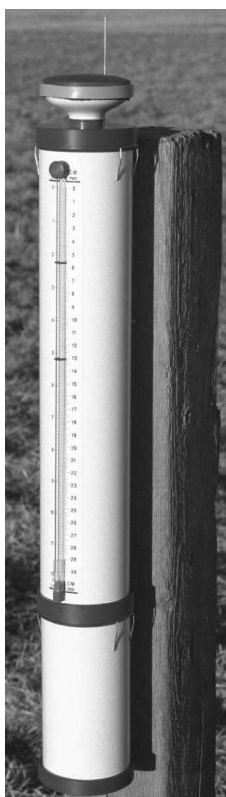


ETgage Model E Instructions

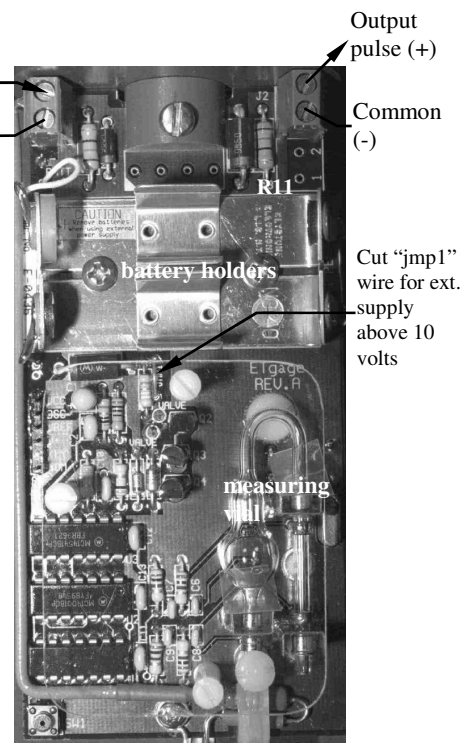


EXTERNAL WIRING

Unclip and drop down the bottom compartment of the instrument to expose the circuit board. Insert lead-in wires through the 3/16-inch diameter hole in the side of the instrument, and through the rubber sealing stopper. Telephone wire works well. At the top of the board there are two terminal blocks for external wire connections. Connect signal output wires to the block on the right. Connect the positive (+) wire to the top screw-terminal. Connect the negative (-), or common wire, to the bottom screw-terminal. (See the back of the board for terminal labels.) The terminal block on the left is for an external power source if one is used (see appendix).

Optional external supply (+)
5 to 16 VDC. Remove batteries

Common (-)



Signal: After each 0.01-inch of evaporation, the ETgage's circuit pulls the signal line low for 2.3 ± 0.7 seconds. Normally this line appears as an open-circuit, with infinite impedance. During an output pulse it falls to 35 ohms¹. The receiving equipment must supply voltage through a pull-up resistor, or other means. Maximum voltage supplied to the signal line should not exceed 30 VDC since larger values will cause an over-voltage current to flow.

PRIMING

1. Use grocery store quality distilled water to prevent mineral build-up on the evaporation surface.
2. Unclip the top assembly from the reservoir. Remove the stopper, and fill the ceramic cup with water. If the ceramic is dry, allow a little time for it to soak up, and re-fill to the top. Push and twist the rubber stopper firmly into the cup.
3. Fill the reservoir with water (this is the main body section). For models with a sight tube on the side of the reservoir, excess water may be drained to bring the level to the zero mark by pulling the sight tube downwards, slipping it out of the upper fitting. The two sliding red markers on the glass sight tube provide visual tracking of water use.
4. Install batteries *only if an external power supply is not to be used*. Unclip the lower compartment enclosure and install four (4) "AA" alkaline batteries. Positive (+) battery ends

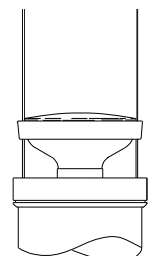
¹ The 35-ohm impedance can be reduced to about 2-ohms by shorting out R11 on the printed circuit board. This will reduce the circuit's ability to withstand lightning damage, but may be necessary for *directly* driving some older types of electromagnetic recording equipment. Current should be limited to under 0.2 amperes. The 33-ohm resistor, R11, is located next to the green terminal block for the signal at the upper right hand corner of the board. See appendix, and circuit schematic diagram.

must be installed at the battery holder locations marked by red plastic bands. Insert the negative end of each battery first and press the positive end in at the red band. If batteries are installed, *and* external power is used, the external supply will try to charge the dry-cell batteries. This will rupture the batteries causing them to leak corrosive fluid on the circuit board and damage it. Always remove batteries when using external power.

5. Press the button switch at the lower left corner of the circuit board to activate the valve, and allow water to run through the glass vial until it is clear of bubbles. This water is coming from the reservoir.
6. Attach a syringe to the upper end of the rubber tube that leads to the ceramic cup (where it would normally connect to the cup's stopper.) With power to the circuit, use the syringe to draw water through the system. Water will cycle through the glass measuring vial, moving in pulses. When the tube is full and free of bubbles, pinch it closed with the plastic clamp located just below the end of the tube.
7. Attach the tube to the stoppered cup. Both the tube and the ceramic cup should be full of water, and the stopper should be firmly in place to prevent air leaks (the water in the cup is under a small vacuum). Air in the cup will not affect accuracy since water makes its way to the top evaporation surface through the porous ceramic sides (but air will expand and contract with changing temperatures and that will affect short-term results, but not long-term results.) If the ceramic cup becomes dry because of air leaks, the system will stop.
8. Priming is now complete. Remember to release the tube clamp. Snap the top assembly onto the reservoir.

FIELD INSTALLATION

1. Protect from freezing. Install after the last spring frost, and remove the ETgage before the first fall frost.
2. Mount the instrument in an irrigated location where wind and sunlight are unobstructed. Placing the ETgage in a dry, fallow field or near hot pavement will give high evaporation readings.
3. Do not put the ETgage under a sprinkler because minerals in the water could contaminate the canvas cover. Instead, place it at the edge of a sprinkler-irrigated field.
4. Secure the stainless steel mounting bracket to the side of a post with the two screws provided. The top of the post must be below the top of the instrument. The canvas covered evaporation surface – which is at the top of the instrument – should be one meter (39 inches) above ground level.
5. Use only distilled water for filling the ETgage. If the canvas becomes very dirty, remove and wash it in warm water (not hot water). Rinse thoroughly to remove any soap. The covering must fit snugly so that there is no air between it and the evaporation surface.
6. To keep birds from perching on the instrument, and fouling its evaporation surface, mount the two 6 inch long “bird wires” as shown in the figure. There



are two opposing holes in the top of the gray plastic top. Insert each wire under the silicone rubber band, and into a hole.

7. For models with a sight tube on the side of the reservoir, the glass tube shows water level change in the reservoir. One-inch change in water level corresponds to one inch of reference ET. The scale under the sight tube is calibrated in tenths of inches and millimeters. Note the short flexible connecting tube at the bottom of the sight tube. *Squeeze this tube several times to force the water to rise and fall, allowing the water in the sight tube to find its natural level.* Using this method, you can make repeatable readings to about .02 inch.

Because all water to the evaporation cup must pass through the electrically operated valve on the circuit board, the Model E must be turned on and operating. For accurate sight tube measurements, eliminate any bubbles in the glass tube or its bottom fitting. If there are bubbles, remove them by first slipping the sight tube down and out of its top fitting, and then blowing into the tube to force water back into the reservoir. The water will come back into the tube without bubbles. The two sliding red markers on the sight tube can help you keep track of water use, or mark limits for allowable soil water depletion.

8. During heavy rainfalls, canvas covers may absorb rainwater. The absorbed water delays resumption of evaporation from the ceramic cup. This absorption can result in lower readings (an error of -0.02 to -0.05 inch).

LOW BATTERY VOLTAGE

The first component that will fail to operate due to falling battery voltage will be the solenoid valve. The glass vial will not refill and the valve will not respond to the push-button switch. This will happen at about 4 volts. To avoid data loss and the need to re-prime the system with water, replace batteries before the voltage gets too low. An indication of low voltage is sluggish valve response when you press the pushbutton switch at the lower left corner of the circuit board. (Pushing this button will not transmit a signal pulse, but it will add water to the glass vial. The unrecorded amount will generally be minimal since a full vial is equivalent to .01 inch ET.) Battery life for continuous operation is about six months.

DRAINING FOR STORAGE

- 1) Remove the ceramic cup, detach the rubber tube, remove the rubber stopper, and drain the cup. Use a twisting motion, or pry from side to side to remove the stopper. Pour water out of the reservoir.
- 2) Attach the syringe to the rubber tube and apply suction. If the circuit is still under battery power, the valve will block the flow for 15 seconds while trying to refill the glass vial. After this "time-out" period, the syringe can be used to completely remove water from the vial. Under freezing conditions, a vial full of water will freeze and break.
- 3) Remove batteries when not in use.

APPENDIX

1. **External Power Supply:** Terminal blocks for an external supply are located at the top left corner of the printed circuit board. They are marked EXT. SUP. "+" and "-" on the back of the circuit board. 5-VDC to 16-VDC may be supplied from an external source. The jumper wire at R12 labeled JMP1 should be cut if using an external power supply greater than 10 volts (but must be in place for the internal battery power). This will prevent wasting current on the solenoid valve, although no harm would result with a higher voltage since the duty cycle is low. If using an external supply, do not install batteries on the circuit board since they would be driven by the external supply. The circuit is protected against accidental reverse voltage.
2. **Timeout Circuit:** A "timeout" circuit keeps the solenoid valve from staying on more than 15 seconds. This prevents battery drawdown if the reservoir runs dry. Normal priming by filling the glass vial with the push-button switch will reset the timer. If, during priming, the system seems unresponsive, wait fifteen seconds: the timeout may have tripped.
3. **Circuit Board and Vial Replacement:**

To remove the circuit board:

- 1) Unclip lower compartment enclosure.
- 2) Remove the two silicone rubber tubes from the barbed fittings on the solenoid valve.
- 3) Remove the single slotted-head screw at the top of the board.

To replace the Pyrex glass vial:

- 1) Remove batteries from the front side of the circuit board.
 - 2) Remove the clear plastic cover plate (3 screws).
 - 3) Slip the silicone rubber tube off the inlet end of the vial. Silicone can weld itself onto glass; it may be necessary to cut the tube off with a razor blade.
 - 4) Loosen the Nylon clamp screw at the inlet end of the vial.
 - 5) Slide the old vial straight up, into battery space, and out.
 - 6) Slide in the new vial. Adjust its position to bring the red lines on the glass tubes into alignment with the two bottom shields which are mounted upright on the circuit board. (Three "shields" support the vial.) The red lines will be centered in the holes where the glass tubes pass through these two shields. To allow for the slight over-shoot when the vial fills (due to the 0.004 seconds the valve takes to close), you can slide the vial down 1/32 inch to bring the red mark (under the bulb) into the gap below the shield. Over-shoot error without the adjustment is only 0.5%.
 - 7) Tighten the Nylon clamp screw, reattach the silicone rubber tube, and replace the clear cover plate. Do not over-tighten plastic screws.
- 4) **Output Resistance:** On some older electromechanical data logging equipment, such as battery operated rain gauge strip chart recorders with stepping solenoids, a very low signal line resistance may be necessary. The 35 ohms of resistance in the ETgage Model

E output circuit can be reduced to less than ten ohms by shorting out R11 (see figure and schematic diagram). (This will reduce lightning protection to the ETgage.) Care should be taken to limit signal current to a maximum of 200 milliamperes. Alternatives to bypassing R11 are to use the ETgage to drive an intermediate switch such as a transistor or relay, or to install an optional reed relay output in the ETgage Model E (factory option, factory retrofit or customer installed).

LIMITED WARRANTY

The reliability and accuracy of the ETgage depends on proper installation, operation, and maintenance. This product is warranted against defects in materials and workmanship for one year. During the warranty period, we will repair or, at our option, replace, without charge for parts and labor, a product that proves to be defective. This warranty does not cover transportation costs, and it does not apply if the product has been damaged by accident, or by misuse, or by modification. No other express warranty is given. The repair or replacement of a product is your exclusive remedy. Except as provided herein, we make no warranties express or implied, including warranties of merchantability and applicability for a particular situation. In no event shall we be responsible for consequential damages. Products are sold on the basis of specifications applicable at the time of manufacture.

U.S. Pats.	4,709,585	5,311,769	5,423,206	5,389,311
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