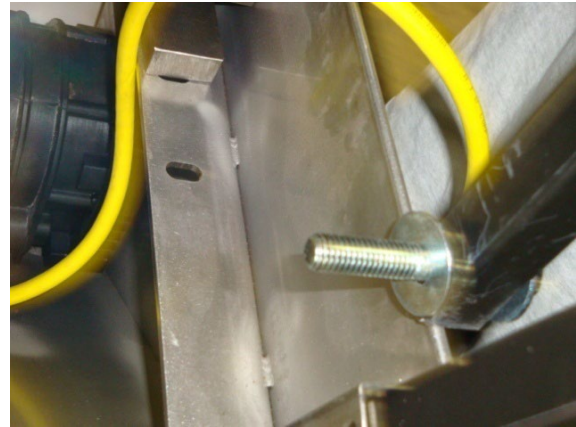


Figure 7-10



Figure 7-11

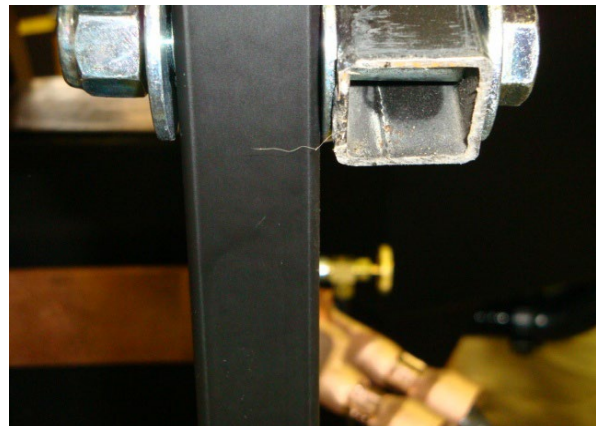


Figure 7-12

20. Now open the hood and stretch out the top curtain as show in Figure 7-13 and Figure 7-14 below.



Figure 7-3



Figure 7-14

21. Locate the four (4) mounting bolts on the stationary frame as shown in Figures 7-15 through 7-18 below. **NOTE: Two (2) are under the curtain.**

22. Remove nuts and set aside.



Figure 7-15



Figure 7-16



Figure 7-17



Figure 7-18

23. In Figure 7-18 above, locate the four (4) mounting holes on the fan and place the bolts in it.
NOTE: Orientation of the fan should be with the light closest to the headstock.
 24. Carefully ensure the white light clears the frames as shown in Figure 7-19 below.



Figure 7-19



Figure 7-20



Figure 7-20

25. Return and tighten nuts onto the mounting studs.
 26. Standard mounting has the vent to the tailstock side of the unit as shown in Figures 7-20 and 7-21.
 27. Removing and reorienting the vent direction is possible by removing the mounting hardware and rotating the vent.
NOTE: Verify white light levels inside booth before changing the orientation.



Figure 7-22

- 28. String the fan cord along the frame and down to the outlet on the headstock side of the unit.
- 29. Plug into the twist lock marked for the hood as shown in Figure 7-22 above.
- 30. If power is available on the unit, the white light and fan operation can be tested by selecting these buttons on the main control panel, as shown in Figure 7-23 below.

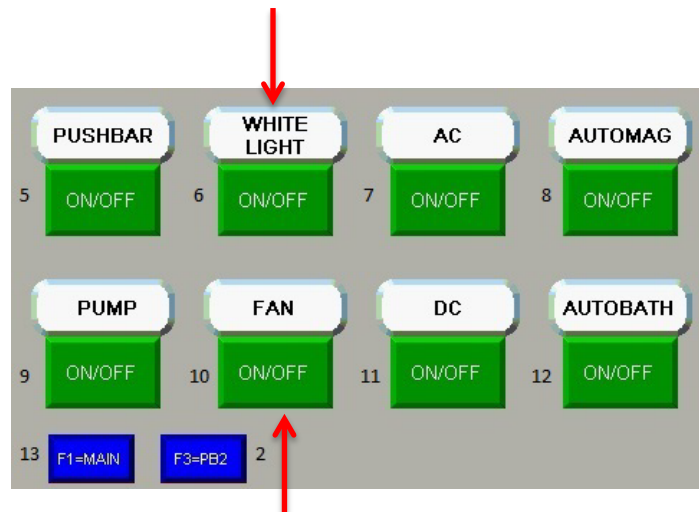


Figure 7-23

31. Now the left and right side curtains can carefully be unfolded as shown in Figure 7-24 below.



Figure 7-24

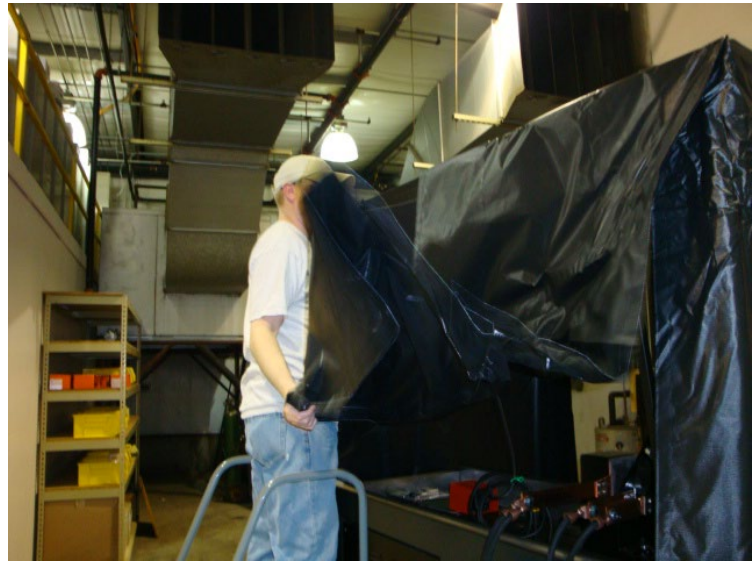


Figure 7-25

32. Bring down the top curtain, carefully working the opening around the fan vent as shown in Figure 7-25.
33. Locate the front curtain and hang it from the front track with hooks as shown in Figure 7-26 below. Once the front curtain is installed, pull down the curtain with “Magnaflux” on it to block white light from entering the inspection booth. This “Magnaflux” curtain is shown in Figure 7-27 below.



Figure 7-26



Figure 7-27

34. The front curtain can be folded in half for extra ventilation. Fold in half and mount the lower eyelets on the same hook already supporting the curtain. Verify white light levels inside the inspection booth are still acceptable if this is done.

BLACK LIGHT INSTALLATION

1. Locate the three mounting bolts for the black light bracket and remove the hardware. Place the bracket in place securing with the hardware provided as shown in Figure 7-28 and Figure 7-29 below.



Figure 7-28



Figure 7-29

2. Position the transformer so the light cord comes out towards the front of the unit. Then, slide the ballast transformer into the slots provided. This is shown in Figure 7-31 below.

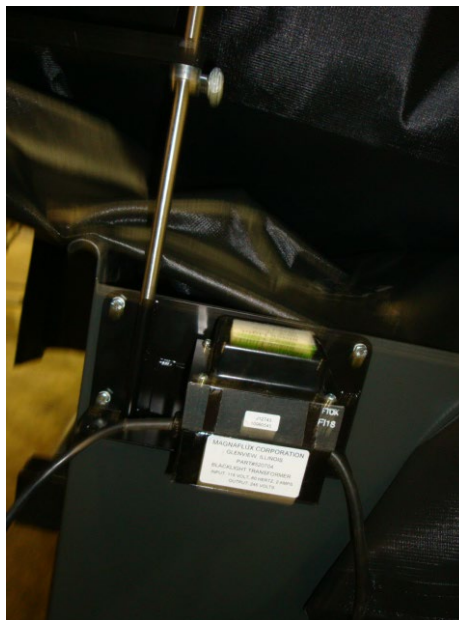


Figure 7-30

3. Plug the transformer cord into the outlet on the side of the unit as shown in Figure 7-31 below.



Figure 7-31



Figure 7-32

4. Mount the ZB-100F black light onto the peg provided, as shown in Figure 7-32. This completes the installation of the hood assembly.

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