

COOP D111E NOTE 1, MODIFICATION

Operations Division
W/OPS12: JD/GLD

SUBJECT: **Fischer & Porter/Belfort (F&P) Rebuild Version E (FPR-E) Installation (D111E)**

PURPOSE: To provide the instructions necessary to replace the tape punch mechanism in F & P precipitation gauges with digital data recording and reporting capabilities.

SITES AFFECTED: All F&P precipitation gauges will be rebuilt, to the limits of the FPR-E kit availability, as coordinated and managed by Observing Services Division (W/OS7).

AUTHORIZATION: The authority for this note is by National Weather Service Headquarters (WSH) direction. This modification is authorized by the Operations Division Director (W/OPS1) for the installation of the FPR-E at all existing F&P sites.

VERIFICATION STATEMENT: This procedure was tested and verified at the NWS Sterling Field Support Center (SFSC), and at National Weather Service Training Center (NWSTC).

ESTIMATED COMPLETION DATE: 30 days after receipt of parts and operations note.

TIME REQUIRED: An estimated three hours, exclusive of travel, will be required to unpack FPR-E equipment, remove the excess F&P parts, service the basic F&P gauge, mount the data logger and solar panel, connect cables, and setup/configure the modified precipitation gauge.

ACCOMPLISHED BY: NWS Representative (NWSREP) for local Cooperative Observer Program (COOP) operations.

EQUIPMENT AFFECTED: D111B F&P gauge

SPARES AFFECTED: See Attachment G.

PARTS/MATERIALS REQUIRED: See Section A.2.1.

SOURCE OF PARTS/MATERIALS: FPR-E kits will be initially issued by the National Logistics Support Center (NLSC) according to the implementation plan governed by OS7.

DISPOSITION OF REMOVED PARTS/MATERIALS: Selected parts (see Section A.6.7) will be retained at the Weather Forecast Office (WFO) until all local F&P gauges are rebuilt.

TOOLS AND TEST EQUIPMENT REQUIRED: See Section A.2.2.

DOCUMENTS AFFECTED: See Attachment F.

PROCEDURE: See Attachment A.

TECHNICAL ASSISTANCE: For questions or problems pertaining to this note, contact SFSC at (703) 661-1268 or nws.sfsc@noaa.gov.

REPORTING INSTRUCTIONS: Report the completed modification using a Cooperative Station Service Accountability (CSSA) site inspection report, and update the site metadata on the B-44 Station Information Report. Follow the reporting instructions in Section A.6.8 for example forms and entries.

Deirdre R. Jones
Director, Operations Division

ATTACHMENT A - Fischer & Porter/Belfort Rebuild Version E Assembly Procedures
ATTACHMENT B - FPR-E Checklist
ATTACHMENT C - Calibration Check Procedure
ATTACHMENT D - FPR-E Monthly Download Instructions
ATTACHMENT E - FPR-E Inspection Report Maintenance Notes
ATTACHMENT F - FPR-E Support Resources
ATTACHMENT G - FPR-E Spares and ASN
ATTACHMENT H - FPR-E Assembly Worksheet

ATTACHMENT A Fischer & Porter/Belfort Rebuild Version E Assembly Procedures

A.1 Before Starting FPR-E Assembly Procedures

NOTE: A worksheet to write down the FPR-E data used throughout this modification note is available in Attachment H.

A.1.1 Sterling Field Support Center (SFSC)

National Weather Service (NWS) SFSC is located approximately 30 miles west of Washington, D.C., in Sterling, VA. SFSC operates as an extension of NWS Headquarters (WSH) to provide operational support to field personnel through a combination of sensor testing, sensor system analysis, and contact center support. SFSC provides a critical service to the NWS field community by using years of experience gained through extensive sensor/system testing and maintenance to assist the field with sensor and system failures. When failures do arise in the field, SFSC provides assistance and help to solve the problems.

SFSC is a critical component of the Fischer & Porter/Belfort Rebuild (FPR) program. SFSC plays a major role in assisting the field when problems arise with FPR Kits installed at Cooperative Observer Program (COOP) sites around the country. SFSC should be the first point of contact made by NWS' Weather Forecast Offices (WFOs) if there are questions or issues with the FPR Kits. If SFSC is unable to solve the problem, SFSC will obtain assistance from WSH.

SFSC troubleshoots potential issues in the field with the installation and usage of the FPR Kits. SFSC is open Monday through Friday from 8:00 A.M. to 5:00 P.M. Eastern Time. SFSC is closed for all federal holidays. All e-mails and phone calls received during the hours of operation will be responded to in a timely manner. E-mails received during non-operation hours will be returned in the order they are received on the following day in which SFSC is open.

SFSC Contact Information:

Main line: (703) 661-1268

Back-up line: (703) 661-1293

E-mail: nws.sfsc@noaa.gov

A.1.2 Estimated Time Required

An estimated three hours is required to complete and verify the Fischer & Porter/Belfort Rebuild Version E (FPR-E) installation whether installing most of the assembly at the WFO and swapping out the gauge at the site, or if doing all the work at the site. WSH strongly recommends the first option – perform the modification at the WFO and swap out the gauge at the site – particularly for the first time performing the modification. WSH recognizes there is a large learning curve to transition from mechanical equipment to all electronic instrumentation and encourages all technicians and their Meteorologist-in-Charge (MIC) to learn this procedure and verify proper gauge operation in the comfort of the WFO before implementing in the field.

A.2 Taking Delivery of the FPR-E Kit

NOTE: For clear photos of the legacy Fischer & Porter/Belfort (F&P) gauges, see f-p_images on the Data Acquisition and Dissemination (DAD) Web site:
<http://www.srh.noaa.gov/srh/dad/coop/f-p.html>

For FPR-E Kit assistance, call SFSC between 8:00 A.M. to 5:00 P.M. Eastern Time, Monday through Friday, at (703) 661-1268, or e-mail at, nws.sfsc@noaa.gov.

A.2.1 FPR-E Kit Components

The FPR-E Kit will arrive at the WFO in one cardboard box. Unpack the shipping carton and inspect all items for visible damage. Use the packing list and the following check-off list (see Table A-1) to verify the Kit is complete. Resolve any discrepancies directly with the NLSC.

Table A-1: FPR-E Kit Check-off List

Container	Content	Yes/No
Main box	FPR-E ZENO® Assembly (ZENO® FPX Assembly)	
	Load cell (S - Type) with mounting hardware	
	Load cell S-hook	
	Solar panel – 10W, 12V nom., and integral with 15 ft. cable	
	Solar panel mounting hardware	
	FPR Kit Operations and Maintenance Manual	
	One USB flash drive	
Interior paper wrap	Battery – 12V, 7.2 Ah (6 lbs.)	

A.2.2 Tools and Test Equipment

The NWS Representative (NWSREP) must have the following tools and test equipment not supplied inside the Kit:

- Phillips screwdrivers, sizes: #0, #1 and #2
- Flat blade screwdriver (1/4-inch, 1/8-inch)
- Small adjustable wrench (or 1/2-inch and 7/16-inch wrenches)
- Electrostatic Discharge (ESD) ground strap
- Anti-seize compound
- Battery charger, 12V DC
- Multi-meter (or voltmeter and ohmmeter)
- Needle nose pliers with wire cutters/strippers
- Wire terminal crimping tool/stripper tool
- File (tool)
- Carpenter’s level
- Personal Computer (PC) with terminal emulation program and serial port (or USB to serial adapter), for access to the ZENO® data logger
- Serial communications cable (for PC) with 9-pin female end and 9-pin female end (null modem)
- Calibration weight set (Agency Stock Number [ASN]: D111-TE500)
- Wristwatch or Chronometer
- Alligator clips

A.2.3 Charging the New 12V Battery

1. Locate a battery charger capable of initially charging the new 12V battery to 14.8V (a three-stage charger is preferred).

WARNING

DO NOT use an automotive charger that cuts off at 13.8V or a charger that charges at a rate greater than two amps for this sealed battery.

2. Remove the 12V battery from its packaging. Remove terminal covers and attach charger cables to the battery's respective positive and negative terminals. Let it charge completely.
3. After the battery is fully charged, disconnect the charger cables and let it rest indoors for a day (with nothing connected).

NOTE: If the battery voltage stays within the range of 12.6V to 14.5V after resting, it will be ready to power the data logger in Section A.3.5.

4. Place the covers back on the 12V battery terminals. Follow the precautions outlined in [NWS Manual 50-1115, Battery Charging and Storage Operations](#).

A.2.4 Configuring the PC

If the PC only provides USB ports, attach a USB to Serial adapter and install the appropriate drivers. Make sure to write down the COM port assigned to the USB to Serial adapter device (if it is different from COM1) for Section A.4.1.

The terminal emulation program used throughout the installation is HyperTerminal. Any terminal emulation program can be used as the commands sent to the ZENO® data logger will be the same. The main difference in terminal emulation programs is in the interface to configure the COM port and to invoke text transfer for uploading/downloading configuration files.

During initial configuration of the ZENO® data logger, the data logger configuration code will be updated with the configuration file *FPRE_ConfigFile_SID.txt* (Section A.4.3). Download this configuration file from the WSH website: <http://www.nws.noaa.gov/ops2/Surface/coopimplementation.htm> (contained within *FPRE_ConfigFile_SID.zip*). Extract the configuration file and save this TXT file to a location on the PC.

A.2.5 Serial Communications Cable

A.2.5.1 Serial Cable Connections Needed

The serial communications cable with 9-pin female end and 9-pin female end (null modem) mentioned in Section A.2.2 can be configured in one of two ways, either as a complete DB-9F to DB-9F null modem cable or as a DB-9F to DB-9F straight through cable with null modem adapter. In either configuration, the serial cable, at a minimum, must have the pinouts listed below for use in signaling between the PC and the ZENO® data logger. Make sure to label one end for connecting to the ZENO® data logger (ZENO® end) and the other end for connecting to the PC (computer end).

ZENO® end			Computer end		
Pin	Signal		Pin	Signal	
1	DCD	-----	4	DTR	
2	RD	-----	3	TD	
3	TD	-----	2	RD	
5	SG	-----	5	SG	

CAUTION

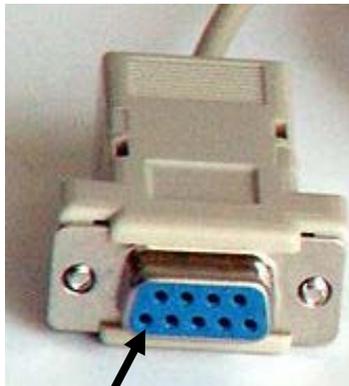
DO NOT USE a null modem cable with a null modem adapter.

A.2.5.2 Verifying Serial Cable Type

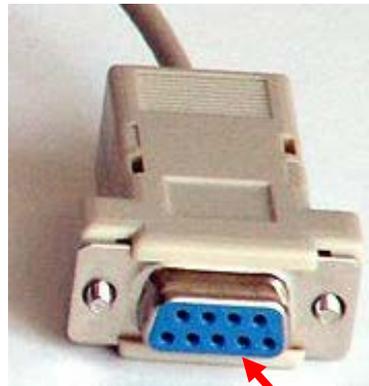
It is important to verify the serial cable is compatible with the FPR-E system to allow for successful two-way communications between the ZENO® data logger and the PC. Lay out both ends of the serial cable next to each other and use the continuity function in a multi-meter to check the pinouts. Place one of the multi-meter probes on pin 5 of the ZENO® end and the other on pin 5 of the computer end. Make sure that the probes touch the metal contacts inside the DB-9F connectors (with additional wires or clips). If the multi-meter beeps, this signal line works as expected; otherwise, the current serial cable will not work with the FPR-E system. Repeat this process for the rest of the pins (on the respective ends of the serial cable) in the order shown below (see Figure A-1). If the signal lines pass the continuity tests, then the serial cable is ready for use with the FPR-E system in Section A.4. Label each end **ZENO®** or **computer** (as identified by testing), and the serial cable as a null modem.

Touch multi-meter probe into the recessed hole (ZENO® end) for:

- a) pin 5
- b) pin 3
- c) pin 2
- d) pin 1



Pin 1



Pin 4

Touch multi-meter probe into the recessed hole (Computer end) for:

- a) pin 5
- b) pin 2
- c) pin 3
- d) pin 4

Figure A-1: Checking Signal Lines

If the signal lines do not pass the continuity tests above, test with one of the multi-meter probes on pin 2 of the ZENO® end and the other on pin 2 of the computer end. If the multi-meter beeps, the serial cable is probably of the straight through type and a null modem adapter is needed. Add a null modem adapter to this serial cable and repeat the continuity tests in the previous paragraph to verify two-way communications capability. Otherwise, obtain another serial cable and repeat this section.

A.3 Modifying the F&P Gauge inside WFO

A.3.1 Disassembling the F&P Gauge at Workbench

1. Remove the F&P conical hood, bucket, and casing housing. Empty, clean, and dry the bucket. The legacy rain gauge recorder is now accessible and ready to be disassembled (see Figure A-2).
2. If the F&P unit still has its paper punch tape on spool from service in the field, then make sure an OFF date and time has been marked. Manually decode this partial-month tape and enter hour-total and day-total amounts to *Form 79-1D* per National Climatic Data Center (NCDC) instruction. Follow the instructions in the *FPR-E Operations Manual, Chapter 1.6.3*, and e-mail the completed Form 79-1D to HPD.NCDC@noaa.gov. Complete this data recovery task prior to disassembling the F&P gauge and prior to mailing the partial-month tape to SourceHOV in Mt. Vernon, Kentucky.

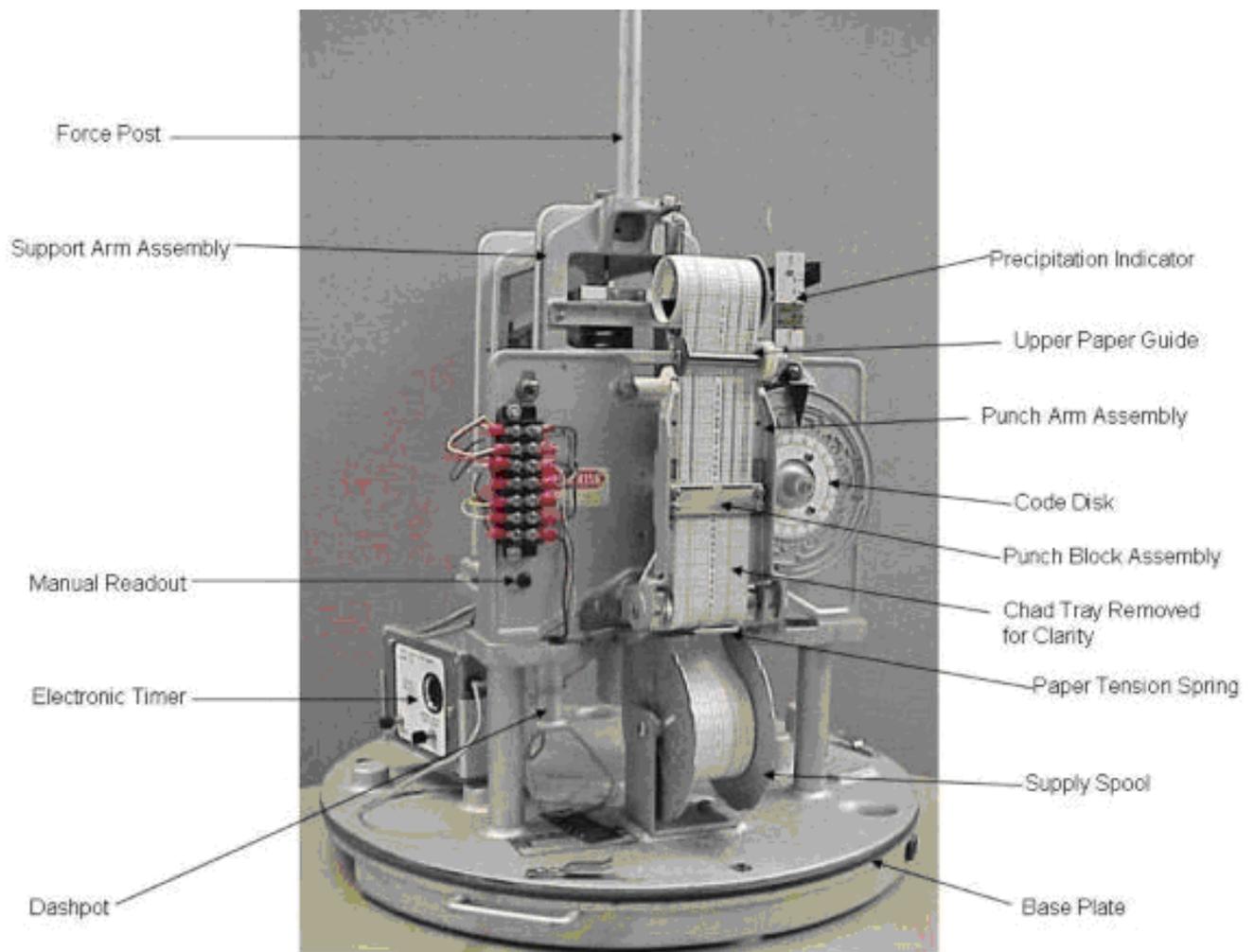


Figure A-2: F&P Gauge

3. Disconnect and remove the 6V battery. Save for use in another legacy F&P gauge, or package and retain the battery for proper disposal by the WFO.
4. Remove the 6V solar panel and its mounting bracket from the pipe supports.

5. Remove the internal wiring, clamps, and terminal strips.
6. Remove the small slotted screw, releasing the eyelet end of the wound cable from the front support arm assembly. Replace the screw to the support arm assembly.
7. Loosen the two 7/16-inch bolts holding the paper recorder assembly to the support stage (see Figure A-3).

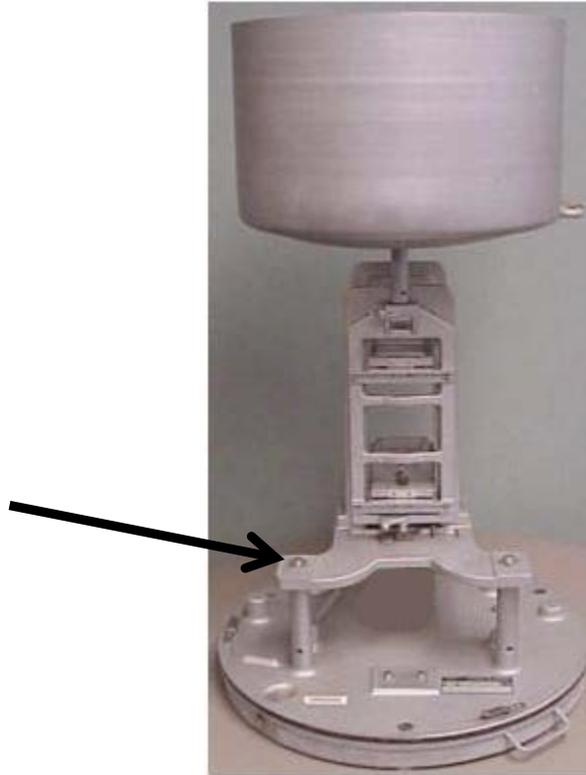


Figure A-3: Support Stage

8. Unhook the small tension spring from the front support arm assembly.
9. Remove the paper recorder assembly (including the punch motor assembly and code disk); and set it aside. Tighten the two 7/16 bolts loosened in Step 7.
10. Raise the front support arm assembly with shipping bolt so the dashpot piston is near the top of travel.
11. Unscrew the zero adjust knob and catch and remove the large coupled main spring as it falls away.
12. Reinstall the zero adjust knob and the top spring hook.
13. Remove the two screws holding the pointer and remove the pointer. Put the screws back.
14. Remove the tape spool assembly. Put the screws back.
15. Remove the plunger. Unthread it from the front support arm assembly.
16. Remove the dashpot. DO NOT put the screws back.
17. Remove the dashpot gasket and clean the oil off all surfaces.
18. Dispose of the dashpot oil in accordance with WFO policy.

19. Check all eight flexures. There are four on the top arm and four on the bottom arm. At the front and back of each arm are one horizontal flexure (D111-3SP112) and one vertical flexure (D111-3SP116). Replace any flexure that is bent, kinked, cracked, or broken. The upper-rear-horizontal flexure is most often damaged.

NOTE: All flexures must be flat and in good condition and all flexure-mounting screws must be tight to ensure proper operation with the load cell.

20. Save only those removed parts that are in good condition per instructions in Section A.6.6, and send the Regional COOP Program Manager (RCPM) an inventory report via e-mail. Otherwise, dispose of locally in accordance with WFO policy.

NOTE: After removing the paper recorder assembly, the support stage will be accessible, and bare as seen in Figure A-3. Make sure the gauge support stage is leveled or make it so by placing shims under the base. The following section assumes the support stage is leveled.

A.3.2 Installing the Load Cell Assembly

1. Open the FPR-E Kit box. Examine the Kit contents and account for the other components (see Section A.2.1).
2. Locate the load cell (see Figure A-4).
3. Write down the serial number (the serial number can be found on the middle of the load cell). It will be needed during the reporting procedures (Section A.6.7.2).



Figure A-4: Load Cell

4. Write down the three calibration constants (C1, C2, C3). The three calibration constants appear on the opposite side of where the serial number is located. The calibration constants are needed during the calibration procedures (Section A.4.6) and the CSSA B-44 update (Section A.6.7.2).

NOTE: The following installation procedures are similar to the Original Equipment Manufacturer (OEM) manual provided by Coastal Environmental Systems, Inc. (CES). It may help to follow both. Locate the *FPR Kit Operations and Maintenance Manual*, published by CES, if needed.

CAUTION

Use care when handling the load cell. It is a sensitive and accurate sensor and can be damaged by rough handling.

5. Install the S-hook on the top spring hook. The orientation of the S-hook does not matter.
6. Hook the load cell to the bottom of the S-hook with the writing on the load cell upright. The load cell cable is passed through the left side or back of the F&P weighing assembly and aligned away from the flexures in the front. Rotate the load cell mounting hardware (rod ends) to route the cable out the left side (as shown in Figure A-5) or back. Finger tighten the rod ends into the screw holes and then back off by a quarter turn.

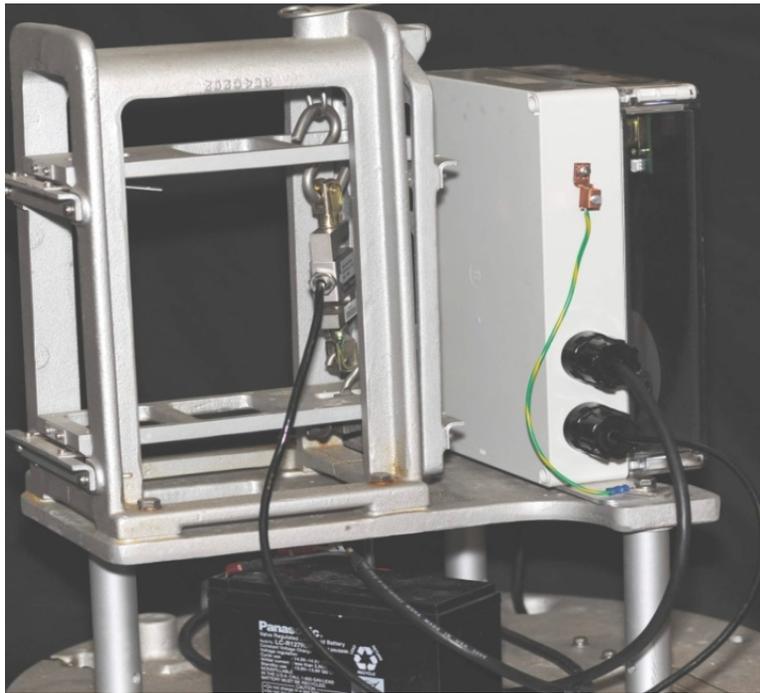


Figure A-5: Left-Side of F&P Weighing Assembly

7. Attach the bottom spring hook to the bottom of the load cell. Lower the shipping bolt so the front support arm hangs on the load cell. Adjust bottom spring hook position front to back with the range adjust screw underneath the bottom flexure arm, if necessary, to ensure load cell is oriented vertically, perpendicular to the support stage.
8. Ensure the load cell does not contact any part of the gauge except at the mounting points. Adjust the zero adjust knob until the bottom flexure arm is parallel with the support stage. Eye level comparison is acceptable.
9. Raise the shipping bolt to support the gauge flexures to prevent shock damage to the load cell during gauge movement, when installing the gauge bucket and while loading calibration weights into the gauge bucket. See Figure A-6.

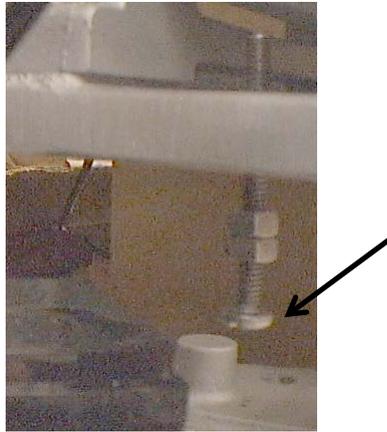


Figure A-6: Shipping Bolt

10. Leave the front support arm resting on the shipping bolt for a later step to perform calibration, as described in Section A.4.6.

A.3.3 Mounting the FPR-E ZENO® Assembly and Connecting Load Cell Cable

1. Remove the FPR-E ZENO® Assembly from its box.
2. Write down the FPR-E ZENO® Assembly Serial Number (see Figure A-7). The serial number will be needed for the CSSA B-44 update (Section A.6.7.2).

Serial Number
(i.e., 103)

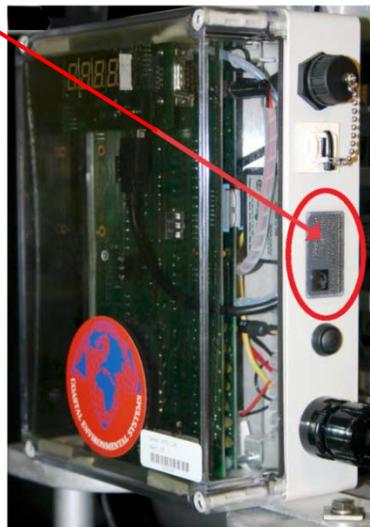


Figure A-7: FPR-E ZENO® Assembly Serial Number

NOTE: The serial number appears above the button on the side of the FPR-E ZENO® Assembly.

3. Completely remove the front two 7/16-inch bolts and washers from their holes on the support stage platform.
4. Place the FPR-E ZENO® Assembly with the display facing the door of the F&P gauge on the support stage where the paper recorder assembly was attached. Position the washers over the two holes of the mounting flange.

5. Apply anti-seize compound to the 7/16-inch bolt, and insert it into the right-side hole of the mounting flange with the washer gripped under the head of the bolt.
6. Locate the FPR-E ZENO® Assembly's green/yellow grounding wire and position it over the square washer, under the lock washer, on the left-side hole of the mounting flange. Apply anti-seize compound to the 7/16-inch bolt, and insert it into the left hole with the green/yellow grounding wire loop terminal gripped under the head of the bolt. Tighten both bolts. See Figure A-8.



Figure A-8: FPR-E ZENO® Assembly Bolted to Support Stage

7. Proceed to Section A.3.4 if the load cell cable is already connected in the FPR-E ZENO® Assembly. Otherwise, continue to Step 8.

CAUTION

The I/O printed circuit board (PCB) inside the FPR-E ZENO® Assembly is ESD sensitive. Before removing the cover, either put on an ESD ground strap on your wrist and connect it to the gauge, or keep one hand on the ground lug of the FPR-E ZENO® Assembly while working inside the case.

8. Loosen the screws at the front corners of the FPR-E ZENO® Assembly with a No. 1 Phillips screwdriver, and remove the clear front cover. Keep the desiccant bags, as they will be placed back inside the FPR-E ZENO® Assembly enclosure.
9. Loosen the gland fitting on the lower left side of the FPR-E ZENO® Assembly. Feed the load cell cable through the fitting parts (see Figure A-9). Thread it through the fitting into the FPR-E ZENO® Assembly and bring the wires around to the front of the I/O PCB.

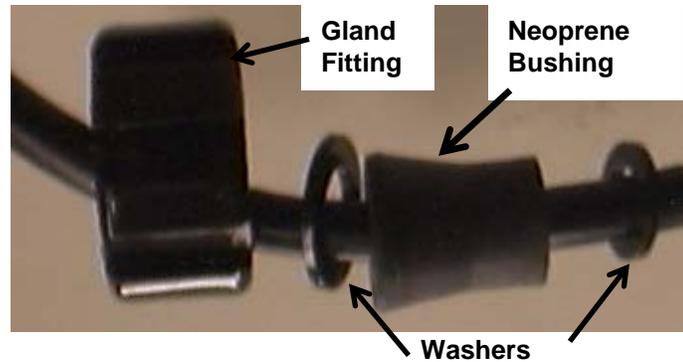


Figure A-9: Load Cell Cable Fed Through Fitting Parts

10. Locate the bottom two black terminal blocks on the lower half of the I/O PCB. Using a small flat blade screwdriver, loosen the terminal screws on the I/O PCB terminal blocks.
11. Connect the wires to the terminals (Figure A-10) and tighten each terminal screw until snug. Tighten the gland fitting.

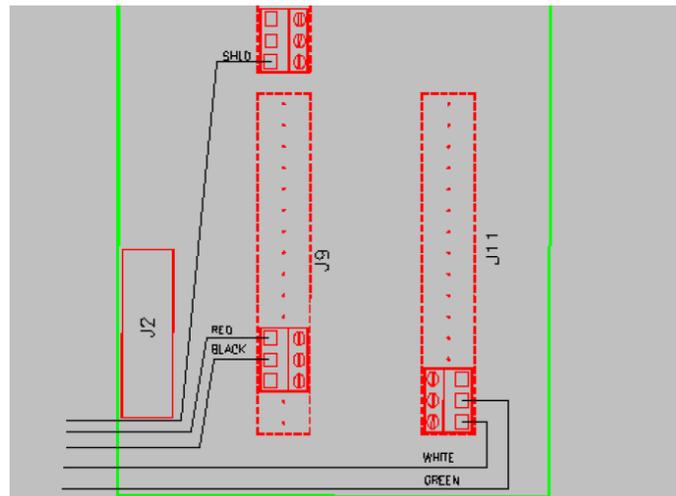


Figure A-10: Wiring

12. Insert all desiccant bags back into the FPR-E ZENO® Assembly enclosure and install the cover. Tighten the four lid screws evenly to compress the cover gasket evenly.

A.3.4 Connecting the Solar Panel

CAUTION

Some installers have reported the corners of the solar panel frame are sharp. If the corners are sharp, slightly round them with a file, scraper, other appropriate tool. Use of a hammer is not appropriate. The frame is soft aluminum and is easily shaped.

1. Locate the solar panel assembly with mounting hardware.

NOTE: The solar panel mounting arm has a hole on one end sized to fit over the threaded rod of the F&P gauge mounting stand. In the field, install it over the mounting rod and under the circular base plate of the gauge. Install it either under the door (preferable, as shown) or to the right of the door if using the rod under the door will not provide a good southern exposure on the solar panel (see Figure A-11).



Figure A-11: Solar Panel Installed

2. Mount the solar panel on the mounting arm using the supplied mounting hardware. The rubber pad mounts between the arm and the pipe to prevent the pipe from rotating on the arm.

NOTE: To determine which mounting hole to use for the site's location, use the following for guidance (see Figure A-12):

Latitude 0° through 27° use the 30° mounting hole
Latitude 27° through 42° use the 45° mounting hole
Latitude 42° and beyond use the 60° mounting hole

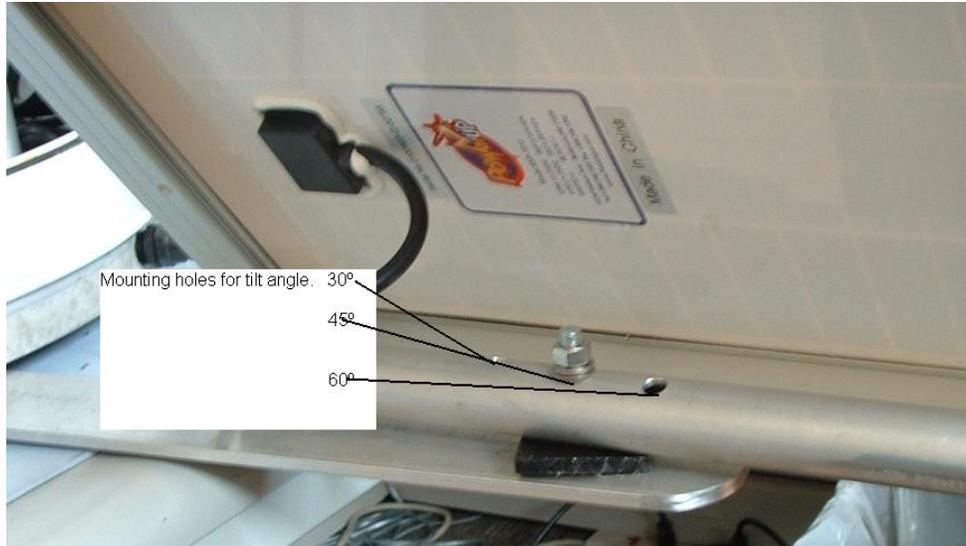


Figure A-12: Mounting Holes for Tilt Angle

3. When at the site, make sure the solar panel faces south and is not shaded by trees or other obstructions. With the panel facing south, tighten all mounting screws and nuts to securely hold panel in place.
4. Locate and remove the plug from the lower right of the F&P gauge door on the F&P gauge base (see Figure A-13).

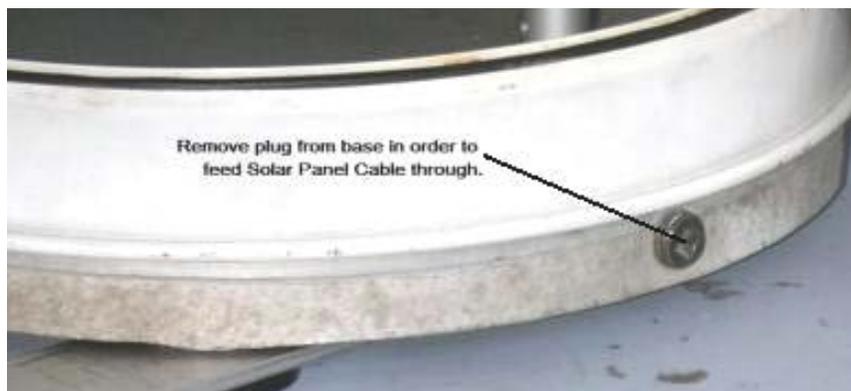


Figure A-13: F&P Gauge Base

5. Feed the solar panel cable through the hole, keeping the strain relief on the outside of the F&P base.
6. Screw the strain relief into the hole in the F&P base (see Figure A-14).



Figure A-14: Strain Relief (movable)

7. Strip the end of the solar panel cable to remove the heat shrink tubing (short rubber tubing) joining the black and white wires to the cable. The extra thickness of the shrink-wrap prevents the solar panel cable from moving through the gland fitting in Step 9. Make sure a total of 1/4-inch of insulation is stripped off the ends of the black and white wires for a good connection in the terminal block.

CAUTION

The I/O PCB inside the FPR-E ZENO® Assembly is ESD sensitive. Before removing the cover, either put on an ESD ground strap on your wrist and connect it to the gauge, or keep one hand on the ground lug of the FPR-E ZENO® Assembly while working inside the case.

8. Loosen the screws at the front corners of the FPR-E ZENO® Assembly with a No. 1 Phillips screwdriver, and remove the clear front cover. Keep the desiccant bags, as they will be placed back inside the FPR-E ZENO® Assembly enclosure.
9. Loosen the gland fitting on the right side of the FPR-E ZENO® Assembly and feed the solar panel cable through it. Make sure the cable also goes through the neoprene bushing (and washers) before it enters the FPR-E ZENO® Assembly.

NOTE: The neoprene bushing is a tight fit for the solar panel cable. Verify the shrink-wrap has been removed as in Step 7 and slowly push the small end of the bushing at an upward angle away from the exposed wires. Repeat this slow pushing around the small end of the bushing to even out the distance pushed. **Do not squeeze the bushing in the middle or from both sides as this will further increase the resistance to movement.** Alternatively, a small wrench can be used to push the small end of the bushing away from the exposed wires. Stop pushing when the small end of the bushing has reached three inches from the tips of the exposed wires (see Figure A-15).

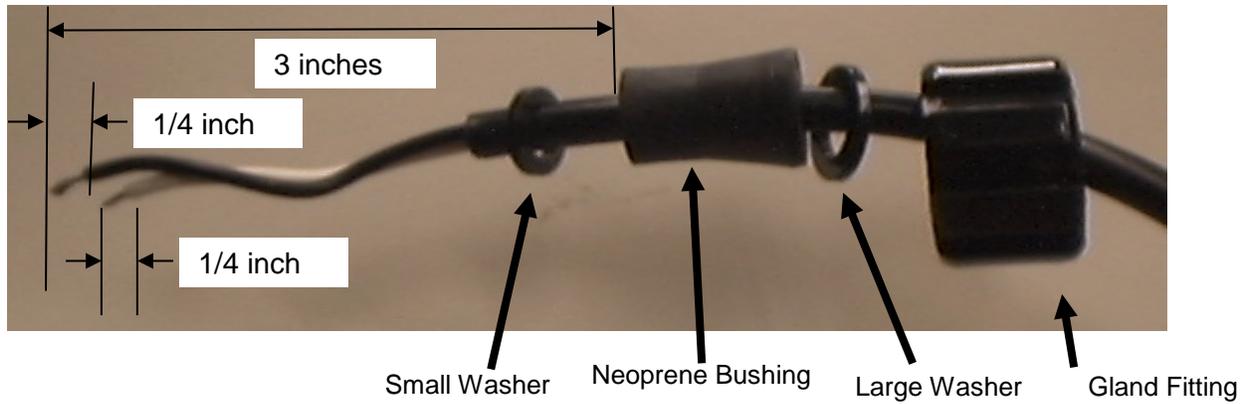


Figure A-15: Solar Panel Cable

10. Insert the black wire into the solar (-) terminal, and tighten with a screwdriver. Insert the white wire into the solar (+) terminal, and tighten with a screwdriver (see Figure A-16). Solar cable connections are as follows:

- Black wire to solar (-) terminal
- White wire to solar (+) terminal

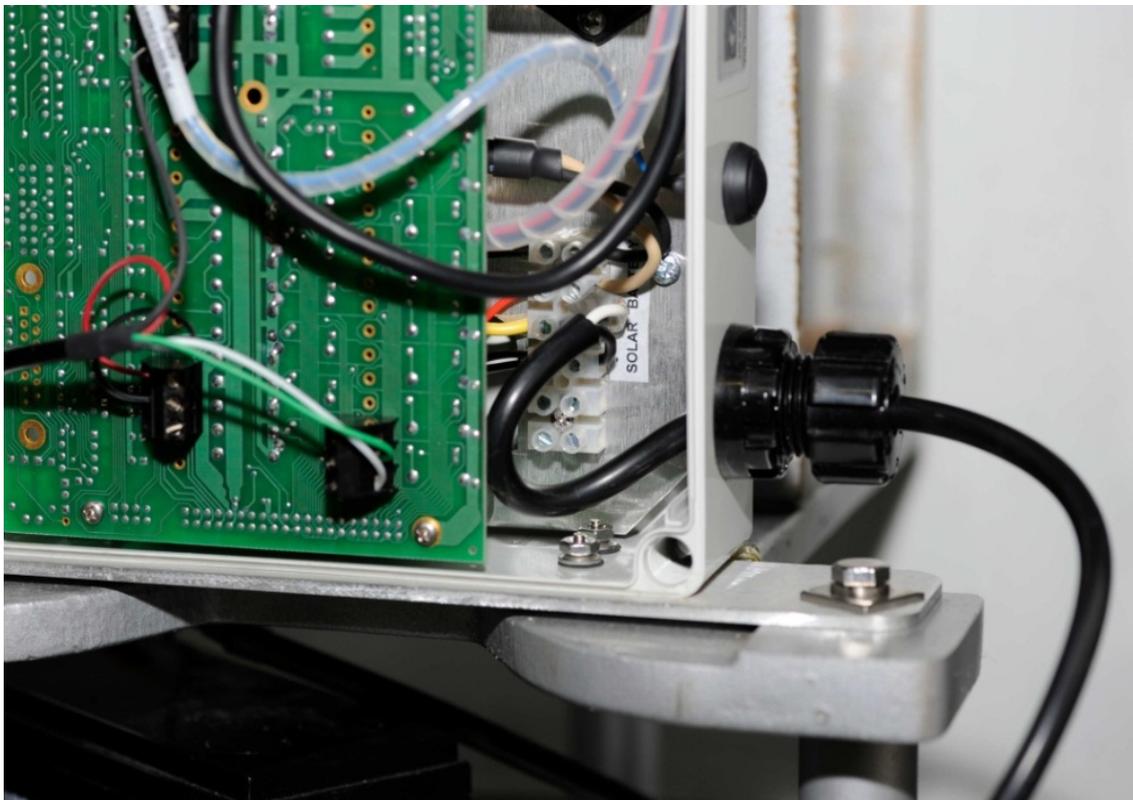


Figure A-16: Solar Panel Cable Installed

NOTE: Terminal block connections defined, top to bottom (see Figure A-17):

- Block 1: GND, battery
- Block 2: +12V, battery
- Block 3: +12V, solar
- Block 4: GND, solar
- Block 5: Unused
- Block 6: Unused

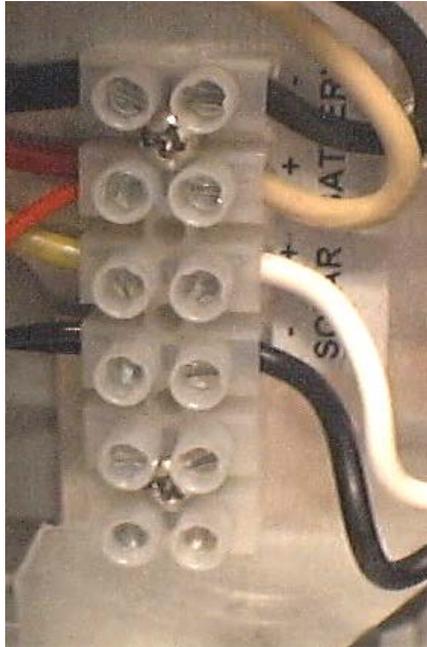


Figure A-17: Terminal Block Connections

11. Tighten gland fitting.

A.3.5 Powering Up System on 12V Battery

1. Remove the terminal covers from the 12V battery that was fully charged in Section A.2.3.
2. Place the battery with the terminal side away from the F&P gauge door on the base-plate, behind the FPR-E ZENO® Assembly on a flat resting surface, for stability.
3. Locate the battery cable (upper cable on left side of the FPR-E ZENO® Assembly). Plug the cable's black wire onto the battery's negative terminal marked black. Plug the cable's white wire onto the positive, red-marked battery terminal. The ZENO® data logger will start up when power is applied (see Figure A-18).

NOTE: There is no indication of the ZENO® data logger powering up. Wait at least 30 seconds before pressing the button on the side of the FPR-E ZENO® Assembly to confirm the ZENO® data logger is now automatically taking measurements and logging data. The illuminated display should show the most recently logged RAIN value (does not necessarily reflect the actual weighted value at the time the button was pressed) or dashes ("- - -") if no logged data is available.

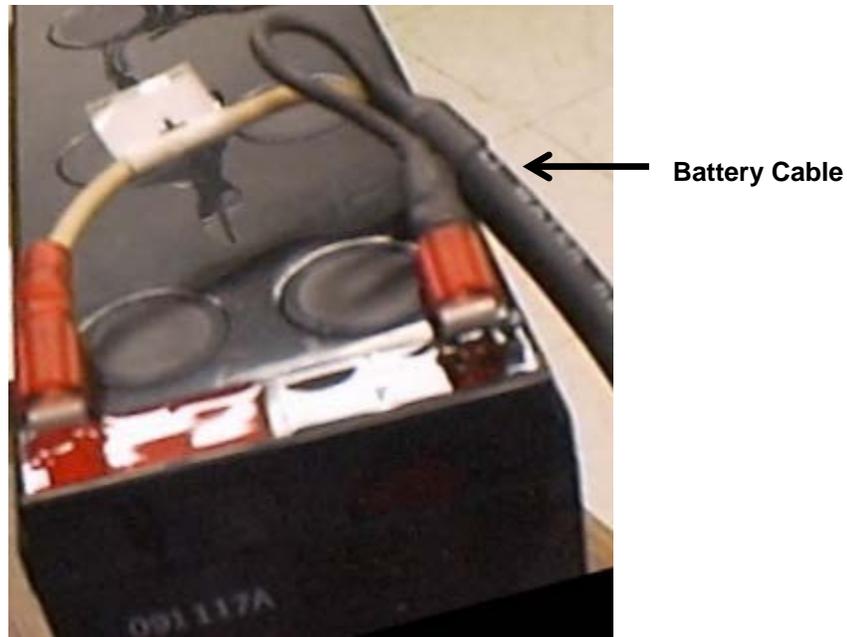


Figure A-18: Battery Cable

NOTE: If nothing is shown on the display after pressing the button, the fuse may have blown (especially if the battery cable connections were accidentally crossed for even a short period). Disconnect the battery, replace the time-delay “slow blow” fuse, ASN: D111E-2F1 (250V, 2A rating, MDL type) behind the display board (gray cap with slot), and repeat Step 3 of Section A.3.5.

A.4 Initializing and Calibrating FPR-E Inside the WFO

A.4.1 Connecting to the ZENO® Data Logger

NOTE: This section requires a computer with a terminal emulation program such as ProComm or HyperTerminal. It also requires a serial cable with 9-pin female end and 9-pin female end (null-modem) to connect the data logger to the computer (Section A.2.5).

1. Make sure to put on an ESD ground strap and remove the front cover (remember to keep the desiccant bags). Locate the ZENO® data logger’s serial port (see Figure A-19).

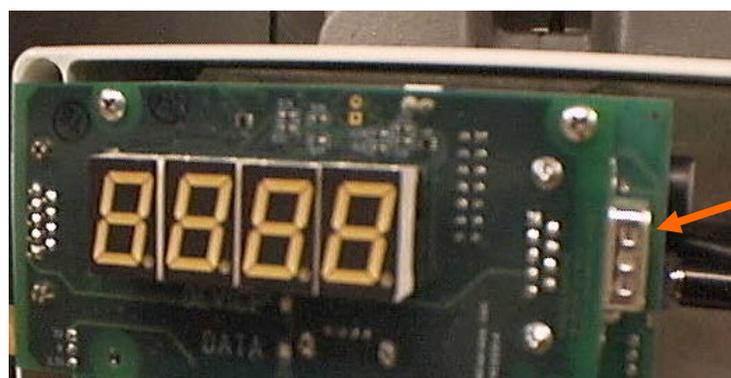


Figure A-19: ZENO® Data Logger’s Serial Port

2. Plug one end of the serial cable into the PC. On the other end of the serial cable, touch the metal shell of the serial cable connector to the ground lug. Connect the cable into the ZENO® data logger.

NOTE: Verify the PC contains the configuration file *FPRE_ConfigFile_SID.txt* and it has been configured according to Section A.2.4 before continuing with the following steps.

3. Set up the PC's HyperTerminal program by performing the following:
 - a. From the Windows desktop, click the **Start** button.
 - b. Click **Programs-Accessories-Communications-HyperTerminal** tab.

NOTE: Depending on the configuration of the PC, HyperTerminal may be installed in another location.

- c. Enter a name (e.g., FPR_Link) for the connection at the prompt. Select an icon and click the **OK** tab.
 - d. At the *Connect To* prompt, select **COM1** and click **OK**.

NOTE: Depending on the configuration of the PC, choose the appropriate COM port that connects the PC to the ZENO® data logger (e.g. COM3, COM12, etc.).

- e. Enter the following Port Settings:
 - 1) Baud rate: **9600** bits per second
 - 2) Data bits: **8**
 - 3) Parity: **none**
 - 4) Stop bits: **1**
 - 5) Flow Control: **none**
 - f. Click **OK**. The HyperTerminal screen will appear and a connection to COM1 will be established.

NOTE: Make sure the ZENO® data logger display is off before continuing with the following steps. Otherwise, a countdown is shown, indicating the time remaining until the display becomes inactive. Wait until the timer stops counting down (120 seconds) or press the button on the right side to turn off the display. At this point, the ZENO® data logger can respond to commands from the PC.

4. Type **u** **<enter>** to wake up the ZENO® data logger and enter the ZENO® User Menu shown in Table A-2.

Table A-2: ZENO® User Menu

USER MENU

(C) Communications Menu	(T) Test Menu
(F) System Functions Menu	(Z) Zeno Program Menu
(S) Sample Period Menu	(Q) Quit
(D) Data Retrieval Menu	(H) Help

NOTE: Since no commands were sent to the ZENO® data logger from the PC prior to this time, the **u** will not show up when pressed to access the ZENO® User Menu. All subsequent commands will be shown unless the ZENO® data logger times out due to no activity.

NOTE: All communications with the ZENO® data logger inside the FPR-E ZENO® Assembly are directed via menus activated by letter commands. The ZENO® User Menu is the starting point. All other menus can be reached by selecting one of the offered choices in the current menu. For example, to check the firmware version number, start at the User Menu, go to the System Functions Menu, and select the version command as shown in the next section.

Commands are **NOT** case sensitive. In other words, type either **u <enter>** or **U <enter>** to access the ZENO® User Menu.

While in any of the ZENO® menus, it is necessary to press **<enter>** every minute or two to prevent the ZENO® data logger from timing out due to no activity. If the ZENO® data logger does time out, simply type **u <enter>** to access the ZENO® User Menu (this **u** will not show) and return to the menu needed.

5. Proceed to Section A.4.2 if the ZENO® User Menu appears in response to the **u** command sent from HyperTerminal. Otherwise, continue with the rest of this section.
6. Make sure the display is off before the commands are sent to the ZENO® data logger. Repeat Steps 3 and 4 to enter the ZENO® User Menu. If there is still no response, keep the HyperTerminal window open (and connected) before proceeding to the next step.
7. With the PC connected to the ZENO® data logger, turn on the display. Verify the RAIN value shown on the display is shown in HyperTerminal. If nothing is shown or if garbled text is received, perform the following:
 - a. Locate the *Call* menu on the Menu Bar near the top of the HyperTerminal window and select **Disconnect**. Verify the port settings are set correctly as in Step 3.
 - b. Check the serial cable connections. Verify the correct end is connected to the ZENO® data logger (as labeled in Section A.2.5).

CAUTION

The following test checks the output voltage of your computer. DO NOT short these connections, even momentarily, or you could destroy the COM port of your computer.

- c. Disconnect the ZENO® end of the serial cable, but leave the computer end connected. Use a multi meter set to VOLTS (DC), and touch the red probe to pin 1 and the black probe to pin 5 on the ZENO® end of the serial cable (see Figure A-20). Write down or take note of the voltage level. With the HyperTerminal session disconnected (see *Status Bar* near the bottom of the HyperTerminal window), the voltage should be **LOW** (i.e., in the range of -25V to +2.0V). In the HyperTerminal window, press **<enter>** to connect HyperTerminal to the ZENO® data logger. Verify the voltage level has changed, is **HIGH**, and has a magnitude greater than +3.0 V. Toggle between **CONNECT** and **DISCONNECT** (Call menu, **Disconnect**) in HyperTerminal. The voltage at the end of the serial cable should be

HIGH on *CONNECT* and **LOW** on *DISCONNECT*. If you do not see the voltage switching, check your serial cable again per Section A.2.5, and if voltage does not switch, have the Information Technology Officer (ITO) check the COM port of your computer.

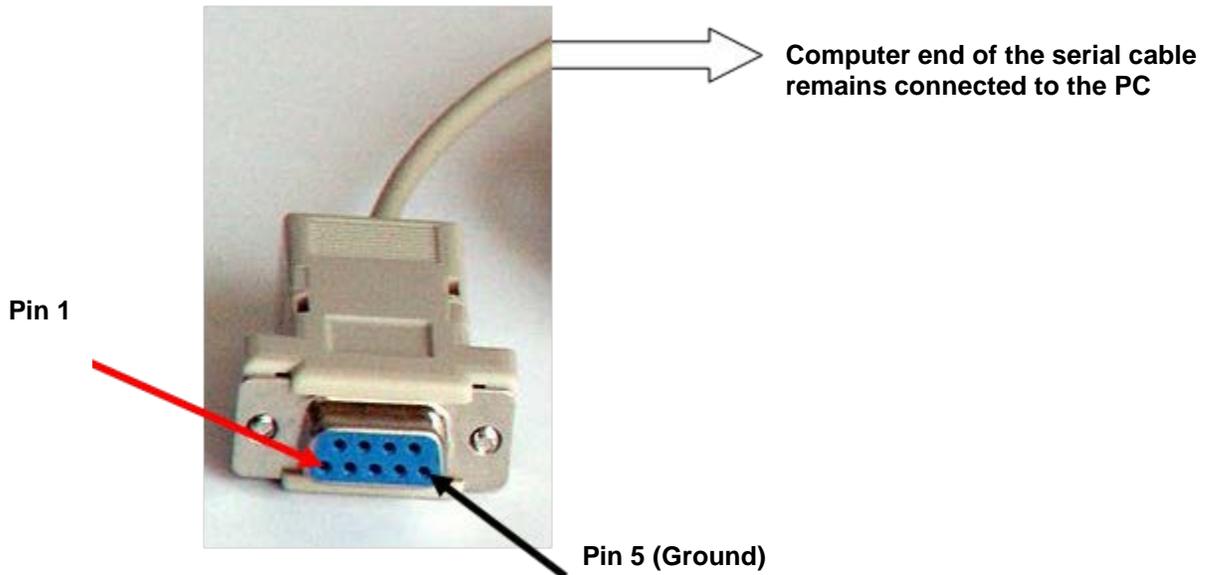


Figure A-20: Probing Serial Cable

8. Connect the ZENO® end of the serial cable back into the ZENO® data logger. Repeat Step 4 to enter the ZENO® User Menu.

A.4.2 Initial Configuration

1. Access the ZENO® User Menu via the PC as described in Section A.4.1, if not already displayed on the PC.
2. Verify Firmware Version by performing the following:
 - a. At the User Menu, type **f** <enter> to access the System Functions Menu shown in Table A-3.

Table A-3: ZENO® System Functions Menu

SYSTEM FUNCTIONS MENU	
(Cn/m) Change Item n To Value m	(I) Contact Info
(S) System Date And Time	(E) Save To EEPROM
(T) Calibrate Internal Temp	(U) User Menu
(V) Program Version	(Q) Quit
(K) Constants Menu	(H) Help
(B) BIT Names Menu	

- b. Type **v** <enter> to view program version. The correct firmware version number and date is **V2.02-Z16eD Jan 28 2009**. Write down the version number of the data logger firmware.
- c. Type **u** <enter> to return to the ZENO® User Menu.
- d. Type **d** <enter> to access the ZENO® Data Retrieval Menu. Type **L1** <enter> to look at the most recent data sample. Write down the configuration version shown at the end of the data sample (e.g. **FPR0E** or **FPR-E001**).

DATA RETRIEVAL MENU

(A) Show Records AFTER Specified Time	(F) Flash Memory Information
(B) Show Records BETWEEN Timespan	(D) Delete All Data Records
(Ln) Show LAST n Records	(N) Number of Records Logged
(*) Show ALL Data Records	(U) User Menu
(@n) Show n Unmarked Records	(Q) Quit
(M) Mark Recently Shown Data	(H) Help
(C) Compute Data Logging Capacity	

NOTE: If no logged data is available, wait 15 minutes before repeating the above step (Step 2.d).

- e. Type **u <enter>** to return to the ZENO® User Menu.
 - f. If the configuration version is **FPROE**, continue with Step 3 to change the Administrator Password and to update the configuration code in Section A.4.3. Otherwise, proceed to Section A.4.4 to set the time *after* making note of the new Administrator Password in Step 3.
3. Perform the following steps to change the administrative password:
- a. At the User Menu, type **z <enter>** to access the ZENO® Program Menu.
 - b. Type **zeno <enter>** for the administrator password. The following screen will appear:

Waiting for all data acquisition tasks to finish . . .

ZENO PROGRAM MENU

(S) Sensor Menu	(M) Memory Management Menu
(P) Process Menu	(W) Password Menu
(D) Data Output Menu	(R) Reset System
(T) Sensor Timing Loop Menu	(E) Save Parameters To EEPROM
(O) Output Message Timing Menu	(U) User Menu
(L) System Load Menu	(Q) Quit
(G) General Serial Script Menu	(H) Help

- c. Type **w <enter>** to access the Password Menu. The following screen will appear:

PASSWORD MENU

(A) Change Administrator Password	(Z) Zeno Program Menu
(U) Change User Password	(H) Help
(V) View All Passwords	

- d. Type **a <enter>** to select *Change Administrator Password*.
- e. Type **zeno <enter>** for the current administrator password.
- f. Type **FPRECOASTAL <enter>** as the new administrator password.

NOTE: Passwords are NOT case sensitive. In other words, you can type either **fprecoastal <enter>** or **FPRECOASTAL <enter>**. Only use the password, **FPRECOASTAL**, it is NWS convention for this rain gauge.

- g. Type **FPRECOASTAL <enter>** again to verify the new administrator password. The following screen will appear:

*Password modified***PASSWORD MENU**

(A) Change Administrator Password	(Z) Zeno Program Menu
(U) Change User Password	(H) Help
(V) View All Passwords	

- h. Type **z <enter>** to return to the ZENO® Program Menu.
- i. Type **u <enter>** to return to the ZENO® User Menu.

A.4.3 Updating Configuration Code in Data Logger

NOTE: PROHIBITION AGAINST LOCAL CHANGE: No one has authority to change the ZENO® data logger configuration code without the express and written direction of Observing Services Division (W/OS7), of the NWS.

Each FPR-E system comes delivered with a manufacturer developed configuration code already installed. However, the manufacturer's code does not include the state portion of the COOP site number in the data file. Therefore, for the initial deployment, W/OS7 authorizes the use of an NWS developed configuration to allow the full 8-digit COOP site number to be included with each data record. The Engineering & Acquisition Branch (W/OPS11) has developed and certified the new configuration.

NOTE: IMPORTANT: It is imperative upon assembly of the FPR-E to update the manufacturer's configuration with the one developed by NWS. The new data structure defined in the NWS developed configuration is the one recognized by the NCDC data ingest processors. Failure to update the FPR-E to this new configuration will result in processing errors when NCDC applies algorithms to produce the Hourly Precipitation Data (HPD) product.

The new configuration is loaded into the ZENO® data logger with the configuration file *FPRE_ConfigFile_SID.txt* saved to the PC in Section A.2.4. If needed, download this configuration file from the WSH website: <http://www.nws.noaa.gov/ops2/Surface/coopimplementation.htm> (contained within *FPRE_ConfigFile_SID.zip*). Extract the configuration file and save this TXT file to a location on the PC that will connect to the ZENO® data logger.

CAUTION

DO NOT change the file after saving it! The configuration files are text files that are viewable in Notepad, but do not change them in any way or they will not work. Do not use a word processor to view the file because it will add considerable formatting and control characters when it opens the file, rendering it useless as a file for updating the configuration code.

Perform the following steps to install the SID code to the ZENO® data logger.

1. At the User Menu, type **z <enter>** to access the ZENO® Program Menu (if prompted for the administrator password, enter the password set in Section A.4.2).
2. Type **L <enter>** to access the *System Load* Menu. The following screen will appear:

SYSTEM LOAD MENU

(R) Receive Configuration From Host (Z) Zeno Program Menu
 (T) Transmit Configuration From Zeno (H) Help
 (V) View Configuration & Menus (ASCII)

3. At the System Load Menu, type **r** <enter> to signal the ZENO® data logger to upload the new configuration file.
4. Type **y** <enter> to accept deletion of all data records and/or to proceed with the file upload.
5. Locate the Transfer menu on the Menu Bar near the top of the HyperTerminal window and select **Send Text File**. Find the configuration file named *FPRE_ConfigFile_SID.txt* and click **Open** to send the text file to the ZENO® data logger. When done, the ZENO® data logger will return to the System Load Menu and start sampling with the new configuration.

CAUTION

DO NOT use *Send File* from HyperTerminal. Always use *Send Text File*.

6. Type **z** <enter> to return to the ZENO® Program Menu.
7. Type **q** <enter> to exit. Do not close the HyperTerminal window.
8. Wait until the first data is available at the quarter of the hour of the ZENO® data logger system clock (may take up to 15 minutes). Verify the first data sent to the PC (displayed in HyperTerminal) from the ZENO® data logger is similar to the following sample data line:

#41005678 10/10/17,17:30:10,15.00,14.999,13.7,22.3,0,FPR-E001

The format is #41005678 yy/mm/dd, hh:mm:ss, PL, P-Cal, BV, IT, BIT, VERS where:

Field	Definition	Units
41005678	Default COOP site number	User settable
yy/mm/dd	Year, Month, Day	
hh:mm:ss	Hour, Minute, Second	
PL	Current Precipitation Level	Inches (2 decimal places)
P-Cal	Precipitation Calibration Value	Inches (3 decimal places)
BV	Battery Voltage	Volts
IT	Internal Temperature	Degrees Centigrade
BIT	Built In Test	
VERS	Configuration Version	FPR-E001

If the data is not in this format, the new configuration is not loaded. Type **u** <enter> to access the ZENO® User Menu (this **u** will not show) and repeat this entire section (Section A.4.3) again.

NOTE: The new configuration is temporary and will be lost if power is interrupted.

9. To save the new configuration permanently, perform the following steps:

- a. Type **u <enter>** to access the ZENO® User Menu (this **u** will not show).
- b. At the User Menu, type **z <enter>** to access the ZENO® Program Menu (enter administrator password when prompted).
- c. Type **e <enter>** to save the new configuration in non-volatile memory.
- d. Type **z <enter>** to return to the ZENO® Program Menu.
- e. Type **u <enter>** to return to the ZENO® User Menu.

A.4.4 Setting Time

1. At the User Menu, type **f <enter>** to access the System Functions Menu.
2. Type **s <enter>** to set the local standard time. The output should look similar to the following:

Current Date and Time: 10/10/17 15:30:22

Enter new Date and Time:

3. Enter the new date and time using the following format:

Format for date & time is **yy/mm/dd hh:mm:ss**, where:

yy is the year (00 to 99) Years are 1970 to 2069

mm is the month (01 to 12)

dd is the day (01 to 31)

hh is the hour (00 to 23)

mm is the minutes (00 to 59)

ss is the seconds (00 to 59)

CAUTION

The date and time format is always, Year/Month/Day Hour:Minute:Second. The ZENO® data logger will accept any numbers in any position, but unless the YY/MM/DD date and HH:MM:SS time formats are used; the ZENO® data logger's date/time stamps will not increment correctly, and the data will be useless.

NOTE: Ensure a wristwatch or chronometer in the forecast office is available that gives the current time to within 30 seconds. Try United States Naval Observatory's animated website: <http://tycho.usno.navy.mil/simpletime.html>.

A.4.5 Installing the COOP Site Number

1. Determine the COOP site number of the location for this FPR-E rain gauge.
2. At the System Functions Menu, type **c1/5678 <enter>**, where **5678** is the four character numeric site ID. This step uses the *Change Item n To Value m* command of the System Functions Menu, to change Item #1.
3. Type **c2/4100 <enter>**, where **4100** is the two character state ID plus two zeros.

CAUTION

**Items 1 and 2 have been changed to the example numbers used above.
Make sure to enter the unique COOP site number!**

<p>NOTE: The COOP site number is entered in the reversed order (site ID as Item 1, then state ID plus two zeros as Item 2) to ensure the data file is named with the site ID when downloading to the USB flash drive.</p>
--

The above changes are only temporary and will be lost if power is interrupted.

4. Save the COOP site number permanently by performing the following:
 - a. Type **e <enter>** to save site information in non-volatile memory.
 - b. Type **q <enter>** to exit.

A.4.6 Calibrating the System

The calibration is dependent on the bucket used. If a bucket from the field was not available to marry to this particular FPR-E rain gauge for permanent use, conduct an on-site calibration using the bucket to be used permanently at that site.

1. Enter the Load Cell calibration constants by performing the following:
 - a. Access the *ZENO® User Menu* via the PC, as described in Section A.4.1.
 - b. At the *User Menu*, type **f <enter>** to access the *System Functions Menu*.
 - c. At the *Systems Function Menu*, type **k <enter>** to access the *Constants Menu*. The following screen will appear:

CONSTANTS MENU

(Cn/m) Change Constant n to Value m	(E) Save Parameters To EEPROM
(P) Previous Page of Constants	(U) User Menu
(N) Next Page of Constants	(Q) Quit
(X) Erase All Constants	(H) Help

<p>NOTE: Make sure to input the minus sign in the following steps if the calibration constants C1, C2, and/or C3 are negative.</p>

- d. Type **c1/n <enter>** where **n** is the C1 calibration constant from the tag on the load cell. This uses the *Change Constant n To Value m* command of the *Constants Menu*, to change Constant #1.
- e. Type **c2/n <enter>** where **n** is the C2 calibration constant from the tag on the load cell.
- f. Type **c3/n <enter>** where **n** is the C3 calibration constant from the tag on the load cell.
- g. Type **e <enter>** to save calibration constants information in non-volatile memory.
- h. Type **q <enter>** to exit.
- i. Manually enter the calibration constants (C1, C2, C3) into the site's station log for future

reference.

2. Before starting the calibration procedure, check the flexures. Verify the flexures have not been inadvertently bent. In addition, make sure the gauge is level and the lower flexure arm is parallel to the support plate.
3. Enter the initial Load Cell calibration coefficients by performing the following:
 - a. Access the ZENO® User Menu via the PC as described in Section A.4.1.
 - b. At the User Menu, type **s <enter>** to access the Sample Period Menu. It is necessary to temporarily change the *Sample Interval* and *Offset* values for the calibration procedure.
 - c. Type **c1/12 <enter>**. The screen will update the Sample Period Menu and the following screen will appear:

SAMPLE PERIOD MENU

```
(Cn/m) Change Item n To Value m      (Q) Quit
(E)      Save Parameters To EEPROM    (H) Help
(U)      User Menu
```

```
Item 1:  12  (Sample Interval Time)
Item 2:  10  (Sample Duration Time)
Item 3:   0  (Sample Offset Time)
```

NOTE: The entries for Items 1, 2, and 3 are in seconds.

- d. Type **u <enter>** to return to the ZENO® User Menu. Then type **t <enter>** to display a Test Menu and the following screen will appear:

TEST MENU

```
(Rx,y)Display Sensors x-y RAW Data      (Ex) Display Sensor x Error Codes
(Sx,y)Display Sensors x-y SCALED Data  (P) SDI-12 Pass-Through Mode
(Cx) Calibrate Sensor Record x         (U) User Menu
(Vx) View Process Record x             (Q) Quit
(D) View Data Collection Counters      (H) Help
(B) Display BIT Status
```

NOTE: To access the Test Menu more efficiently while in another menu, type **u<space>t <enter>**. This shortcut can also be applied to other menus located above the User Menu.

- e. Type **c2 <enter>**. This request calibrates sensor number two. If prompted for the administrator password, enter the password set in Section A.4.2, Step 3.

This request will display the sensor name, the current *A conversion coefficient*, and a prompt to enter a new *A conversion coefficient*, for example:

```
Sensor Name: RainWeig
Conversion Coefficient A: 0
Enter new Conversion Coefficient A:
```

- f. Type **0 (zero) <enter>** for the new *A conversion coefficient*.

- g. The screen will display the current *B conversion coefficient* and prompt for a new value. Type **2000 <enter>** for the new *B conversion coefficient*.

Conversion Coefficient B: 1256.6

Enter new Conversion Coefficient B: 2000

- h. The screen will show the current *C conversion coefficient* and prompt for a new value. Type **0 (zero) <enter>** for the new *C conversion coefficient*.

Conversion Coefficient C: -4.92398

Enter new Conversion Coefficient C: 0

- i. Type **u <enter>** to return to the ZENO® User Menu.

A.4.6.1 Calculating Actual Gain/Slope

1. With an empty, clean, and dry bucket on the gauge, lower the shipping bolt so that there is a visible gap (~ 1/4 inch) between the end of the bolt and the front support. Verify the weight of the empty bucket assembly is on the load cell.
2. At the User Menu, type **d <enter>** to access the Data Retrieval Menu.
3. Allow the system to run for at least 90 seconds. Type **L6 <enter>** to look at the last six Precipitation Calibration (P-Cal) data samples. The P-Cal data value will be to three decimal places and is the fifth field for each sample record. If the last three are stable readings (i.e., within ± 0.005 inch), then write down the last P-Cal data value and label it **b1** for later use. If they are not stable, then wait for 60 more seconds and repeat.

NOTE: The load cell is very sensitive. Use care to not bump the gauge during the following steps. If it is windy, replace the upper gauge cover (including funnel) during the following measurements.

CAUTION

Be careful not to drop the weights, the load cell could be damaged and/or the flexures might bend. It is recommended to raise the shipping bolt while adding or removing weights to the bucket, and subsequently, lowering the shipping bolt to verify the weight of the bucket assembly is on the load cell.

4. Place 15 inches of weight into bucket. These are the three brass weights marked 4111g.
5. Allow the system to run for at least 90 seconds. Type **L6 <enter>** to look at the last six P-Cal data samples. If the last three are stable readings, then write down the last P-Cal data value and label it **b2** for later use.
6. Calculate the new gain coefficient B, with $B = 30000/(b2-b1)$. Round to the nearest hundredth (two decimal places). This equation represents (15 inches x gain) / (full weight - empty weight).
7. Type **u<space>t <enter>** to access the Test Menu. Type **c2 <enter>** to enter the new gain coefficient B (if prompted for the administrator password, enter the password set in Section A.4.2, Step 3). Leave A and C at zero by pressing **<enter>** at both prompts. Enter the calculated B value for gain coefficient B.

A.4.6.2 Calculating Actual Offset

1. Remove test weights from the bucket.
2. Type **u<space>d <enter>** to access the Data Retrieval Menu. Allow the system to run for at least 90 seconds. Type **L6 <enter>** to look at the last six P-Cal data samples. If the last three are stable readings, then write down the last P-Cal data value and label it **c3** for later use.
3. Calculate new coefficient C, with $C = -c3$.
4. Type **u<space>t <enter>** to access the Test Menu. Type **c2 <enter>** to enter the new offset coefficient C (if prompted for the administrator password, enter the password set in Section A.4.2, Step 3). Enter the calculated C value for coefficient C. Leave A and B as is by pressing **<enter>** for each.

A.4.6.3 Adjusting Actual Offset (Thermal Correction)

NOTE: Under some conditions, there can be a small additional offset correction required due to temperature corrections done automatically by the instrument. With the bucket still empty, wait at least 15 minutes before performing the following steps.

1. Type **u<space>d <enter>** to access the Data Retrieval Menu. Allow the system to run for at least 90 seconds. Type **L6 <enter>** to look at the last six P-Cal data samples. If the last three are stable readings, then write down the last P-Cal data value and label it **c4** for later use.
2. If $c4$ is not = 0, calculate the new coefficient C, with $C = -(c3+c4)$.
3. Type **u<space>t <enter>** to access the Test Menu. Type **c2 <enter>** to enter the new offset coefficient C (if prompted for the administrator password, enter the password set in Section A.4.2, Step 3). Leave A and B as is by pressing **<enter>** for each. If the new C value has not changed, press **<enter>** to leave the C coefficient as is; otherwise, enter the calculated C value for coefficient C.

A.4.6.4 Verifying Correct Calibration

1. Verify the weight of the empty bucket assembly is on the load cell.
2. Type **u<space>d <enter>** to access the *Data Retrieval* Menu. Allow the system to run for at least 90 seconds. Type **L6 <enter>** to look at the last six P-Cal data samples. Verify the last three values are 0.0 ± 0.02 inches. If not within this range, redo the calibration, starting with Section A.4.6, Step 3.
3. Raise the bucket with the shipping bolt then place the equivalent weight of 15 inches of precipitation into the weighing bucket. (Use the same three large brass weights (4111g) as used in Section A.4.6.1, Step 4.) Lower the shipping bolt 1/4-inch below the point at which the load cell is supporting the bucket weight.
4. Type **u<space>d <enter>** to access the *Data Retrieval* Menu. Allow the system to run for at least 90 seconds. Type **L6 <enter>** to look at the last six P-Cal data samples. Verify the last three values are 15.0 ± 0.02 inches. If not within this range, redo the calibration, starting with Section A.4.6, Step 3.
5. If the calibration was successful, type **u<space>s <enter>** to access the *Sample Period* Menu to reset the Sample Interval and Offset lines to the original values.

6. At the *Sample Period Menu* prompt, type **c1/900 <enter>**. You should see the following on your screen:

SAMPLE PERIOD MENU

```
(Cn/m) Change Item n To Value m      (Q) Quit
(E)      Save Parameters To EEPROM    (H) Help
(U)      User Menu
```

```
Item 1:      900  (Sample Interval Time)
Item 2:      10   (Sample Duration Time)
Item 3:       0   (Sample Offset Time)
```

NOTE: The entries for Items 1, 2, and 3 are in seconds.

A.4.6.5 Saving Load Cell Calibration Coefficients

1. While still at the *Sample Period Menu*, type **e <enter>** to save calibration values to EEPROM. The display should appear similar (the numbers will be different) to that shown below:

```
Verifying parameters can be stored in EEPROM . . .
Saving parameters to EEPROM . . .
Saving sensor lists to EEPROM . . .
Saving process lists to EEPROM . . .
Saving data output lists to EEPROM . . .
Saving repeater lists to EEPROM . . .
Saving general serial scripts to EEPROM . . .
Saving constants to EEPROM . . .
1057 out of 8192 bytes used in EEPROM.
Total EEPROM Writes = 17, EEPROM Checksum = 200.
```

NOTE: This action shuts down all ZENO® data logging.

2. Type **u<space>t <enter>** to access the Test Menu. Type **c2 <enter>** to view the conversion coefficients (if prompted for the administrator password, enter the password set in Section A.4.2, Step 3). Leave *A*, *B*, and *C* as is by pressing **<enter>** for each.
3. Write down the values of the three conversion coefficients (*A*, *B* [Gain/Slope], *C* [Offset]) for ready reference when conducting a future calibration check at the observer's site. If the calibration check (Section A.6.5 and/or Attachment C) fails to show measurements within ± 0.2 inch of 15.0 inches, this reference will be needed to see if the calibration coefficients have changed.

NOTE: To restore the calibration coefficients to the ones originally recorded, repeat Step 2, but type in the actual value of the calibration coefficients instead of pressing **<enter>** at the prompt for *A*, *B*, and *C*. Additionally, make sure to save these calibration coefficients to EEPROM via the *Sample Period Menu* (type **u<space>s <enter>**, then type **e <enter>**).

4. Type **q <enter>** to exit.

A.4.7 Completing Setup

In the event the ZENO® data logger loses its configuration for any reason, the backup configuration file (created below) can be reloaded by following the instructions in Section A.4.3 with this

configuration file instead of *FPRE_ConfigFile_SID.txt*. This configuration file includes the new data structure definitions, COOP site number, calibration numbers, and calibration coefficients.

1. Access the ZENO® User Menu via the PC as in Section A.4.1.
2. At the User Menu, type **z** <enter> to access the ZENO® Program Menu (if prompted for the administrator password, enter the password set in Section A.4.2, Step 3).
3. Type **L** <enter> to access the System Load Menu.
4. Type **t** <enter> to signal the ZENO® data logger to backup the current configuration code to a configuration file.
5. Locate the *Transfer* menu on the Menu Bar near the top of the HyperTerminal window and select **Capture Text**. Save the configuration file with the name ***FPRE_ConfigFile_SID_SS00NNNN_yyyymmdd.txt*** (where *SS00NNNN* is the COOP site number and *yyymmdd* is the date in year/month/day format). Click **Start** to begin text capture to the specified file location.
6. Press <enter> to display and capture the configuration file.
7. Locate the *Transfer* menu on the Menu Bar near the top of the HyperTerminal window. Select **Capture Text** and click **Stop** to stop the text capture when *EOF* is displayed.
8. Press <enter> to return to the System Load Menu.
9. Type **z** <enter> to return to the ZENO® Program Menu.
10. Type **q** <enter> to exit. Do not close the HyperTerminal window.

A.4.8 FPR-E ZENO® Assembly Functional Checkout

NOTE: As the ZENO® data logger (in a timed-out state) is still connected to the PC, HyperTerminal will also display messages related to the following two checkout procedures. If the ZENO® data logger has not timed out, make sure to quit the ZENO® Menu interface before continuing.

1. Verify display operation by performing the following:
 - a. Press the button on the right side of the FPR-E ZENO® Assembly to light up the display. See Figure A-21.

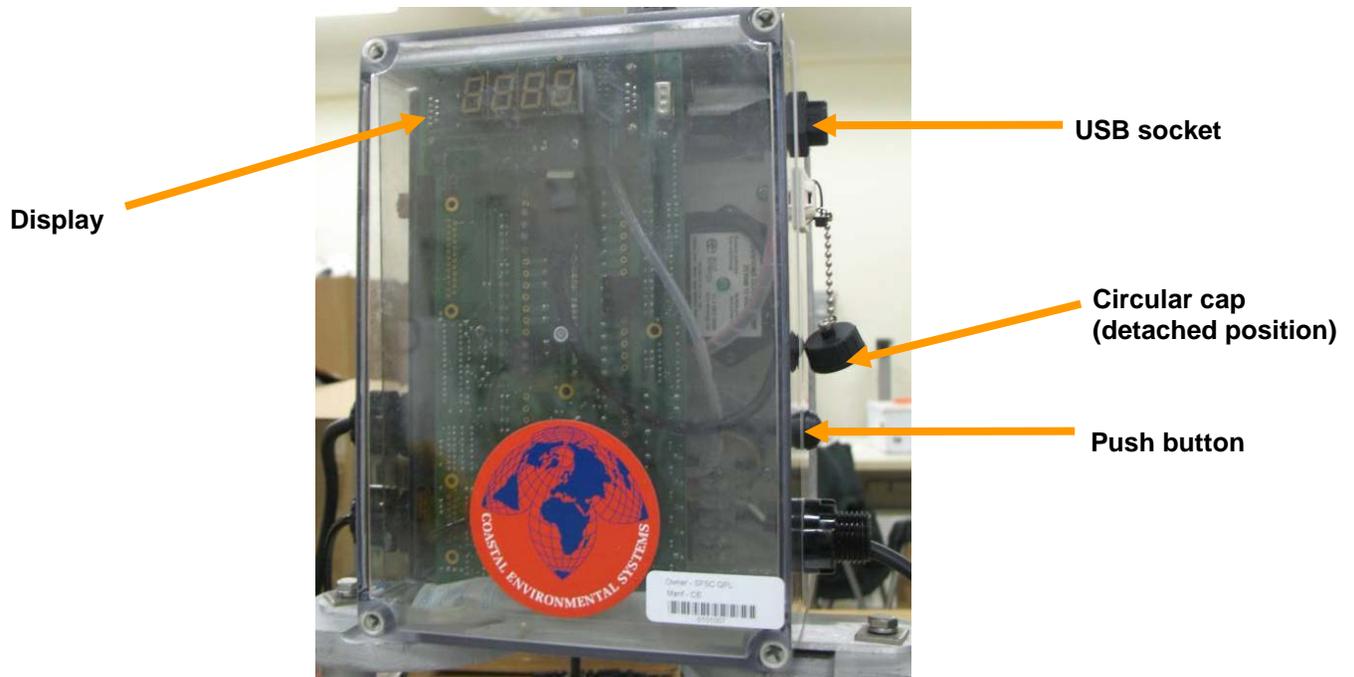


Figure A-21: FPR-E ZENO® Assembly

- b. Place a reference weight into the empty bucket. A single large 4111-gram weight represents five inches of precipitation.
- c. Press the button again after the next 15-minute sample interval. The RAIN value on the display should now show the increase.
- d. Verify display is showing data.

NOTE: If the ZENO® data logger was only recently powered up, there may be no data available as indicated by dashes (“- - -”). Data will be available at the quarter of the hour of the ZENO® data logger system clock.

2. Verify USB flash download operation by performing the following:

- a. Unscrew the circular cap covering the USB socket on the right side of the FPR-E ZENO® Assembly.
- b. Press the button on the right side of the FPR-E ZENO® Assembly to light up the display.
- c. With the display active, insert a USB flash drive into the USB socket.
- d. Watch the display for verification of USB flash drive insert. The display should show the approximate time left to download data as MM.SS (minutes and seconds).

NOTE: If the display shows *ERxx*, press the button to turn off the display. With the display off, press the button again. If display shows *ERxx* again, verify with the PC the USB flash drive is in good working condition and there is at least 3.5 Megabyte (MB) of room left for the data download.

- e. Watch the display for notice of download completion: *UFdC*.
- f. Remove the USB flash drive from its socket.

- g. Place the circular cap over the USB socket and tighten it.
- h. Verify display momentarily indicates “...” and then turns off.
- 3. Verify data logging with PC by performing the following:
 - a. Access the ZENO® User Menu via the PC as described in Section A.4.1.
 - b. At the User Menu, type **d** <enter> to access the *Data Retrieval* Menu.
 - c. Locate the *Transfer* menu on the Menu Bar near the top of the HyperTerminal window and select *Capture Text*. Save the text capture file with the name ***FPRE_Data_SS00NNNN_yyyymmdd.txt*** (where ***SS00NNNN*** is the COOP site number and ***yyymmdd*** is the date in year/month/day format). Click **Start** to begin text capture to the specified file location.
 - d. Type **L22** <enter> to display and capture the last 22 data records.
 - e. Locate the *Transfer* menu on the Menu Bar near the top of the HyperTerminal window. Select **Capture Text** and click **Stop** to stop the text capture when the *Data Retrieval* Menu displays.
 - f. Type **q** <enter> to exit.
 - g. View the text capture file, *FPRE_Data_SS00NNNN_yyyymmdd.txt*, and look at the data to verify the latest timestamp occurred within the last 16 minutes.
 - h. Make sure that each record is similar to the following sample data line:

#41005678 10/10/17,17:30:10,15.00,14.999,13.7,22.3,0,FPR-E001

Format is #SS00NNNN yy/mm/dd, hh:mm:ss, PL, P-Cal, BV, IT, BIT, VERS where:

Field	Definition	Units
SS00NNNN	COOP site number	User settable
yy/mm/dd	Year, Month, Day	
hh:mm:ss	Hour, Minute, Second	
PL	Current Precipitation Level	Inches (2 decimal places)
P-Cal	Precipitation Calibration Value	Inches (3 decimal places)
BV	Battery Voltage	Volts
IT	Internal Temperature	Degrees Centigrade
BIT	Built In Test	
VERS	Configuration Version	FPR-E001

- 4. Verify Date/Time with PC (yy/mm/dd hh:mm:ss) by performing the following:
 - a. Follow the procedure for setting date and time as outlined in Section A.4.4.
 - b. Follow the procedure for data logging as outlined in the previous step (Step 3), and proceed to Step 4.c.
 - c. Verify that the date and time are correct in the timestamps on logged data.
- 5. Remove the serial cable from the ZENO® data logger.
- 6. Insert all desiccant bags removed back into the FPR-E ZENO® Assembly enclosure and install the cover. Tighten the four lid screws evenly to compress the cover gasket evenly.

NOTE: If the desiccant bags are wet, replace them with dry ones. Insert three 1/6-unit desiccant bags or one 4-unit desiccant bag into the FPR-E ZENO® Assembly enclosure.

A.4.9 Transferring Data File from USB Flash Drive

A.4.9.1 Scanning the USB Flash Drive

Follow NWS policy on scanning removable media before use, and verify that **No Viruses Detected**. WSH recommends MacAfee Active Virus Detection (AVD) software, together with the Federal Desktop Core Configuration (FDCC) installed on a PC running WinXP. The PC should have no internet connections whatsoever, be as devoid as possible of any extraneous applications software. In other words, the PC should serve only one purpose, to scan external media for IT security risks.

1. Insert the USB flash drive into USB port on the PC.
2. Conduct the MacAfee AVD scan of the USB flash drive. Ensure the scan comes up **No Viruses Detected**. This step completes the virus scan of the USB flash drive.

A.4.9.2 Downloading TXT File to NWS Workstation

On the WFO workstation, copy the TXT file from the subdirectory CES on the USB flash drive into the subdirectory marked *C:\HPD\2010\OCT*. Filenames are generated by the ZENO® data logger and have the following format:

Z5678AHA.txt
ZNNNNmdv.txt

- NNNN: 5678 is the station's alphabetically ordered COOP Station ID Number for that given State or Territory as issued by the NCDC as described by *CSSA Manual (NDS 10-1313)*, Station Number, Section 2.4.1.2.
- md: AH is October 17, the date the file was downloaded to the USB Flash Drive (date uses alphanumeric characters starting with 1 and continuing with A = 10, B = 11, ...).
- v: A is the first file downloaded for the given month and day. This letter is incremented to B, C, ... for each subsequent file downloaded with the same date.

A.4.9.3 Viewing Data Files

Saved files may be accessed by opening the TXT file with Notepad using the mouse right-button. Notepad should open, displaying the selected file. An example is provided as follows:

```
#41005678 10/10/17,17:30:10,15.00,14.999,13.7,22.3,0,FPR-E001
#41005678 10/10/17,17:45:10,15.00,14.998,13.7,22.2,0,FPR-E001
#41005678 10/10/17,18:00:10,15.00,14.998,13.7,22.2,0,FPR-E001
#41005678 10/10/17,18:15:10,15.00,14.999,13.6,22.3,0,FPR-E001
#41005678 10/10/17,18:30:10,15.00,14.999,13.7,22.2,0,FPR-E001
#41005678 10/10/17,18:45:10,15.00,14.997,13.7,22.3,0,FPR-E001
#41005678 10/10/17,19:00:10,15.00,14.997,13.7,22.3,0,FPR-E001
#41005678 10/10/17,19:15:10,15.00,14.998,13.7,22.3,0,FPR-E001
#41005678 10/10/17,19:30:10,15.00,14.997,13.7,22.3,0,FPR-E001
#41005678 10/10/17,19:45:10,15.00,14.999,13.7,22.3,0,FPR-E001
```

A.5 Transporting the FPR-E to Observer’s Site

A.5.1 Pack the Modified Gauge and Battery into the Truck/Van at the WFO

1. In the WFO, remove any test weights from the bucket and remove the bucket from the force post. The F&P weighing assembly needs to be open and accessible to adjust the shipping bolt and secure the parallel arms.
2. Secure the modified gauge for the road trip to the observer’s site. Raise the shipping bolt’s height by threading it upward until it just touches the front support arm. Thread upwards an additional 1/2 turn to slightly loosen the load cell. Lock it in position using the lock nut, underneath.
3. To ensure the flexures are protected, block or tape the movable end of the parallel arms so they cannot move or bounce in transit. The upper-rear horizontal flexure is most susceptible to bending. A loop of duct tape around the lower flexure arm and the support stage will hold the assembly tight against the shipping bolt and stop any bouncing. In this way, the parallel arms will stay firm against lateral and vertical forces.
4. To ensure the load cell is protected, block or tape the S-hook, mounting hardware, load cell cable, and bottom/top spring hook so they cannot move or bounce in transit. Make sure the load cell itself is not taped to prevent losing label information.
5. Disconnect the solar panel cable from the terminal block and remove from the F&P base. Dismount the solar panel from the mounting arm. Disconnect the wire leads off the 12V battery terminals and secure the battery.

Securing FPR-E for Road Trip	Methods
Solar Panel	Dismount the solar panel from the mounting arm and wrap it in protective cardboard or newspaper.
<div style="border: 1px solid black; padding: 5px; display: inline-block;">CAUTION:</div> Always disconnect the solar panel before disconnecting the battery.	
12V Battery	Remove the six-pound 12V battery from inside of the gauge, and secure it separately in a box outside of the F&P shell. Cover the terminals with plastic protector caps to prevent shorting.
<div style="border: 1px solid black; padding: 5px; display: inline-block;">CAUTION:</div> Read the safety precautions for handling a sealed lead-acid 12V battery. https://www.ops1.nws.noaa.gov/Secure/SAFETY/Safety_manual.htm	
Shipping Bolt	Make sure it is threaded upward, raised, and touches the front support arm.

6. Hand-carry the modified gauge (attached to its base plate and enclosed in its casing) to the truck/van with a second person. Be aware of this assembly’s heavy weight. Set it down gently

onto the floor of the truck/van and if possible, anchored, or snugly fitted between boxes to prevent toppling.

7. Place the 12V battery, solar panel, mounting arm, and tool kit in separate boxes and surround with packing material (i.e., newspaper, Styrofoam, or cardboard) to prevent contact and surface damage.
8. Place the collection bucket and its force post into the truck/van and secure it from sliding or toppling.
9. Observer site installation does not require any extraordinary tools. Items needed for installation and checkout include a printed copy of this FPR-E Assembly Procedures, common SAE standard size hand tools such as screwdrivers (Phillips and slotted blade), open-end wrenches, alligator clips, carpenter's level, the F&P calibration weight set (D111C-TE500), and a multi meter (voltmeter). The mounting nuts on the F&P pedestal will need to be adjusted, so take appropriate wrenches.

NOTE: Refer to the checklist of parts and tools in Sections A.2.1 and A.2.2.

A.5.2 Unload the Modified Gauge from Truck/Van: (At COOP Observer's Site)

1. At the Observer's site, unload the components in the following order: the tool kit, bucket, force post, solar panel, mounting arm, modified gauge, and the 12V battery. Set the components on a clean and level surface that will not interfere with the Observer's work place or residence access.
2. Re-inspect the shipping bolt to ensure it remains in full contact with the front support arm.
3. Re-inspect the modified gauge's flexures.

A.6 Installing the FPR-E at Observer's Site

NOTE: The observer's F&P to be removed will become the next gauge modified and delivered to the upcoming site on the FPR deployment list. This efficient method will result in a site-by-site rotation of the F&P gauges.

A.6.1 Dismount Legacy Rain Gauge from its Pedestal: (At Observer's Site)

This section details the removal of a legacy F&P rain gauge from an observer's site and securing it inside the truck/van for transport back to the forecast office.

1. Remove the conical hood by grasping each of the two large white handles. Remove the bucket. Drain the bucket before proceeding.
2. Rotate the casing shell (white cylinder with service door) counterclockwise until it slides out of the three metal locking tabs (located inside the casing shell). Remove the shell by slowly raising it, exactly vertically, to clear the F&P weighing assembly (see Figure A-22).



Figure A-22: Casing Shell with Service Door Opened

3. Secure the F&P weighing assembly for the road trip back to the WFO. Install the code-disk locking device. Use a pair of alligator clips placed on each side of the code disk pointer to secure the disk. Rotate the zero adjust knob (located at the top of the weighing assembly) clockwise until the top of the upper main spring hook is flush with the top of the knob. See code-disk: <http://www.srh.noaa.gov/srh/dad/coop/f-p.html>.
4. At the bottom of the weighing scale, just above the paper supply spool, on either side of the dashpot, locate two bolts that rise through the stage plate on each side of the plunger. One is the lower limiting screw and the other is the shipping bolt. Both work to block the plunger's downward travel. Raise the shipping bolt (the longer of the two) so the dashpot is not bottomed out and the weighing assembly is resting on the shipping bolt. Lock the shipping bolt into position, using the lock nut underneath the stage plate.

NOTE: The upper-rear horizontal flexure is the one most susceptible to bending. To protect all the flexures and get this gauge ready for the next site (see Section A.3.1), block or tape the movable end of the parallel arms so they cannot move or bounce in transit. This action will ensure the parallel arms stay firm against lateral and vertical forces.

5. Replace the casing shell removed in Step 2 by carefully and slowly lowering it down the modified gauge's (FPR-E) weighing assembly until it fits into the groove of the base plate. Then rotate the casing shell clockwise until it slides into the three metal locking tabs.
6. Unbolt the legacy F&P from the gauge support. Directly under the casing shell, view the base plate's circumference where the rim of shell sits. There are two large indentations in the dark gray metal circumference. These are the grip locations for removal.
7. With a second person, lift the legacy F&P by grasping the bottom of the base plate with both hands, in the two locations noted above, and set it aside onto a smooth and clean surface.

Later, after installing the FPR-E system, load the legacy F&P into a cardboard box and set into the truck/van.

NOTE: Do NOT split apart the legacy F&P punch block assembly at the Observer's site. Bring it back to the WFO and disassemble it according to the instructions in Section A.3.1, of this FPR-E Assembly Procedures.

A.6.2 Install Modified Gauge onto Pedestal

1. With a second person, carry the modified gauge to the mounting pedestal of the removed legacy F&P. Inspect the triangular foundation plate and clean the bolt threads if needed. Place the solar panel mounting arm over one of the mounting bolts.

NOTE: Lower the adjusting nut under the solar panel mounting arm and raise the other two or add washers to the other two to re-level the base plate.

2. Set the modified gauge's circular base plate onto its triangular plate and fasten the bolts loosely. Tighten them by wrench after inspecting the top of the gauge hood with a carpenter's level for horizontal trueness.
3. Ensure the mounting arm is either under the casing shell door or to the right of it. Mount the force post, mount the bucket onto the force post, and mount the conical hood on top of the casing shell. Ensure the hood is fully seated.
4. With a carpenter's level, selectively tighten the three pedestal bolts to ensure the rain gauge is seated level (see Figure A-23). Tighten bolts. Remove the conical hood and the casing shell, but leave the force post and bucket attached.



Figure A-23: F&P Gauge Levelled

5. Cut away any safety tape wrapped around the load cell assembly and around the parallel arms.
6. With the bucket still empty, lower the shipping bolt so there is a visible gap ($\frac{1}{4}$ -inch) between the top of the bolt and the bottom of the front support arm (i.e., standard operating position). Verify there is a $\frac{1}{4}$ -inch gap above the shipping bolt.

A.6.3 Mounting the Solar Panel: (At Observer's Site)

The new solar panel is mounted on the supplied mounting arm. Make sure the solar panel faces due south and is not shaded by trees or other obstructions.

CAUTION

THE SOLAR PANEL MUST NOT BE SHADED! If any portion of the solar panel is shaded, the panel could effectively shut down and not deliver any real power to the application. The solar panels are made from multiple solar cells, connected in series to give the voltage needed and in parallel to give the power needed. When a solar cell is shaded, it becomes a high resistance to any current impressed upon it. If any individual cell of a series string is shaded, that cell will block the current generated by the other cells in that string, effectively shutting off the output.

Mount the solar panel where it will be fully in the sun, not in a fringe area under trees or potentially in the shadow of an instrument tower, utility poles, power lines, phone lines, cable lines, antenna masts, or even guy-wires. Mounting the solar panel at the gauge is not required, particularly if it will be shaded by doing so. The solar panel may be installed up to 300 feet away from the gauge using the same-size wire to give it good exposure, if needed.

The FPR-E Kit comes with a 15-foot connecting cable. The cable can be extended as far as needed using good outdoor-rated wire of the same size or larger, with waterproof connections above ground. If the cable must be trenched, use direct burial rated cable. Problems have been reported where construction or farming resulted in a lot of dust on the panel. Instruct the Observer to inspect and clean the panel on an as needed basis.

The supplied solar panel with its mounting arm comes with three angle mounts. Follow the instructions in Section A.3.4.

This section completes all the mechanical work. Carefully check the whole unit for hazards such as sharp edges/corners and dangling wires. Take appropriate action to remove the hazards.

A.6.4 Installing the 12V Battery: (At Observer's Site)

1. Place the 12V battery on a flat portion of the base plate behind the load cell.
2. Attach the battery cable leads to the battery terminals. The position of battery terminals, positive and negative are shown in Figure A-24.
 - black wire to (-) terminal
 - white wire to (+) terminal



Figure A-24: Battery Connections

NOTE: There is no indication of the ZENO® data logger powering up. Wait at least 30 seconds before pressing the button on the side of the FPR-E ZENO® Assembly to confirm that the ZENO® data logger is now automatically taking measurements and logging data. The illuminated display should show the most recently logged RAIN value (does not necessarily reflect the actual weighted value at the time the button was pressed) or dashes (“- - -”) if no logged data is available.

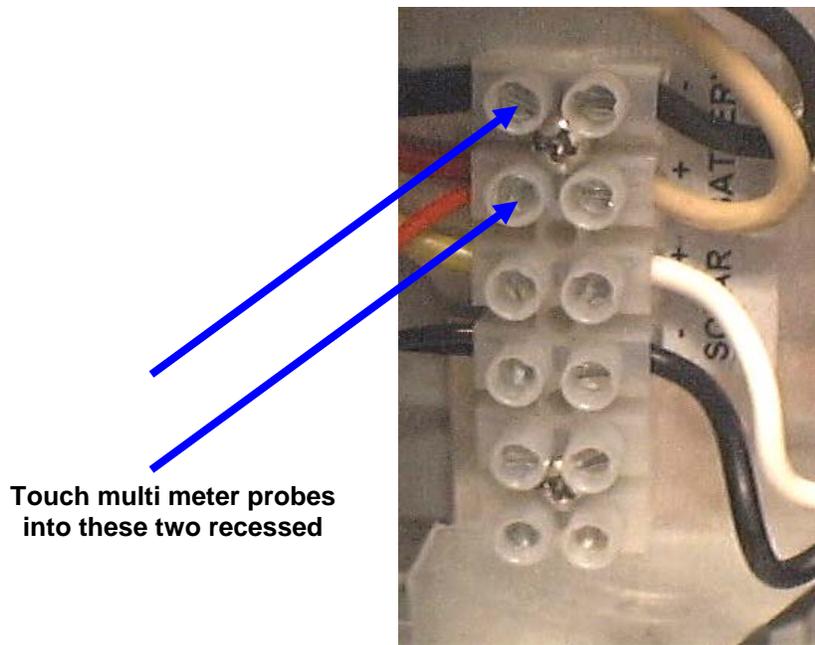
If nothing is shown on the display after pressing the button, the fuse may have blown (especially if the battery cable connections were accidentally crossed for even a short period of time). Disconnect the battery, replace the time-delay “slow blow” fuse (250V, 2A rating, MDL type) behind the display board (gray cover with slot), and repeat Step 2.

A.6.5 Checking Solar Charging of Battery: (At Observer’s Site)

CAUTION

Please probe the screws used to clamp the wires.

1. Ensure the solar panel mounted in Section A.6.2 is receiving full sun exposure. The panel is capable of generating 17V and should reach the junction box inside the FPR-E ZENO® Assembly.
2. Open the front cover of the FPR-E ZENO® Assembly and disconnect the white wire of the solar cable from the terminal block.
3. Measure the voltage between the white wire and the black wire of the solar cable. In full sun exposure, it should be above 14V.
4. Measure the battery voltage across the top two terminals in the junction box by touching multi meter probes into the recessed holes (see Figure A-25). A fully charged battery should have approximately 12.6V.



Touch multi meter probes into these two recessed

Figure A-25: Recessed Holes

5. Reconnect the white wire from the solar panel to the solar (+) terminal and again measure the voltage coming from the solar panel. It should be slightly above the battery voltage.

NOTE: If it was higher than the battery voltage when not connected and drops to battery voltage when reconnected, the solar panel is providing current to the battery.

A.6.6 Checking Calibration with Brass Weights: (At Observer's Site)

NOTE: See Attachment C for a reference of this calibration check procedure.

1. Use the carpenter's level (approximately 18 inches long) to span across the top of the collection bucket.
2. Wait 15 minutes. Press the button on the right side of the FPR-E ZENO® Assembly to activate the display and take a reading. Write it down on a piece of paper.

NOTE: To reduce the waiting time, refer to Section A.4.6, Steps 3.a through 3.c, to change the sample rate to 12 seconds with the PC. However, the sample rate must be changed back to 15 minutes (900 seconds) as in Section A.4.6.4, Steps 5 through 6, once this calibration check is completed.

3. Place one, two, or three large brass weights (4111g each) on the carpenter's level (see Figure A-26).



Figure A-26: Weights on Top of Bucket

4. Take a new reading after 15 minutes. Write down this weighted value.
5. Subtract the value taken in Step 2 from that taken in Step 4. Determine if the difference lies within acceptable ranges according to the number of the brass weights in or on the bucket. See Table A-4.
6. If the difference falls into the acceptable range (Table A-4), the calibration check produced good readings. Enter Cal Check – Good Readings to the FPR Maintenance Log Sheet. If a Cal Check difference fails to come into the acceptable range (Table A-4), conduct a calibration reset as described in Section A.4.6. Write down in the Maintenance Log Sheet, **Cal Check – Reset Performed**.

Table A-4: Calibration Check

Cal Test Options	Weights Required	Acceptable Range
5.0" equivalent rain	1 large weight	4.75 " thru 5.24"
10.0" equivalent rain	2 large weights	9.75" thru 10.24"
15.0" equivalent rain	3 large weights	14.75" thru 15.24"

NOTE: Always take the un-weighted measurement first, and then place the weight in/on the bucket to get the weighted value.

7. Remove the weight(s) from the carpenter's level and remove the carpenter's level.
8. If this is a semi-annual visit and other maintenance will be performed, annotate the FPR Maintenance Log Sheet; Added Oil, and/or Added Food Grade Propylene Glycol (FGPG), ASN: D111-153.

A.6.7 Disposition of Replaced Items

Logistics Branch (W/OPS14) has determined it is not practical to mix used parts with stocked new parts. Instead, they recognize while stripping gauges, the NWSREP will know if the parts being removed are worth retaining for use with remaining gauges. Retain the following listed items for local use, and dispose of the remainder (i.e., items not listed) locally.

From the punch tape mechanism (see Figure A-27):

- Punch block and pin assembly
- Punch motor and microswitch assembly

- Two wrap cables
- Chad tray
- Plastic upper tape spool and spring
- Any other parts needed prior

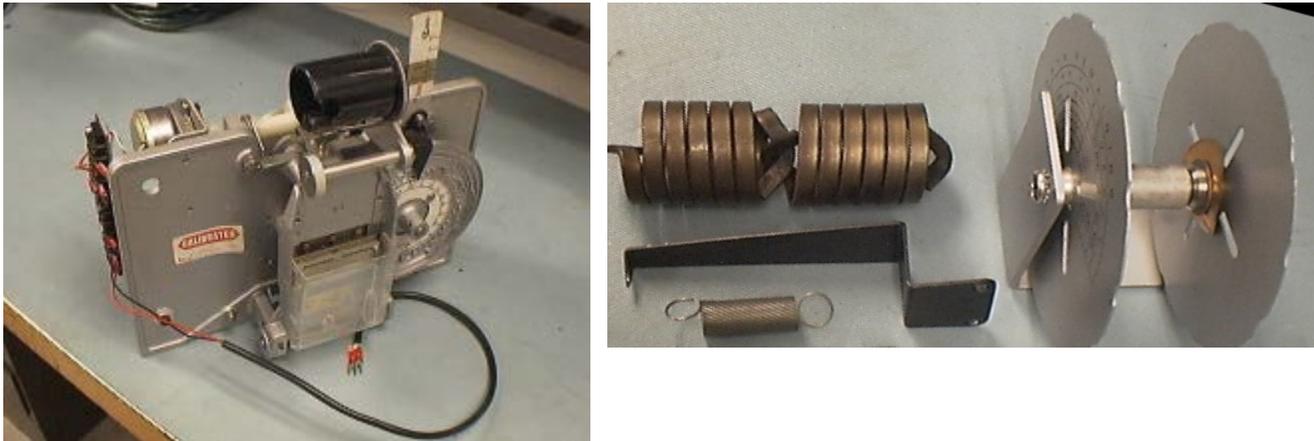


Figure A-27: Items from Punch Tape Mechanism

- Any model, electronic timer and bracket (Figure A-28)
- Solar panel (if good)
- 6V battery (if good)



Figure A-28: Solid State Timer

NOTE: If upgrading all the F&Ps in the area, email the site's RCPM to inform him/her that these legacy F&P parts can be distributed to other offices/sites within the region.

A.6.8 Metadata Requirements on FPR-E Implementation

A.6.8.1 Creating a CSSA Site Inspection Report

After completing the FPR-E site installation and returning to the office; access the site's CSSA and call up the CSSA Station Name/CSSA Station Number to generate a new *Site Inspection Report*. Account for the total hours of work and total dollars of expense incurred to install the FPR-E system. Be sure to complete all these fields to account for the FPR-E installation work (see Figure A-29).

**COOPERATIVE STATION SERVICE ACCOUNTABILITY (CSSA)
SITE INSPECTION REPORT**

Station Name: **LIVINGSTON RADIO WLIV** Station Number: **40-5332** Climate Division: **02**

INSPECTION DATA

Inspector: NETWORK PROGRAM MANAGER Per Diem: N
 Inspection Type: ANNUAL Trip Number:
 Inspection Date: 10/17/2010 Supplies Cost:
 Staff Hours: 6 Trip Cost:
 Miles Driven: 183

EQUIPMENT	Maintenance Performed - More than one may be chosen				
SRG	<input type="checkbox"/> Not Serviced	<input type="checkbox"/> Painted	<input type="checkbox"/> Modified	<input type="checkbox"/> Replaced	<input type="checkbox"/> Moved/Relocated
	<input checked="" type="checkbox"/> Routine Maintenance	<input type="checkbox"/> Calibrated	<input type="checkbox"/> Repaired	<input type="checkbox"/> Installed	<input type="checkbox"/> Removed
MMTS-1	<input type="checkbox"/> Not Serviced	<input type="checkbox"/> Painted	<input type="checkbox"/> Modified	<input type="checkbox"/> Replaced	<input type="checkbox"/> Moved/Relocated
	<input checked="" type="checkbox"/> Routine Maintenance	<input type="checkbox"/> Calibrated	<input type="checkbox"/> Repaired	<input type="checkbox"/> Installed	<input type="checkbox"/> Removed
F&P	<input type="checkbox"/> Not Serviced	<input type="checkbox"/> Painted	<input type="checkbox"/> Modified	<input checked="" type="checkbox"/> Replaced	<input type="checkbox"/> Moved/Relocated
	<input type="checkbox"/> Routine Maintenance	<input type="checkbox"/> Calibrated	<input type="checkbox"/> Repaired	<input type="checkbox"/> Installed	<input type="checkbox"/> Removed

137 characters left

REPLACED F&P WITH THE FPR-E. INSTALLED THE FPR-E GAUGE WITH USB FLASH DRIVE ON OCT 17, 2010, SERIAL NUMBER "70054747".

Remarks

Save Inspection Report Clear Changes Delete Inspection Quit Form(don't save)

Figure A-29: Site Inspection Report

Inspector: Network Program Manager
 Inspection Type: Annual
 Inspection Date: 10/17/2010
 Staff Hours: 6
 Miles Driven: 183
 Per Diem: N
 Trip Number: 2WT0B3804&05
 Supplies Cost: 75.50
 Trip Cost: 113.75

Be sure to select the check box labeled *Replaced* under *Maintenance Performed* for the Equipment category F&P. Finally, in the bottom of the CSSA Site Inspection Report, in the free text field, always remember to write in the following information: *Replaced F&P with the FPR-E. Installed the FPR-E Gauge with USB Flash Drive on Oct 17, 2010, serial number "70054747."*

NOTE: These values are for example only, and will differ for each FPR-E system.

A.6.8.2 Updating the B-44 for FPR-E Equipment

1. Access a copy of the CSSA Manual (NDS 10-1313), for current policy on B-44 updates at <http://www.nws.noaa.gov/directives/010/010.htm> or <http://www.nws.noaa.gov/directives/sym/pd01013013curr.pdf>.
2. Make the following changes in the Station Information Report (B43) (see Figure A-30):

NOTE: These values are for example only, and will differ for each FPR-E system.

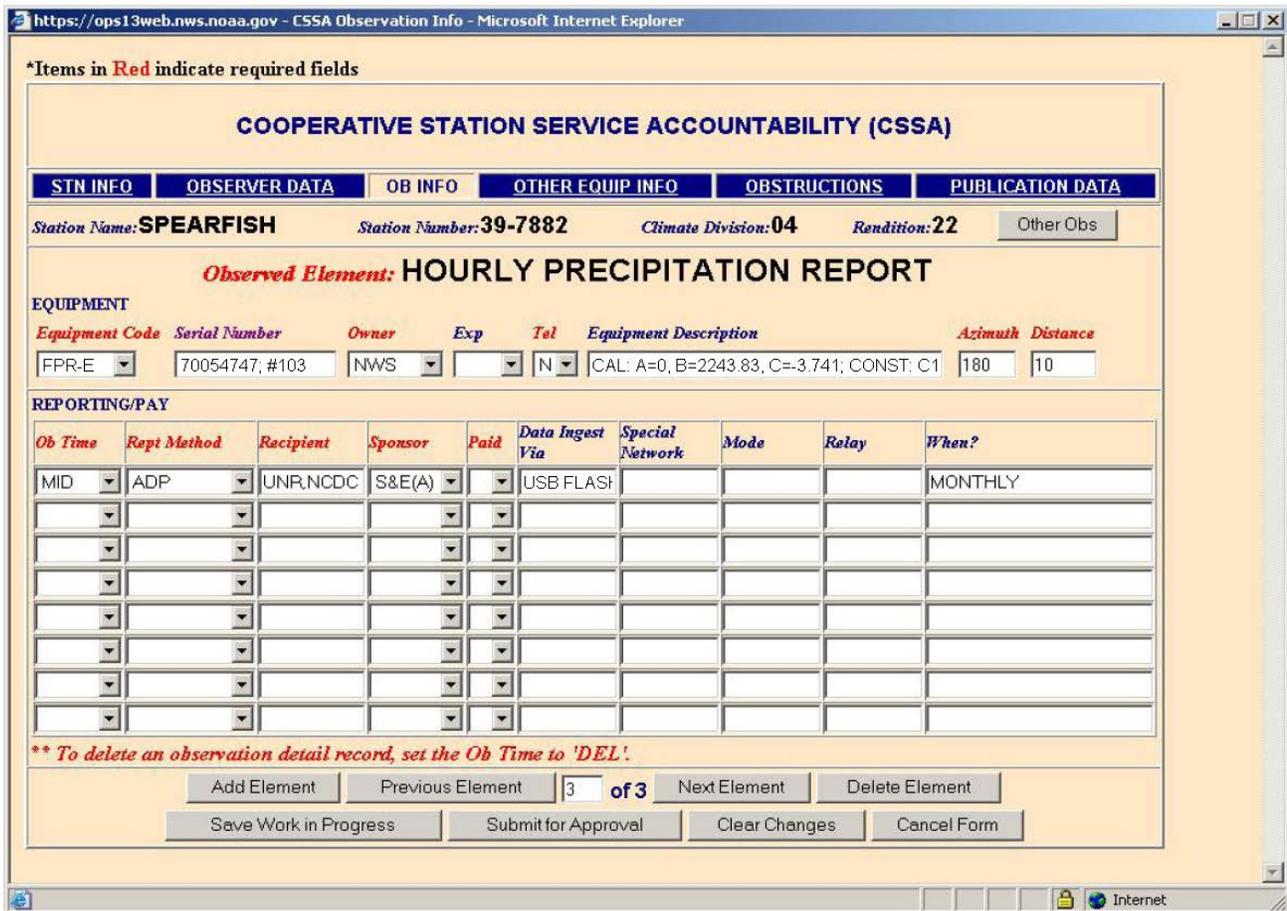
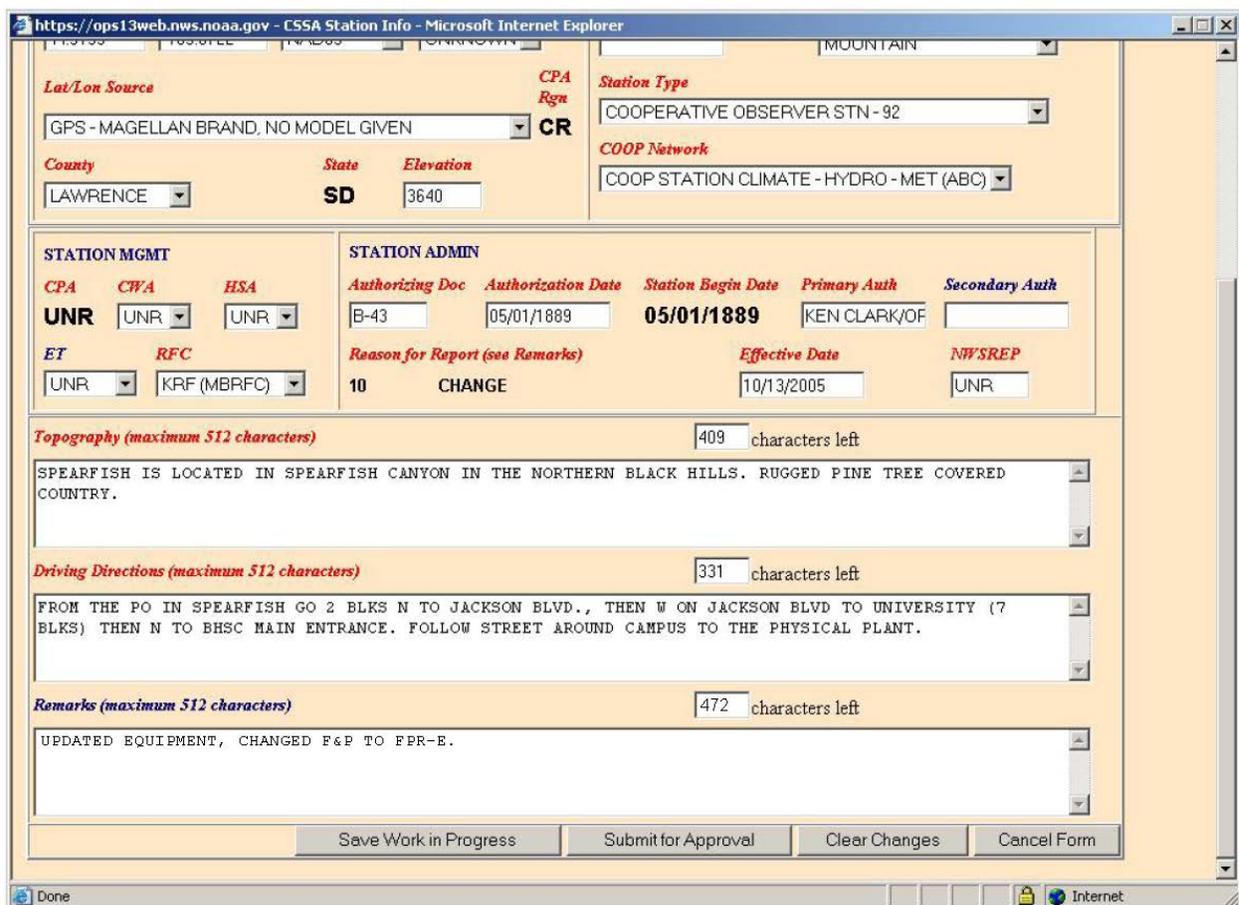


Figure A-30: CSSA

- a. **Equipment Code**, select *FPR-E* from the drop-down menu, replacing F&P.
- b. **Serial Number** (see example in Figure A-30), enter the load cell's serial number (i.e., 70054747, collected in Section A.3.2, Step 3) and the FPR-E ZENO® Assembly serial number (i.e., 103, collected in Section A.3.3, Step 2). Enter the two serial numbers separated by a semicolon, a space, and the # sign as follows: 70054747; #103
- c. **Equipment Description** (load cell calibration constants), enter **CAL: A=0, B=2243.83, C=-3.741; CONST: C1=-0.000525 C2=0 C3=-0.000005.**

- d. **Ob Time**, keep *MID*, referring to midnight, retain *MID*.
 - e. **Report Method**, select **ADP**, replacing B18.
 - f. **Recipient**, keep *Site's WFO, NCDC* no changes.
 - g. **Sponsor**, keep the same. If there is none, use *FC-1* as the default. For a list of sponsor codes, see p. G-12 (Table G-13) and p. C-61 (Section 2.4.3.13 – Sponsor) in the *CSSA Manual, NDS 10-1313* (pages refer to the March 18, 2005 edition).
 - h. **Data Ingest Via**, enter text **USB FLASH DRIVE** replacing a blank field.
 - i. **Special Network**, default is a blank field.
 - j. **Mode**, default is a blank field.
 - k. **Relay**, default is a blank field.
 - l. **When?** Keep the word *MONTHLY*.
3. Before submitting the revised B-44 to NCDC, ensure the **Remarks** section has been updated to state, *Updated equipment, changed F&P to FPR-E* (see Figure A-31).



The screenshot shows a web browser window displaying the NOAA CSSA Station Info form. The form is titled "https://ops13web.nws.noaa.gov - CSSA Station Info - Microsoft Internet Explorer". The "Remarks" section is highlighted, showing the text "UPDATED EQUIPMENT, CHANGED F&P TO FPR-E." The form also includes sections for "STATION MGMT", "STATION ADMIN", "Topography", and "Driving Directions".

STATION MGMT			STATION ADMIN				
CPA	CWA	HSA	Authorizing Doc	Authorization Date	Station Begin Date	Primary Auth	Secondary Auth
UNR	UNR	UNR	B-43	05/01/1889	05/01/1889	KEN CLARK/OF	
ET	RFC		Reason for Report (see Remarks)	Effective Date		NWSREP	
UNR	KRF (MBRFC)		10 CHANGE	10/13/2005		UNR	

Topography (maximum 512 characters) 409 characters left
 SPEARFISH IS LOCATED IN SPEARFISH CANYON IN THE NORTHERN BLACK HILLS. RUGGED PINE TREE COVERED COUNTRY.

Driving Directions (maximum 512 characters) 331 characters left
 FROM THE PO IN SPEARFISH GO 2 BLKS N TO JACKSON BLVD., THEN W ON JACKSON BLVD TO UNIVERSITY (7 BLKS) THEN N TO BHSC MAIN ENTRANCE. FOLLOW STREET AROUND CAMPUS TO THE PHYSICAL PLANT.

Remarks (maximum 512 characters) 472 characters left
 UPDATED EQUIPMENT, CHANGED F&P TO FPR-E.

Buttons: Save Work in Progress, Submit for Approval, Clear Changes, Cancel Form

Figure A-31: Remarks Section

ATTACHMENT B FPR-E Checklist

Completed	Not Completed	Preparation in Weather Forecast Office (WFO)
		1. Remove casing from the available F&P gauge and prep gauge.
		2. Unpack, inspect, assemble, and check the FPR-E Kit.
		3. Charge the 12V battery to full charge.
		4. Configure the Personal Computer (PC) and verify serial cable compatibility.
Completed	Not Completed	Assemble FPR-E and Checkout in WFO
		5. Install the load cell assembly and FPR-E ZENO® Assembly.
		6. Update configuration code.
		7. Install SID settings.
		8. Perform system calibration.
Completed	Not Completed	Prepare for Transport
		9. Secure the FPR-E and peripherals inside vehicle.
		10. Read the checklist of tools and FPR-E parts before and after packing the vehicle.
Completed	Not Completed	Install the FPR-E at COOP Site
		11. Remove the legacy F&P hood and bucket. Dismount the circular mounting plate from pedestal.
		12. Install the solar panel arm and then the circular base plate with FPR-E onto the pedestal.
		13. Mount the solar panel.
		14. Perform a Solar Charging Check.
		15. Perform a Cal Check (gauge reading in office prior to deployment): ± 0.02 of an inch
		16. Download to USB flash drive as check-up, and train observer.
		17. Charge the bucket with oil and/or FGPG.
Completed	Not Completed	Meta-data and Operational Implementation Tasks at WFO
		18. Update the B-44, Equipment Description, to account for the load cell serial number, FPR-E ZENO® Assembly serial number, calibration coefficients and calibration constants.
		19. Retain repairable F&P parts (Section A.6.6) at the WFO for possible shipment to a neighboring WFO still operating the F&P for another year or two.
		20. Begin 30-day monitoring and coordination with the Observer.

Completed	Not Completed	Meta-data and Operational Implementation Tasks at WFO
		21. Create a Form 79-1D Hourly Precipitation Data (HPD) spreadsheet to convert partial month's paper tape data to hourly values and enter in Excel spreadsheet. Email to NCDC (HPD.NCDC@noaa.gov).
		22. Submit FPR-E Implementation Checklist to MIC, one for each site, with COOP site number on checklist.
		23. Submit WFO Implementation Certificate to WSH via Fax at (301) 713-1598 OCWWS ATTN: COOP Program Manager. Just one certificate is required to account for all FPR-E sites implemented within a single WFO/ County Warning Area (CWA). The MIC's signature is required.

ATTACHMENT C Calibration Check Procedure

Before installing oil or FGPG for full-time operation, and while the bucket is still clean and dry, perform this calibration check. Use a carpenter's level across the top of the collection bucket if oil or FGPG has been placed in the bucket.

1. Place carpenter's level flat-side, across the top of the collection bucket.
2. Wait 15 minutes. Press the button on the right side of the FPR-E ZENO® Assembly to activate the display and take a reading. Write it down on a piece of paper.

NOTE: To reduce the waiting time, refer to Section A.4.6, Steps 3.a to 3.c, to change the sample rate to 12 seconds with the PC. However, the sample rate must be changed back to 15 minutes (900 seconds) as in Section A.4.6.4, Steps 5 to 6, once this calibration check is completed.

3. Place one, two, or three large brass weights (4111g each) on the carpenter's level.
4. Take a new reading after 15 minutes. Write down this weighted value.
5. Subtract the first reading written in Step 2, from the second reading taken in Step 4. Write down this difference in hundredths of an inch.
6. If the difference falls into the acceptable range as given in the Table below, the calibration is acceptable and full calibration is not needed. Write down in the site inspection report *Cal Check – Good Readings* into the FPR Maintenance Log Sheet. If any difference falls outside of its respective range listed below, conduct a full calibration as described in Section A.4.6 through Section A.4.6.5, of this modification note. Write down in the Maintenance Log Sheet, **Cal Check – Reset Performed.**

Calibration Test Options	Weights Required	Acceptable Range
5.0" equivalent rain	1 large weight	4.75 " thru 5.24"
10.0" equivalent rain	2 large weights	9.75" thru 10.24"
15.0" equivalent rain	3 large weights	14.75" thru 15.24"

NOTE: Always take the un-weighted measurement first, and then place the weight in/on bucket to get the weighted value.

7. Remove the weight(s) from the carpenter's level, and remove the carpenter's level.

ATTACHMENT D FPR-E Monthly Download Instructions

1. Unscrew the circular cap that covers the USB socket on the right side of the FPR-E ZENO® Assembly.
2. Press the button on the right side of the FPR-E ZENO® Assembly to light up the display.
3. With the display active, insert a USB flash drive into the USB socket.
4. Watch the display for verification of USB flash drive inserted. The display should show approximate time left to download data as MM.SS (minutes.seconds).

NOTE: If the display shows **ERxx**, press the button to turn off the display. With the display off, press the button again. If display shows **ERxx** again, verify with the PC the USB flash drive is in good working condition and there is at least 3.5 MB of room left for the data download.

5. Watch the display for notice of download completion: UFdC.
6. Remove the USB flash drive from its socket.
7. Place the circular cap over the USB socket and tighten it.
8. Verify display momentarily indicates "...” and then turns off.

ATTACHMENT E FPR-E Inspection Report Maintenance Notes

The FPR-E system does not flag/indicate external activity, nor does it have functionality for user entered notation codes. Therefore, both the Observer and NWSREP will document maintenance actions (i.e., adding FGPG, or adding oil) to an FPR-E Log-Sheet to communicate the interruptions in precipitation data to NCDC through the CSSA Site Inspection Report.

The COOP Observer reports the following to the Log-Sheet when delegated by the NWSREP.

Valid Remarks for Observer to report in FPR-E Log Sheet:

- Added oil to bucket
- Added FGPG to bucket
- Partially drained bucket – Some liquid (i.e., oil) left in bucket
- Emptied bucket – bucket completely emptied
- Installed funnel – for summer
- Removed funnel – for winter
- Routine gauge check
- Foreign object found in bucket
- Time is more than 15 minutes fast/slow
- Non-routine download to flash drive

The NWSREP reports the following to the CSSA Site Inspection Report.

Valid entries for NWSREP to report in Site Inspection Report for FPR-E:

- Annual visit
- Semi-annual visit
- Emergency visit
- Awake display – Start
- Awake display – End
- Precip level before bucket serviced
- Precip level after bucket serviced
- Calibration check – good readings
- Calibration check – reset performed
- Partially drained bucket – some liquid (i.e., oil) remains in bucket
- Emptied bucket – bucket completely emptied
- Added FGPG to bucket
- Emptied and cleaned bucket
- Foreign object found in bucket

- Data downloaded to USB flash drive
- Cleaned F&P housing
- Cleaned solar panel
- Cleaned FPR-E ZENO® assembly
- Cal Coefficient B – value before calibration
- Cal Coefficient B – value after calibration
- Cal Coefficient C – value before calibration
- Cal Coefficient C – value after calibration
- Installed auto-syphon
- Removed auto-syphon
- Time is more than 15 minutes slow
- Time is more than 15 minutes fast
- Replaced one or more flexures
- Replaced FPR-E ZENO® assembly – With same model FPR-E ZENO® assembly
- Replaced load cell assembly – with same model load cell assembly
- Replaced S hook
- Replaced desiccant bags
- Replaced fuse
- Gauge moved to a compatible location – equipment move
- Gauge moved to a non-compatible location – station relocation
- Gauge removed from service – placed in storage
- Gauge put back in service after being in storage

ATTACHMENT F FPR-E Support Resources

F.1 Primary Resources Online

FPR-E Assembly Procedures

FPR-E Observers Guide

FPR-E Operations Manual

<http://www.nws.noaa.gov/ops2/Surface/coopimplementation.htm>

Clear photos of the original F&P rain gauge:

<http://www.srh.noaa.gov/srh/dad/coop/f-p.html>

F.2 Support Resources – NWS Policy and Procedures

*NWS Instruction (NWSI) 10-1315, COOP Station Observations (October 2010): **

<http://www.nws.noaa.gov/directives/sym/pd01013015curr.pdf>

*NWSI 10-1313, Cooperative Station Service Accountability (CSSA) User Manual (March 18, 2005):**

<http://www.nws.noaa.gov/directives/sym/pd01013013curr.pdf>

Engineering Handbook (EHB) 1: Instrumental Equipment Catalog:

<https://www.ops1.nws.noaa.gov/Secure/ehbs/EHB1files/ehb1.htm>

NWS Manual (NWSM) 50-1115: Occupational Safety and Health Manual:

https://www.ops1.nws.noaa.gov/Secure/SAFETY/Safety_manual.htm

NWSM 30-3102: Integrated Logistics Support Planning:

<http://www.nws.noaa.gov/directives/sym/pd03031002curr.pdf>

NWSM 30-3101: Supply Manual and Catalog:

<http://www.nws.noaa.gov/directives/sym/pd03031001curr.pdf>

* Observing Services Division (W/OS7) of the Office of Climate, Water, and Weather Services (OCWWS) is the Office of Primary Responsibility (OPR) for these asterisked documents.

F.3 Vendor's Manual Supplied with the NLSC Kit

FPR Kit Operations and Maintenance Manual v4.2 (May 17, 2010), delivered with the Kit, is published by Coastal Environmental Systems, Inc. (CES).

NOTE: The NWS Headquarters (WSH) issued *FPR-E Assembly Procedures* is the primary assembly manual. If needed, reference *FPR Kit Operations and Maintenance Manual*, for detailed information on ZENO® data logger measurements and controls.

F.4 NWS Engineering Handbooks

The following content in EHB-10 is superseded by the *FPR-E Assembly Procedures*, issued by W/OS7:

- Section 1.2: Items 10-204, 10-206, 10-207, and 10-208

- Section 4.2: Revised Maintenance Schedule for Fischer & Porter Punched Tape Precipitation Gauge, dated April 30, 1976

The following content in EHB-1, Issuance Number 02-11 (November 1, 2002), needs to be supplemented for the new Fischer-Porter Rebuild (FPR) equipment:

- Section D: Hydrologic Equipment; Instrumental equipment listings.

NWS Logistics Branch (W/OPS14) has assigned an ASN, a National Stock Number (NSN), a Source, Maintenance and Recoverability (SM&R) Code, and will list FPR-E equipment in the EHB-1 Instrumental Equipment Catalog.

F.5 Sterling Field Support Center (SFSC)

For operational support when implementing the FPR modification, call the SFSC, 8:00 A.M. – 5:00 P.M., Monday – Friday, on (703) 661-1268; or e-mail them, nws.sfsc@noaa.gov. Before calling SFSC, write down the issue or question and inform the Regional COOP Manager by phone or email.

SFSC Information:

Main Line: (703) 661-1268

Back-up Line: (703) 661-1293

Email: nws.sfsc@noaa.gov

ATTACHMENT G FPR-E Spares and ASN

General Name	Short Description	Long Description	ASN	SM&R*
Load Cell Assembly	Load cell assembly, FPR	Load cell assembly, FPR, complete with load cell, S Hook, and mounting hardware (CES)	D111E-1	PAODD
S Hook, LC mounting	S Hook, Load cell mounting, FPR	S Hook, Load Cell mounting, FPR (CES or Open Market)	D111E-1MP1	PAOZZ
Null Modem Cable	Null Modem Cable	Null Modem Cable DB9F to DB9F, Fischer-Porter Rebuild Kit (FPR-E), 3 meter length	D111E-1W1	PAOZZ
FPR-E ZENO® assembly	ZENO® FPX assembly with bracket	ZENO® FPX assembly for F&P gauge rebuild, includes ZENO® data logger, solar panel regulator, display, push button, USB flash drive interface, housing and mounting bracket (CES)	D111E-2	PAODD
Battery cable	Battery cable, FPR Kit	Battery cable, FPR Kit	D111E-2CBL1	PAOZZ
Stuffing gland	Gland fitting, FPR Kit	Gland fitting, FPR Kit	D111E-2MP1	PAOZZ
Desiccant bag	Desiccant bag	Desiccant bag, 3.66 ounce, 4-Unit, silica gel, Silica Gel Desiccant Products Company P/N S-3043	D111E-2MP2 or 052-D-1	PAOZZ
CES FPR Manual	Manual, FPR, OEM, CES	Manual, FPR, OEM (CES)	D111E-2D1	PAOZZ
Fuse	Fuse, 250V, 2A	Fuse, 250V, 2A, Busmann	D111E-2F1 or 017-F-5-31s	PAOZZ
Battery	Battery, 12V, 7Ah, sealed lead acid	Battery, 12V, 7Ah, Sealed Lead Acid, Spade Terminals, 4 lbs., Panasonic LC-R127R2P or Equivalent	D111E-2B1 or 017-B-2-32	PAOZZ
Solar Panel Assembly	Solar Panel, 10W, 12V nom, @0.66A, no regulator	Solar Panel, 10W, with Diode, 12V nom. @0.66A, no regulator, metal frame, with 15-foot cable, hardware, and mounting arm (CES or PowerUp Co.)	D111E-3	PAODD

General Name	Short Description	Long Description	ASN	SM&R*
Solar Panel (only)	Solar Panel only, 10W, 12V nom, @0.66A, no regulator, FPR Kit	Solar Panel only, 10W, with Diode, 12V nom. @0.66A, no regulator, metal frame, with 15-ft cable, PowerUp BSP-1012	D111E-3A1	PAODD
Solar Panel Mount (only)	Mounting Hardware, for Solar Panel, FPR Kit	Mounting Hardware, hardware and mounting arm (CES), custom for PowerUP BSP-1012 solar panel and F&P gauge, FPR Kit	D111E-3A2	PAOZZ

* The FPR unit has only two types of SM&R codes assigned to its parts: PAODD and PAOZZ.
 Reference: [EHB-1, Instrumental Equipment Catalog \(Issuance 1996-1\)](#), Section 2.3, Source, Maintenance and Recoverability Code.

PAODD: You must return these parts to National Reconditioning Center (NRC) in exchange for a replacement.

The **PA** signifies item procured and stocked for anticipated or known usage that is not deteriorative in nature; the **OD** signifies this part shall be isolated and removed by the field and shipped to the depot (NRC) where the depot (NRC) will perform the repair; and the final **D** signifies that just the depot (NRC) is authorized to repair, condemn, or dispose of this part.

PAOZZ: A non-repairable part. You may dispose of these parts (e.g., 5 Amp fuse) at the Weather Forecast Office (WFO).

The **PA** signifies item procured and stocked for anticipated or known usage that is not deteriorative in nature; the **OZ** signifies the field level shall remove and replace this part, however it is non-repairable and no repair to the item is authorized. The final **Z** signifies that the field office is authorized to condemn and dispose of the part when it becomes unserviceable.

ATTACHMENT H FPR-E Assembly Worksheet

Parameter	Value
Load Cell Serial Number	
FPR-E ZENO® Assembly Serial Number	
Calibration Constant C1	
Calibration Constant C2	
Calibration Constant C3	
Firmware Version	
Configuration Version	
COOP Site Number	
Site ID	
State ID plus two zeros	
P-Cal data for b1	
P-Cal data for b2	
$B = 30000/(b2-b1)$	
P-Cal data for c3	
$C = -c3$	
P-Cal data for c4	
$C = -(c3+c4)$	
Cal Coefficient A	0 (default)
Cal Coefficient B	
Cal Coefficient C	