NWSREP'S

FISCHER–PORTER REBUILD MODEL D (FPR-D)

OPERATIONS MANUAL

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U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service - Cooperative Weather Observer Program
~~Office~~ of Observations, Surface and Upper Air Division,
Program Management Branch – W/OBS31

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CHAPTER 1 – Program Management

1.1 FPR-D System Configuration:

The Fischer-Porter Rebuild, Version D configuration (FPR-D) kit was manufactured by Sutron, Corp., for the modernization of the mechanical Fischer-Porter/Belfort (F&P) punch tape model rain gauge. The National Weather Service (NWS) field offices modified 921 F&P mechanical gauges to the FPR-D configuration in the years 2009- 2014. An additional 82 rain gauges converted from FPU to FPR-D configuration from 2012-2014.

1.1.1 Qualification For Gauge Modernization: The FPR-D initial implementation kit is available only for legacy F&P gauge basic configuration, ones not configured with a shaft encoder (i.e., for telemetry service). The FPR-D may not be installed to any F&P gauges that use LARC phone modems or use GOES satellite telemetry equipment. In addition, gauges configured with the Fischer-Porter Rebuild Version E configuration (FPR-E) are not eligible for conversion to FPR-D.

1.1.2 Required Measurement Settings: The FPR-D models are internally programmed to produce data records in hundredths of an inch, once every 15 minutes, at HH:00, HH:15, HH:30, and HH:45. The rain gauge should always be set to Local Standard Time. Refer to the *FPR-D Assembly Procedures*, if you need to confirm the settings or make authorized changes.

1.1.3 SD Card: The Observer should always have an available SD card on hand on the first day of each month. Direct your observers to phone you of immediately if they should lose the SD card you issued to them.

Use only SD cards that are standard-capacity "SDSC" they are 2GB or less, and formatted for 32FAT. Note: The SD card is not intended to store the monthly data files therefore proper procedures include deleting the past copied data files from the SD Card to avail memory volume for future file downloads.

1.1.4 Laptop Requirement for Firmware Upgrade or Full Database Download: The FPR-D rain gauge requires a portable computer (i.e. laptop) when the NWSREP installs firmware to the Precip Recorder (i.e., COOP Mod Note D111D, Note 4) and when the entire contents of the Precip Recorder need to be saved upon special request. Due to the NOAA Security standards in place to prevent virus and malware contamination from online downloads (i.e., of the firmware from the Headquarters website), you should use these minimum requirements when selecting a laptop for these tasks.

The minimum requirements for a Netbook/Laptop to serve the FPR-D/COOP maintenance are:

- Windows 7 Enterprise Operating System is required with Bitlocker that overrides the Safeboot application. Requires a Microsoft Software Assurance (SA) license. http://www.microsoft.com/licensing/about-licensing/windows7.aspx#tab=3

- Hardened metallic case with durable hinges

- Install HyperTerminal to Laptop. (May need to request ITO assistance.)
- Capability to Link-to-Network
- AutoUpdate via Network – No expense software
- Maintenance/ Repair Coverage by Existing Enterprise Software License
- Battery Life, 4.5 to 10 hours

1.1.5 Security Scanning for Virus/Malware: Observers at COOP sites are permitted to email the FPR-D precipitation data each month to an NWS email address. For the email method, the Weather Forecast Office (WFO) enterprise system will scan all attached files, per routine, for any malware or virus. If your observer uses the postal mailing service to report the monthly precipitation, you will need to follow your IT Specialist's instructions and be compliant with the NOAA policies on scanning external delivered removable memory devices.

The Information Technology Officer (ITO) has the responsibility to ensure virus/malware systems are used by the NWSREP on all external sourced media including SD Cards. The ITO manages a secure platform and ensures routine updates of the McAfee Active Virus Defense (AVD) dat files.

Therefore, the NWSREP follows ITO security policy as it applies to these media that arrive each month.

If your ITO scans the Removable Memory devices, then ensure s/he communicates this action to you. Create an accurate account of which SD Cards have been scanned and saved to the WFO workstation. If malware or a virus is detected on the Memory Device, then notify your ITO and regional IT system security officer.

If malware or virus is detected, and your ITO authorizes so, you may dispose of the Removable Memory device according to National Institute of Standards and Technology (NIST) policy, NISTS P800-88, revision 1, *Guidelines for Media Sanitization* (Sep 2012). The policy directive is accessed from the list available on: http://csrc.nist.gov/publications/PubsSPs.html.

1.2 Maintenance Requirements:

1.2.1 Routine Maintenance: In the course of normal operation the FPR-D will need routine periodic maintenance such as the emptying of the precipitation collection bucket. Instructions for this task and other routine maintenance actions are found in Chapter 5, of this manual. The NWSREP is expected to understand and be capable of conducting the routine maintenance actions.

1.2.2 Semi-Annual Maintenance: Twice each year the NWSREP is required to visit COOP sites in possession of the FPR equipment. This is done as a quality assurance measure to protect

equipment from damage, and to ensure the proper measurement of precipitation data. A checklist of Semi-Annual Maintenance tasks is found in Chapter 5 of this manual.

1.2.3 Annual Maintenance: Once per year the NWSREP is required to check the calibration of the rain gauge weighing sensor. Calibration is checked at three levels, five inch, ten inch, and fifteen inch equivalent rainfall amounts. This requires the use the brass test weights. Instructions for calibration checks are given in Chapter 6. In the rare occasion the rain gauge fails the check then a full calibration reset is required. Instructions to re-calibration the rain gauge sensor are found in Chapter 6.

1.2.4 Restorative Maintenance: Some failures are evident upon inspection, such as a non-responsive display. Other failures (i.e., battery weakness or low voltage) will be evident upon viewing of data through use of the FPRD_PlotData_V1_3.xls plotting macro when battery voltage and bucket levels are graphed. Chapter 7 gives detailed instructions that require careful attention to safety precautions in order to properly troubleshoot FPR-D electrical system.

1.3 System Modification Policy:

To keep the FPR-D systems running properly and to reduce risk of damage to equipment and data, new requirements may be proposed that involve some substantial change to the form, fit, and function of the FPR-D systems. The office responsible for proposing changes that affect, firmware, hardware, and software, is the Services Branch (OBS32), of the Office of Observations.

The Program Management Branch (OBS31), of the Office of Observations at NWS Headquarters is responsible for evaluation and approval of the proposed changes and calls upon the Services Branch (OBS32) to write the necessary COOP Modification Notes, and COOP Maintenance Notes. The COOP Program is managed similarly to, yet separately from the Hydrology program, which is governed by policy found in NWSI 30-2111, *Hydrologic Maintenance*. The NWSREP is responsible for installing the FPR-D system modification. Specific procedures for implementation of system modifications are given in Section 7 of this manual.

1.4 Metadata Requirements:

As stated in Section 8, *Requirements and Standards for NWS Climate Observations*, NWSI 10-1302, the COOP Program requires all hydrometeorological observations to be traceable to a minimum corresponding set of metadata. The NWS Representative (NWSREP) is responsible for entering these metadata into a centralized database (e.g., Station Information System [SIS]). The data can then be accessed by the National Climatic Data Center (NCDC) and help build accurate long term climate records.

The metadata you will enter to SIS is given in Section 9 of this manual and will describe the basic character of the FPR-D precipitation observations.

1.5 File Retention Policy:

The following data records and policy documents for FPR-D shall be saved by the WFO:

- FPR-D precipitation data files (e.g., **247610_log_20120302.csv**) kept for at least 36 months on the network workstation. Retain the CSV data files with their original filename and format!

- Any *FPR Log Sheet*, or any *SD Card Tracking Table*, keep a printed or an electronic copy (i.e., optical scan of printed form) at WFO for 12 months.

- Bookmark: http://www.nws.noaa.gov/ops2/Surface/coopimplementation.htm for ready access to FPR-D manuals and FPR-D policy directives issued by NWS headquarters. Update the bookmark every 6-months.

CHAPTER 2 – System Operations and Data Acquisition

2.1 FPR-D Primary Components:

The FPR-D modification consists of five major components: the load cell assembly (Fig 2.4), the data logger (Fig 2.3), the solar panel (Fig 2.1), the 12-V battery, and an SD card. A cable connects the weighing sensor (e.g., load cell) to the data logger assembly (e.g., Precip Recorder). Another cable, the solar power cable, enters the assembly to recharge the battery.

2.1.1 Data Logger: The Precip Recorder contains the data logger and it fits in place where the mechanical weighing assembly and paper puncher had been mounted in the legacy Fischer & Porter (F&P) housing. When you open the access door (Fig 2.2) you will see a blue and white plastic box which is the Precip Recorder. The Precip Recorder stays closed and allows memory download to an SD card (standard capacity card only) on the right side. Behind and below the recorder you may see the weighing sensor, a metallic bar that measures the weight of the bucket and its liquid contents (Fig 2.4).

Figure 2.1. FPR-D Gauge

Figure 2.2. Access Door

Figure 2.3. Precip Recorder

2.1.2 Weighing Sensor: The weight of the catch bucket with liquid presses down on a metallic bar (Figure 2.4) that bends with increased weight. This weighing sensor is very sensitive and can detect changes of one thousandth of an inch of precipitation in a matter of several seconds.

Figure 2.4. Load Cell Mounts Under Stage

Readings from the sensor are processed by the Precip Recorder every 15 minutes and stored. Once per month the Observer inserts an SD card of standard capacity (i.e., SDSC) into the Precip Recorder to make a portable copy the precipitation data.

2.1.3 Rain Gauge Display: The display stays in a sleep mode until you wake it up by pressing the 'OFF' button on the face of the Precip Recorder (Fig 2.6). Note: Although any one of the six control buttons (four arrows, Set, and Off buttons) can light-up the display, we avoid pressing the 'Set' button in routine actions so to avoid inadvertent changes to important system settings.

The Precip Recorder will stay lit for about two-minutes before automatically going back to sleep. The blinking green lamp tells you the recorder system is working properly.

This green fluorescent display (Fig 2.5) provides the 'Precip' reading. It tells you the accumulated rain-equivalent weight of everything in the bucket, i.e., rain water, plus any additives like food grade propylene glycol (FGPG) or oil. The units are hundredths of an inch of rainfall.

Figure 2.5. FPR-D Data Display

The current Date and Time appear together in the same display as the Precip (Fig 2.5) reading. Notice the order is YYYY/MM/DD (i.e., 2008/10/20, indicates Oct 20, 2008).

The current local Time in hours, minutes, and seconds, appears next, 11:06:13. This is 11:06am local **Standard** time in the 24 hour convention. Policy states all FPR will be kept in **Standard** time and never adjust to daylight savings time. Time should be accurate to within one minute of an accurate time reporting station (i.e., //nist.time.gov).

2.1.4 Data Download to SD Card: To collect precipitation data, first make sure the display is lit-up and shows the current bucket level. Then insert the SD card (i.e., small square memory card) to the socket on the right side of the Precip Recorder. The display will respond with the amount of data (the number of bytes) of the total amount copied to the SD card. **It will take about 5 minutes to complete.** Your Observer should stand by to monitor the display for any display messages.

Figure 2.6. Operator Control Points

This is the routine monthly process whereby the last 60 days of precipitation are saved to the SD card. It is important to stand by the Precip Recorder while it downloads the data because the system display may indicate messages other than time remaining to completion.

Figure 2.7. SD Card Inserted

2.1.5 Menu Driven Controls: The Precip Recorder serves the NWSREP with an easy to navigate user interface. One only needs to press the Arrow Buttons below the display (Fig 2.6) to call up six primary fields of information. The first field is the Precip Display (Fig 2.8) that will always appear when you wake-up the system. The Precip Display gives you the accumulated rain-equivalent weight of everything in the bucket (i.e., rain water, plus any additives, like oil, or food grade propylene glycol) in hundredths of an inch. It also gives the current date and time. When you press the keypad's down arrow key (▼) you advance to the next field of the six primary fields. These six fields are listed in Table 2.1.

Figure 2.8. Precip Display Gives Bucket Level (15.00) and Current Date and Time

Figure 2.9. Arrow Buttons to Scroll the Alpha-numeric Selections

If you keep pressing the down-arrow (▼) key, the display revolves back to the Precip Display field (Fig 2.8).

Primary Fields	*Description*
Precip 15.00 2009/02/13 10:52:30	*Upon system wake-up, the 'Precip Display' appears.*
Battery Now 12.6V	*Battery voltage.*
Logged Data	*Stored 15-min data.*
Station Setup	*Password protected*
Diagnostic	*Calibration*
Station Name & Time	*COOP site number*

Table 2.1. The Six Primary Fields

⚠ **Caution:** Observers are never required to access any of these six fields in Table 2.1. If you notice data missing from monthly files, you may phone Observer to instruct him/her to call up the battery voltage display. However, the Observer must always fully exit the menu system and press the OFF button multiple times to ensure the display goes to sleep. **Otherwise, if certain menu pages are left open, the logger will not go to sleep, and the battery will get discharged, and data will be permanently lost.**

Press the ▼ (down) key twice, and you advance to the parameter 'Battery Now' – this informs you of the battery's voltage (Fig 2.10).

Figure 2.10. Battery Voltage Status

Press ▼ (down) four more times and your COOP station name and number appear on the screen, this is the Station Name and Time, menu (Fig 2.11). This field enables you to change the station ID number and the date and time.

Figure 2.11. Station ID Number – Ensure it appears like this example SS00NNNN

To return to the home display, simply press the ▼ (down) button one more time and you revolve back to the first of the six primary fields. For a table of the sub-field and menu structure, see Table 6.2, in Chapter 6, Sensor Calibration Policy.

2.2 Data Acquisition – Observer's Responsibility:

2.2.1 Data Acquisition Timeliness: Instruct your observers to download data in the first five days of each month, but never before 12am local time on the first day of month.

Inform them this outdoor task will take 5 minutes and requires them to plug in the SD card when the display is dark – in the sleep mode. The Observer stays near the Fischer-Porter gauge to monitor the display for any possible alert message. Observers must wait until the display message "Download Complete" appears. Only after seeing this message, should the Observer eject the SD card.

Ensure you provide each of your observers a printed copy of *FPR-D Observer Instructions*. Access the NWS website, http://www.nws.noaa.gov/ops2/Surface/Coopimplementation.htm; for the latest edition.

2.2.2 Un-plug the SD Card Port: Pull out the plastic plug that keeps the SD card socket closed when not in use. (Fig 2.6).

2.2.3 Keep Display Dark: Do not touch any of the control buttons on the Precip Recorder (Fig 2.9). Or wait for display to go to sleep.

2.2.4 Insert SD Card: With the display still asleep, insert the SD card into the socket on the right side of the Precip Recorder (Fig 2.12). The system automatically downloads data to the SD card.

Figure 2.12. SD Card port

2.2.5 Display Activates: The display responds with a running count of the number of bytes of the total 60-day record copied to the SD card.

2.2.6 Stand By When System Downloads: Expect the rain gauge to take about five minutes to download the last 60 days of data. Always wait nearby the Precip Recorder while the system downloads the data until the message 'Download Complete' appears. Then press the OFF button.

Figure 2.13. System Begins Download 10-Seconds After Insert

2.2.7 Verify the End of Download: When the download is finished the message "**Download Complete**" (Fig 2.15) will display together with the name of the CSV data file.

Figure 2.14. Data Download Progress – Indicates Portion of Total Number of Bytes

2.2.8 Clear the System: The Observer must press the **OFF** button **three times** to return to the Home Menu before ejection of the SD card.

Figure 2.15. "Download Complete" indicates download has finished

2.2.9 Remove SD Card: Press the SD card gently into its socket, and then release, so card ejects slowly. Remove the SD card and bring indoors.

⚠ **Caution:** Never walk away with the display illuminated. This will drain the battery and system will not log precipitation data every 15-minutes, and result in a permanent loss of precipitation records. For this reason after the Memory Card is ejected, you must press the 'Off' button to ensure the display is dark.

Figure 2.16. OFF button to Exit

⚠ **Caution:** If the Observer accidentally ejects the SD card early, before the 'Download Complete' message appears, then the data file will **not** be created and saved to the SD card! Unfortunately, the system does not flag this as an Error Message. Instead, it gives the Download Complete message after a brief pause after the ejection. The Observer will have to press the OFF button three times and start the download process from a dark display.

2.2.10 Re-plug the SD Card Port: Place the square plug its tether, onto the SD card socket.

At this point the Observer will take the SD card to his/her PC and upload the CSV file while at the same time preparing an email to you as NWSREP. The observer attached the CSV file to the email and reports the data to you. For those observers who use the United States Postal Service, the observer places the SD card into the pre-addressed WFO supplied padded envelope (see Figure 2.20).

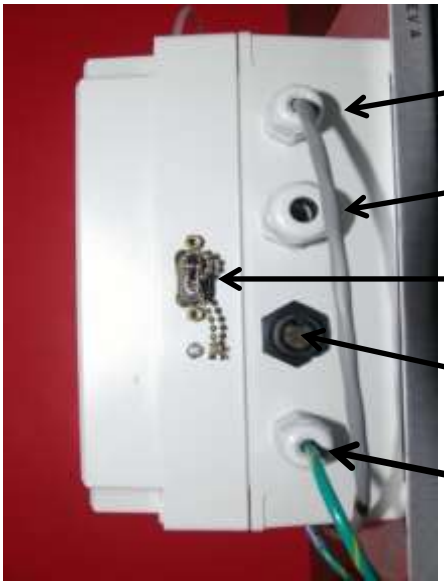


Figure 2.17. Underside of Logger – Locations of All Cable Ports

2.3 Observer Proficiency:

Give a tutorial on how to download monthly data, for any new observers or any secondary observers who want to assist. Ensure they are familiar with the NWS operations and maintenance policy as outlined in, '***FPR-D Observer Instructions.***' Encourage their dialogue, solicit their questions, and offer them additional instruction if needed.

These concepts need to be understood by the Observers as their responsibilities to the NWS:

- Timely operational download to SD card on the first five (5) calendar days of the month. The Observer shall not download before 12AM on the first day of month!

- Insert the SD card only when the display is dark (asleep). Understand the system will pause for one or two minutes right before completion of the download. This is when the SD card is being formatted. Be patient and wait for display to post, "Download Compete." Now is the time to remove the SD card.

Figure 2.18 SD card
(standard capacity, only)

- **Note:** If you insert a high density SD Card, an error 4027 will appear immediately and the system will not write anything!

- Timely mailing of the SD card to the WFO on the same day as data was downloaded.

- If the observer uses Email, then ensure s/he uses your official NOAA address (i.e., **firstname.lastname@noaa.gov**) for timely Emailing in the first five days of the month. (Follow special Email instructions in Section 2.7, below.)

- Possess a printed copy of the ***FPR-D Observer Instructions,*** (June 2014).

- Possess a filled-in copy of the ***Mailing Address/WFO POC Sheet*** (Appendix A, *FPR-D Observer Instructions*, June 2014).

- If the observer conducts basic bucket maintenance, then ensure s/he reports the action to you, either by email or by postal service. The report is done using the *FPR Log Sheet* (See Appendix E), for an example.

When you open the F&P door press the OFF button on the front of the Precip Recorder, to light-up the display with a reading of the current bucket level.

2.4 Routine Checks by Observer:

2.4.1 Report Bucket Nearing Capacity: The display gives the current rain equivalent, in inches (i.e., 15.01 inches of liquid is indicated in Figure 2.10), of everything in the bucket. This includes rain water, melted snow, oil (to prevent evaporation), food grade propylene glycol (to prevent freezing solid), and possibly anything that fell or crawled into the bucket since it was last serviced.

Figure 2.19. Rain Gauge Display

Have your Observer phone you if the display ever reads a negative value or reports more than 15.00 inches, so as to prepare for draining before the fluid exceeds bucket capacity! This way you will know to arrange a visit to service the gauge.

2.4.2 Error Message in Display: Instruct your Observer to journal and report to you any Error message that displays, or any data discrepancy. If delegated, the Observer can make a record of the event by writing it to the *FPR Log Sheet*, as described in Section 2.5.

2.4.3 Clean Solar Panel: Make sure the surface of the solar panel is free of dust or mildew or snow. Trim any tall grass, bushes, or tree branches that would cast a shadow on the solar panel.

2.4.4 Delegated Bucket Maintenance: Some Observers have an agreement with their NWSREP to drain the bucket; or add oil; or add food-grade propylene glycol. Instruct your Observers who have this responsibility they need to follow Chapter 5.6, Journal Responsibilities, to write their maintenance actions into the *FPR Log Sheet* (Appendix E) and mail/email you this log sheet at end of the month in which buck maintenance was performed.

2.5 FPR Log Sheet – Reporting by Observer:

Certain Observers are given the responsibility to perform gauge/bucket maintenance. These Observers are required to review and update the *FPR Log Sheet* for any performed maintenance or discrepancies that occurred since the last monthly submission.

When an observer encounters a system anomaly then they should phone the NWSREP and journal the anomaly to the *FPR Log Sheet*, in the Remarks section to describe the nature of the trouble and any system Error messages that appeared on the Zeno display. Phone back your Observer to learn more about the reported discrepancy in an attempt to see if the problem is one the Observer could resolve on his/her own. If your Observer's *FPR Log Sheet* contains any maintenance entries then determine if the Site Inspection Report needs to be updated.

Observers may use the *FPR Log Sheet* to inform you if they need additional supplies or if there is a request to make station visitation for an operational issue that warrants your visit.

Note: Observers are *not* required to journal the date and time of the monthly SD card download.

2.6 SD Card File Reporting to WFO – Observer's Responsibility:

Instruct your Observers to send you the SD card precipitation data on the same day they downloaded it from the gauge. They can do this by email, if able, or by postal service, yet either way, they need to do this in the first five days of the month.

Emphasize to your Observer the importance of data file integrity – and never should the file be copied to their PC computer or opened. The observer may delete an older file from the SD card, yet always keep the two most recent months' files saved to the SD card.

Observers should have a full-time awareness of where their government-issued SD card is located. The SD card has to be in the possession of the Observer on the first day of each month to accomplish the download of the precipitation data file.

All the more important for Observers who do not use email to report their monthly precipitation is for them to understand how you will use the United States Postal Service (USPS) to routinely mail a SD card each month to their preferred mailing address. This SD card will be mailed in the familiar looking envelope and will be sent to arrive a day or two before the Observer downloads the monthly data.

If the observer lives in a zone that is remote or rural and postal deliveries are less reliable, then provide this observer with a spare government-issued SD card.

2.7 Email Reporting Option for Observers:

2.7.1 Capabilities Required of Observer: In 2011, NWS Headquarters policy was updated to give Observers permission to e-mail the monthly FPR precipitation data to the WFO. As of 2014 a majority of the Observers email their monthly precipitation files to their WFO. The email reporting method is just an option and not a requirement. For those Observers who want to email, they need to meet these requirements:

- Their computer must have an SD Card reader and observer must be able to view the file.
- Have internet access on the same computer with SD Card reader.
- Able to send and email with a file attachment.
- Have knowledge of how to attach a file to an email message
- Observer fully understands the NWS will not offer **any** IT support for these tasks.

2.7.2 Emailing Instructions for Observers: Due to the many different operating systems and email clients in use, specific instructions will not possible here. These are generic instructions for the Observer to send the FPR-D monthly data file to your WFO. These same instructions are found in the June 2014 version, of the *FPR-D Observers Instructions*, posted to the NWS Headquarters COOP Modernization website.

a. Download the data from the gauge by established methods.

b. Insert the SD card into an SD card reader port on your Observer computer.

c. Open your email client program.

d. Create a new message.

e. Address the message to your NWS Representative.

f. Give the message a subject of "**FPR Data: <station number>.** " Type your COOP Station Number (i.e., 41-1234) in place of <station number>.

g. You may pass along any pertinent information in the body of the email.

h. Attach the data file DIRECTLY FROM THE ELECTRONIC MEDIA. It is important that you DO NOT OPEN THE FILE OR COPY IT TO YOUR COMPUTER FIRST. If there is more than one file on the SD card, select the file with the most recent date.

i. Send the email with attachment.

j. Since the data logger does not erase files from the SD card, it will eventually become full. Observers should understand they have the option to delete prior months' file(s) from the SD card.

2.8 Data Collection Requirements and Tasks:

Instruct your observer to download the FPR-D data in the first five days of the month, yet not before 12AM on the first day of the month.

The majority of observers use e-mail to report their monthly precipitation data. The best practice is when the observer emails the precipitation data file to you on the same day as the download from the rain gauge.

As a matter of priority you should strive by the 15th of the month, to mail back (i.e., via U.S. Postal Service) the processed SD card to the respective observers. In this way the Observers should have their SD card in their possession at the start of the new month to download new data.

You should keep a monthly SD Card Tracking Table (see Fig 3.1) to journal the date you mailed your Observers their SD Card. The term 'Incoming SD Card' refers to any SD card or Email an Observer sends you, filled with the most recent month's records, but not yet uploaded to your WFO's workstation. The term 'Outgoing SD Card' applies to a SD card after you have downloaded the CSV to the WFO's workstation. Once you complete this transfer, place the 'Outgoing SD Card' in a container or box, marked 'Outgoing.'

Figure 2.20. Mailer for SD Card and Log Sheets

2.8.1. Filename and Storage Standard:

The following naming convention for FPR-D precipitation data filed (also known as 'log files') applies to all NWS offices handling FPR-D precipitation data.

Example: **04001272_log_20141002.csv**
Station ID_log_DownloadDate.csv

Format: ss00nnnn_log_yyyymmdd.csv

Translation: **ss00nnnn** = State code (ss) is '04' and Local code (nnnn) is '1272'
log = Indicates the data originated in a 'Sutron' data logger
yyyy = Year in which the data was downloaded to SD card
mm = month of download to SD card
dd = date of download to SD card

The Sutron rain gauge generates this filename for each log file when you download data to SD memory card. The first eight characters give the Station ID number (i.e., 04001272). This is similar to the COOP SID except it has two Zeros embedded. This is followed by the word '_log_' and the third section gives the year, month, and day of the data download.

Store on the WFO workstation all the monthly CSV data files for a minimum of 36 months.

Caution: Ensure all monthly files in your WFO workstation remain unchanged from their automatically named format! Never rename a data logger generated filename!
Store the original files in their proper subfolder according to year and the last full month of precipitation. Files your observers send you in October get stored in, this folder: C:\HPD\2014\SEPTEMBER\. Always keep the original source files in their original name: i.e., 04001272_log_20141002.csv.

After you run McAfee Active Virus Defense (AVD) suite and you have confirmed 'no detections' remove the SD card. Do not save the CSV file to the Virus Scanner PC.

This name convention applies to both platforms where you handle FPR data files:

- Designated PC/Laptop where you run McAfee virus scanner on the SD cards, and
- WFO workstation that hosts your HPD directory (i.e., C:\HPD\Year\Month\)

2.8.2 Instructions to Virus Scan and Upload the Data Files:

a. Follow your forecast office's established Virus scanning procedures for external SD card media. The NWS uses McAfee Active Virus Protection (AVD).

b. If this is your office's policy, then work with your Information Technology Officer (ITO) to arrange a time for the ITO to scan as many SD Cards as possible.

c. Ensure that all the SD cards are virus-free with no detections in accordance with the convention stated in Section 1.1.5. Increment the HPD subfolder for the current collection month (i.e., C:\HPD\2014\NOV\).

d. Upload the most recent month's CSV data file, from each SD Card to the NWS workstation. Click "File → Save As." Keep the filename unchanged for each CSV file. See Section 2.8.1, for details on the filename standard.

e. Ensure the most recent month is present in its entirety. Follow the instructions in Section 3.5, of this manual. View the CSV data file's contents from the pop-up 'Notepad' window to ensure the most recent month was delivered.

   Delete the CSV file if it is missing 15 days or more from the collection month. Phone the Observer to inquire into the problem and ask Observer to perform a download today, and mail the data his earliest convenience. When you receive his SD card, then mail the Observer a replacement SD card because he has none.

f. To finish the process, delete the oldest of the two files on the SD card.

g. Unplug the SD card and place it in a new Jiffy envelope ready for mailing back to the Observer.

2.8.3 Mail Back the SD Card to Observers Who Use Postal Service:

On or about the 15th of the month mail the observers their SD card.

SD cards when mailed to the Observers are not required to be labeled to identify a specific COOP SID. The file is not required to have originated from the Observer to whom you are mailing. Rather, the purpose is to deliver a nearly blank SD card. Likewise, the Observers are not required to label or identify on the SD card any information.

You may choose to label the SD cards when necessary to resolve certain situations (i.e., SD card missing current reporting month's file).

Write down to the monthly SD card Tracking Table (Fig 3.1) the date you mailed-out the 'outgoing' SD cards.

Each SD card should hold just two files: (a) the reporting month – with precipitation data in all 15-minute periods, from every day of the entire calendar month; and (b) a second file, the preceding month's CSV file, preferably from the same Observer's site.

Note: Each incoming SD card should contain only two (2) CSV data files. The current reporting month and the preceding reporting month – each were given a filename upon download at the Observer's site. You may not rename any CSV data file, neither those on the SD card nor those in your NWS workstation.

Note: Keep a log sheet to account for any incoming SD Cards that arrives 'blank.' You may affix a label to these SD cards to check them later when you visit the COOP site.

Your next major responsibility is to transmit the monthly FPR precipitation records to the NCDC before the 25th of each month. For rare occasions, when the Observer was unable to mail the SD card or was instructed by the WFO to postpone a download to SD card, the date of your transmitting the FPR file may be extended by one or two weeks. The intention here is to limit unnecessary FTP transmissions and to simplify your SD card tracking work.

2.8.4 Download All Observer Emailed Data Files to HPD Folders:

On or before the 25th of the month conduct several KEY WORD SEARCHES of the Inbox of the WFO email account where you receive all of the Observers monthly reported FPR precipitation data files.

Start your Key Word Search with the words "**FPR Data**" because these words are required to be written into the subject line by the Observers when they email you their monthly precipitation data files. See Section 2.7.2 for specific instructions for how Observers should address their emails to you.

Try each of these Key Word Searches in the email inbox, to locate all FPR files:

- "FPR Data"
- COOP SID (i.e., 41-5678) for each site with FPR gauge in your CWA
- Observer's Tag Name (or their specific Email Address)

Filter by email date, the found files, and examine the dates to ensure the most recent observing month was delivered.

Without opening the message's attachment, download the attached file to the HPD subfolder for the observation month (i.e., C:\HPD\2014\NOV).

Check the inbox email messages for any additional information that may have been sent. Observers may report on maintenance actions conducted, supplies needed, bucket fluids that require disposal, and any relevant notes or comments on the rain gauge performance..

For your Observers who were delegated the bucket maintenance tasks are required to report the *FPR Log Sheet*, either by printed form via the United States Postal Service, or via Email, if they have an electronic form of the *FPR Log Sheet*.

CHAPTER 3 – Monthly Data Collation and Reporting to NCDC

3.1 Data Handling Procedures - Overview:

Each month, by the 25th day, you are required to FTP the data to ftp.ncdc.noaa.gov, the NCDC data ingest server in accordance with policy stated in, *Requirements and Standards for NWS Climate Observations*, NWSI 10-1302. This chapter gives detailed instructions to successfully collate and report the monthly precipitation files to NCDC.

a. By 10th day of month phone your Observer if you have not received the SD card or the Emailed data file.

b. Scan the SD cards on the workstation your offices uses to scan 'External non-NWS memory devices. See Section 2.8.2, in preceding chapter for specific instructions. If the virus checker give a 'clean' report of the SD card, then download the CSV file that has the most recent saved date, as seen in the Windows viewer environment.

c. Display the contents of data file in a graphical plot (i.e., **FPRD_PlotData_V1_3.xls**) or use Notepad to read the file and scroll through the most recent month, to ensure the 15-minute data records for the start and end of the month are present. If you see extensive numbers of records missing, then phone the observer. When you phone the observer, ask him/her if they noticed any system anomalies. Also ask observer to download to SD card and send this new file to you.

d. Save the monthly Precipitation Data (i.e., 44000766_log_20090704.csv) files received from your observers into a single folder for named with the Month in which the most recent full month of precipitation was measured. This will enable you to quickly Zip together all files for quick upload to the NCDC monthly ingest server.

   For example:

   C:\HPD\2014\AUG
   C:\HPD\2014\SEP
   C:\HPD\2014\OCT

e. No later than the 15th of month, mail back your observer one SD card, per routine.

f. By 25th of month, transmit to NCDC all your sites' FPR data in one Zip file.

3.2 Log-in Each SD Card When Received:

For all the Precipitation Data files you receive by email, account for each **email** data file received. If your office has a number of Observers who email, then modify the SD Card Tracking Table to accommodate the sites that send monthly FPR precipitation files.

By the 15th of the month, ensure you have received either the emailed data file or the SD card from all your FPR observers.

Read the return address on the USPS mailing envelope (Fig 2.20) to identify from which site this SD card originated, and mark the SD Card Tracking Table (Table 3.1) for the date it arrived. Positively identify all observer files between the 5th and 15th of each month.

Check the same mailing envelope for these items:

- SD memory card,
- *FPR Log Sheet* (for a report of bucket maintenance or anomaly).

The Jiffy No. 0 (zero) padded mailing envelope (Fig 2.20) is sufficient to hold the *FPR Log Sheet* and SD card. This photo shows the standard ten inch square, darker color envelope. Newer, bubble-pack square envelopes have thinner paper and tear more easily and can result in the SD card being lost in the mail.

SD CARD TRACKING TABLE					
Month Ending	**COOP Station Name**	**WFO RECEIVED Observer's SD Card, i.e., Incoming card:**	**WFO SCANNED Incoming SD Card for virus and malware:**	**WFO MAILED OUT Observer's SD Card, i.e., Outgoing card:**	**WFO REPORTED Data File to NCDC:**
JUNE 30 2014	Slidell	July 6th	July 15th	July 15th	July 25th
	Pascagula 3 NE	July 8th	July 15th	July 15th	July 25th
	Biloxi 9 WNW	July 19th	July 19th	July19th	July 25th
	LSU Ben-Hur Farm	July 7th	July 15th	July 15th	July 25th
	Hammond 5 E	**Not Arrived Yet:** Phoned him 7/20, to inquire. He'll mail it Monday.	July 29 same day as arrived!	July 29th same day as arrived!	July 29th as combined with the 7/25 zip file.

Figure 3.1. SD Card Tracking Table

If any Email or SD card is missing on the 15th, first search your office's Email inbox, or incoming USPS mail station, for possible mis-distributed / misplaced envelopes.

The same day you open the envelope holding the Observer's mailed SD card, log the date to the column marked 'WFO RECEIVED' in your SD Card Tracking Table (Table 3.1).

You may want to wait until the 15th of the month until all SD cards have arrived, and scan them at the same time. Instruct the Information Technology Officer (ITO) to inform you when he/she has run the McAfee software on all SD cards. After you view the CSV file and check the identity and date for current reporting month (see Section 3.5), log each SD card as 'scanned' in the ***SD Card Tracking Table***.

Phone the Observer if his SD card has not arrived by the 10th day of month.

If you have not received the Observer's SD card or Data Email by the 10th day of month, phone the Observer to inform him you are missing the current precipitation report and ask if he had any difficulties or was simply behind in mailing. On the 20th review the SD Card Tracking Table to identify any SD card still missing, if so, phone that Observer a second time. If the Observer does not have a phone, or a phone answering system prevents direct conversation, then mail a letter to the attention of the Observer, to direct him to mail the SD card.

Note on Missing Files from SD Card: Occasionally an Observer mails you an SD Card missing its most recent data file. This can occur if the Observer ejected the SD Card from the recorder before the system finished its full download process. Unfortunately, the system does **not** produce an error message for a premature ejection of the SD Card. The Observer may not realize the file never copied to the SD Card because the system returns the normal 'Download Complete' message.

If the data file is missing, then mail the SD Card back to the Observer inform him/her of the likely explanation. Instruct him/her to perform a normal monthly download. This requires one to wait until the 'Download Complete' message appears after five minutes before ejecting card.

3.3 Create New Subfolder to Store New Monthly Data:

In the same NWS workstation you plan to FTP your monthly files to NCDC, you need to establish a directory folder according to the year and month, for easy, ready reference of the precipitation data files.

Go to folder for the current year C:\HPD\2015\ and create a new monthly sub-folder, for the precipitation data collected for the full month of February, then name the sub-folder: C:\HPD\2015\FEBRUARY\.

Note: Always keep in mind that Notepad is the only program for viewing and opening the CSV stored in these directory folders! To do otherwise will corrupt the data format of the CSV file!

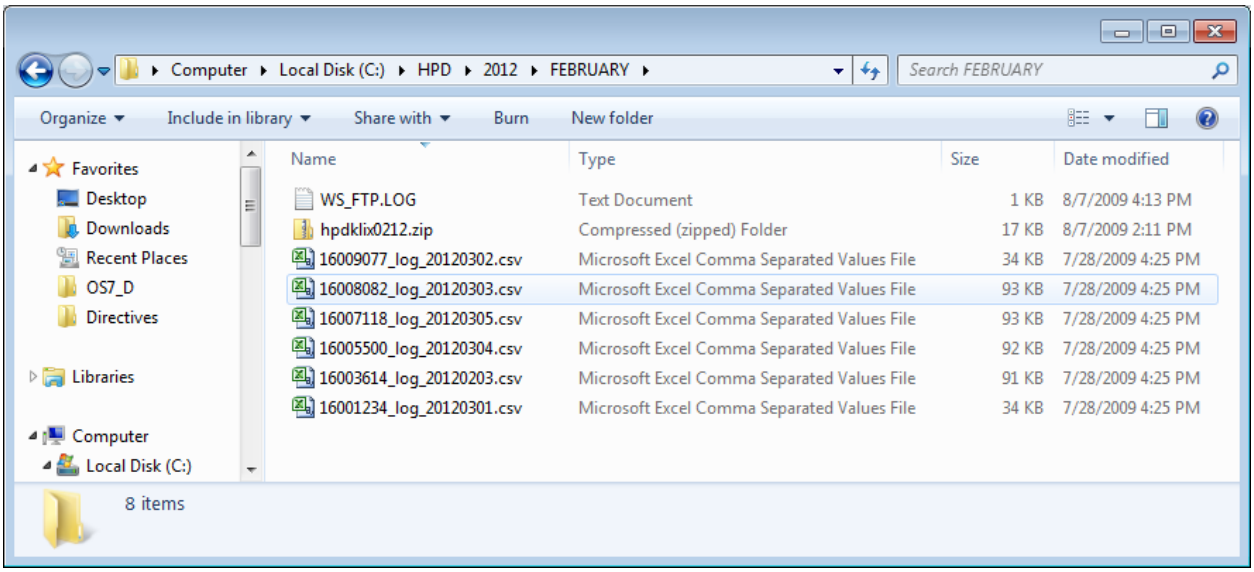


Figure 3.2 For Each Month Create a New Sub-Directory

3.4 Examine CSV file with Graphical Plotting Macro (FPRD_PlotData_V1_3.xls):

Examine the contents of the CSV data file, to identify from which COOP Site this SD card originated.

At this time, it is essential to read the COOP Site Identifier (SID) in the first word, of the second row of the headline (i.e., 44000766) and use this to update your 'SD Card Tracking Table.'

Update the SD Card Tracking Table in the respective row (i.e., Blacksburg NWSO) and write in the date on which this CSV file was virus scanned and uploaded to NWS workstation.

The next section, 3.5, explains how to decode each of the nine fields in the FPR-D data records.

⚠ **Always use Notepad (Fig 3.2) to view the CSV data file. Never open the CSV file at any time in an Excel (XLS) application!**

Follow these Windows procedures to call up the Notepad application to view the CSV contents.

Access your Network station's file directory containing these FPR data files and carefully single click the right-mouse-button to select the CSV file for a controlled application opening within **Notepad** and not Excel.

Important: Be careful not to double click the CSV file as this will open it within the Excel spread-sheet applications program and you risk losing the date/time data format!

Now, click the right-mouse-button once to expand the drop down menu (see graphic, below), and notice the option "Open With". Slide the cursor to the word, 'Notepad' it is the second application listed on this pop-out menu. Single click on it to open a Notepad text screen viewer window and conduct your examination of the 15-minute data records.

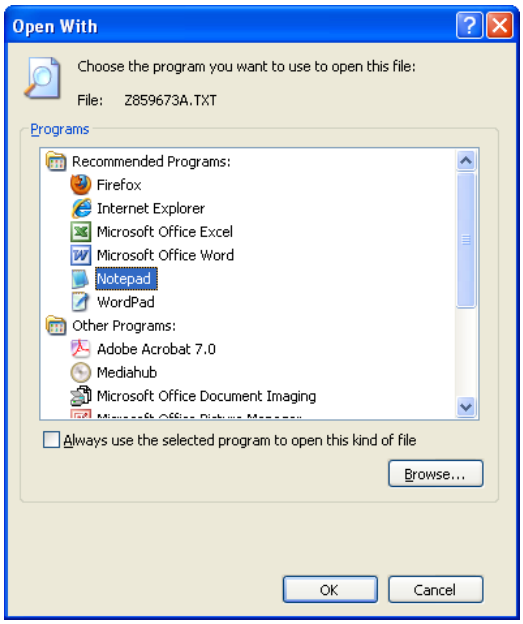


Figure 3.3 Use Notepad to View the Data Files

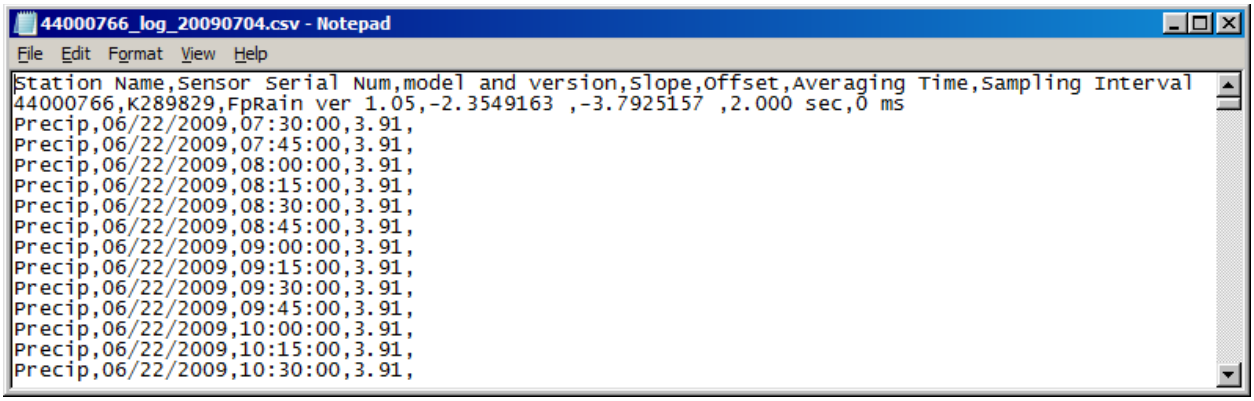


Figure 3.4. Portion of a Precipitation Data File (44000766_log_20090704.CSV)

Saved files may be accessed by opening the CSV file with Notepad using the Mouse right-button. Notepad should open, displaying the selected file. See the example in Fig 3.3.

Note: Your CSV data will appear in Notepad similar to site, 44000766, Blacksburg NWSO, VA, from June 22, 2009.

3.5 Examine CSV to Confirm Observation Month is Present:

Give a quick one minute or so visual inspection of your Observer's CSV file's contents, to confirm the file holds the complete number of observations for the collection month. Confirm there is a precipitation record for the start of the month as accounted for by the 12:00AM record of the first day of the month as pointed out in the first **bold font** call-out in Figure 3.4. Notice the record, 02/01/2009, 00:15:10, 2.65, marks the first full record of the day April 1, 2013.

Heading Format: 44000766,K289829,FpRain ver 1.05,-2.3549163 ,-3.7925157,2.000 sec,0 ms			
Parameter	**Example**	**Definition**	**Units**
Station Name	44000766	Rain Gauge Identifier	User settable, 8 digits
Sensor Serial Num	K289829	Load Cell Serial Number	User settable, 8 digits
Model and Version	FpRAIN 1.05	Model and Version	Configuration File Version
Slope	-2.3549163	Calibration Factor	Unit-less, 7 decimal places
Offset	-3.7925157	Calibration Factor	Inches, 7 decimal places
Averaging Time	2.000	Length of each sample	Seconds, 3 decimal places
Sampling Interval	0	Time between each sample	Milliseconds (0 decimal places)

Table 3.5. Heading Explanation for each Data File

15-Min Data Record Format: Precip,06/22/2009,08:45:00,3.91,			
Parameter	**Example**	**Definition**	**Units**
Precip	3.91	Total equivalent rain in bucket	Hundredths of an Inch
Date	06/22/2009	Date measurement completed	MM/DD/YYYY
Time	08:45:00	Time measurement completed	HH:MM:SS

Table 3.6. Description of One Ordinary 15-Minute Record

Daily Voltage Record Format: Batt Voltage,06/22/2009,23:59:59,13.7,			
Parameter	**Example**	**Definition**	**Units**
Batt Voltage	13.7	Daily voltage reading (12:00am)	Volts, one decimal place
Date	06/22/2009	Date of measurement	MM/DD/YYYY
Time	23:59:59	Time of measurement	HH:MM:SS

Table 3.7. Description of Daily (Midnight) Voltage Record

Events are Logged into the Data File: Slope After,05/21/2009,12:22:41,-2.4352,				
Log Events	**Example**	**Description**	**Date**	**Time**
Display On	- blank -	Display woke-up	05/21/2009	12:34:34
Slope Before	- 2.5000	Calibration Slope	05/21/2009	12:42:41
Slope After	- 2.4352	New Calibration Slope	05/21/2009	12:22:41
Offset Before	- 3.5378	Calibration Offset	05/21/2009	12:22:41
Offset After	- 3.1459	New Calibration Offset	05/21/2009	12:22:41
Display Off	- blank -	Display fell asleep	05/21/2009	12:33:56
Log Download	- blank -	Download 60 days	05/27/2009	08:22:47

Table 3.8. System Events Are Logged to the Precipitation Data File

```
Precip,01/31/2009,23:15:00,10.90,
Precip,01/31/2009,23:30:00,10.90,
Precip,01/31/2009,23:45:00,10.90,
Batt Voltage,01/31/2009,23:59:59,13.7,
Precip,02/01/2009,00:00:00,10.90,
Precip,02/01/2009,00:15:00,10.90, ← First 15-minute record of the month.
Precip,02/01/2009,00:30:00,10.90,
Precip,02/01/2009,00:45:00,10.89,
Precip,02/01/2009,01:00:00,10.90,
Precip,02/01/2009,01:15:00,10.89,
Precip,02/01/2009,01:30:00,10.89,
Precip,02/01/2009,01:45:00,10.89,
Precip,02/01/2009,02:00:00,10.89,
Precip,02/01/2009,02:15:00,10.89,
Precip,02/01/2009,02:30:00,10.89,
Precip,02/01/2009,02:45:00,10.89,
Precip,02/01/2009,03:00:00,10.89,
Precip,02/28/2009,23:00:00,11.53,
Precip,02/28/2009,23:15:00,11.53,
Precip,02/28/2009,23:30:00,11.53,
Precip,02/28/2009,23:45:00,11.53,
Batt Voltage,02/28/2009,23:59:59,13.5,
Precip,03/01/2009,00:00:00,11.53, ← Final 15-minute record of the month.
Precip,03/01/2009,00:15:00,11.53,
Precip,03/01/2009,00:30:00,11.53,
Precip,03/01/2009,00:45:00,11.53,
```

Figure 3.9. Expanded View of a Precipitation Data File to Point Out Dates/Times

Scroll to the end of the CSV file and locate the end of the collection month. Confirm there is data from the end of the month as accounted for by the first 15-minute record past 12 Midnight on the first day of the new month.

If the collection month is missing then phone the Observer and request s/he download and send you the data. The FPR-D logger holds 100-days of data. You have only 10-weeks after end of the collection month for the observer to report the full month, before it gets overwritten by new data.

If 50% or more of the month's 15-minute records are missing, then notify the NCDC via email HPD.NCDC@NOAA.GOV.

After you have examined the CSV file for proper dates and times to verify the full reporting month is present, you may wish to confirm the Precip values are consistent in that they contain data and not 'zeroes' or erroneous data with negative values. Use FPRD_PlotDat_V1_3.xls to view the file.

3.6 Zip Compress all Rain Gauges' Data Files:

Once you have received all the Observers SD cards and Emails for the reporting month (after logging their arrival in the SD card/Email Log Sheet), you are ready to 'zip' all the CSV data files into a single .ZIP file on the NWS network workstation.

Use only the NWS network workstation to zip together all CSV files from the observed month.

a. Using Windows Explorer, select all files in folder by selecting one file in the folder and then using (Ctrl-A),

b. Right-Click on files and select "add to ZIP"

c. The file should now be re-named hpdkxxxMMyy.zip

You must always use this NCDC filename convention, **hpdkxxxMMyy.zip**, for all files transmitted to NCDC. Code explanation: kxxx= is your 4-letter WFO identification (e.g., klix for Slidell), and >MM= is the data-month (i.e., 06), and >yy= is the data-year (i.e., 09).

SD cards Delivered Late to WFO: If any Observers have not yet sent you their SD card, phone and remind them, and wait until the 25th of the month. Then, on or about the 25th of the month ZIP together all the CSV files you have collated in Section 3.3.

In certain rare cases of lateness, you may postpone the ZIP process and FTP transmission for six weeks beyond the 15th. August 31, 2009, is seven weeks 'late' from the Observer's reporting date for the June 1-30, 2009, precipitation report. Further lateness from the Observer will cause confusion in your account of HPD transmissions to NCDC. Remind the Observer to download and mail the SD Card the first week of each month.

NCDC Advice on Zip Compression:

- The CSV data file must contain the **entire** month's data being reported in the file name of the zip file.

- For example, a ZIP file named **hpdkxxx0609.zip** must contain all data for the month of June. The Observers shall download the data logger to their key only after midnight on June 30, 2009. Since NCDC will be processing the June data, if any data is missing, it will not appear in the publication or archive databases, and will be marked "missing".

Caution: Do not right-click on the folder and "add to zip" as this causes your PC's folder name to appear to NCDC as the path name from which to extract data. Then, your data will never get processed by the ingest program!

Caution: Make sure that the "save full path info" is not checked under the Folder Option. This creates a separate sub-folder. Then, your data will never get processed by the ingest program!

Caution: Do not send a self-extracting executable file (.exe). The files must be zipped with a file compression utility such as 7-Zip or Winzip. However, ensure you name the extension '.zip.'

For additional guidance on ZIP procedures see chapters, 5, 6, and 13, in the publication, *"HPD Digital File Submission Troubleshooting Guide."* It is available from NCDC's website: http://www1.ncdc.noaa.gov/pub/data/hpd/inv/HPDDigitalFileIssuesPrimer_02122014.pdf

3.7 Upload Precipitation Data to NCDC:

Between the 15th or 25th of month, you should have zipped together all your current CSV files at your NWS-network workstation (Sec 3.6, above). Now you are ready to start an FTP session.

Double-click the desktop icon for WsFTPLE (i.e., Ipswich WSFTP95.exe) on your network workstation. If there is no icon, run the executable file that is located in C:\Program_Files\WS_FTP Windows\. The Session Properties 'General' panel will open immediately (graphic, below). Confirm it is configured properly with each NWSRSEP to use 'anonymous' as his User ID, and each NWSREP shall use his NWS- network e-mail address as his Password.

Host Name / Address:
ftp.ncdc.noaa.gov
User ID: anonymous

your.name@e-mail.address.

The general session properties do not change, except for the Password field, which will show the e-mail address of the person who most recently transmitted an FTP data file to NCDC.

Also, about half of all offices send upper-air observations this same way. So, now update the Password: dialogue box with your name.

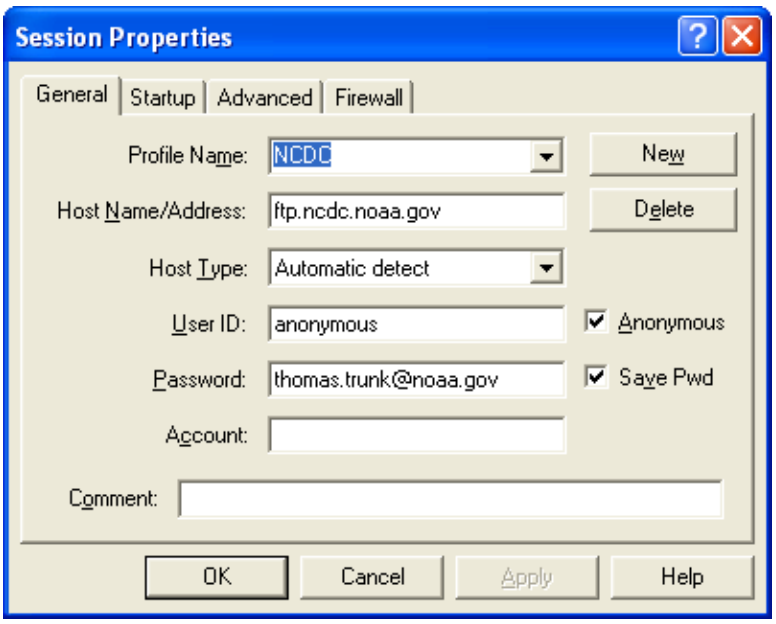


Figure 3.10. Set-up Your FTP Session

Click on the Apply button (on bottom of Figure 3.5, to the right of the 'OK' button) so you can enter your password (do not click on OK, yet call-up the 'Startup' tab immediately it is located on the top of Figure 3.6) to advance the session. The 'Remote Host Directory' will appear in the first line. This is the NCDC ingest webserver folder, and it should appear: **/pub/upload.**

Place your mouse cursor inside the second dialogue box, marked 'Initial Local Folder:' (see graphic, right) and update the default local folder from C:\hpd\2009\may, to C:\hpd\2009\june, by typing in the letters 'june' (below) and clicking on the button Apply.

Finally, while still in 'Session Properties', click on the OK, expect sound-effects (i.e., train-whistle), and the program will quickly update your FTP user-control panel (see graphic, below) as the Session Properties windows closes.

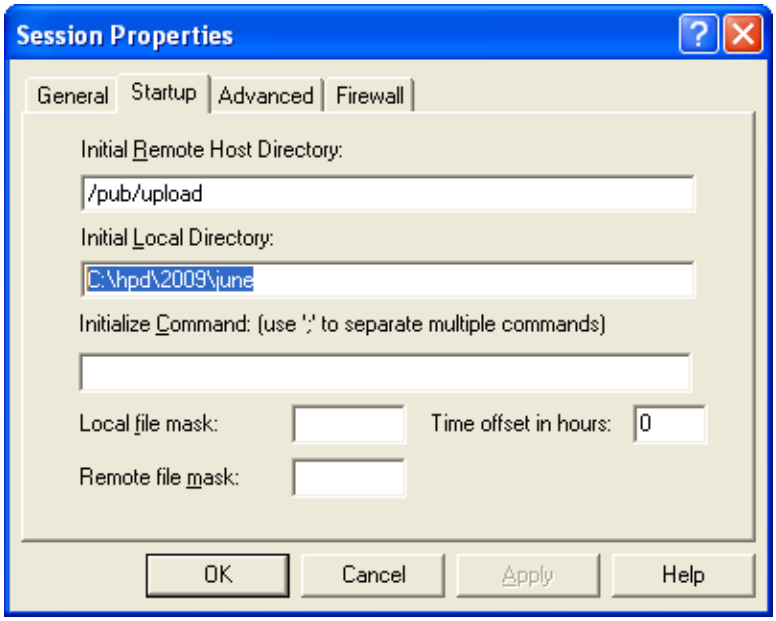


Figure 3.11. Select Your Data Sub-Directory

The FTP twin-pane user-control panel (see, below) is a standard design with the left-pane titled 'Local System', and the right-pane titled, 'Remote Site'. Your Observers' monthly data files are visible in the Local System's left-pane view arranged by filename as they appear in your NWS-

network (AWIPS) workstation. The NCDC directory path for data file ingestion appears in the right-pane, under the title, Remote Site.

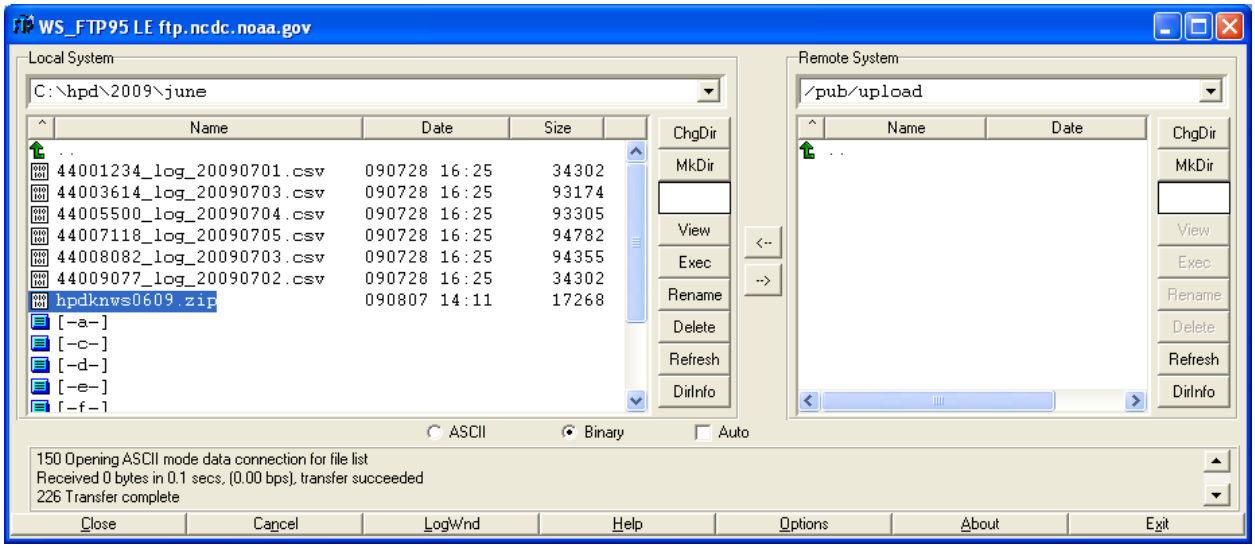


Figure 3.12. Select your ZIP file to send to NCDC

<u>Note:</u> Verify that your ZIP filename is properly coded and spelled: **hpdkxxxMMyy.zip** is the proper code, where 'kxxx= is your 4-letter WFO identification (e.g., krnk for Roanoke), and 'MM' codes for data-month (i.e., 06), and yy= codes for data-year (i.e., 09). For zip files the year 'yy' is always on the end of the filename!

<u>Note:</u> Always name the ZIP file with the same month designation as the Collection Month of the observed precipitation data being reported to NCDC! You may call-up a full view of the precipitation data files to understand which CSV files you have just zipped. Use your mouse – locate the lowest tab in the median of the double-pane window – labeled 'DirInfo'. Click on this 'DirInfo' tab to open the viewer as seen in the illustration, below.

Ensure that the Local System window displays the relevant month's FPR zip files (e.g., hpdkxxx0609.zip) along with the CSV filenames of each COOP station that sends you monthly FPR data. The Remote Site window will show no files having been uploaded as of this session.

a. **Select** the ZIP file (e.g., hpdknws0609.zip) you will send to NCDC. Even though you use 7-Zip utility to compress your files, always remember, you **must rename** the file extension to "**.zip**". So, single click with left mouse button on the filename with the '.zip" extension in the left-side window, to select the file.

b. Locate the two small square buttons [←] and [→] that **control** the direction of FTP file transfer. They are located in the vertical median of the twin-pane panel.

c. Click on the right pointing button [→] and you will **transmit** your monthly FPR-ZIP file to the NCDC's data ingest port. Your task is now completed.

At the 100% transfer complete, audio effects will sound (i.e., several rapid chirps).

d. Click on '**Exit**', on the menu bar at the bottom-right of the twin-pane panel.

e. Click on the receipt file that arrived upon successful transmission, titled "WS_FTP.LOG", highlighted in the graphic, below.

Note: It has been discovered some versions of Ipswitch FTP will not produce this *log* file.

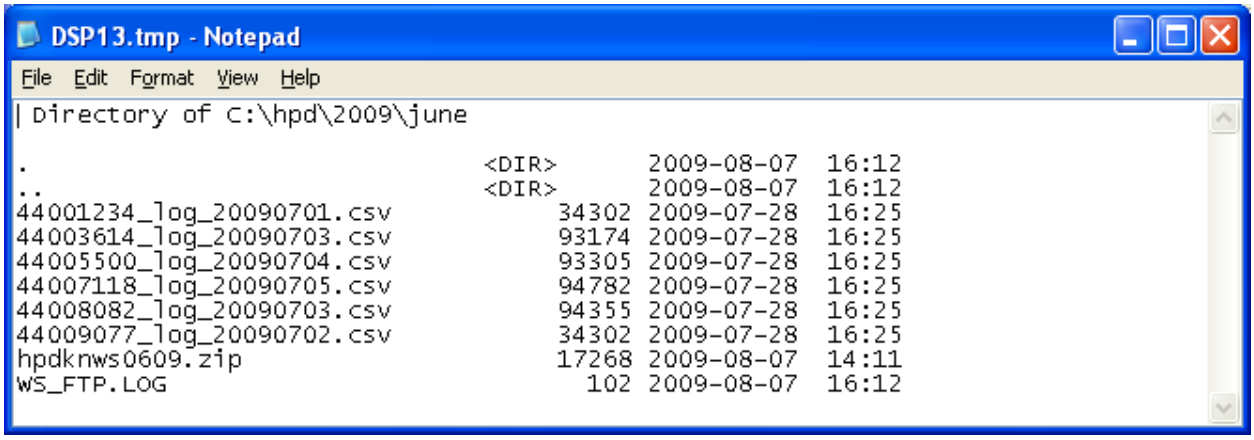


Figure 3.13. Example of a Receipt Message 'WS_FTP_LOG'

Select the WS_FTP.LOG in your subfolder C:\hpd\2009\june\ with mouse cursor (so it highlights), then click on the 'View' tab, to the right, the fourth tab from top of the center median. To produce an 'FTP transmission receipt'. Note the date and time 16:12 Aug 7, 2009.

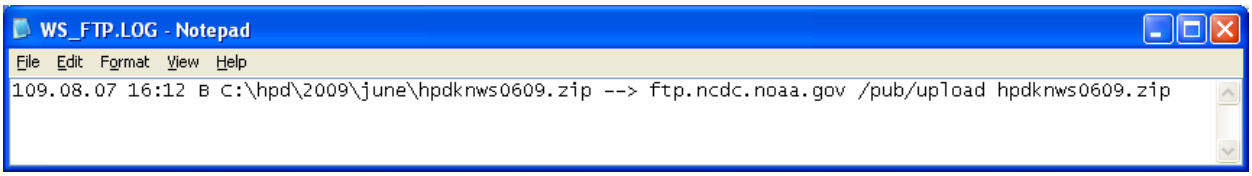


Figure 3.14. Contents of the 'WS_FTP_LOG' message

At NCDC an automated program (Cron job) will be looking for the "hpdknws0609" and the "zip" when it runs once each hour. Any files located will be automatically processed.

Immediately after you have FTP'd your Zip file, use the same utility to call up the 'message log' to confirm your Zip file was successfully received to the /upload/ folder. See the screen display, of the FTP-LE Message Log (see Fig 3.12, below).

Note: Email HPD.NCDC@noaa.gov, if you have any questions on Zip file compression or FTP transmission.

3.8 Confirm NCDC Has Ingested Your Monthly Precipitation File:

Call up the NCDC website, 'HPD-Received,' the day after you have transmitted your monthly ZIP file. Check for the successful arrival of your monthly FPR data files in the folder that is named according to the month in which you uploaded the file (and not the month of the precipitation observation).

Type the NCDC ingest folder web address with the final portion, YYYYMM (gray shaded), http://www1.ncdc.noaa.gov/pub/data/hpd/inv/**hpd-inventory_200907**.CSV ; for the year and month, you uploaded the Zip file to NCDC

For example, July is given in this situation in which you are routinely reporting the June 2011 precipitation files (i.e., HPD data).

Scroll through the reports, until you locate your office ID (e.g., **hpdkrnk0609.zip**) with the files unpacked directly below the zip filename. (*Notice the '0609' in the zip file's name…this is proper - you must use the month '06' because this is when precipitation was measured…and the zip filename 'hpdkrnk0609.zip' you created to contain all COOP sites for this reporting month*)

3.9 If 'ERROR' Flags Occur then Access NCDC Troubleshooting Guide:

If you do not see your ZIP file on the ingest website, or if ERROR messages appear next to your Log Files that were extracted from the ZIP file, then call up the, "*HPD Digital File Submission Troubleshooting Guide*" and diagnose the problem. Access the guide from the NCDC website:

http://www1.ncdc.noaa.gov/pub/data/hpd/inv/**HPDDigitalFileIssuesPrimer_02122014.pdf**

Try to diagnose if there was a common mistake made. Perhaps a misnamed file extension or you accidentally opened the log file into an Excel environment? Resolve the problem if possible, and resubmit the Zip file to the ingest folder.

Note: If your ZIP data file is still missing, then you need to email the NCDC on this address: HPD.NCDC@noaa.gov.

```
hpdklix0609_c2009071514.zip    [Wed Jul 15 18:00:56 EDT 2009]:
    OK       16004030_log_20090702.csv
    OK       16005620_log_20090707.csv
    OK       22006718_log_20090711.csv
    OK       16001899_log_20090701.csv
```

Figure 3.15. NCDC Ingest Folder Reveals COOP Sites Received

Now ensure each of your FPR-D sites appears beneath your WFO zip file date line. Look for their COOP number. In Fig 3.15, the sites are 16-4030, 16-5620, 22-6718, and 16-1899. Each line should start with an "OK" and not a "ERROR." If "ERROR" appears analyze your Zip file

to see if you accidentally zipped the folder rather than just the data file. If so, then re-Zip, and transmit data.

To prevent any problems with successful upload of data to NCDC, you should review the NCDC's publication, *"HPD Digital File Submission Troubleshooting Guide." It is available from their website:*
http://www1.ncdc.noaa.gov/pub/data/hpd/inv/HPDDigitalFileIssuesPrimer_02122014.pdf

If after you have analyzed and tried to resolve the problem, and your Data Files are still not appearing on the NCDC webserver, then email NCDC.HPD@noaa.gov to inform them. They may advise you contact the Sterling Field Hotline, NWS.SFSC@noaa.gov, to resolve the issue.

3.10 Monthly Timeline of FPR Tasks:

Day of Month	Countdown to Data Upload	Task to perform.
Jun 25th	T – 31 days	Access the http://www1.ncdc.noaa.gov/pub/data/hpd/inv/hpd-inventory_200906.CSV website to confirm NCDC has received your precipitation data Zip file. (**Section 3.8**)
25th	T – 31	Mail back the SD cards to the Observers who mailed them.
July 1st	T - 24	Prepare a new ***SD Card Tracking Table*** for month ending June 30th.
3rd	T – 22	Log first SD card arrival into your ***SD Card Tracking Table***. Did the Observer enclose any operational log-sheet or notes?
3rd	T – 22	McAfee virus scan each SD card on same day it arrives. Then use SD card reader on NWS workstation to upload precip data file. Examine CSV file's date/time headings to confirm proper month. Upload precip data files that were emailed by the qualified Observers.
10th	T – 15	Virus scan any outstanding SD cards and update the ***SD Card Tracking Table***. Identify any missing (late) drives. Check NWS workstation email inbox for missing or late precip data files. Phone the Observer to prompt for the missing (late) SD card.
July 15	T – 10	Check WFO inbox and retrieve Observer envelopes to reduce risk of being misplaced. Upload any outstanding SD cards and update the ***SD Card Tracking Table***.
15th	T – 10	Take inventory of CSV files on your enterprise workstation. Examine the date/time fields to ensure the first and last days of the reporting month are present with no missing data.
15th	T – 10	Upload any outstanding SD cards and update the ***SD Card Tracking Table***. There should be no missing or late cards now. Check NWS workstation email inbox for missing or late precip data files. Phone the Observer a second time (first time was on the 10th) to prompt her/him to mail it!
July 15	T – 10	Mail back the SD cards to those observers who have reported their monthly precipitation to you via the U.S. Postal Service.

25th	T – 0	Confirm all SD cards were received and McAffee virus scanned (PC/laptop) - then update the ***SD Card Tracking Table*** as necessary. Ensure all CSV files were saved to the proper monthly folder in the NWS enterprise workstation.
25th	T – 0	ZIP all the CSV files submitted this month, to form a single bundled ZIP file.
25th	T – 0	Important: Ensure the filename is spelled properly. **Example: hpdkxxx0609.zip** Where the **kxxx** is the WFO site ID (e.g., lix); the **06** is the data-filled month (June); and **09** represents year 2009.
July25th	T – 0	Report to NCDC all the sites monthly data with one ZIP file via F.T.P.
25th	T – 0	Access the http://www1.ncdc.noaa.gov/pub/data/hpd/inv/hpd-inventory_200907.CSV website to confirm NCDC has received your FPR sites' monthly CSV files. (**Section 3.8**)
25th	T – 0	Delete the older of the two files from each SD card. Strive to keep each SD card holding just one data file, the one most recently downloaded by the Observer.
25th	T – 0	Mail each of your Observers his new SD card. It should contain just one data file on it.

Table 3.1 Monthly Timeline of FPR Data Reporting Tasks

Note: T-0 Denotes the day on which you FTP'd the monthly files to NCDC.

CHAPTER 4 - Quality Assurance and Best Practices

4.1 Data Quality Review:

4.1.1 Data Degradation**:** Recording rain gauges are prone to a number of factors that challenge the quality of the precipitation record. Small variations on the order of ±0.01-inches that occur several times across 24-hours are common and should not be reported.

Evaporation is the most common issue, and less common are lawn sprinklers or objects that fall into the collection bucket. If the Observer informs you of something that could cause errors in the precipitation record, then upon receipt of the file, use the FPR Plotting Macro and then view the data file in Notepad, and if validated as a data problem, then notify the SFSC with an email of the effected file.

Bent, broken, and over-tightened flexures will result in a diurnal oscillatory pattern in the precipitation data (Figures 4.2 and 4.3). Rain gauge platforms that are not level and weighing assemblies that are misaligned will stress the flexures and corrupt the data. See Chapter 5, Routine Maintenance, for guidance on replacing flexures and leveling the rain gauge.

These events need to be documented by the WFO and communicated to the SFSC, and if warranted an Error Report submitted to NCDC via the Datzilla website. See Section 4.1.3, for NWSREP policy to report data errors.

Oscillations, drifts, or spikes in data that exceed ±0.04-inches should be reported to the Sterling Field Support Center (SFSC), NWS.SFSC@noaa.gov . Include a copy of the CSV or Notepad file with the data aberrations.

4.1.2 Data Outages: If the Observer has informed you of an outage (i.e., display fails to light upon SD card insertion) report this to the Sterling Field Support Center (SFSC) with an email NWS.SFSC@noaa.gov. The prior month's CSV file with its log history of voltage may reveal a pattern. You can examine the occurrence of outages more easily by plotting the data with the FPR-D Plotting Macro. Then, the SFSC may advise you to troubleshoot for known causes.

The 15-minute records will be permanently lost when system goes into continuous sequence of "Reset Powerup" outages. This is easy to identify in the CSV file when viewed in Notepad because the system notates the data log file with the words 'Reset Powerup Outage.' To troubleshoot, refer to Section 7.4 in chapter on, *System Troubleshooting and Repair*.

Three possible causes of Reset Powerup outages are:

- Loose electrical wire connections in the junction box of the Precip Recorder
- User menu left open and results in a continuously lit display
- Solar panel shaded by obstructions or coated by dust

4.1.3 Check Data with Graphical Plotting Macro: The NWSREP confirms the Observer submitted a file that contains the most recent reporting month with no major quantities of data missing, before transferring the data to NCDC. To accomplish this quickly, the NWSREP applies the "FPRD_PlotData_V1_3.XLS" macro to get the full view of the last 60 days of recorded data.

The plotted chart (See Figure 4.1) enables the NWSREP to quickly determine if there is an issue with data quality – either missing data or aberrant data.

The 'FPR Plotting Macro' was developed by NWS Engineering and Acquisition Branch and made available on website: http://www.nws.noaa.gov/ops2/Surface/coopimplementation.htm.

Caution: Once you run the plotting macro, do not save the file! The CSV files must remain unaltered and never opened into an XLS format! Therefore close the macro, and respond 'no' to the save-prompt.

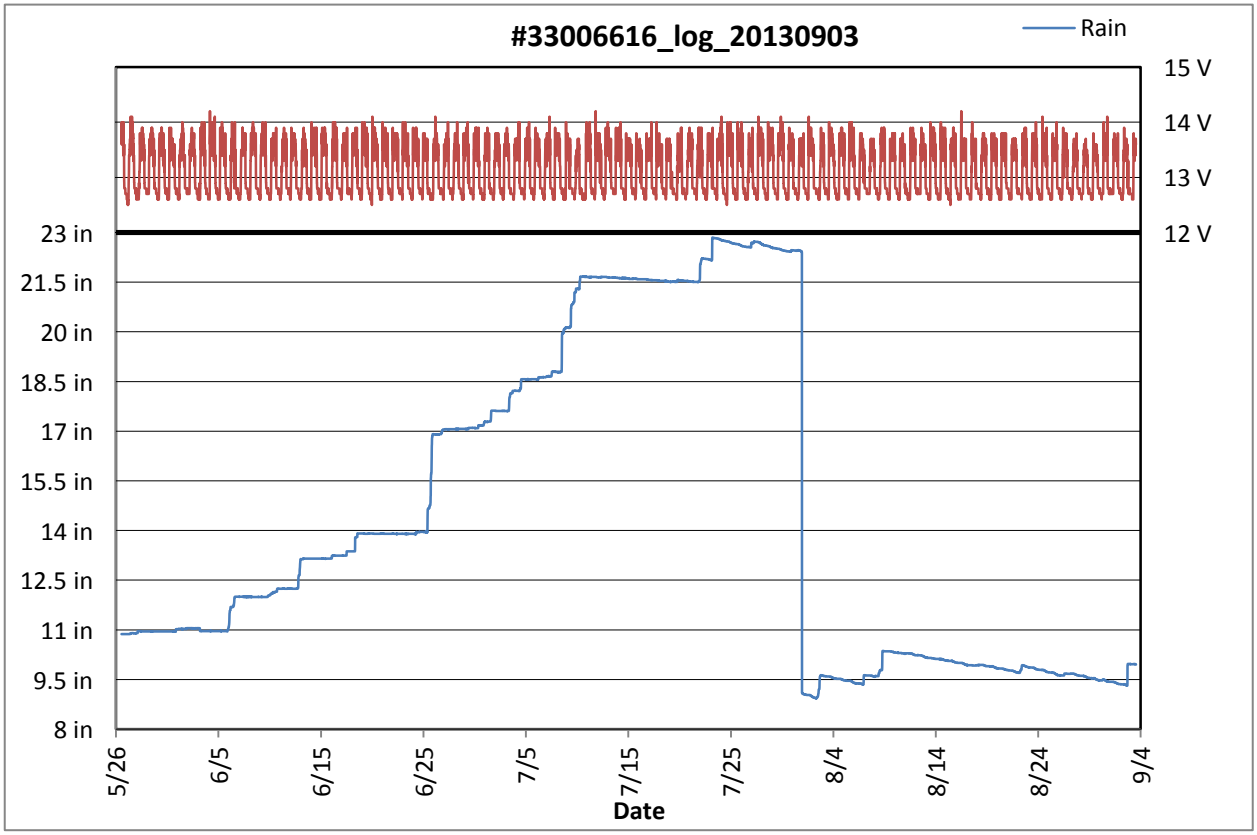


Figure 4.1. FPR-D Plotting Macro Plots Bucket Levels and Voltage

Look at the data with a plotting program "FPRD_PlotData_V1_3.xls" to verify the following:

- The data is smooth and continuous, not noisy, disjointed, or has other problems.
- The battery voltage is being maintained by the system.
- Evaporation is not evident in the data.
- Bucket level is not more than 15 inches.
- If there is a problem in the data file; does this problem fit a pattern from the same Observer?

Also, look at the data in a text viewer like Notepad to verify:

- The date/time of the start and end points of the data file are correct.
- The data file possesses proper filename, station number, Year/Month/Day.
- There are no data missing data problems, no garbled data; and there are no zeroes filling the pages.

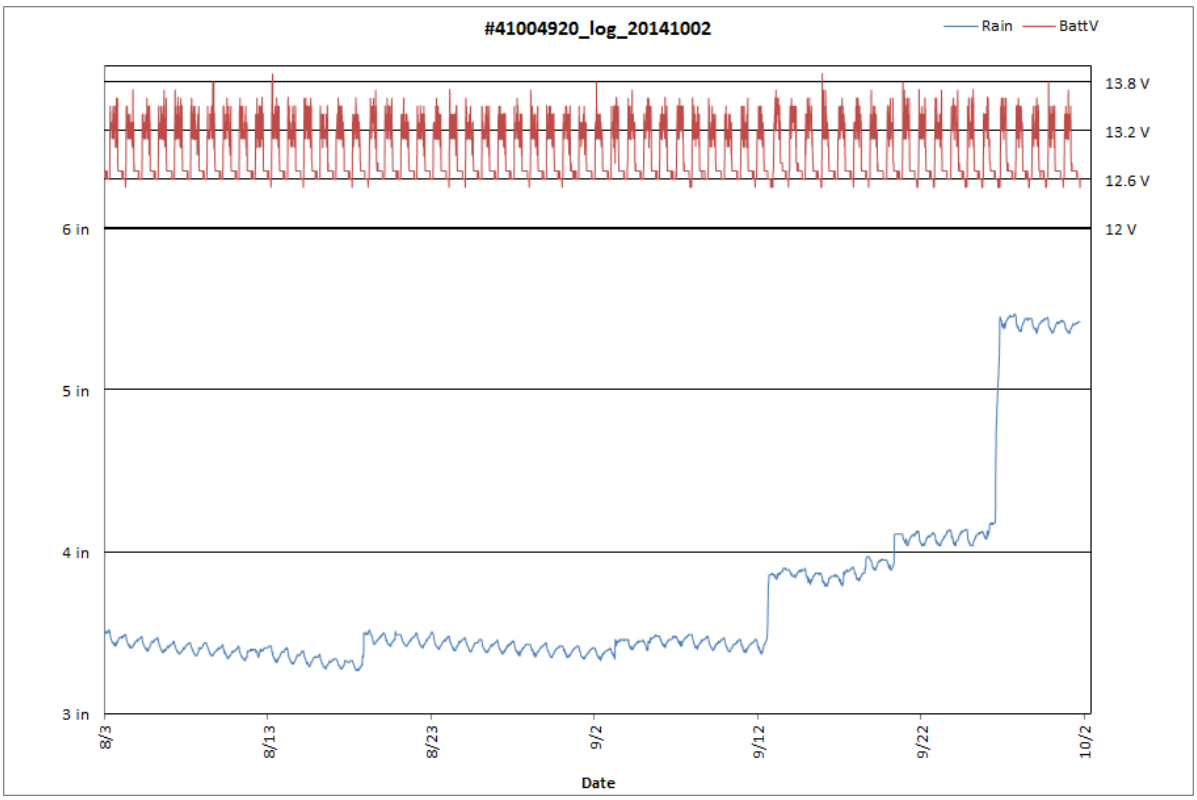


Figure 4.2. Report Noisy Data (Oscillations Exceed ±0.04 Inch) to SFSC.

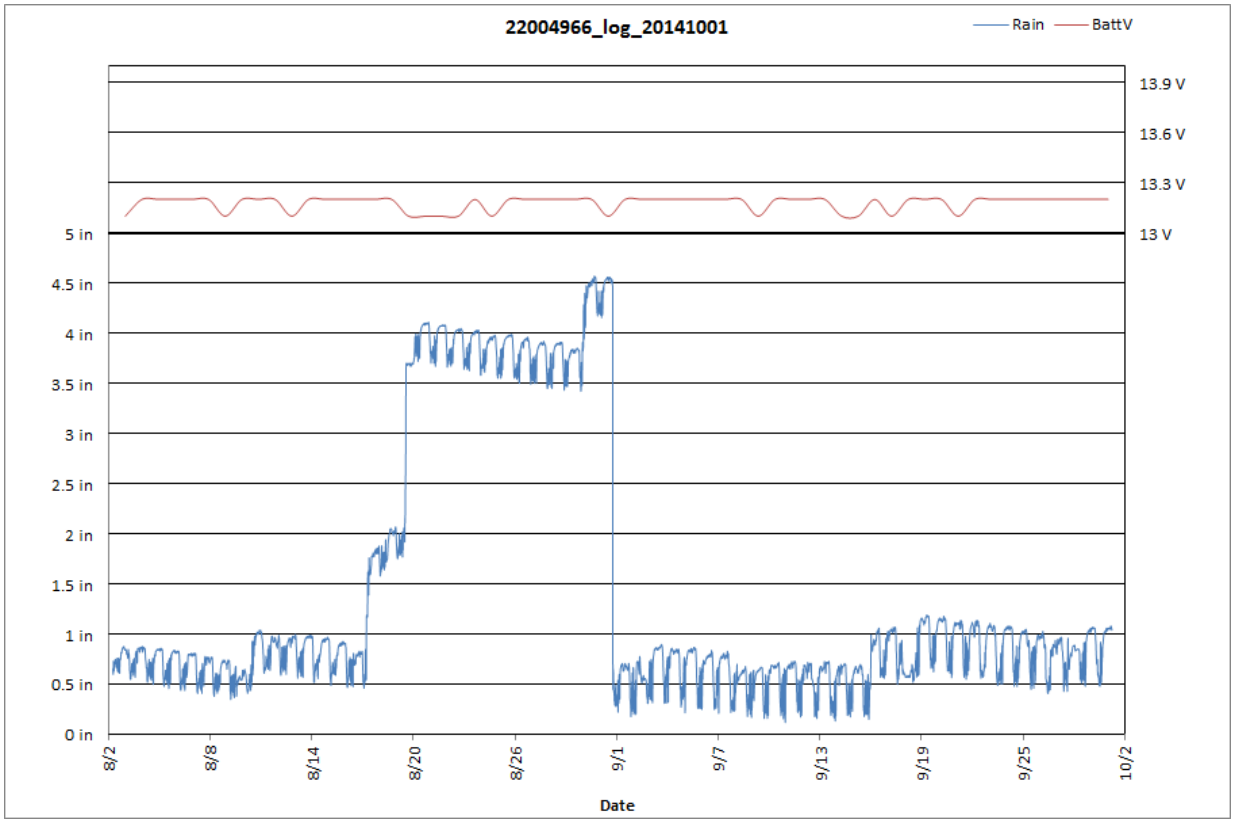


Figure 4.3. Report Bad Data (Oscillations Exceed ±0.10-inch) to NCDC.

Obtain a copy of the **FPRD_PlotData** Excel program from the NWS HQ website: http://www.weather.gov/ops2/Surface/coopimplementation.htm

4.1.4 Recognizing a Corrupted "CSV" Data File**:** If you open Notepad to view the monthly data, and then make the mistake of saving into an XLS file, data corruption will result.

The precipitation readings are stripped of their trailing "0" for instances where the values had ended in a zero (i.e. 7.6 opposed to 7.60). In addition, MS Excel processes **three extra cells** after the precipitation value's commas. This occurs because ***Excel*** identifies the first and second-line headers of the CSV as seven (7) individual columns while the CSV actual records are four (4) columns each. See Figure 4.5, for example of a corrupted 'CSV' file.

Assistance from Sterling Field Support Center (SFSC): If you have accidentally reformatted a file the SFSC can instruct you on the phone, the steps needed to restore the CSV file's integrity.

If you have an extensively corrupted or broken format, you should email the CSV file to NWS.SFSC@noaa.gov and explain how the data file became corrupted, and include the name of your forecast office. Your report will be logged by SFSC as a Hotline Ticket for future reference.

```
Station Name,Sensor Serial Num,model and version,Slope,Offset,Averaging
Time,Sampling Interval
44003104,7050046,FpRain ver 1.05,-2.4458711 ,-3.4538922 ,2.000 sec,0 ms
Precip,02/16/2009,08:15:00,9.81,
Precip,02/16/2009,08:30:00,9.81,
Precip,02/16/2009,08:45:00,9.81,
Precip,02/16/2009,20:15:00,9.81,
Precip,02/16/2009,20:30:00,9.81,
Precip,02/16/2009,20:45:00,9.80,
Precip,02/16/2009,21:00:00,9.80,
Precip,02/16/2009,21:15:00,9.80,
Precip,02/16/2009,21:30:00,9.80,
Precip,02/16/2009,21:45:00,9.80,
```

Figure 4.4 Example of a Good CSV File as Viewed in Notepad

Station Name	Sensor Serial Num	model and version	Slope	Offset	Averaging Time	Sampling Interval
44003104	7050046	FpRain ver 1.05	-2.44587	-3.45389	2.000 sec	0 ms
Precip	2/16/2009	8:15:00	9.81			
Precip	2/16/2009	8:30:00	9.81			
Precip	2/16/2009	8:45:00	9.81			
Precip	2/16/2009	20:00:00	9.81			
Precip	2/16/2009	20:15:00	9.81			
Precip	2/16/2009	20:30:00	9.81			
Precip	2/16/2009	20:45:00	9.8			
Precip	2/16/2009	21:00:00	9.8			
Precip	2/16/2009	21:15:00	9.8			
Precip	2/16/2009	21:30:00	9.8			
Precip	2/16/2009	21:45:00	9.8			

Figure 4.5 Example of a File Corrupted when Opened in XLS – Heading Gets Partitioned

4.2 Reporting Bad Data to NCDC:

The NCDC has advised NWS the best practice to account for bad or missing FPR precipitation data is to report the event into the Datzilla system. First coordinate with the Sterling Field Support Center, via email NWS.SFSC@noaa.gov, to report the problem with your rain gauge or precipitation data. Inform them you seek to change the official NCDC precipitation record.

The Datzilla system enables registered users to flag specific range of observed data as bad, and ensures that NCDC will have a permanent record of the problem. It is a web based interface that allows select partners (including WFOs) to request changes to the NCDC datasets to ensure the accuracy of the official climate record.

You may access the system, http://datzilla.srcc.lsu.edu/datzilla/ and if you do not have a Datzilla account notify your Regional Cooperative Program Manager (RCPM).

Datzilla also allows you to search and review previously entered reports – ones you have entered and reports other offices have entered, before you report an error. This function will not be described here, however, you can use the word 'FPR' as a keyword to get a sense for phrasing your error report.

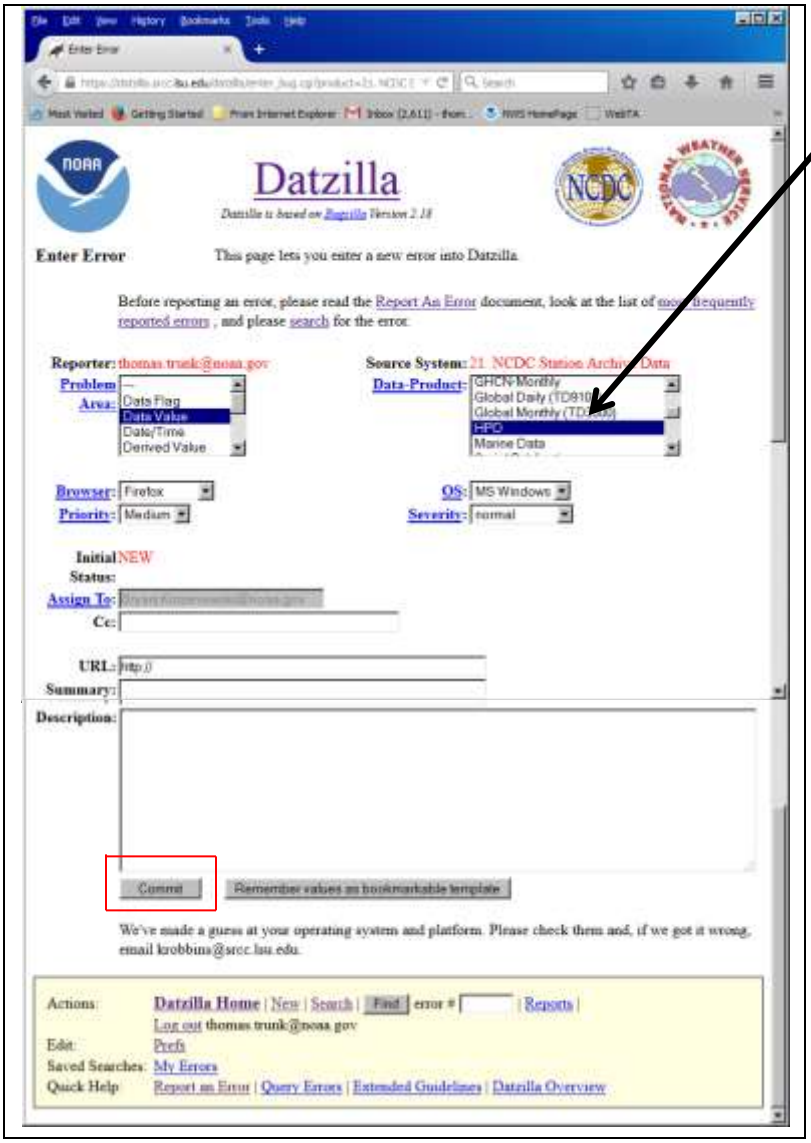
a. After log-in, click on the word, 'New' in this panel.

Figure 4-6. Log-in to Datzilla System (Managed by the Southern Region Climate Center)

The next panel opens.

b. Click on number '21. NCDC Station Archive Data.

Figure 4-7. Click on #21, *NCDC Station Archive Data*



c. Select, "HPD" for the **Data-Product**, window.

d. Write a short description in the **Summary:** window (i.e., Gauge Bucket Overflowed)

e. Write a detailed description in the **Description:** large window. Give the date/hour of the event and the range of data affected by the event.

f. Click on the **Commit** button (see red rectangle, in Figure 4.8) to create a 'Ticket."

g. You will receive an Email from Datzilla, to which you can respond with attached files.

h. Attach the precipitation monthly data file (i.e., **44001234_log_20090701.csv** file) to the Ticket (email), and

i. If available, attach the *FPR Log Sheet* (ms-word.doc) to provide maintenance history for this specific rain gauge.

Figure 4-8. Datzilla System for Reporting Errors

4.3 Accidental Menu Activation (SD Card Downloads):

If the Observer strays from the standard procedure and inserts the SD Card when the display is awake (lit-up) then the logger will trigger a more complex download sequence that requires user input into a hidden menu, called: "SD Operations." This may confuse the Observer because the system requires selections be made on what file(s) to download. For example it offers the entire Log File, the Configuration File, and precipitation Log Files from a user-defined number of days (i.e., 60 days).

For this reason, whenever the "SD Operations" sequence is activated, the Observer is instructed to exit this menu without interaction with interaction with any of the displayed options. To quit the process gracefully, press the OFF button, or the Left Arrow button, repeatedly until

the display turns off. Then when the display is dark, reinsert the SD Card. The system will then wake up, and automatically download the last 60-days of precipitation Log Files.

4.4 Data Acquisition Management (SD Cards and Emailed Files):

Establish strict logistics management of all your sites SD Cards through use of a SD Card Tracking Table (Figure 3.1) posted in your WFO. See Section 3.2, of this manual, for more on the SD Card Tracking Tables.

Carefully follow the instructions given in this manual, in Section 2.8, to ensure timely and efficient collection and storage of all the FPR-D monthly data files.

Offer your observers the opportunity to email the monthly precipitation data to your NWSREP email address. See qualifications for email participation, found in Section 2.7 of this manual. Spare SD cards: At the time the FPR-D was installed to the Observer's property just one government issued SD card was provided the Observer. Ensure you have a minimum quantity of spare SD cards one spare for each Observer who uses the postal service to mail you the monthly data. Spare SD cards should be no larger than 2GB, and be of the original "standard-capacity", also known as SDSC. **Note: Do <u>not</u> use high capacity cards, i.e., SDHC.**

4.5 Quality Assurance Checklist:

Use these 'best practices' to prevent transmission of incorrect monthly files, improperly named files, and prevent a disorganized exchange of SD cards. These guidelines need to be stressed when you train a new person on FPR-D tasks.

4.5.1 <u>Log-in the SD Card and E-Mails that arrive each Month</u>:

- Establish a SD Card Tracking Table template; update and print it monthly
- Consider a QA Log Sheet for broader, more general FPR responsibilities
- Establish firm time-table, routine
- Perform Quality Assurance review of the monthly data files (see 4.1)

4.5.2 <u>Transmit to NCDC</u>:

- Assure all FPR data files are FTP'd to NCDC in sufficient time to meet the deadline of the 25th day of Month.
- Do not e-mail the FPR data files to NCDC.
- Check NCDC Inventory web site to confirm NCDC receipt of all of your FTP'd files
- http://www1.ncdc.noaa.gov/pub/data/hpd/inv/hpd-inventory_201506.txt (see Section 3.8 of this Manual).

4.5.3 Data File Retention and Availability of Ready Reference Instructions:

- Save the FPR-D precipitation data files (e.g., 44001234_log_20090701.csv) for at least 36 months on the network workstation. Retain these data files with their original filename and format! The NCDC may need you to resend missed data and SFSC may request past data to complete a trouble ticket.

- Save the *FPR Log Sheet*, or any *SD Card Tracking Table*, for 12 months.

- Make available the Instruction and Policy Manuals with a Browser Bookmark: Save this address: http://www.nws.noaa.gov/ops2/Surface/coopimplementation.htm for ready access to FPR-D manuals and FPR-D policy directives issued by NWS headquarters. Update this bookmark every 6-months.

4.5.4 Set a 'Best Practice Policy' for your WFO to handle all the FPR stations.

- Establish expectations with Cooperative Institutions.
- Establish consistency:
  - Schedule firm cut off for routine receipt
  - Follow-up on missing Data Emails, and Flash-Drives consistently
  - Establish deadlines, patterns with Observers

4.5.5 Perform Quality Assurance Review:

- Have there been quality improvements (observer) for same site?

- Log problems at the WFO to establish patterns.

- Read and take action on any *FPR Log Sheet* that is submitted by the Observer

- Determine QC corrective procedures. Is there something NCDC can do; or recover?

- Schedule your QC. Does NCDC need to be specially notified about this Station's data?

- Follow-up with your Observer, and with NCDC if needed.

CHAPTER 5 – Routine Maintenance

5.1 Preparing for Semi-Annual Site Visitation:

A day or two prior to your trip, call up the Site **Inspection Report** and review the results of your last inspection. Call up any other ready reference you may have, such as *FPR Log Sheets* you may have received from the observer.

Phone the observer to ask if he or she has any special needs with regard to the FPR-D operations. Does the observer have any bucket maintenance responsibilities? If so do they have a hardcopy or softcopy of the FPR Log Sheet? Does this site require multi-gallon containers or instructions for the proper disposal of bucket liquids? Does this observer use the Postal Service to report the monthly precipitation data? If so, does the observer need mailing supplies (i.e., Jiffy envelope)?

Check the NWS web site, www.nws.noaa.gov/ops2/Surface/coopimplementation.htm, to see if there are any Mod Notes that may apply to the FPR-D equipment at this site. If any rain gauges have had battery failure due to overcharging from solar panel, you will want to install a Solar Panel Regulator and obtain the COOP Mod Note, 'FPRD D111D Note 3,' from this website.

For general policy on COOP site visits, access Appendix B, **Visitation Procedures**, in NWSI 10-1307, *Cooperative Program Management and Operations* (Aug 2012). This directive is located on the NWS web site: http://www.nws.noaa.gov/directives/sym/pd01013007curr.pdf.

Note: Offices with 10 or more sites with FPR-D gauges may benefit from creation of an electronic logbook that comprises FPR calibration data, supply inventory, and special notes.

5.2 Semi-Annual Visitation Checklist:

SEMI-ANNUAL MAINTENANCE AND CHECK POINTS		
What to Check	**How to Check**	**Precautions and Remarks**
1. Overall Appearance	Observe paint finish, or evidence of vandalism.	Clean oil film from the outside of gauge using nonflammable liquid detergent.
2. Weather Stripping around Base Plate and Access Door.	Check for breaks or general deterioration. Weather stripping is used around Base Plate (ASN part D111-1MS100).	Replace as needed the weather stripping or door gasket. Cut base plate weather stripping to about 50 inches.

3. Horizontal and Vertical Flexures in the Weighing Mechanism.	A quick glance will reveal the condition of the four horizontal flexures. If any are bent, broken, or binding it might affect gauge calibration. Ensure you replace any horizontal flexures which are 'v-shaped.' The upper-rear flexure (ASN part D111-SP112) is most susceptible to bending.	Use the smallest test weight of the D111-500TE set to ensure the Precipitation display shows a change in current values. If it does not change, the flexure(s) should be replaced.
4. Funnel	Use the funnel in warm season. Remove funnel for winter season when snow or freezing precipitation is expected.	On the *FPR Log Sheet* check boxes, 'Funnel- Out'. Reinstall funnel after winter season then check, 'Funnel-In.'
5. Charging Collection Bucket – Warm Season Operation.	Collection bucket is charged for warm season by adding one-half quart of oil (ASN part, '014-O-15); to retard evaporation.	Before charging bucket, remove any foreign material and clean the interior surface.
6. Charging Collection Bucket – Cold Season Operation.	When collection bucket is charged for winter weather, add two quarts of FGPG, (ASN part # D111-153) then add one half-quart of oil. For exact amount see Table 5.2.	For colder climate sites where temperatures drop to 15°F and colder, more FGPG needs to be added when collected rain and melted snow dilutes the FGPG concentration. Refer to Table 5.2, for the number of quarts to add as the bucket level rises.
7. Draining or Emptying the Collection Bucket	The collection bucket is drained when the display indicates **15 inches or more.** See NWSM 50-5116, section 2.11.1, for rules on disposal. The used-oil contractor will usually accept this oil- propylene glycol mixture.	Revise *FPR Log Sheet* by marking box 'Add FGPG' and if oil was added, 'mark the box 'Add Oil.' Before you start any action, press the display button to learn the level in the bucket. Journal this number to *FPR*

	Ensure the Observer has one printed copy of the Material Safety Data Sheet (MSDS) for the Oil. The MSDS can be printed from the CLS parts ordering website. See NWSM 50-5116, section 2.11.1, for rules on disposal. The used-oil contractor will usually accept this oil- propylene glycol mixture.	*Log Sheet*. Mark the *FPR Log Sheet*, 'Bucket emptied' or 'Partial Drained' if cleaned, write in notes section: 'Cleaned Bucket'. When you have completed all bucket re-charging actions write the new value of the precipitation display (or dial reading) to *FPR Log Sheet.*
8. Calibration Check	At least once per year, use the brass test weights to check the sensor calibration at 5.0 inches, 10.0 inches, and 15.0 inches.	Refer Chapter 6, of the *FPR-D Operations Manual,* for instructions.

Table 5.1 Semi-Annual Maintenance and Check Points

5.3 Winter Operation:

Minimize the risk of damage to the collection bucket from freezing of the bucket fluids. When water freezes it expands and presses the bucket walls and can crack the floor of the bucket.

a. At the start of winter, remove funnel from the cone shaped hood. Remove the hood, tip it upside down. Rotate the funnel so its slots allow it to slide free from the three pins. Store the funnel in the base of gauge. Make a note in *FPR Log Sheet* that funnel was removed for winter.

b. Empty the collection bucket with the drain tube into a multi-gallon container. **Caution:** A full bucket can weigh 40 pounds. Always be careful when unhooking the drain tube from the rim of the bucket – seal the end and lower the plastic tube into the container, before releasing the pressure. Be patient, as it may take more than five minutes to drain a full bucket.

   Note: To conserve oil in the bucket you may partially drain the bucket, rather than completely emptying the bucket. A partial draining should result in a minimum quantity of liquids that measure approximately one-inch deep in the collection bucket.

c. Inspect the 12-inch long vinyl drain tube for cracks or breaks. If needed replace the drain tube. This is a local purchase item because most home improvement

stores have Tygon tubing. The tube should be vinyl, the required inside diameter is 5/16-inch, and length is 12-inches. Save the metal nozzle and attachment clip from old drain tube. Install them to new tube and then install new tube to bucket.

d. Clean and dry the empty bucket. Return bucket to its position on the force post.

e. Initial charge: Into the empty bucket, pour an amount of FGPG as specified by one of the three temperature categories listed in this table. Choose the category that offers protection against the coldest condition possible for the site. Make an initial charge of 1.0 quart of FGPG if the coldest the site could get is 15ºF.

Coldest Temperature	Initial charge and subsequent charges of FGPG. Each time the Zeno Display rises and reaches: 3.5 inches, 7.0 inches, 10.5 inches, and 14.0 inches, then add this amount of FGPG.	To Maintain this Concentration
+ 15º F	1.0 quart	25%
0º F	1.5 quarts	35%
- 30º F	2.0 quarts	50%

Table 5.2 For Increasing Display Levels – Add More FGPG to Bucket

Note: An initial two quarts charge of food grade propylene glycol (FGPG) produces a height of just one inch in bucket. Never use commercial anti-freeze and do not add water.

f. Subsequent Charges: When the Zeno Display shows the level has reached 3.5 inches add the specified amount of FGPG; for example the coldest category sites (- 30ºF) require 2 quarts be added. Always add the same amount as the initial charge. If you had not serviced the bucket at either 3.5 inches, or 7.0 inches, or 10.5 inches and now notice the bucket holds 11 inches, and you are in the coldest category, then pour six quarts of propylene glycol to maintain the 50% concentration. To prevent the bucket contents from ever freezing add FGPG per the schedule in Table 5.2, each time the level reaches 3.5, 7.0, 10.5, and 14.0 inches.

g. Install one-half quart of oil after the initial charge of FGPG. For sites more prone to evaporation, these include tropical sites and sites with windy conditions with low relative humidity; ensure a film of oil is visible after draining water/FGPG mixture. Use NWS supplies, only.

h. Make no adjustments to the gauge after FGPG and/or oil has been added.

i. Document the date and hour each time the bucket was charged with FGPG and/or oil. Remember to journal this action into the *FPR Log Sheet* (Appendix F).

If you have a site where you are fully confident they can assist you, then train them in the agreed to maintenance actions and provide them with the necessary supplies and forms. Inform the Observers that all check-ups and bucket discharges shall be conducted in dry weather only.

5.4 Warm Season Operation:

In spring or early summer, remove the hood and inspect the contents of the bucket with a mixing stick (i.e., paint stirrer). Remove and properly dispose of any leaves or debris that might have collected when the funnel was removed at start of winter season. Then with the stick, ensure there is still a one-quarter inch film of oil on the surface to inhibit evaporation. If the Sutron's **Display** value exceeds **15.00 inches** on the day you are installing the funnel then perform a partial emptying of the bucket by keeping the oil from running out the drain tube. Add FGPG if local climate requires.

To install the funnel remove the conical hood, turn it upside down, and fasten the funnel by rotating its three slots onto the three pins of the cone shaped hood. Return this hood assembly to the gauge. Check the box 'Installed Funnel' in the *FPR Log Sheet*.

5.5 Observer Delegated Actions:

Some offices have an agreement with Observers to assist in basic works of maintenance on the FPR-D. Consider asking your Observers if they could conduct the following activities:

- Draining and recharging the collection bucket
- Installing/removing funnel
- Cleaning the solar panel

5.5.1 Delegated Responsibilities: If your Observer has agreed to take-on routine maintenance activities, then the Observer also must agree to take on the responsibility of writing journal entries to the *FPR Log Sheet*. The Observer shall follow the instructions for completing the *FPR Log Sheet* (Appendix F) whenever the bucket is drained emptied, or the fluid levels in any way are altered. Likewise whenever Food Grade Propylene Glycol (FGPG) is added to prevent freezing, or oil is added to retard evaporation. The Observer will write these actions to the *FPR Log Sheet.*

Then on the next available routine monthly mailing after these actions, the Observer will enclose a hard copy of the *FPR Log Sheet*, into the same mailer-envelope as the SD Card, and mail to the attention of the NWSREP. If the Observer uses e-mail, he will attach a softcopy of *the FPR Log Sheet*, as a separate file, when he emails the monthly data file.

Before Observer Begins Maintenance Activity: Observer needs to obtain the *FPR Log Sheet*, and write down the current Date (MM/DD/YYYY), and Start Time (HH:MM, for local

'standard' hours, i.e., do not use Daylight Time values). The Observer then writes down the 'Amount' that appears in the display – this is the bucket level that is about to change.

Maintenance Activities to be Noted: Observer moves to Column 3, 'Routine Actions,' and marks off one or more of the Check Boxes that describe this maintenance action.
Types of Maintenance Activities:

- Partial Draining of Bucket: Drain the bucket into a sealable container. When finished, return the drain tube to its operational position, and in the same row of the Log Sheet write down the Stop Time, and the Amount that now appears in the display. Make sure you marked the box, "Partial Drain" in the 'Routine Actions' column. See example in Appendix E, of this manual.

- Emptying of Bucket: Empty the bucket into a sealable container. When finished, return the drain tube to its operational position, and in the same row of the Log Sheet write down the Stop Time, and the Amount that now appears in the display. Make sure you marked the box "Partial Drain" in the 'Routine Actions' column.

- Added FGPG (Winter): Add one or more whole Quarts of Food Grade Propylene Glycol (FGPG) to prevent seasonal freezing of the bucket fluids. Make sure you marked the box 'Add FGPG' in the 'Routine Actions' column.

- Added Oil: Add one half quart of Oil to the bucket to retard evaporation of the collected precipitation liquids. Make sure you marked the box, 'Add Oil' in the Routine Actions, column.

- Removed/Installed Funnel: Remove the funnel at start of winter season, and install the funnel at start of summer season. Make sure you marked the box, 'Funnel In' when you are installing the funnel. Make sure you mark the box, 'Funnel Out' when you are removing the funnel in the Routine Actions column.

- Removed Object from Bucket: Twice yearly inspection of the contents of the bucket is advised. If you find an object, such as a pinecone, bird, or small animal, proceed to empty, rinse, and towel dry the bucket. Then describe the object that was removed, with a written entry to the 'Special Notes' section (Log Sheet, Column 5).

- Cleaning of Gauge Exterior: Use a damp cloth or paper towel with rubber gloves to wipe clean the exterior surfaces of the access door, lower casing, and the hood.

5.5.2 When Observer Reports a Technical Fault or Error Message: Phone the Observer and inquire into the nature of the event s/he reported on the *FPR Log Sheet.* Analyze and understand the history of installation, implementation, calibration data, maintenance actions, and seasonal weather conditions that might have contributed to the reported event. Does the event involve a faulty or broken system component that could be resolved with a maintenance visit?

Phone Sterling Field Support Center (SFSC), on 703-661-1259, or email nws.sfsc@noaa.gov, if there is a system technical error. Inform your RCPM to report what type of maintenance action was necessary. See Chapter 7, System Troubleshooting and Repair, of this *FPR Operations Manual*, for general policy on trouble shooting and see Appendix D, for guidance on returning bad parts.

FPR LOG SHEET

Forecast Office (SID): TFX COOP Station Name: Silverstar (24-7610) Your NWSREP Name: J. Brown

Date MM/DD/YYYY	Time hh:mm am/pm	Amount NN.cc	Routine Actions	Special Notes (i.e., displayed error messages, etc.)
03/28/2014	Start: 10:15 am Stop: 10:45 am	15.47 02.75	☐ Add Oil ☐ Add FGPG ☐ Empty Bucket ☒ Partial Drain Funnel - ☒ In ☐ Out	
06/14/2014	Start: 4:15 pm Stop: 4:45 pm	8.72 8.72	☐ Add Oil ☐ Add FGPG ☐ Empty Bucket ☐ Partial Drain Funnel - ☐ In ☐ Out	'Error 4027' message displayed. Phoned NWSREP.
09/28/2014	Start: 2:30 am Stop: 2:45 am	10.39 10.39	☐ Add Oil ☐ Add FGPG ☐ Empty Bucket ☐ Partial Drain Funnel - ☐ In ☒ Out	Wiped down the F&P shell to remove dust.

Figure 5.1. ***FPR Log Sheet*** **-** Observer Reports to NWSREP when Authorized to Drain Bucket, Add Food Grade Propylene Glycol (FGPG), Add Oil, or Change the Funnel.

5.6 Journal Responsibility:

5.6.1 Bucket Maintenance – Journal Entries: When routine maintenance activity changes the weight of the collection bucket – the precipitation record for the climate program is at risk of data corruption. To avoid damaging the climate data record, changes in the bucket level have to be accounted for with a written entry in the *FPR Log Sheet*. Each time you or your observer add Food Grade Propylene Glycol (FGPG) for winter season – this must be accounted, and when the one-half quart of oil is added to the bucket to prevent evaporation write an entry to the *FPR Log Sheet*. Appendix F, gives an example with instructions on how to journal these important interruptions in the data record to the *FPR Log Sheet.*

The *FPR Log Sheet* is formatted so you can mark with a pen multiple boxes for a given maintenance job, and simply report the Start Time, Stop Time, the corresponding Bucket Level (i.e., display reading), at start and finish of the maintenance.

5.6.2. Bucket Capacity: The bucket's capacity is about 20 inches of precipitation or 4.9 gallons. Advise the Observer to daily monitor the Zeno's **Display** readings and to phone you when it surpasses **15.00 inches**, at that time the collection bucket needs to be drained. Always schedule the bucket draining to be done when weather is dry, when no precipitation is forecast for either the day before, or the day of, this important maintenance.

If your Observer has agreed to conduct the bucket draining or emptying, then remind him/her to always **make note of the Level in the bucket to the *FPR Log Sheet*.** Also, have him/her write down the Day/Hour/Minute the Bucket activity was started and completed, and write down the new Level in the bucket.

Note: Remind your Observer to mail you the ***FPR Log Sheet*** as soon as the next monthly Flash Drive is mailed. You should enter his maintenance actions to your SIS site inspection report for continuity of records.

5.6.3 System Discrepancies Noted: The observer should always journal to the *FPR Log Sheet* any error code that appears in the display. For a list of Error Codes grouped by subcomponent of the FPR-D system, see Table 7.1 of this manual, in Chapter 7, System Troubleshooting and Repair.

Drifting clock time is another important discrepancy to note. This can occur when the small internal battery loses charge. Small errors of several minutes are tolerable, however errors that are ten minutes and greater need to be reported to the NWSREP for response.

5.7 Rain Gauge Supplies:

These quantities will vary as a function of the amount of precipitation a site receives in a given season. Phone your Observer and ask if the gauge requires any special servicing: :

- One quart of oil might be consumed each year.
- Three 2-quart containers of Food Grade Propylene Glycol might be consumed each year.
- One multi-gallon sealable plastic container available to discard bucket fluids.

5.8 Solar Panel Exposure Issues:

If any part of the FPR-D solar panel is shaded, the panel may shut down and not deliver sufficient power to the logger. The solar panel is comprised of multiple solar cells connected in series to give the voltage needed and then in parallel to give the power needed.

The solar panel gets mounted for full sun and not in the fringe area under trees or behind guy wires or tower supports. The FPR-D is supplied with a 15-foot connecting cable. The cable can be extended as far as needed.

Power problems have been reported where construction or farming resulted in a film of dust coating the panel. The NWSREP trains the Observer to inspect and clean the solar panel, and advises the Observer to inspect the panel on a regular schedule. Gently brush of snow deposits.

5.9 Annual Inspection and Preventive Maintenance:

These ten inspection points should be checked at least once per year.

- **Calibration Check:** Follow procedure in Chapter 6. If any one test point fails, conduct a full reset of the system calibration as described in Section 6.3.

- **Drain Tube on Collection Bucket:** Check for leakage and deterioration of the drain tube. Assure the clip on the end of the tube has a clip that fastens securely to the rim of the bucket. When the tube is deteriorated, purchase new tubing from a home improvement store. This is 5/16-inch inside diameter tube 12-inches long. Ask for Tygon tubing.

- **Four Horizontal Flexures:** Remove lower casing and examine horizontal flexures for bent appearance. Diurnal saw-tooth pattern in precipitation data is one symptom of bent or binding flexures.

- **Force Post Condition:** Force post should be clean (i.e., understand insects can inhabit this area). Ensure force post never rubs or binds against its access hole in the lower casing. Adjust lower casing if necessary. Force posts that bind result in data quality degradations.

- **Level to True Horizontal:** Ensure the entire gauge is level. Use carpenter's level to adjust the base plate.

- **Door Latches:** Ensure hinges, latches and locks are working properly. If any are worn or broken, order a replacement latches (D111-1MP100) or new door (D111-1A101).

- **Solar Panel:** Ensure the solar panel is not covered by dust, bird droppings, or obstructed by any objects. See Section 5.8 for guidance if solar panel needs to be relocated.

- **Overall Appearance:** If cleaning or minor repair was unable to restore function or appearance, then you may order a casing (D111-1A100-2) or hood (D111-1A100-1). If possible, plan to repaint housing and/or hood at a local shop (i.e., auto collision repair).

- **On-Site Gauge Supplies:** If delegated, ensure the Observer has one quart of oil, and if cold climate, three 2-quart containers of food grade propylene glycol. Does site have a multi-gallon sealable container to hold decanted bucket fluids?

- **Observer Supplies:** If delegated, ensure new *FPR Log Sheets* are on site. If Observer mails SD card through U.S. Postal Service, ensure a 12 month supply of shipping envelopes. Ensure your NWSREP point of contact information (i.e., phone number, email, address) is up to date, and printed for Observer.

CHAPTER 6 – Sensor Calibration Policy

6.1 Rain Gauge Accuracy:

At least once per year, preferably at the time of the semi-annual site visitation, conduct a Calibration Check-Up on the FPR-D rain gauge. This requires the use of the large brass test weights and a calculator. You may use an alternate bucket (i.e., calibrating a sensor at the WFO) to calibrate the load cell sensor and to conduct a calibration check-up.

Never conduct a Calibration Check on a day when precipitation is falling as this will corrupt the test results. Never attempt a calibration check when a bucket is even partly filled. Always be prepared before visiting the site visit and bring a multi-gallon container to drain fluids if a container is not already available at the observer's site.

You are permitted to place a flat bar or board across the top of the bucket (see Figure 6.1) in order to position the test weights in the exact center of the bucket. See additional rules in section 6.2 (below) that originated in a memo for NWSREPS dated June 18, 2014.

Only if the Calibration Check-Up fails to come into range of ±0.25 inch at any one of the three check points in Table 6.1 (Calibration Check Table) will you need to conduct a full Calibration Reset. Calibration Reset procedures are given in Section 6.4. Otherwise, you should <u>not</u> perform the Calibration Reset.

6.2 Preparing the Collection Bucket for Calibration Checks and Resets:

Whenever possible, use the operational bucket when performing checks or resets of calibration. If an alternate bucket is used (i.e., WFO spare) it should be empty and dry and include the drain hose with its metal clip. Follow these rules:

a. Empty and dry the bucket.

b. Level the gauge's base plate. Use a carpenter's level on two horizontal axes perpendicular to one another. If necessary adjust the base plate's mounting bolts.

c. The preferred method is to slide the Test Weights onto the spindle (see photo) inside the bucket. This prevents any lateral force being imposed on the support post. Lateral forces decrease the downward force being measured and result in an erroneous calibration. Lateral forces can also damage flexures.

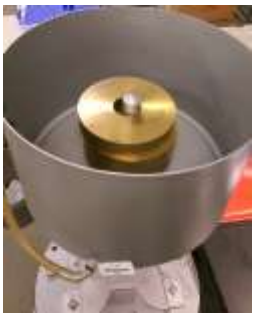


Figure 6.1 Test Weights on Spindle in Bucket

d. Test all three check points in succession. Start with 5-inch, then 10-inch, and finish with the 15-inch check points. Make sure the Test Weights are as centered as possible either inside bucket or on support on top of bucket. This applies to an alternate bucket (if used) as well as the operational bucket.

⚠ If a Calibration Reset is necessary then **remove all test weights (and board, if used)** before pressing SET button as described in Section 6.4.b.

6.3 Calibration Check-Up (Once Per Year):

Before you install oil and food grade propylene glycol for routine operation and while the bucket is still clean and dry, perform this Calibration Check. Take the un-weighted measurement first, and then place the three weights sequentially into the bucket to test the three reference points.

a. Lift off the conical hood and leave the bucket on its force post.

b. Activate the display by pressing the OFF button on the display. Write down this reading in hundredths of an inch to a piece of paper.

c. Slide one brass weight (4111g size) onto the spindle inside the bucket (Fig 6.1).

d. Wait 30 seconds, look at the display and **write down this value to hundredths of an inch and subtract from it the value you wrote in Step "b."** This is Calibration Test Point value for the **5.0 inch** equivalent rain.

e. Does this Calibration Test Point value in Step 'd.' fall within the Acceptable Range for the 5.0 inch test in Table 6.1? If it does not, stop the check process, and go to Section 6.4, and perform the Calibration Reset.

f. Now add a second brass weight (4111g) onto the spindle int the bucket to test the sensor at the **10.0 inch** test point. Follow the same procedures in Steps 'd ' and 'e.' If it does not pass this test, stop the check process, and go to Section 6.4, and perform the Calibration Reset.

g. Now add a third brass weight (4111g) onto the post protrusion to test the sensor at the **15.0 inch** test point. Follow the same procedures in Steps 'd' and 'e.' If it does not pass this test, stop the check process, and go to Section 6.4, and perform the Calibration Reset.

If each of the three Calibration Test Point values meets the acceptable range given Table 6.1, then the sensor calibration is acceptable and a calibration reset is not needed. Write into your Site Inspection report '**Sensor Calibration Check Passed.**' You may enter the same phrase into the Special Notes column of the *FPR Log Sheet*.

Calibration Check Table		
CAL TEST POINTS	**WEIGHTS REQUIRED**	**ACCEPTABLE RANGE***
5.0” equivalent rain	1 brass weight of 4,111 g	4.75 “ thru 5.24”
10.0” equivalent rain	2 brass weights of 4,111 g	9.75” thru 10.24”
15.0” equivalent rain	3 brass weights of 4,111 g	14.75” thru 15.24”
Note * These values are not necessarily the values displayed on the screen. If you use a board or a bar to hold the test weights, you subtract the board/bar’s weight as instructed.		

Table 6.1. FPR-D Accuracy Tolerance - Calibration Reset Not Required

6.4 Calibration Reset of FPR-D System:

When the **Precip:** reading fails to come within range of ±0.25 inches for any of the test weights described in the previous section, then take the following steps to perform a complete Reset of calibration. The FPR-D is calibrated completely through the Precip Monitor in the steps below.

There are just two calibration parameters, ‘Slope’ and ‘Offset’, and their values are dependent on the bucket you use. If you have installed a different bucket, then you always need to perform a calibration Reset, as soon as the bucket is seated to its post.

Note: You will need to drain and dry the bucket to perform this Reset.

a. **Wake-up** the display before you take the next steps.

b. From the Home Menu press the Down-arrow four times until you reach the ‘Diagnostic’ menu and then press the Right-arrow. The display will show, “**Two Point Cal, Press SET to Cal.**”

c. Press the SET button and the sensor will prompt, ‘**Put Empty Dry Bucket, Press SET to proceed**.”

d. Place an empty dry bucket on the sensor and press SET. The sensor will display the message, ‘**Calculating, Please Wait’** while it takes a measurement. The sensor will use the current settings to make the measurement.

e. When the sensor completes its measurement, the sensor will prompt, “**Put 15” of Weight, Press SET to Proceed.”**

f. Load the bucket with the three large brass weights (i.e., 4111G each). This equates to 15-inches of rain water. Then press the SET button.

Figure 6.2 Carrying Case for Test Weights Set

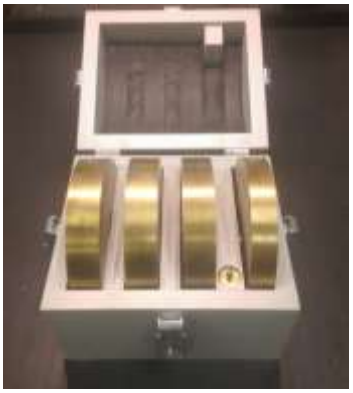


Figure 6.3 Select Three 4111G Brass Weights

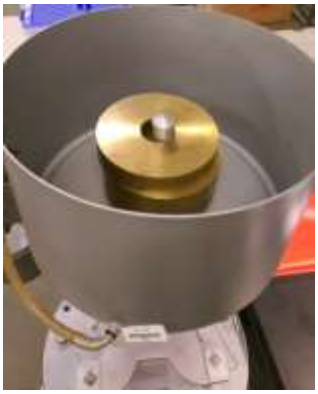


Figure 6.4 Place Each onto Spindle

g. The sensor will ask "**Enter Weight in Inches**" and prompt an entry of a number. Enter the numerals "15" by pressing the Up- and Down-arrow buttons to select and enter.

h. This number corresponds to the weight placed in bucket. The weight will be expressed in inches of water. The sensor will display, "**Calculating, Please Wait.**" The sensor will then use the two measurements to compute a calibrated Slope and Offset.

Figure 6.5 System Prompts for Input

i. The sensor displays the computed Slope and Offset with this prompt: "**Press SET to accept.**"

Figure 6.6 Accept the Given Values

j. Press the SET button. Values of Slope and Offset may vary among sites.

Note: The Offset equates to the weight of the bucket/weighing mechanism in inches of water.

k. If the displayed values of Slope and Offset are in their respective ranges, then press the SET button. If not, press CANCEL/OFF button, and investigate the cause of the problem.

l. After pressing SET the sensor displays, '**Calculating, Please Wait**" while it updates the Slope and Offset and begins a new measurement.

m. The sensor displays the last measurement using the new Slope and Offset. These values are automatically stored into the data logger. Every data file generated upon download reports the values of Slope and Offset in the top-most line.

n. Once completed, journal the words "Calibration Check – Reset Performed" to the ***FPR Log Sheet.***

o. **Wake-up** the display upon completing the Calibration Reset to generate a second flag to mark the end of the disrupted portion of data. This is an important step!

Caution: When completed with the full reset of the Calibration, make sure you exit the Menu System and turn off the display. If the menu screen is left in Calibration mode, the display will not time-out and this will drain the battery and cause permanent loss of the 15-minute precipitation records.

Note: If for some reason this is not possible, place a support surface across the top of the bucket (i.e., snow board, or flat metal bar) and **position the Test Weights as close to the center of the diameter of the bucket as possible. See Figure 6.7.**

Note: If a board or flat bar is placed on top of the bucket to hold the Test Weights (three brass weights total 27.1 lbs) it should be sufficiently strong and stable to support all three weights. The board or bar should not be too heavy because if total weight exceeds 1.5 times the weight of a full bucket (i.e., 40-lbs) then it will overstress the load cell and cause permanent damage to the load cell.

Figure 6.7 Brass Weight Centered on Bucket

6.5 Retrieve the 'Slope' and 'Offset' Values:

From the Home Menu, scroll down to the 'Station Setup' menu, and press Right-arrow button to call up the 'Measurement Setup' submenu. Press Right-arrow again. Scroll down to the fourth and fifth parameters, to access the values for 'Slope' and 'Offset.'

Write down the 'Slope' and 'Offset' to a log sheet and enter this information to the Site Inspection report's Remark's section. This will become useful references when you next conduct a calibration check at the Observer's site. By keeping a continuous history of these two parameters, you can determine by how much Slope and Offset have changed, should the system fail to check within ±0.25inch of the three test points. This metadata will also aid in troubleshooting if the Load Cell or Precip Recorder develop problems.

Primary Menus (6)	Second Level	Third Level	Details
Precip and Time	- none -	- none -	- none -
Battery Voltage	- none -	- none -	- none -
Logged Data ►	Precip ► Logged Events ► All Logged Data ►	Fifteen-minute data. Ie., 'Display on', etc. Data and events.	15-min records Various records Both types
Station Setup ►	Measurement Setup ► Temperature Setup ► Other Settings ►	11 parameters 6 parameters Sets the password	Numerous Numerous Password entry point
Diagnostic ►	Two Point Calibration ► Precip Details ► Temp Details ► Software Version	Instructions (3) Parameters (7) Parameters (3) - none -	Several Numerous Several - none -
Station Name & Time	- none -	- none -	- none -

Table 6.2 Overview of FPR-D Menus – Sensor Calibration is Done in 'Diagnostic'

6.6 Site Inspection Report (Accessed in SIS):

From the SIS home page access the **Inspections Menu** and from the two drop-down choices select '**Create Trip'**.

After entering the pertinent trip information (i.e., Trip date, Station Number, Visitation Type) go to the **Remarks** field. From the notes you wrote at time of inspection and Calibration reset you should have the new values for the "Slope" and the "Offset" parameters.

Type into the Remarks field the outcome of the Calibration Reset procedure.

- Calibration Reset Performed. Slope is now -2.4536; and the Offset is now -3.8163. (use valid numerical values per your situation). See Figure 9.8 of this manual for an example of the Remarks Field in the SIS Site Inspection Report.

Next, examine the section immediately below the Remarks field. See the **Equipment Maintenance Performed** matrix (illustrated in Figure 9.9, with the blue and white horizontal stripes). Notice it has one row each for each piece of equipment at this specific COOP site. Identify the row titled "FPR-D" and the ten (10) check boxes on this row. Mouse-click on the box "**Calibrated**," because you performed the **Calibration Reset** procedure.

Note: For inspections when the weighing sensor checked within tolerance at all three test points, and no calibration reset was performed, you mouse-click on the box, "**Routine Maintenance**" and *not* the Calibration box.

CHAPTER 7 – System Troubleshooting and Repair

7.1 Notify Sterling Field Support Center (SFSC):

When the FPR-D system experiences a technical failure or the precipitation data appears with a diurnal oscillation that exceeds ±0.10 inch, you will report the trouble to the Sterling Field Support Center (SFSC) by phone 703-661-1268 (8am-5pm ET Mon-Fri). Their backup line is 703-661-1293. You may email them on: NWS.SFSC@noaa.gov.

After you notify SFSC, you notify your Regional COOP Program Manager of the issue.

Inform the SFSC technical specialist whether your office has an "in-office spare FPR-D" one in which you can take to the COOP site to troubleshoot the gauge. The SFSC Hotline may instruct you to follow specific testing procedures and if the component tests 'bad' you may need to ship the bad component to National Reconditioning Center (NRC).

Note: Do not attempt to repair or order repair parts from NLSC, until you have first contacted SFSC to report the problem.

7.2 Logger Points of Failure and Troubleshooting:

The FPR-D rain gauge is a microprocessor controlled instrument. It can detect and report malfunctions. If the health lamp is lit 'red' (rather than green) this indicates a problem. If the display shows a " ? " after the reading, this indicates a bad quality reading. The display will report a coded 'Error' message in the display for specific problems. When it does so, the logged data will be marked as invalid. The Precip Recorder (i.e., logger) enables users to call up the current battery voltage, and logged fifteen minute precipitation records, to analyze conditions. For background on the system, refer to the Sutron, Co., "*FPR Kit Operations and Maintenance Manual, Revision 1.00"* © 2008.

7.2.1 No Display on the Logger: It is normal for the display to go dark (asleep) after approximately five minutes of inactivity. Wake-up the display by pressing the OFF button on the front of the Precip Recorder (see Figure 2.16).

If the Display fails to respond, there are five general conditions that could be the cause. Before troubleshooting, disconnect the solar panel cable. Test and replace each as necessary in this order of progression. In the baseline Sutron unit, there is no fuse or regulator – the solar panel is directly connected to the battery at the terminal block.

- Faulty battery,
- Faulty battery cable,
- Faulty solar charging,
- Blown fuse – *only if Voltage Regulator modification was installed*
- Faulty data logger.

Refer to Section 7.3, *Battery Voltage Too Low – Recurring Condition*, for testing of solar panel output. Use your multi-meter and measure the voltage at the battery terminals. If it is lower than 10.6V (temperature dependent) the unit will not turn on. You will need to replace the battery with a charged one to continue troubleshooting. See the procedures described in 7.3.3, *Check Solar Charging System*.

With a fresh battery installed, review the most recent **logged data** and examine the logged **Battery Voltage**, it is recorded once per day at 23:59:59, just before the 15-minute precipitation record ending Midnight, 00:00:00. Look to see if it slowly dropped over days - an indication of no solar charging, or if it dropped suddenly - an indication of a fault that drained the battery.

Finally, use your multi-meter as described in Section 7.3.3, at the battery terminals, all connections, terminal block, and cable wires to ***rule out*** a faulty battery and solar panel.

7.2.2 Loose Connections in Terminal Block: Loose wires or cables in the Terminal Strip inside the Precip Recorder (Figure 7.3) are known to cause this low-voltage breakdown. The Sterling Field Support Hotline (SFSC) has taken numerous calls of reported loose connections in the Terminal Block. Check the connections for the solar power wires (black and white) wires and battery power wires (red and black) inside the Terminal Block. Heed the safety precautions given in Fig 7.3, when probing on the Terminal Block.

Note: Ensure the insulation on the wire is not getting crimped by the terminal strip's screws and preventing metal-to-metal contact. Ensure the small recessed screws are tight enough to securely fasten the ends of these wires.

7.2.3 Precipitation Sensor Data Missing, Out of Range, or No Change: These conditions may be caused by a faulty load cell assembly or possibly a faulty Precip Recorder. Remove and replace each unit, until system is functioning properly. Equipment needed:

- Spare Load Cell assembly
- Spare Data Logger
- Calibration Weights

7.2.4 Download Prevented - Display Gives 'Err 4027': If 'Err 4027' interrupts the regular display, then remove the SD card from its receptacle on the Precip Recorder. Examine and wipe the edge of the SD card to ensure the metal contacts are dry and free of any dust or residue. Examine the read/write protect switch, to ensure it is in the 'unlocked' position. With the display dark, re-insert the SD card gently and fully into its receptacle until you feel it click. If the display does not respond normally, eject the SD card, and use a spare SD card that you know is standard capacity (SDSC) and is formatted to 32FAT. If the Zeno still displays 'Err 4027' then phone Sterling Field Support Center (SFSC) and report your findings. See section 7.5.3, for discussion an on Error 4027.

7.2.5 Data File Missing From SD Card: If the SD card is ejected before the system has completed its process and before the display reads 'Download Complete' the Precipitation Data file will not be saved to the SD card. Unfortunately, the system does not flag this with an error

message, and worse it indicates 'download complete.' To remedy this accidental ejection, press the OFF button several times until the display goes dark. Then re-insert the SD card and allow the system to complete its download process – which typically takes five minutes – and the display responds 'Download Complete.' If the data still cannot be retrieved, use a known 'good SD card' download the data. If the CSV file (also known as the Log File) is still missing from the SD card, then replace the Precip Recorder.

7.2.6 Wrong Time/Date on Data: The internal real time clock (RTC) establishes the date/time records for the 15-minute precipitation records. The RTC has a 10-year lithium battery source, which is independent of the system backup battery. This allows the RTC to keep time even if all external power is removed. The clock is calibrated to give an accuracy of 30 seconds per month (2 parts per million). However, if either the clock or the clock battery fails, the time and date will begin to deteriorate. If this occurs, remove and replace the Precip Recorder.

7.3 Battery Voltage Too Low – Recurring Condition:

Use the FPR Plotting Macro to review the battery voltage history. The baseline FPR-D firmware logs the battery voltage just once per day at midnight as seen in every Log File. To enable finer scale analysis (i.e., 15-minute voltages) you need to install the Firmware Upgrade v1.06 on your next maintenance visit. The firmware file and instructions (i.e., Mod Note) are posted together on www.nws.noaa.gov/ops2/Surface/coopimplementation.htm in the FPR-D portion of the COOP Modernization Webpage.

When visiting an FPR-D site always carry a spare fully charged battery with you. It is not possible to trouble shoot the system if the existing battery is dead or low on charge.

The FPR battery weighs four pounds, and is a 12V, sealed lead-acid, rated 7-AmpHours. Battery voltage is a problem when it runs below 11.5V. Repeated system shutdown due to low battery voltage is caused by either:

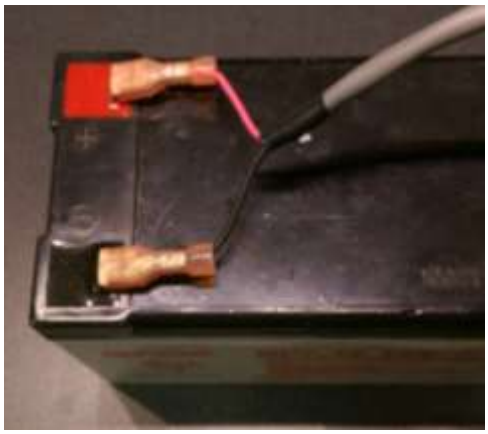
a. Charging system failure:
   - Terminal Block connection failure. Screws are loose in the white, red, and black contact sections. See Figure 7.1. Use screwdriver to gently tighten the loose screws
   - Solar cable
   - Solar panel

b. No sunlight on panel:
   - Panel fully or partially shaded by obstructions
   - Weak or low sun angle (i.e., Alaska in winter)
   - Panel dirty

c. System fault, load failure:
   - Menu system and/or display stuck in the 'awake' state, draining battery
   - System shorted

d. Battery failure:
- Battery cell shorted
- Battery worn out (i.e., over-charging from intense sun)
- Battery destroyed by repeated deep discharge cycles

All the above must be checked when you see repeated shutdowns in the data, or have a dead system.



red wire to (+) red terminal
black wire to (-) black terminal

Figure 7.1 Battery Terminals

The red wire is the Positive Lead

Figure 7.2 Power Sonic is the Stock 12V Battery

7.3.1 <u>First check the battery voltage</u>: Disconnect positive lead from battery (Figure 7.1). Measure the voltage across battery terminals. A discharged or bad battery can result when FPR-D logger menus were not properly exited. For example the calibration procedure was followed and yet menus were not exited and the system never returned to the normal Precip and Time display. The system never went to sleep and the display stayed lit until the battery was drained.

If the voltage is around 7.0V, then the battery is discharged, and the FPR system shuts down. You will need to find the fault, fix the problem, and then replace battery.

a. If <u>below</u> 12.0V, find a fully charged spare battery, swap out the weak battery, and conduct a system fault check. For instructions, see Sec 7.3.2, ***Check System Fault, Load Failure***. Do not reconnect positive lead to battery, yet.

b. If about 12.0V, proceed to ***Check System Fault, Load Failure***, but do not yet reconnect positive lead to battery.

c. Does the battery voltage indicate an over-charging (i.e., 15V in full sun)? If so, you may need to install the Solar Voltage Regulator as a priority maintenance action. Refer to Mod Note COOP D111D Note 3, and replace the battery.

7.3.2 Check System Fault, Load Failure: With solar panel clean and oriented for full sunshine:

a. Solar Panel Wake Up – Wake up logger to see if it will run on solar panel alone. The FPR-D uses a 2-watt solar panel which is marginal to fully run an 'awake' logger without the battery. If the logger wakes up, or tries to wake up, and cycles on and off, consider this test 'Good.'

- Logger wakes up (or tries to wakeup). Good. Proceed to Battery wake up.
- Logger does not wake up – proceed to ***Check Charging System*** (Sec 7.3.3)

b. Battery Wake Up – Disconnect solar panel from the logger, reconnect the battery to the logger.

- Logger wakes up – Good. System will run on both battery and solar panel confirmed. Proceed to ***Check Charging System*** (Sec 7.3.3).

- Logger does not wake up

    1. Check connections at terminal block. (Figure 7.3)

    2. If battery voltage is getting from battery, through terminal block and to internal board, then logger may be bad.
    3. Contact SFSC for further analysis and suggestion for possible replacement of Sutron logger assembly

Blue: Not Used

White: +12V Solar

Red: +12V Battery

Black: GND Battery

Black: GND Solar

Figure 7.3 Terminal Block Assignments

Figure 7.4 Battery Voltage for Logger (Red and Adjacent Black)

⚠ **Caution:** Only probe the screws used to clamp the wires. Do **not** probe the center screws, particularly the area illustrated by the white box in Figure 7.3.

Figure 7.5 Terminal Block Caution Zone

7.3.3 <u>Check Charging System</u>: With solar panel clean and in FULL sun, oriented to sun, disconnect positive lead from battery, and measure voltage across the battery.

Then measure the voltage between the positive lead and negative lead (still on the battery).

Voltage on the positive lead (from solar panel) <u>must</u> be higher than Battery voltage by 1.2V minimum, in order to charge battery.

a. **Solar Panel Voltage** - Must be 13.6V or higher and could be as high as 23V without a regulator, or up to 14.8V with a regulator.

- If 13.6V to 23.0V (14.8V with regulator), then solar panel voltage is okay. Go to ***Load Test*** (7.3.3.b), next.

- If not 13.6 to 23.0V (14.8V), troubleshoot the connections to the solar panel (7.3.3.c), below.

Figure 7.6 Solar Voltage at Terminal Block

b. **Load Test** – Connect a 100-400 ohm 10-watt resistor across the solar panel wires. Measure the voltage across the resistor.

- If still above 13.6V, the solar panel and connections are working fine, as the panel is putting out enough voltage and current to charge the battery.

- If below 13.6V, find what is stopping the current from solar panel / wiring / connectors / path. Corrosion in connectors is a typical cause. Go to ***Troubleshoot Solar Charging System*** (7.3.3.c), next.

Figure 7.7 Solar Cable Test for Corrosion

c. **Troubleshoot Solar Charging System** – Leave battery disconnected, and check every connection between the solar panel and the battery connectors.

Start with connections closest to the solar panel, disconnecting each pair in turn, and proceed toward the battery, applying tests 7.3.3.a, and 7.3.3.b (above), at each pair of connections. Reconnect the connection pair you are testing, before proceeding to the next connection pair in the wires to the battery.

- If both tests are good at the connections closest to the solar panel, reconnect those and move to the next pair of connections toward the battery, repeat tests at each successive accessible point in charging path until you find blockage. Repair any corrosion, loose wires, etc., found.

- If both tests are bad at the connections closest to the solar panel, then the solar panel is bad and should be replaced.

- Done when tests (Items 7.3.3.a., and 7.3.3.b, above) pass at the battery leads.

7.3.4 Return All Cable Wires to their Operational Connections: Following 7.3.3 above will result in all connectors between the solar panel and the battery connected except the battery terminals. Now, connect the battery leads to the battery. At this point the system should be working fine on a good battery/power system.

7.3.5 Upon Return to WFO Check Old Battery for Viability: This *cannot* be done in the field.

a. Take the old battery back to your WFO workshop charging station

b. Connect it to an AC charger that is appropriate for the size of the battery.

c. Leave it on for three (3) days.

d. Disconnect from the charger.

e. Wait 12-hours for it to cool to room temperature. Have nothing connected to the battery.

f. Measure battery voltage. It should be fully charged.

- 12.6V or above, battery is good. Load test it if you have a 1-Amp load tester to confirm, but do ***not*** use an automotive load tester! Put battery in your truck as a spare.

- 11.2V and below. Battery is bad, has at least one cell dead. Discard/recycle battery per NWS guidelines.

Caution: Be familiar with the safety precautions when you are charging a lead-acid battery. Access NWSM 50-1115, Chapter 15, https://www.ops1.nws.noaa.gov/Secure/SAFETY/EHB-15/Procedures_2011/pd05011015f_15.pdf and read Procedure 15.3, *Battery Charging and Storage Operations*.

7.3.6 Solar Panel Location: If any part of the solar panel is shaded, the panel can shutdown and not deliver any power to the application. The solar panels are made with multiple solar cells connected in series to give the voltage needed and then in parallel to give the power needed. When a solar cell is shaded it becomes a high resistance to any current impressed upon it. Thus, 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 panels where they are in full sun, not in the fringe area under trees or behind guy wires or tower supports. Also, problems have been reported where construction or farming resulted in a lot of dust on the panel.

So, train the Observer to inspect and clean the solar panel as needed (especially of snow and ice). The FPR-D is supplied with a 15-foot connecting cable. The cable can be extended as far as you need, provided you use good outdoor rated wire of the same size or larger, and make waterproof connections above ground. If you need to trench the cable, use direct burial rated cable.

7.4 Data Contains Numerous 'Reset Powerup' Messages:

The Sutron Precip Recorder will not log 15-minute data records when battery voltage falls below a threshold value. Neither will the logger record a status message when this occurs. See **Figure 7.8** for an actual example. Notice the complete loss of data from 17:30 LST on Aug 5, 2012, to 11:30 LST on Aug 6, 2012, in this actual example from Pickens, South Carolina (38-6831).

If the battery is able to raise its charge by one-tenth of one volt to 10.6V, then the logger will record a status message with the words, 'Reset Powerup.' However, the voltage is still too low for the logger to report either a 15-minute record or the daily voltage reading. The logger will report the Date, and Time of the reset, and will report a sequential number (i.e., 33168) to show the count of the number of resets observed by the logger's microprocessor.

It is easy to confirm whether or not the rain gauge has had a 'Reset Powerup' outage problem, when you view with Notepad either the current CSV file, or the last recently received CSV file, simply perform a word search in Notepad for these words, 'Reset Powerup.' Refer to Figure 7.8 for the placement of this notation among the 15-minute records.

7.5 System Error Codes to Assist Troubleshooting:

7.5.1 Failure Messages Appear in Display and Are Logged Automatically:

The Sutron Precip Recorder is a microprocessor controlled instrument. It can detect and report malfunctions. When the Precip Recorder detects an error the Sutron logger will display something similar to Figure 7.11.

Most of the possible errors are internal hardware errors that are non-fixable in the field. Contact the SFSC to report the error and the type of failure indicated on the display, together with the four-digit error code.

If you return an FPR-D component to National Reconditioning Center (NRC) include a note stating the unit has reported errors and write down the Error Code number along with any information you learned through contacting SFSC.

38006831_log_20120904 - edited down for Illustration in FPR Ops Manual.csv ...

File Edit Format View Help

```
Station Name,Sensor Serial Num,model and version,Slope,Offset,Averaging
Time,Sampling Interval
38006831,K291799,FpRain ver 1.05,-2.394984,-3.7264862,2.000 sec,0 ms
Precip,8/3/2012,16:00:00,5.61,,,
Precip,8/3/2012,16:15:00,5.61,,,
Precip,8/3/2012,16:30:00,5.61,,,
Precip,8/3/2012,16:45:00,5.61,,,
Precip,8/3/2012,17:00:00,5.61,,,
Precip,8/3/2012,17:15:00,5.61,,,
Precip,8/3/2012,17:30:00,5.61,,,
Precip,8/3/2012,17:45:00,5.61,,,
Precip,8/3/2012,18:00:00,5.61,,,
Precip,8/3/2012,18:15:00,5.61,,,
Precip,8/3/2012,18:30:00,5.61,,,
Precip,8/3/2012,18:45:00,5.61,,,
Precip,8/3/2012,19:00:00,5.61,,,
Reset Powerup,8/4/2012,11:35:21,28336,,,
Reset Powerup,8/4/2012,11:36:11,28343,,,
Reset Powerup,8/4/2012,11:44:53,28443,,,
Precip,8/4/2012,11:45:00,6.34,,,
Reset Powerup,8/4/2012,11:45:25,28447,,,
Reset Powerup,8/4/2012,11:47:03,28449,,,
Reset Powerup,8/5/2012,10:30:59,32058,,,
Reset Powerup,8/5/2012,10:47:56,32136,,,
Display Off,8/5/2012,10:52:56,,,,
Precip,8/5/2012,11:00:00,6.35,,,
Precip,8/5/2012,11:15:00,6.35,,,
Precip,8/5/2012,11:30:00,6.35,,,
Precip,8/5/2012,11:45:00,6.35,,,
Precip,8/5/2012,12:00:00,6.35,,,
Precip,8/5/2012,12:15:00,6.35,,,
Precip,8/5/2012,12:30:00,6.35,,,
Precip,8/5/2012,12:45:00,6.35,,,
Precip,8/5/2012,13:00:00,6.35,,,
Precip,8/5/2012,13:15:00,6.35,,,
Precip,8/5/2012,13:30:00,6.35,,,
Precip,8/5/2012,13:45:00,6.35,,,
Precip,8/5/2012,14:00:00,6.35,,,
Precip,8/5/2012,14:15:00,6.35,,,
Precip,8/5/2012,14:30:00,6.35,,,
Precip,8/5/2012,14:45:00,6.35,,,
Precip,8/5/2012,15:00:00,6.35,,,
Precip,8/5/2012,15:15:00,6.35,,,
Precip,8/5/2012,15:30:00,6.35,,,
Precip,8/5/2012,15:45:00,6.35,,,
Precip,8/5/2012,16:00:00,6.35,,,
Precip,8/5/2012,16:15:00,6.35,,,
Precip,8/5/2012,16:30:00,6.35,,,
Precip,8/5/2012,16:45:00,6.35,,,
Precip,8/5/2012,17:00:00,6.35,,,
Precip,8/5/2012,17:15:00,6.35,,,
Reset Powerup,8/6/2012,10:53:34,33168,,,
Reset Powerup,8/6/2012,10:57:35,33211,,,
Reset Powerup,8/6/2012,11:19:32,33489,,,
Reset Powerup,8/6/2012,11:23:18,33491,,,
Reset Powerup,8/6/2012,11:26:30,33523,,,
Reset Powerup,8/6/2012,11:27:00,33525,,,
Reset Powerup,8/6/2012,11:33:29,33548,,,
Display Off,8/6/2012,11:38:29,,,,
Precip,8/6/2012,11:45:00,6.36,,,
Precip,8/6/2012,12:00:00,6.36,,,
```

Figure 7.8. Example of Reset Powerup Messages in Data File (Symptom of Weak Battery)

7.5.2 Errors Can Be Attributed to Specific Components:

The following errors relate to failures within the FPR-D rain gauge. If you see any of these note the error number and try to clear the error, following the procedure below. If the error will not clear, repeats after another attempted use of that part of the system, or prevents/affects system operation the unit may need to be replaced. Contact the SFSC for further assistance.

Source Component	**Error Codes (Range)**
Sutron Display	Error 1001 to 1008
Real Time Clock	Error 1101 to 1104
Keypad	Error 1201 to 1204
RS232	Error 1301 to 1316
Flash Memory	Error 1401 to 1403
SDI-12 (Serial/Digital Interface)	Error 1501 to 1506
Miscellaneous Errors	Error 3001 to 3201
SD Card	Error 4027
Load Cell	Error 7001 & 7002

Table 7.1 Listing of Error Codes by Probable Origin

7.5.3 Error 4027 is an SD Card Issue:

The "Err 4027" always relates to the SD card operation. It covers hardware errors as well as issues that can be caused by the user, such as improper SD Card insertion or removal, write-protect on, card full, etc. If you see this error, remove the SD card, make sure the write protect switch found on some SD cards is in the OFF, RW, or UNLOCK position. Clear the error as shown below, and retry downloading to the SD card.

Observers should note in their log that they saw (and cleared) this error, so you are aware of it. If the error will not clear or data will still not download, the unit will need to be replaced.

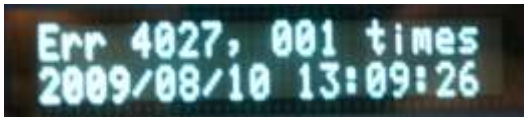


Figure 7.9 Code 4027 Indicates SD Card problem as Identified in Table 7.1.

The SD Card Fail error can easily be caused by operator fumbling, but also includes hardware failures. It is not possible to determine what caused the 4027 error from the display. However, if you can access the logged data, you will notice a '**Test**' notation logged together with the '**Fail**' message. See example in Figure 7.10.

Log file reveals 'Test 16' an improperly inserted SD Card.

Precip,07/13/2009,14:15:00,1.38,
Precip,07/13/2009,14:30:00,1.38,
Display On,07/13/2009,14:37:16,
Test,07/13/2009,14:41:13**,16.0000,** ← **Test Code '16.0000' is associated with the Hardware Fail**
Hardware Fail,07/13/2009,14:41:13,**4027**, ← **Error Code '4027' indicates an SD Card problem**

Figure 7.10. Example of Log File with notations for 'Hardware Fail' and 'Test'

The Test notation will include a numerical value between 1 and 27, with four decimal places. See Figure 7.10, which indicates a 'Test 16' condition. Anything other than the following Test Codes in **Table 7.2** will be a hardware failure and one or more FPR-D parts may need to be replaced. Unfortunately, if it is a hardware failure you will not be able to download the data to SD card to further analyze the Fail condition. Then, you will have to connect a laptop to the logger and examine the logged data to find the values of the Fail and Test codes.

Test Codes	Meaning
3	SD Card not formatted
8	SD Card is full
16	No init function available / error in init (i.e. SD card not inserted properly)
17	SD Card not detected
19	A sector has developed an error
21	Error writing file to volume (i.e., card pulled out before finish)
22	Media not recognized
23	SD Card is busy
24	SD Card is write protected
25	FAT not recognized

Table 7.2 Test Codes when SD Card Fails

Note: Operator Error will occur if you eject the SD card before the system has finished writing the file to the card, before the display shows "Download Complete." **Unfortunately, the system does not display an 'Err 4027' in these situations.** If the Observer realizes the ejection was premature and needs to download the data, then s/he must exit the process by pressing the OFF

button three times, and after the display goes dark, then insert the SD card. The system will automatically begin the download process which requires approximately five minutes to complete the process an respond 'Download Complete.'

7.5.4 <u>How to Read and Clear the Error Messages</u>: When the logger displays a 'Hardware failure' message (see Figure 7.9) you will need to take these actions at the logger display with the four Arrow buttons to navigate one or two of the menus.

a. Press the RIGHT Arrow to see the error.

b. Press the DOWN Arrow repeatedly to display all errors.

c. When you get to the end of the error list you will see **'End of error list.'**

d. Press **SET**, to clear the errors and the display will briefly show: "**Errors Cleared**"

The unit will automatically revert back to the normal precip, date and time screen.

e. Then press OFF button ***<u>several times</u>***, until the display goes dark.

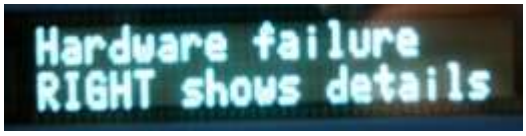


Figure 7.11 Appears in Home Display

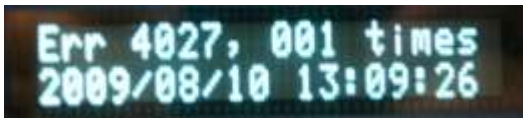


Figure 7.12 Identify Error by 4-Digit Code

Figure 7.13 Use Down Arrow to Scroll and Search for Any Other Error Codes

⚠ **Caution:** Make certain the display goes dark. Otherwise the display will remain lit, and drain the battery within a couple of days!

<u>Reminder</u>: When you open the rain gauge door you should wake-up the display. After five minutes, if left inactive, the display will go to sleep. So after you complete all your maintenance (i.e., bucket work), wake-up the display again. Then remember to turn off the display by pressing the 'OFF' button. Waking up the display generates a permanent flag in the precipitation file. Then NCDC algorithms can recognize the flag and exclude the ambiguous data that results when you replaced FPR parts, changed settings in the FPR rain gauge, or installed updates to the data logger software. Always journal these restorative activities to your ***FPR Log Sheet***, see Appendix E, of this manual.

When you visit a station to perform FPR-D restorative maintenance consider conducting preventative maintenance including a check on sensor calibration, and draining the collection bucket if needed. If you need to diagnose the electrical system while on site, then follow the procedures given in Section 7.3, of this chapter.

7.6 Flexure Replacement – Use Preassembled Weighing Mechanism to Swap-out:

Gauges with ±0.10 inch and greater diurnal oscillation, should be written up to the maintenance planning checklist, for a priority maintenance visit, for the change-out of the FPR-D gauge's weighing mechanism. An example of this oscillation pattern is given in Figure 4.3, in Chapter 4, Quality Assurance and Best Practices.

Refer to Appendix D of this manual for instructions on how to swap out a field rain gauge with bad flexures with a preassembled weighing mechanism built inside your WFO.

Appendix D, also gives the detailed instructions for how to rebuild the weighing mechanism by installing new flexures and thereby restock a preassembled spare weighing mechanism in your WFO.

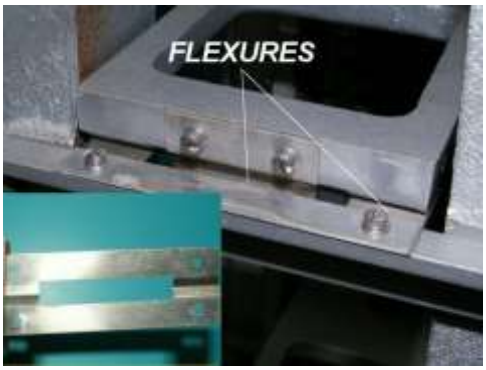


Figure 7.14 Damaged Horizontal Flexure - Note the V-shape bend.

CHAPTER 8 – System Modification Policy

8.1 Management Responsibilities:

Unlike ASOS managers, the national managers who maintain COOP observing systems are *not* governed by the instructions covered in NWSI 30-1203, *Configuration Management Policy for Operational Systems*. However, instructions in the NWS Directives System which apply to the surface observing program's parts logistics, maintenance, and configuration control, also apply to the cooperative observer program. Field, regional, and national managers follow the specific policies outlined in the, *Cooperative Program Management and Operations* (NWSI 10-1307) directive.

The NWS headquarters office in charge of the Cooperative Observer Program (i.e., OS7) will:

a. Evaluate existing and new requirements for FPR-D systems.

b. Fund, coordinate, and manage the development and certification of proposed changes that include Modification Notes to keep the FPR-D systems working properly.

c. Delegate to the Engineering and Acquisition Branch, the development and publication of Maintenance and Modification Notes.

d. Delegate to the Engineering and Acquisition Branch, the determination of costs for proposed changes.

e. Fund, coordinate, and manage the implementation of any new hardware and/or software for the FPR-D systems.

f. Coordinate change actions with Regional Managers, and maintains procedural and policy documents on, http://www.nws.noaa.gov/osp2/Surface/coopimplementation, the COOP Modernization web site; and ensure Mod Notes are posted on the NWSHQ Operational Systems site: http://www.ops1.nws.noaa.gov, under Surface Hydrology and COOP.

g. Verify completion of maintenance actions with effected field offices through the Station Information System (SIS) through updates to the Station Profile reports and the Station Inspection reports.

8.2 Policy on Cooperative Station Management:

The overarching directive that governs the implementation, operation, maintenance, and modification of any type of meteorological or hydrological observing equipment, is the NWSI 10-1307, http://www.nws.noaa.gov/directives/sym/pd01013007curr.pdf, *Cooperative Program Management and Operations (Aug 2012).*

Field and region managers who make equipment and service changes at the volunteer Observer sites whether in response to Observer requests, or in compliance with national headquarters

directives, then have to comply with the policies in the NWSI 10-1307, *Cooperative Program Management and Operations*, Section 6. In that section, managers are instructed to use the national data base of COOP site metadata to track numerous minor and major modifications to each of the approximately nine thousand sites. With implementation of the Station Information System (SIS) relatively few policies and procedures have changed. For this reason the NWSM 10-1313 remains a valid reference for FPR metadata entries until the directive is revised for SIS.

The project to convert the F&P rain gauges to electronic sensing and logging began in 2004 when the Office of Operational Systems issued their *FPU Operational Implementation Plan* (OIP). All field managers involved in the FPU, FPR-D, and FPR-E projects, had to abide by the OIP's management and administrative instructions.

A technical manual, the ***FPR-D Assembly Procedures***, was written to give a detailed description of the authorized configuration of the FPR system with an account of the Part Numbers and Software versions used in the FPR-D modification kit.

For the management of the FPR-D systems, including operations, maintenance, and issuance of Mod Notes for the FPR-D system, this handbook, the *FPR-D Operations Manual*, will be the governing document.

8.3 FPR-D System Modifications:

8.3.1 Hardware: Hardware components that may be affected by modifications appear in Appendix F, of this manual. The significant hardware groupings are:

- Load Cell Sensor Assembly
- Precip Recorder (i.e., Data Logger)
- Solar Panel
- 12V Battery

When NWS headquarters issues hardware modifications they will appear as COOP Mod Notes and they get filed in Appendix B, of this ***FPR-D Operations Manual***. For example the FPR-D Mod Note to enable the recorder to log the battery voltage every 15-minutes, requires an upgrade to the original firmware. The note is 'COOP D111D Note 4.' The Mod Note was released October 25, 2013, and the firmware is available on the COOP Modernization website.

8.3.2 Software: Software may be affected by upgrades issued by NWS Headquarters, refer to *FPR-D Assembly Procedures*, Chap 8.4, to identify the initial issue version number (i.e., FpRain ver. 1.05). The significant software groupings in the FPR-D program are:

- Operating system firmware of the Precip Recorder (Sutron, Corp.)
- McAfee Active Virus Defense (AVD) Suite

- Laptop/Netbook with Hyper-terminal (or equivalent) is not required to access the FPR-D logged. However, it is used to download the entire contents of the logger (i.e., 12 months) when needed.

8.3.3 Precedence of Mod-Note Implementation: When changes are needed to be made as soon as practical (within one to four weeks) the RCPM will inform you of the subject of the Mod Note, and provide you the website and/or email to access the specific instructions. However, COOP Mod Notes rarely get issued with that high or urgent precedence. Rather, the level of importance for implementation is found within the cover page of the Mod Note, stated in the heading, "Estimated Completion Date.'

Most Mod Notes are specified with a completion date 'As Needed.' This is the case for COOP D111D Note 3, for integration of a solar panel regulator. The phrase 'as needed' applies to when need arises to replace the 12-volt battery upon its exhaustion. Some Mod Notes will *not* apply to all sites, so carefully read the heading, 'Sites Affected' on the cover page. The heading 'Purpose' should adequately explain the reason for the modification.

It is the NWSREPs' responsibility to review all possible COOP Mod Notes for applicability to their field equipment. As a general rule of thumb Mod Notes that do not have a high level of precedence, should be implemented within 12 months or by the next regularly scheduled visit.

8.4 Manufacturer's Firmware Update:

As of this time there is no anticipation of the manufacturer, Sutron Corp., making an update to firmware that would require the NWSREP to install manufacturer's firmware to the FPR-D rain gauge. Should there be one, the NWSHQ policy in Section 8.6 will apply.

8.5 Prohibition of Local Changes:

Each FPR-D system comes delivered with a manufacturer developed firmware already installed. The data logger firmware (FpRain ver 1.05) can be upgraded with the NWS headquarters developed version, "ver 1.06" through use of a Laptop connection to a serial port on the underside the Precip Recorder.

The FPR-D firmware is standardized and configuration controlled. The firmware version number appears in each Log File (i.e., monthly data file) in the third field of the heading row (see Figure 4.4). No one has authority to change the data logger configuration software without the express and written direction from the National Cooperative Program Manager (NCPM), in NWS Headquarters.

The FPR-D data logger will produce two types of measurements by default: the precipitation level and battery voltage. While the logger is capable of temperature sensor input, the FPR-D will not be configured to input the MMTS thermistor readings. Neither shall the Sutron internal temperature sensor be enabled from the Sutron menu commands.

As of 2015 only the precipitation data is certified for operational use. In the future, if a temperature sensor becomes certified for use, updates will be given to the NWS field offices to install configuration software.

8.6 NWS Modification Notes:

All Modification Notes issued from headquarters shall take into consideration the length of time that may be required to implement the Modification Note, due to the following: FPR site unique properties, difficult site exposures, harsh climates, difficult electrical grounding, and temporary interruption to institutional site activities, and interruptions to agreements with network users.

Emergency modification work is authorized for immediate restorative maintenance, when hardware or software has been damaged or at risk as described in the Modification Note. Preventative actions will only be authorized on a case by case basis, after the Engineering Branch has been informed of site history and reviewed system outages or degradation from: (a) damaged hardware or software, or (b) hardware/software failures with damaged equipment.

Implementation of a Modification Note must be completed by the 'Estimated Completion Date' date. Submit a rendition update for the effected Station Profiles as soon as possible after the maintenance was completed, and no later than two weeks after the action.

8.6.1 Requires Rendition Update of Station Profile: Report any completed modifications (i.e., COOP D111D NOTE 4 (e.g., Firmware Upgrade FPRain ver 1.06) as a Rendition update to the Station Information System (SIS) Station Profile.

To account for the modification, you need to edit the 'Permanent Remarks' field in Station Profile to clearly indicate in plain English the subject of the modification. For example write: "Upgraded Sutron Firmware to FPRain ver 1.06, to enable 15-minute voltage logging, per instructions in Mod Note, COOP D111D Note 4."

When implementing other types of Mod Note and either the Load Sensor or Precip Recorder are changed, you will need to account for the serial number of the new equipment in the equipment description portions of the Station Profile.

8.6.2 Requires Filing a Station Inspection Report: To account for the amount of labor and the nature of the technical changes made to accomplish the implementation of a Mod Note, the same officer who traveled to the COOP site and conducted the modification, should be the person to file the Station Inspection Report.

Follow the detailed instructions in Chapter 9.4, of this manual, to create a Site Inspection Report that accounts for the implementation of a Mod Note. For an example of detailed entries that may be required see Figure 9.9.

Notice, the Site Inspection Report offers separate categories of work, including: Calibrated, Repaired, Modified, Installed, Removed, Moved, and Painted. Choose the column marked, 'Modified' and choose the equipment row marked, 'FPR-D' and click on the check box.

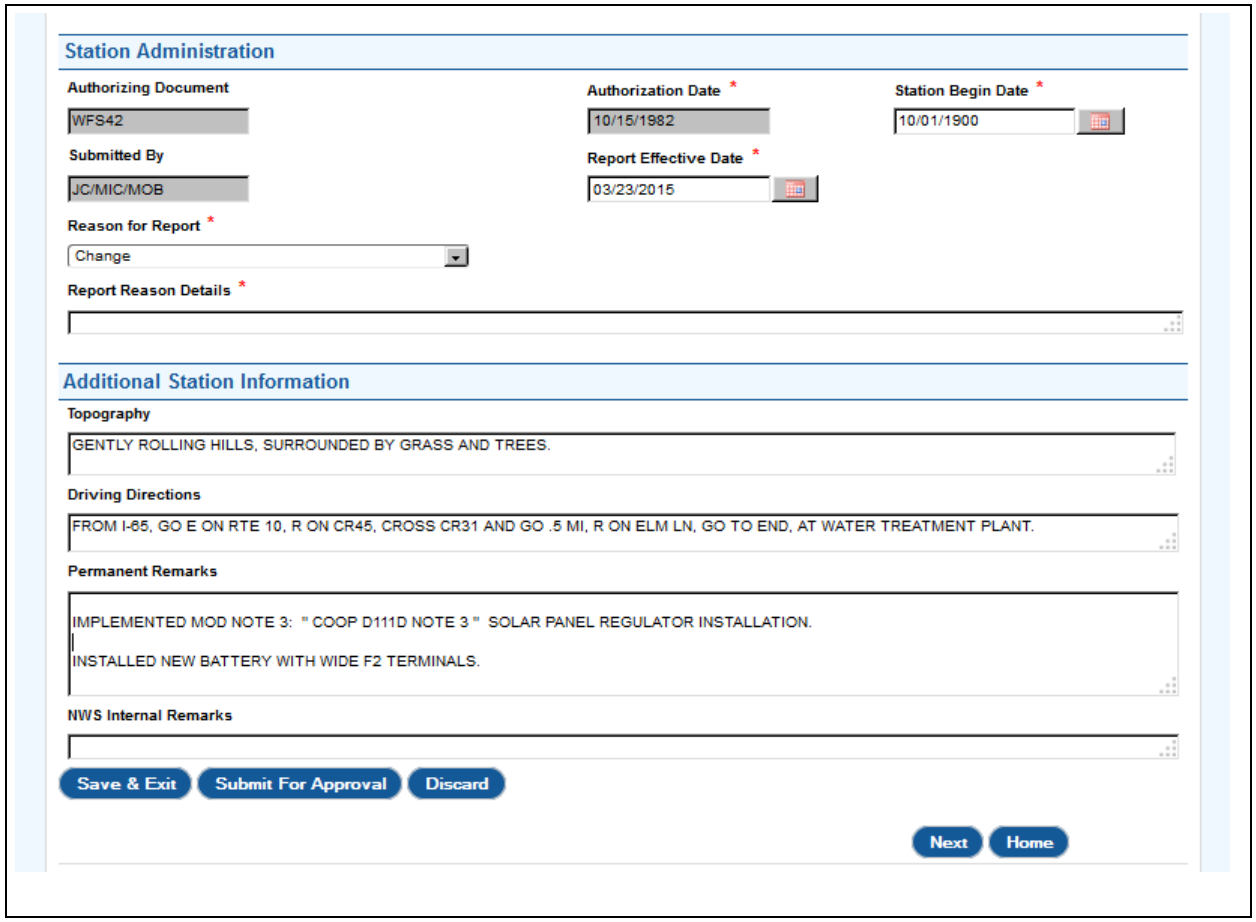


Figure 8.1. SIS Rendition Update Required for Mod Note Implementation (Permanent Remarks)

Then proceed to the Remarks field to enter any specific information that changed due to the Mod Note (i.e., Offset value, and Slope value). If primary equipment was replaced (solar panel, regulator, load cell, Precip Recorder) then mention it in the remarks section and include the serial number of the new equipment if applicable.

Before closing the Inspection Report, make sure the Remarks field contains a plain English description of the modification along with the official title of the Mod Note (i.e., COOP D111D Note 4. Installed the Firmware update for 15 minute voltage logging).

8.6.3 Records Retention - Modification Notes: Every 6 months visit the NWS HQ website and check for any possible Mod Notes that applies to the FPR-D rain gauge: http://www.nws.noaa.gov/ops2/Surface/coopimplementation.

Download and print each FPR-D Mod Note starting with COOP D111D Note 3, and the each subsequent Mod Note. File one copy into Appendix B, *Modification Notes*, of this *FPR-D*

Operations Manual. This way you will have a ready reference of changes that could apply to some or all of your FPR-D gauges in your Cooperative Program Area.

Note: As of 2015, there are three Mod Notes in effect. The assembly instruction for initial implementation of the Kit to convert the F&P mechanical gauge to the FPR-D configuration represents the first note, titled: 'COOP D111D Note 2.' The second, 'COOP D111D Note 3' applies as needed when the 12-V battery is prone to damage from overcharging. This requires installation of a voltage regulator. The third Mod Note, COOP D111D Note 4, instructs on how to upgrade the version of Firmware to enable 15-minute logging of the battery voltage. The Note 3 affects a limited number of COOP sites, perhaps fewer than ten percent of all. The Note 4 is optional yet is offered to improve the NWSREP's analysis of electrical system performance.

CHAPTER 9 – Metadata Requirements

9.1 NWSREP Responsibilities:

There are two categories of metadata for the FPR-D. The first includes permanent values (equipment model type, serial numbers, location) established at time of operational implementation. The second include maintenance data (i.e., calibration values, seasonal maintenance) that are overcome by successive actions or inspections.

The NWSREP generates metadata to account for these FPR-D actions:

- Initial installation of FPR-D system is accounted by Station Information System (SIS) Station Profile.
- Seasonal Maintenance (draining) is accounted by SIS Inspection Report.
- Routine checks of calibration are accounted by SIS Inspection Report.
- Restorative Maintenance is accounted by SIS Inspection Report.
- Equipment Modification Notes are accounted by Station Profile <u>and</u> Inspection Report.

The NWSREP stores FPR-D metadata in these locations:

- Station Profile gets saved to the SIS database.
- Site Inspection Report saved to SIS locally at WFO - yet Regional HQ may have access. if necessary, Station Inspection, is the backup printed form (i.e., Form B-23.)
- Current FPR-D system calibration data and bucket level status and seasonal maintenance can be copied from Site Inspection Report and saved to a *FPR-D Logbook*. This way all rain gauges in CPA can be accessed in one notebook to facilitate planning for semi-annual site visits.

9.2 Metadata Accuracy for FPR-D:

The NWSREP conducts semi-annual visits to the COOP sites with FPR-D gauges and checks the calibration of the weighing sensor. If the calibration needs to be reset, then new calibration values (i.e., Slope, and, Offset) are generated and have to be saved in the Site Inspection report.

If the weighing sensor (load cell) is replaced from failure or due to a system-wide equipment modification, this will change the values of permanent metadata in the Station Profile. The NWSREP is responsible for updating the metadata as needed following restorative maintenance or mod-note implementation.

The SIS data base is the single most authoritative source of COOP station information. The information it contains describes site location, exposure, dates of changed equipment, and method of data reporting. These elements of information constitute 'metadata' that are then used by the NCDC to create a permanent archive of station information. The accuracy of each of these parameters should be checked every six months.

When an FPR-D recording gauge is implemented, it is critical to update the Station Profile Station Information Report's '***Remarks***' field with the following text: "UPDATED EQUIPMENT, CHANGED F&P TO FPR-D WITH SD MEMORY CARD."

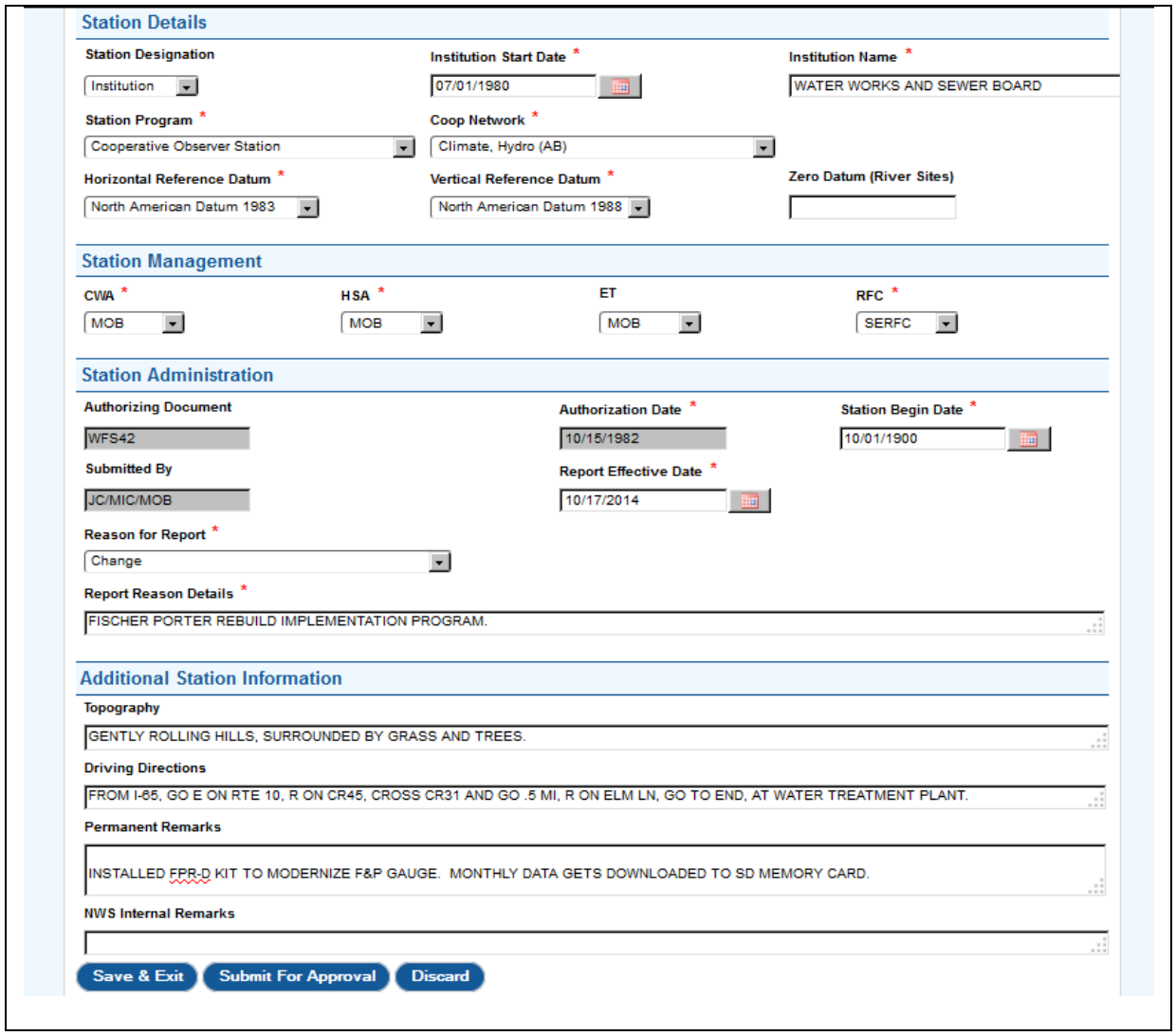


Figure 9.1 Station Profile Rendition Update Upon FPR-D Installation

There are two types of metadata saved to the SIS application. The first is equipment type and serial number values (i.e., load cell) are saved to the Station Profile, as they are by and large permanent values. The other type is non-permanent metadata that include calibration data (i.e., Slope and Offset). This latter type is saved to the SIS Site Inspection report and not distributed from the forecast office.

Policy on how metadata shall be accounted in SIS (Station Profile) is found in the ***SIS User Guide***. The ***SIS User Guide***, is accessible from the "Help" link next to the "Reports' link, at the top of the SIS application's **home page**.

9.3 Station Profile – Detailed Entries:

The first page of the Station Profile in the SIS gives the reason why a new Rendition of Station Profile was necessary. Click on the drop down menu for "Reason for Report" and select "Change" from the options available.

For installation of FPR-D rain gauge, make these entries in screen categories marked with the red asterisk. See Fig 9.1 for the required metadata parameters.

Enter a short description to the Remarks box to explain in plain English the change you have made.

For example: "**Updated equipment, replaced F&P with FPR-D. Requires SD Memory Card to download data.**" See Figure 9.2.

Then make the changes in the Station Profile as described in the next section, Section 9.3.1.

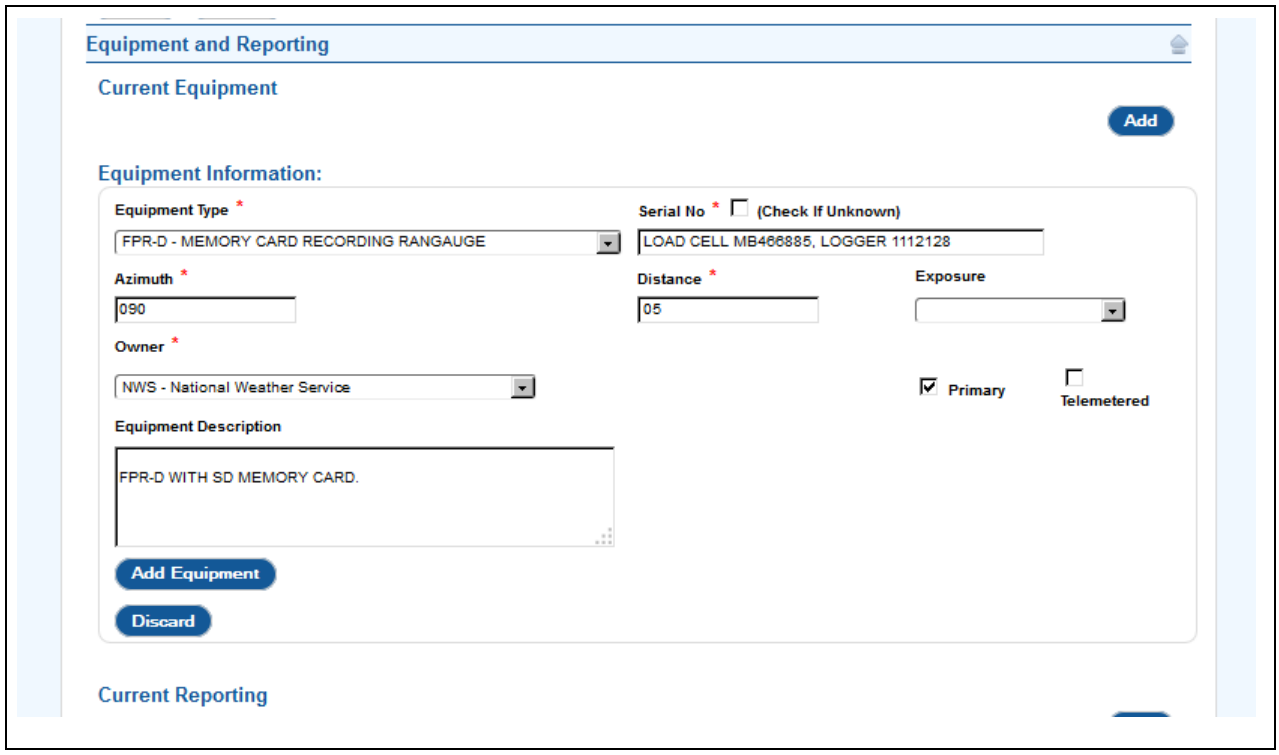


Figure 9.2 Detailed Entries for 'Equipment and Reporting' page of Station Profile

9.3.1 Current Equipment Field: Equipment Type:

a. ***Current Equipment***, select '**FPR-D – Memory Card Recording Gauge'** from the drop-down menu. This replaces F&P.

b. ***Serial Numbers,*** enter the Load Cell's serial number (i.e., MB467015) followed by the Data Logger's serial number (i.e., 1112128). Enter the serial number to the entry box with red asterisk "Serial Number" See Fig 9.2.

The eight character Load Cell serial number appears at the top of the white decal on the front of the Load Cell (see Figures 9.3 and 9.4). The Logger serial number appears on the metallic plate on the top of the Precip Recorder (Fig 9.5 and 9.6).

Figure 9.3 Load Cell Sensor (Sutron) with UPC

Figure 9.4 Load Cell Serial Number appears above UPC as "MB466885"

Note: The first round of production of Sutron kits had no serial numbers on the Precip Recorder. In more recent years the model and serial number appear as illustrated.

Figure 9.5 Precip Recorder has metallic decal on top side of box

Figure 9.6 Precip Recorder Serial Number "1112128"

c. ***Azimuth***, Enter the bearing (in degrees) the FPR-D subtends from the point where the SRG is situated. The SRG is the geospatial reference point of the COOP Site.

d. ***Distance,*** Enter the numerical value in feet the FPR is separated from the SRG.

e. ***Owner***, keep **NWS** as the default agency for this category.

f. ***Equipment Description***, Enter the words, "FPR-D Recording Gauge with Memory Card." If you have installed a Modification to the system, then enter a second sentence that gives an explanation of the Modification Note (i.e., Installed FPRD Firmware Upgrade, ver 1.06) and include the official number (i.e., COOP D111D Note 4).

9.3.3 Current Reporting Field: Hourly Precipitation Data:

a. ***Reporting Method***, select '**ADP – Electronic Reporting Method**.'

b. ***Recipient***, type-in free text the WFO identifier (i.e., "**MOB**"), and '**NCDC**' separated by a comma (MOB, NCDC).

c. ***Observation Time***, select '**MID**' from the drop-down, this refers to midnight.

d. ***Frequency,*** Select "**MONTHLY**" from the drop-down (see Figure 9.7).

e. ***Archive / Public Distribution,*** Data from virtually every FPR gauge that is *not* telemeterized, gets processed by NCDC for 'Public Distribution.' Click on the radio- button for public distribution.

f. ***Special Network***, Select '**NONE**' from the drop-down, unless rain gauge is part of a special network of the several dozen listed in the SIS drop-down menu.

Reference: The ***SIS User Guide,*** is available from, https://sis.nws.noaa.gov . After log-in, find at the top of the homepage, the 'Help' tab, click it, then select **Draft User Guide** from the drop down menu. The SIS User Guide gives guidance on how to navigate between the fields and menus within the pages of the Station Profile's user interface. There are approximately ten major pages: Station Details, Station Management, Station Administration, Additional Station Information, Current Observer(s), Current Observation(s), Current Obstructions, Station Information, Equipment Information, and Equipment and Reporting.

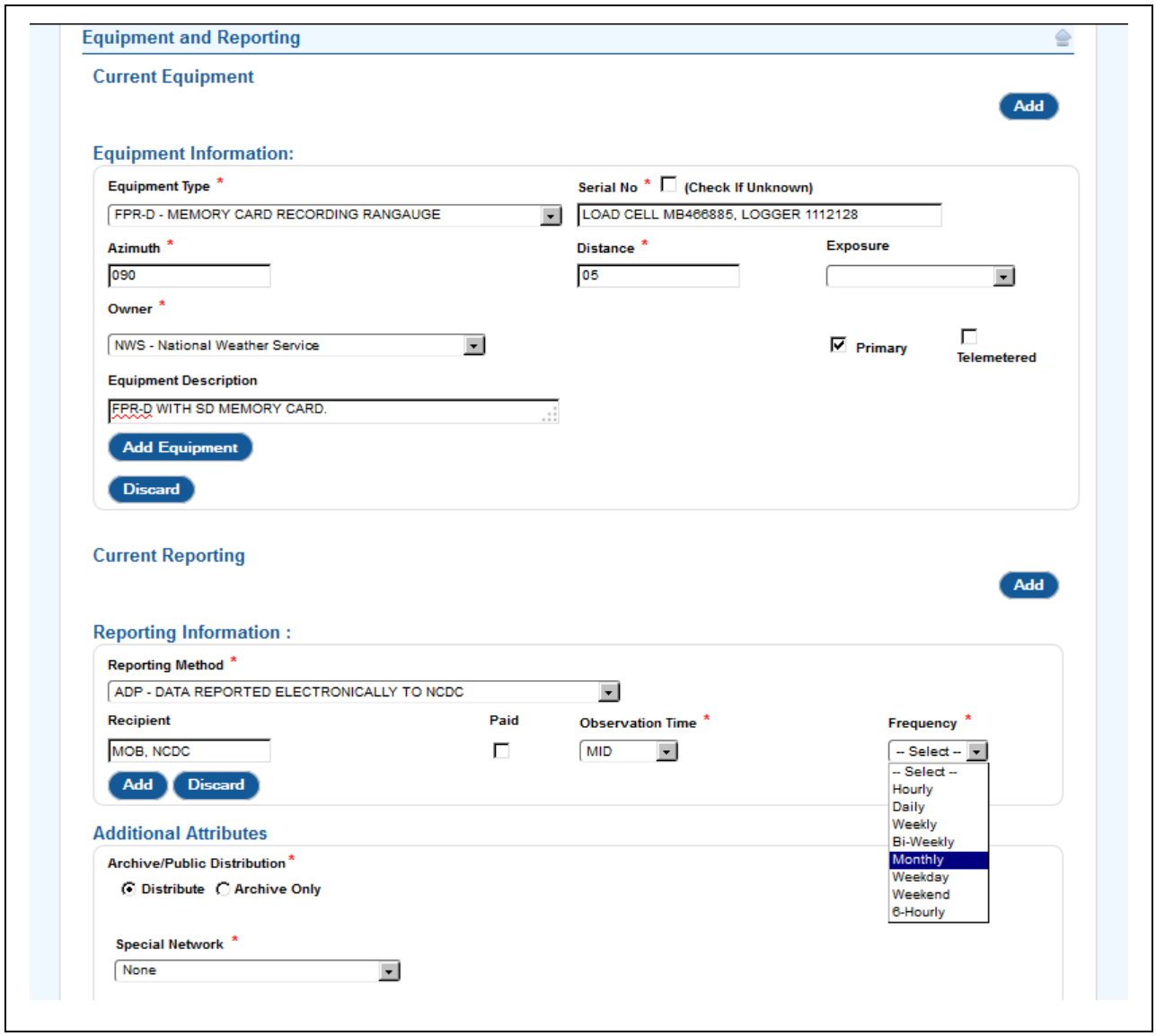


Figure 9.7 Detailed Entries for 'Current Reporting' field of the Station Profile

9.4 Site Inspection Report – Detailed Entries:

When you have completed site visitation and are back in the office, access the SIS and click on the top bar, the tab for 'Inspections.' System will prompt you to either create a report, or edit an existing report.

Account for the following in the 'Inspection Data.' Refer to Figure 9.6 as a guide:

- **Trip Date:** 09/17/2014 (Select from the on screen calendar.)
- **Start Date:** 09/17/2014 (Format: mm/dd/yyyy)

- **End Date:** 09/17/2014 (Format: mm/dd/yyyy)
- **Day Trip?** Click on Yes button; or No button, if an overnight trip.
- **Per Diem?** If YES, then click on check box. If not Per Diem, leave blank.
- **Trip Miles:** 239 (free text)
- **Trip Cost:** 195.00 (free text)
- **Staff Hours:** 12 (free text)
- **Remarks:** Enter a simple one or two sentence description for the purpose of this trip. For the FPR-D rain gauge, accurate metadata is required for the weighing sensor (i.e., the load cell). Enter the Calibration values associated with 'Slope' and 'Offset' into the Remarks field. See Chapter 8, when you are conducting a system modification (i.e., COOP D111D NOTE 4).

9.4.1 Inspection Report - Remarks for Initial Implementation: Each site inspection report is saved to the SIS local database as a required document for ready reference. The initial installation report should never be deleted because it contains relevant metadata to describe the weighing sensor and calibration coefficients not saved to the Station Profile.

The ***Remarks*** field in the Site Inspection report should contain these five parameters:

- Description of Action and Date of Action – Replaced F&P (or FPU) with FPR-D equipment on Month, Day, Year. (See Figure 9.8).
- Serial Numbers – Enter into the same user entry field the character Serial Number of the Load Cell, and the seven digit number of the Precip Recorder (i.e., data logger). See Figure 9.5.
- New Calibration Parameters – The values of 'Slope' and 'Offset' are calculated on-site when you have added the proper amount of Test Weights resting in/on the collection bucket. See Figure 9.8.

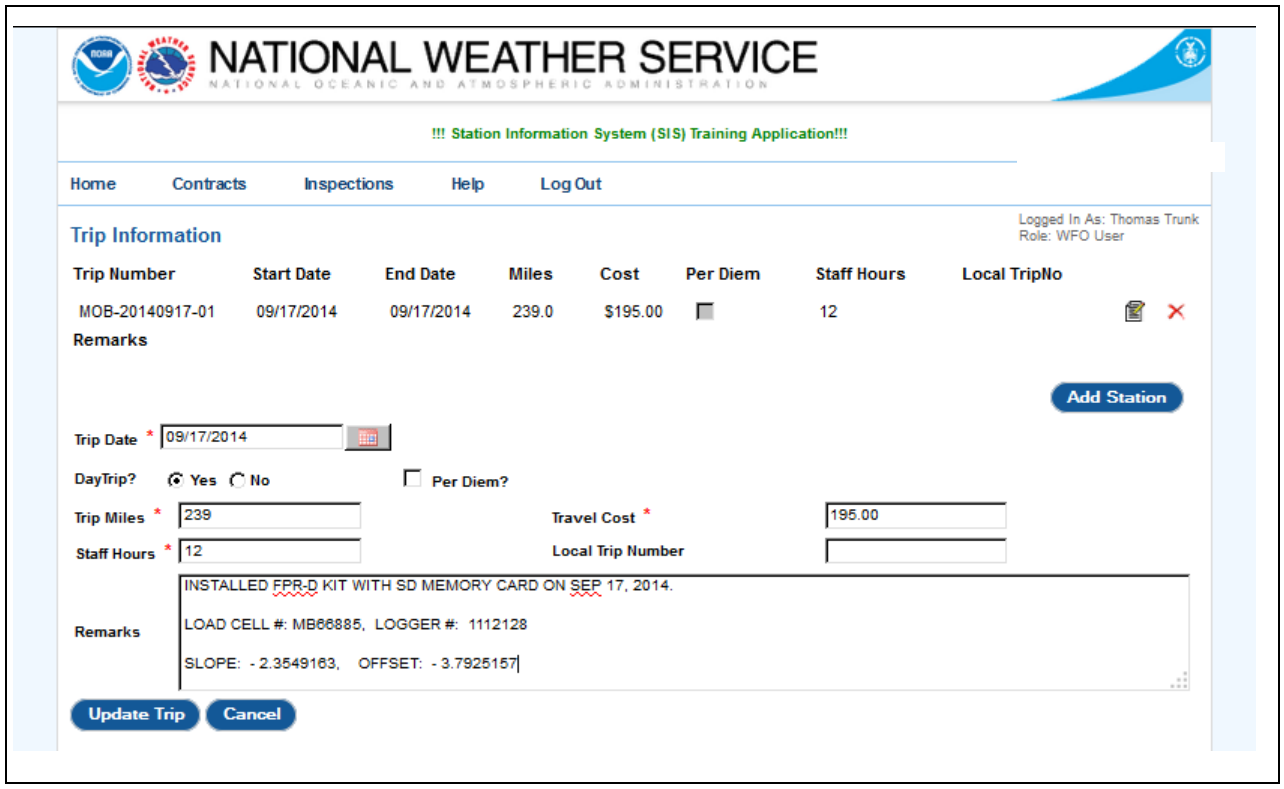


Figure 9.8 SIS Site Inspection Report – For Initial Installation

9.4.2 <u>Inspection Report - Remarks for Calibration Check (Annual)</u>**:** You are required to check the calibration performance at least once per year. Document the results of the check into the Remarks field of the Inspection report. The outcome of the test may result in the two calibration parameters changing their values. If the rain gauge tested 'good' on its calibration check, and you still want to confirm the values of the 'Slope' and the 'Offset' calibration parameters, then you can call them up from the display by selecting the "Station Setup Menu and then selecting the 'Measurements Setup' menu and scrolling down to 'Slope' and then 'Offset' the values will display.

Enter this statement to the Remarks field when the Calibration Check passes (i.e., ±0.25 inch of the test point values; 5.00 inches, 10.00 inches, and 15.00 inches).

"Sensor Calibration Check Passed: Slope = - 2.4525123; and Offset = - 3.5503674" (see Figure 5.5 for actual example).

If the test of Calibration fails at any one of the three test points (i.e., 5-inches, 10-inches, 15-inches), you will need to conduct a Calibration reset of the system (See Section 6.3, of this manual) and journal the new values of 'Slope" and "Offset.'

When done re-calibrating enter this statement to the Remarks field.
"Sensor Calibration Was Reset: New Slope = -2.3971552; and New Offset = - 3.4526389"

Note: These values are for example only. Each rain gauge will produce specific values.

When a Calibration Check is performed you should document this required maintenance in the lower portion of the Inspection screen (Figure 9.9) where you are given options for the type of maintenance performed. After the column Routine Maintenance, the first category is "Calibrated." Follow these guidelines for calibration and other maintenance actions.

- If a Calibration Reset was not necessary, click on the check-box '**Routine Maintenance**.'
- If a Calibration Reset was necessary, and completed, then click on the check-box, '**Calibrated.'**
- If you restored the FPR system to full operation, click on the check-box '**Repaired.**'
- If you removed a bad part from FPR and replaced it, click on check-box '**Replaced.**'
- If a configuration change (i.e., Modification Note) was made, click on the check-box '**Modified.**'
- If an FPR rain gauge was installed to this COOP site, when there had never been and F&P installed to this COOP site, then click on the check box, '**Installed**.'
- If the FPR rain gauge was removed from this COOP site, click on the check box, '**Removed**.'
- If the FPR rain gauge was Moved or Relocated from this COOP site, click on the check box, '**Moved/Relocated**.'
- If the FPR shell (hood and/or lower housing) was painted, click on the check box, '**Painted**.'

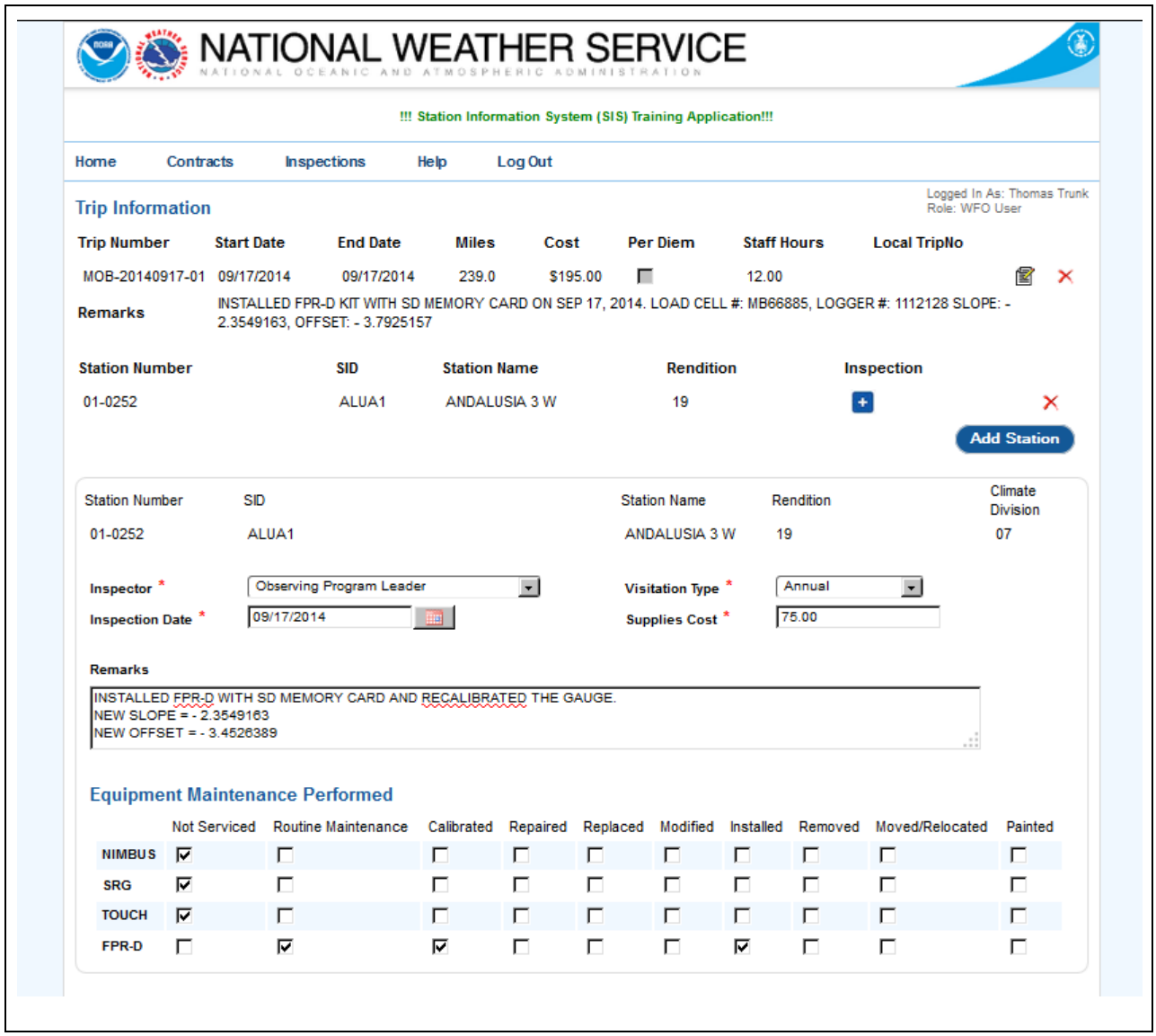


Figure 9.9 Site Inspection Report – Type of Maintenance Performed

9.5 Site Inspection Report – Valid Remarks for FPR-D Maintenance:

The FPR-D system does not flag/indicate external activity, nor does it have functionality for user entered notation codes. Therefore, both Observer and NWSREP shall document maintenance actions (i.e., draining bucket, adding food grade propylene glycol, or adding oil) to an *FPR Log Sheet* as the means to schedule future preventive maintenance and prevent bucket overflow and bucket freezes that would result in a loss of, or degradation of, precipitation data in the climate record.

Valid Remarks to Include to Site Inspection Report	
Annual Visit	Cleaned Precip Recorder
Semi-Annual Visit	Slope – Value before Calibration
Emergency Visit	Slope – Value after Calibration
Awoke the Display – Maintenance Start HH:MM	Offset – Value before Calibration
Awoke the Display – Maintenance End HH:MM	Offset – Value after Calibration
Precip Level - Before Bucket Serviced	Installed Auto-Syphon
Precip Level - After Bucket Serviced	Removed Auto-Syphon
Calibration Check – Good Readings	Time is more than 15 minutes slow.
Calibration Check – Reset Performed	Time is more than 15 minutes fast.
Partially drained bucket – some liquid remains in bucket	Replaced one Flexure – Upper Rear
Emptied bucket	Replaced multiple Flexures
Added Oil to bucket	Replaced Precip Recorder – With same model
Added Food Grade Propylene Glycol (FGPG) to bucket	Replaced Load Cell Assembly – With same model
Emptied and cleaned bucket	Replaced Plunger
Installed Funnel	Firmware Updated
Removed Funnel	Replaced fuse (if regulator is installed)
Foreign Object Found in Bucket	Gauge moved to a compatible location – equipment move
Data downloaded to SD Card	Gauge moved to a non-compatible location – station relocation
Cleaned F&P Housing	Gauge removed from service – placed in storage
Cleaned Solar Panel	Gauge put back in service after being in storage
Modified the Gauge – With COOP Note D111D #1	Resolved Error Condition – Flagged by Error Code #

Table 9.1 - Valid Comments for Site Inspection Report – Remarks Field

Table 9.1 gives the range of potential notes you should enter to the Remarks field of the SIS Site Inspection Report. While at the rain gauge the NWSREP (and Observer, if delegated) shall journal to the ***FPR Log Sheet*** any maintenance action that appears in this table. Reminder: While at the rain gauge you need to wake-up the display by pressing the OFF button on the front of the Precip Recorder and then journal the reading (i.e., bucket level) to the *FPR Log Sheet*.

9.6 FPR Station Logbook:

After you create a Site Inspection Report in SIS and after your Station Profile update was successfully processed by NCDC and is accessible in the data base, consider the benefits of organizing an **optional** FPR Logbook (electronic), particularly if you have more than ten COOP sites with FPR-D equipment.

The FPR Logbook will account for your installation work, expenses, calibration coefficients, calibration check dates, semi-annual visitation, maintenance trips, and any delegated maintenance responsibility given to the Observer. In this way you will have a ready reference from which to retrieve detailed information on FPR-D system and Observer correspondence.

Be careful in the metadata entries to distinguish between the two models of FPR, the Sutron model (FPR-D) and the CES, Inc. model (FPR-E). With the exception of three forecast offices, each office was delivered just one model type (i.e., FPR-D).

You may want to spell out the definition of the ‘D’ suffix in the FPR-D acronym. The ‘D’ identifies this equipment as manufactured by Sutron Corporation. Both the weighing sensor assembly and data logger were manufactured by Sutron, Corp.

APPENDIX A – TECHNICAL AND POLICY DOCUMENTS

1. FPR-D Technical and Instructional Handbooks:

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

a. ***FPR-D Assembly Procedures*** *– May 2013*

b. ***FPR-D Observer Instructions*** *– June 2014*

c. ***FPR-D Operations Manual*** *– April 2015*

d. ***FPRD_PlotData_V1_3.xls*** *– Aug 2012*

e. ***COOP Mod Note D111D Note 3, Solar Panel Regulator Installation*** *– Oct 2013*

f. ***COOP Mod Note D111D Note 4, Firmware Upgrade (1.06)*** *– July 2014*

2. NWS Policy and Program Management Documents:

a. *NWSM 10-1315, COOP Station Observations and Maintenance* (April 2014) *
http://www.nws.noaa.gov/directives/sym/pd01013015curr.pdf

b. *NWSM 10-1313, CSSA User Manual* (May 27, 2013) *****
http://www.nws.noaa.gov/directives/sym/pd01013013curr.pdf

c. *EHB-1: Instrumental Equipment Catalog*
https://www.ops1.nws.noaa.gov/Secure/ehbs/EHB1files/ehb1.htm

d. *EHB-10: Hydrologic Equipment*
https://www.ops1.nws.noaa.gov/Secure/ehbs/EHB10/hndbk10.pdf

e. *NWSM 50-1115: Occupational Safety and Health Manual*
https://www.ops1.nws.noaa.gov/Secure/SAFETY/Safety_manual.htm

r. *Integrated Logistics Support Planning* NDS 30-3102
http://www.nws.noaa.gov/directives/030/030.htm

g. *Supply Manual and Catalog* NDS 30-3101
http://www.nws.noaa.gov/directives/030/030.htm

h. *SIS USER GUIDE* Available from the SIS homepage after log-in.
https://sis.nws.noaa.gov (Click on the Help tab, then select from drop down menu)

* The Observing Services Division of the Office of Climate, Water, and Weather Services (OCWWS) is the Office of Primary Responsibility (OPR) for these asterisked documents. The CSSA system was shut down in October 2014, and was replaced by the Station Information System (SIS) in November 2014. The general policies in the NWSM 10-1313, will remain valid for the SIS applications.

3. Sterling Field Support Center (SFSC)

The Sterling Field Support Center (SFSC) provides a critical service to the National Weather Service (NWS) field community through use of their years of knowledge and experience gained through extensive sensor and system testing and maintenance. The SFSC has assisted the field since 2009 with the deployment and operation of the Fischer Porter Rebuild (FPR) rain gauges.

When you have a an operational or maintenance anomaly or a system failure on any FPR-D rain gauge, phone the SFSC, 8:30am – 5:00pm, 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 your Regional COOP Manager by phone or email.

All emails and phone calls received during the hours of operation will be responded to in a timely manner. Emails received during non-operation hours will be returned in the order they are received on the following day in which the facility is open. The SFSC is closed for all federal holidays.

SFSC Contact Center Information:

Main Line: 703-661-1268

Back-up Line: 703-661-1293

Email: nws.sfsc@noaa.gov

APPENDIX B – LIST OF ALL FPR-D MODIFICATION NOTES

Issue Date:	Title of NWS Engineering Mod Note:	Regions/ Sites Effected	Complete-by Date:
05/2009	COOP D111D Note 2, 'Fischer-Porter Belfort Rebuild Version D (FPR-D) Installation'	All	Six Months
05/2012	COOP D111D Note 3, 'Solar Panel Regulator Installation'	High Solar Angle Sites	As Needed
03/2013	COOP D111D Note 4, 'Firmware Upgrade 1.06'	Optional	As Needed

See Chapter 8.3 of this manual for policy on compliance with, and documentation of each Engineering Modification Note that affects FPR-D operational systems.

APPENDIX C - PRECIP RECORDER REMOVAL AND SHIPPING INSTRUCTIONS

The Precip Recorder features a control surface with soft push buttons (i.e., arrow keys) where you can program the rain gauge and enter site identification data to the logger. The fascia mounting fixture behind the fascia has been known to break and render the keypad buttons unresponsive. If this occurs you will need to order a replacement Precip Recorder. The part number is "D111D-2A1" and it should be ordered from NLSC as you would any other broken part.

If the Precip Recorder becomes broken in some other way, for example if the hinges break or the cover is cracked, then moisture could enter the assembly and risk the integrity of the circuit boards, then you will need to order a replacement Precip Recorder (D111D-2A1).

There are no lower replaceable parts on the Precip Recorder, so the entire unit gets replaced.

After you determine the need to replace a Precip Recorder, follow these instructions.

1. Order a replacement Precip Recorder from NLSC: Part number is 'D111D-2A1.'

1.1. Prepare to Remove Precip Recorder at COOP Site: Conduct your maintenance visit on a rain-free day. Bring the laptop PC if you plan to install the Firmware Upgrade ver 1.06 to the new Precip Recorder.

a. Download Precipitation Data to SD Card: Download the last 60-days of data onto your SD Card, for routine reporting to NCDC. Make sure the display is 'asleep' before you insert the SD Card. After the system has completed its download, press the OFF button, to turn off the display.

b. Power-Down System: Refer to *FPR-D Assembly Procedures,* Section 6 and work in reverse order, to power down and remove the Precip Recorder. **Important:** You may need to use an Electrostatic Discharge (ESD) grounding strap.

1. Open the Precip Recorder case with a Flat Blade Screwdriver: Unscrew each of the four plastic screws in their corner positions.

> ⚠ CAUTION: The next step involves working on a LIVE electrical circuit. Do not allow your screwdriver or the disconnected wires to touch any exposed circuits in the opened box.

2. Disconnect the solar panel cable from the Precip Recorder: Refer to Section 5.6 in *FPR-D Assembly Procedures,* to remove white wire and black wire from their respective white and black color terminals.

3. Disconnect the battery connectors from the 12V battery's terminals: Refer to Section 6.3 (with photo) in *FPR-D Assembly Procedures*. Do not disconnect the battery cable from the Precip Recorder.

4. Disconnect Load Cell Cable: Refer to instructions in Section 4.6, *FPR-D Assembly Procedures*.

5. Dismount Precip Recorder: Refer to instructions in Sections 4.1, through 4.5, *FPR-D Assembly Procedures.*

1.2 Mount, Initialize, and Calibrate the New Precip Recorder: Follow instructions as they appear in Sections 7, 8, and 9, in the *FPR-D Assembly Procedures*. Consider installing the 'COOP Mod D111D Note 4, Firmware Upgrade, so the rain gauge can record voltage data every 15-minuets rather than once per day. You will need a Laptop PC, to install the firmware file. Finally, set the Password, enter the SID, and set the date and time.

a. Install the Precip Recorder to Scale Stage: Follow the steps in Section 4, *FPR-D Assembly Procedures*.

b. Initialize the Precip Recorder: Follow the steps in Sections 7 and 8, *FPR-D Assembly Procedures.*

c. Calibrate System with Test Weights: With collection bucket in place, and protector-bolt retracted, calibrate the system exactly as described in Section 9 *FPR-D Assembly Procedures*. Verify proper data display, data download, and data logging.

1.3 Package and Ship Bad Assembly to National Reconditioning Center: Return all the original hardware, namely the stuffing glands, fittings and caps. Of the four cables (grounding, sensor, solar, and battery) return only the *battery cable*.

a. Prepare a Form H-14, Equipment Return Tag: Fill out all 12 boxes. Take special care to write-in the explanation, as noted in Line Item #11. Make sure the H-14 is complete and enclosed in the box you will send to National Reconditioning Center (NRC).

b. Pack the Broken Precip Recorder: Use the box in which you received the replacement Precip Recorder. Use the same padding, clear plastic wrap, to protect the bad logger.

c. **Important** to Ensure All Port-Glands Get Returned: Double check on the broken logger, to ensure each of the three cable ports with plastic stuffing pieces, in fact have those pieces connected.

d. Ship to National Reconditioning Center (NRC): Prepare a UPS Shipping Label, as follows – as you would any part that requires repair work.

NOAA-National Reconditioning Center (NRC)
Weather Systems Repair Branch (W-OPS62) Org Code: WG9162
1520 East Bannister Road
Kansas City, Missouri 64131-3009
816-823-1057 x245

1.4 Update the Metadata in the Site Inspection (SIS): Follow instructions in Chapter 9.4 of this manual for where in the Site Inspection Report to enter the new logger's seven digit Serial Number (i.e., 1114567) and enter the new Calibration parameters (i.e., Slope, and, Offset) to the remarks section.

APPENDIX D - FLEXURE REMOVAL AND REPLACMENT (IN-OFFICE)

1. Introduction to Flexures Maintenance:

If any graphical plots of FPR precipitation data appear with a saw-tooth data pattern (Figure D-1) it is probably because the horizontal flexures are bent, broken, or binding. Rain gauges that have less than ±0.10 inch diurnal oscillation should be written up to a maintenance planning checklist as having suspected flexure problems. For gauges with a minor saw-tooth pattern, you should plot the data file you receive each month to monitor the problem to see if it is growing worse.

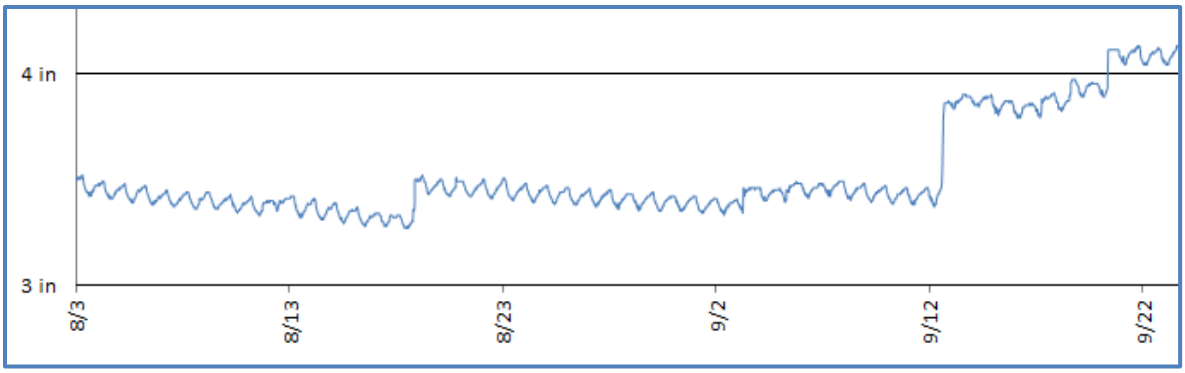


Figure D-1. Bad Flexures Can Produce Diurnal Oscillation Pattern (FPR Gauge)

Gauges with ±0.10 inch and <u>greater</u> diurnal oscillation, should be designated as a priority maintenance job, and scheduled for your next visit to the COOP site.

Figure D-2.

Figure D-3. Example of Bent Flexures

Figure D-4.

Flexures are susceptible to damage from; dropped collection buckets, rough handling during maintenance, and unsecured lever arms when gauge is being transported. Horizontal flexures will deform to a "v-shape" and produce poor data quality (Figure D-1). They are also at risk of breaking and further corrupting the data. Poor data quality may also be indicative of 'binding flexures.' The binding flexures should be removed and replaced according to these same instructions.

2. On-Site Change-out of Weighing Mechanism:

We do not recommend replacing flexures outdoors because the process requires dexterity to handle small parts, and requires adequate lighting in a calm and dry setting. Instead, the best practice is to replace the whole Weighing Mechanism with a pre-assembled spare with documented good flexures. The change-out itself is not difficult, it requires just four screws (7/16 inch) to be removed from the base of the Scale Frame to remove it from the Stage (see Figure D-5). To prepare for this removal, you will need to drain and remove the collection bucket and remove the lower casing assembly. Always plan ahead and reserve the needed time to conduct full bucket maintenance when you change-out the weighing mechanism.

2.1 Weighing Mechanism Change-Out Tasks: At the observer's site, you will perform these tasks to efficiently replace the weighing mechanism and return the FPR-D to operational status:

a. Remove the hood.

b. Drain the collection bucket.

c. Remove the collection bucket.

d. Remove the force post.

e. Remove the lower casing.

f. Remove the four 7/16 inch hex bolts at bottom of Weighing Mechanism.

g. Remove the Weighing Mechanism.

h. Level the Base Plate with carpenter's level.

i. Install a preassembled spare Weighing Mechanism, with documented good flexures.

j. Replace the casing, force post, and collection bucket.

l. Conduct a full calibration of FPR-D gauge.

m. Charge the bucket for seasonal operational use.

3. In-Office Replacement of Flexures – Detailed Instructions:

Flexure replacement is a time consuming process. The upper rear Horizontal Flexure is the most accessible for replacement. However, all flexures should be examined when and precipitation data develops a diurnal oscillation pattern. Flexures need to be replaced inside a workshop environment. If spare F&P legacy equipment is available in your WFO, you are strongly encouraged to prepare a weighing mechanism as a preassembled spare kit. Follow the instructions given in this section.

The spare Weighing Mechanism should consist of the Weighing Mechanism without the Load Cell and without the Force Post (Figure D-5). The spare will have new flexures in all four junctions and have both Lever Arms fastened with wire or string to the Scale Frame to prevent any motion. The spare should be kept protected with suitable packing material in a cardboard box, ready for transport to the site.

Background: Each Lever Arm has the same flexure configurations (Front and Back) as the other. In each of the four locations each flexure is connected to its Lever Arm by two screws and by two screws the same flexure is connected to its respective L-shaped Mounting Bracket

(see Figure D-5).

The easiest method of replacing the flexures is to remove each Lever Arm one at a time. Before you remove the Lever Arms, you will need to remove the Collection Bucket and Force Post. Note: The load cell is unaffected as it is mounted underneath the support stage.

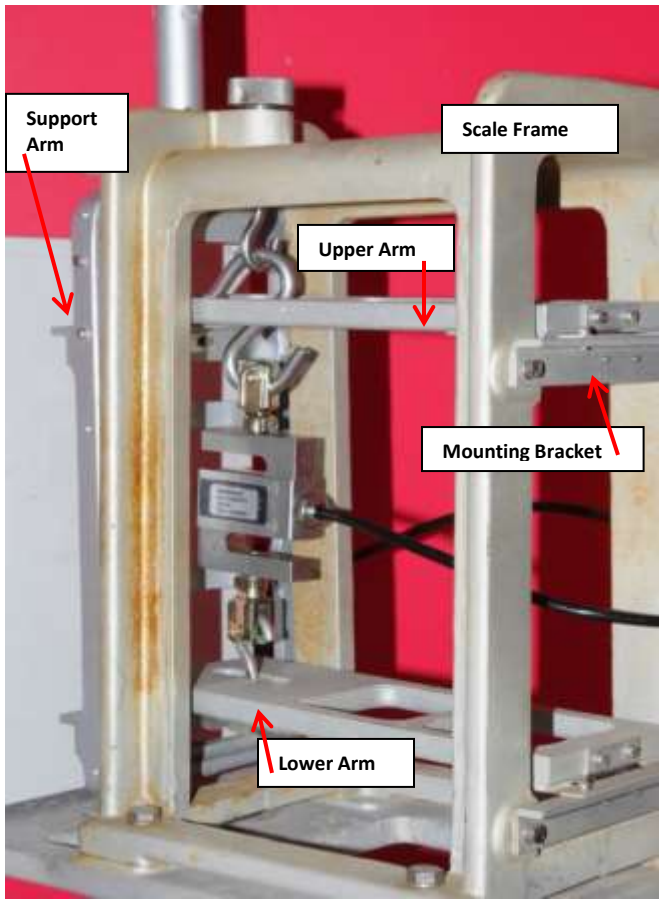


Figure D-5. Weighing Mechanism (aka, the Tower). *Realize the FPR-D load cell is bolted onto the bottom of the lower arm. This illustration, by contrast, shows an FPR-E load cell, which operates by hanging from the frame.*

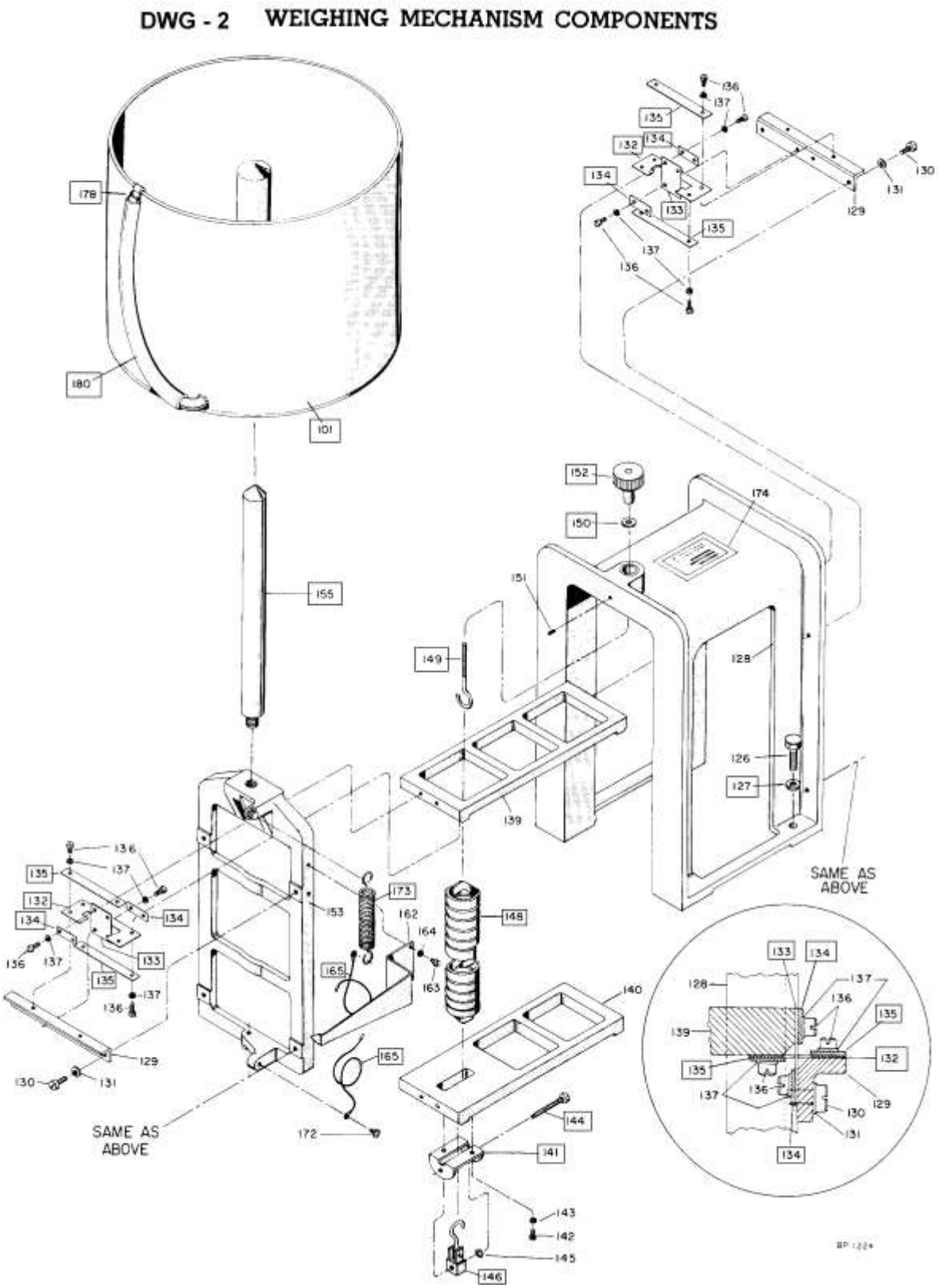


Figure D-6. Lever Arms and Flexures Are Used Operationally on all FPR model gauges.

PARTS LIST – WEIGHING MECHANISM COMPONENTS		
Drawing Item#	**Agency Stock No.**	**Description**
101	D111-1SP104	BUCKET, MANUAL DRAIN
126	D111-____	BOLT, 7/16 inch Hex Head
127	D111-4H103	WASHER
128	D111-___	SUPPORT, SCALE (FRAME)
129	D111-____	BRACKET, Flexure
130	D111-TMS900	SCREW, Fillister Head
131	D111-TMS900	WASHER, Lock #8
132	D111-3SP112	FLEXURE, HORIZONTAL
133	D111-3SP116	FLEXURE, VERTICAL
134	D111-3SP117	PLATE, CLAMP, FOR VERTICAL FLEXURE
135	D111-3SP118	PLATE, CLAMP, FOR HORIZONTAL FLEXURE
136	D111-TMS900	SCREW, Fillister Head #4-40-0.250
137	D111-TMS900	WASHER, Lock #4
139	D111-___	ARM, Lever: Upper
140	D111-___	ARM, Lever: Lower
141	D111-3SP114	BRACKET, RANGE ADJUST
142	D111-___	SCREW, Truss Head
143	D111-TMS900	WASHER, Lock: #4
144	D111-3H110	SCREW, RANGE ADJUST
145	D111-TMS900	RING FASTENER, External
146	D111-3A111	COUPLING ASSEMBLY
148	D111-3MP111	SPRING, MAIN ***(Not Applicable to FPR-D)***
149	D111-3SP113	HOOK, UPPER MAIN SPRING ***(Not Applicable to FPR-D)***
150	D111-3H112	WASHER, D, UPPER HOOK GUIDE ***(Not Applicable to FPR-D)***
151	D111-____	SET SCREW, Hex Hole ***Not Applicable to FPR-D)***
152	D111-1SP115	KNOB, ZERO ADJUST ***Not Applicable to FPR-D)***
153	D111-____	SUPPORT ARM ASSEMBLY
155	D111-3SP119	POST, SCALE FOR WEIGHING ASSY
162	D111-____	POINTER ***(Not Applicable to FPR-D)***
163	D111-TMS900	SCREW, Fillister Head: #4-40-0.250 ***(Not Applicable to FPR-D)***
164	D111-TMS900	WASHER, Lock: #4 ***(Not Applicable to FPR-D)***
165	D111-3W110	CABLE, MECHANICAL GUIDE ***(Not Applicable to FPR-D)***
172	D111-TMS900	SCREW, Binding Head ***(Not Applicable to FPR-D)***
173	D111-3MP110	SPRING ***(Not Applicable to FPR-D)***
174	D111-_____	NAMEPLATE
178	D111-1SP100	NOZZLE, DRAIN, WITH CLIP
180	D111-1SP106	TUBING, TYGON: 7/16 INCH O.D. 5/16 INCH I.D. AND 12 INCHES LONG

Table D-1. Parts Description for Weighing Mechanism (see Drawing in Figure D-6)

3.1 Remove Upper Lever Arm:

1. Loosen the rear Mounting Bracket by loosening its two screws (#8-32-0.375). Hold the center of the arm to prevent it from falling, or tie it to the top of the Scale Frame.
2. At the front of the Arm, remove the two visible screws that hold the Horizontal Flexure to the Mounting Bracket.
3. At the front of the Arm, remove the two visible screws that attach the Vertical Flexure to the Arm.
4. At this point, with the arm braced, take out the two screws you loosened in step #1, that hold the rear Mounting Bracket to the Scale Frame.
5. Now, holding the Arm from its center, carefully carry the arm out from the weighing mechanism. This arm has three of the four flexures attached to it. Only the front Vertical Flexure was left behind. You will remove that flexure after you remove the others from this arm.

3.2 Remove Flexures:

1. Set the Arm with rear Mounting Bracket still attached onto a prepared surface so you can remove all flexure screws. At rear of the Arm, remove the two screws in the Vertical Flexure that had connected it to the Mounting Bracket.
2. At rear of the Arm, remove the two visible screws in the Horizontal Flexure that attach it to the Mounting Bracket. The Mounting Bracket is now removed from the arm.
3. From this same rear of the Arm, proceed to remove the two visible screws that connect the Vertical Flexure to the Arm. **The rear Vertical Flexure is now removed.**

Figure D-7. Upper-Rear Connection

4. At this same end, remove the two screws that connect the Horizontal Flexure to the underside of the arm. **The rear Horizontal Flexure is now removed.**
5. On the front end of the arm, just the Horizontal Flexure remains. Remove the two screws that fasten it to the underside of the arm. **The front Horizontal Flexure is now removed.**

6. Finally, go to the front Mounting Bracket and remove the two screws that still hold the Vertical Flexure to this Mounting Bracket. **The front Vertical Flexure is now removed.**

   Note: At this point you have removed all four flexures associated with the Upper Arm.

Figure D-8. Upper-Front Connection

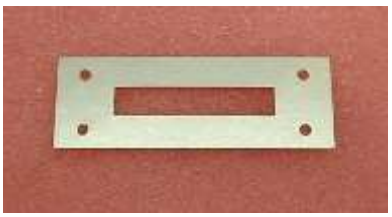


Figure D-9. Horizontal Flexure

Figure D-10. Vertical Flexure

3.3 Install New Flexures:

1. Install one new Horizontal Flexure and one new Vertical Flexure on the rear end of the arm by following steps #2 and #3, in next paragraphs. Then install to the front of the arm, one new Vertical Flexure and one new Horizontal Flexure, by following steps #4 and #5. Each flexure requires one plate clamp, two lock washers, and two screws to attach to the arm. See Figure D-6, for a diagram for how the flexures and fasteners are assembled.

2. Install to the rear of the underside of the Arm, one Horizontal Flexure. Align one pair of the widely spaced holes (Figure D-9) in this flexure with the two holes on the underside of arm. Then add the plate clamp. Insert one screw with lock washer into each hole. *Thread these screws lightly into the Arm until they fit snugly. Do not tighten - save for Section 3.6.*

Figure D-11. Lower-Rear Connection

3. Install to the rear of the Arm, one Vertical Flexure. Align the top two holes (Figure D-10) in the flexure with the two holes in back edge of Arm. Then, add the plate clamp. Insert one screw with lock washer into each hole. *Thread these screws lightly into the Arm until they fit snugly. Do not tighten - save for Section 3.6.*

4. Install to the front of the Arm, one Vertical Flexure. Align the top two holes in flexure (Figure D-10) with two holes on front edge of Arm. Then, add the plate clamp. Insert one screw with lock washer into each hole.

   Thread these screws lightly into the Arm until they fit snugly. Do not tighten - save for Section 3.6.

5. Install to the front of the Arm, one Horizontal Flexure. Align one pair of widely spaced holes (Figure D-9) in this flexure to the two holes in the underside of the arm. Then add the plate clamp. Insert one screw with lock washer into each hole. *Thread these screws lightly into the Arm until they fit snugly. Do not tighten - save for Section 3.6.*

Figure D-12. Lower-Front Connection

Caution: Never grip the Lever Arm by the ends or you will damage the flexures. Instead, always handle the arms at their midpoint, and leave the ends free from contact.

3.4 Remove Lower Lever Arm, Remove Its Flexures, and Install New Flexures

1. Remove the Lower Arm from the weighing assembly. Follow the same steps #1 – 5, from Section 3.1.

2. Remove the Range Adjust Bracket (Item #141, in Table D-1) from the underside of the Lower Arm because it is an obstruction for access to the flexure screws. See Figure D-13. This is a small bracket that anchors the Coupling Assembly (e.g., #146 in Table D-1). Remove the two quarter inch screws that attach the Range Adjust Bracket to the lower Arm.

3. Remove all four flexures from the Lower Arm. Repeat steps #1- 6, from Section 3.2.

4. Install all four flexures to the Lower Arm. Repeat steps #1- 5, from Section 3.3. At this point all flexure screws should be fitted into the Arm snugly. They will be tightened to 8 pound-inches, in Section 3.6.

5. Install the Range Adjust Bracket (it includes the Coupling Assembly) to the underside of the Lower Arm (Figure D-13). Use the same the two screws (#4-40-0.25) you removed in Step #2.

Note: The Lower Arm with its new flexures is now ready to be installed to the Weighing Mechanism according to the same instructions as given in Section 3.5 for the Upper Arm.

3.5 Install Lever Arms:

1. Reinstall the rear Mounting Bracket that was removed in Section 3.1, step 4. Use the two fillister head screws (#8-32-0.375) with the #8 lock washers to install to the Scale Frame. Tighten these screws.

2. Brace the arm by wrapping string or wire around it and the Scale Frame. Then move the Arm back to position so the front of the Arm can be attached to the inside of the front Mounting Bracket. You have to access this point from below and inside the weighing mechanism, where you will screw the front Vertical Flexure into the front Mounting Bracket. Install each of the two screws to attach arm to the front Mounting Bracket. Use the proper sequence: flexure onto mounting bracket, plate clamp onto flexure, and insert screw with lock washer into each hole. Thread the screws so each fit snugly – do not tighten.

Figure D-13. Bracket is on Underside of Lower Arm

3. Upon completing step 1, the front Horizontal Flexure lies flat upon the Mounting Bracket and is most easy to access. On top of this Horizontal Flexure, place the horizontal plate clamp, and insert one screw each, with lock washer, into the two holes. Thread the two screws down into the bracket (visible), so they fit snugly (See Figure D-12).

   Note: Avoid damaging new flexures always hold the Lever Arm from its midpoint, and not from the ends.

4. With the upper Arm held securely by string or wire to the Frame, connect the back end of the Arm to the rear Mounting Bracket. Connect the rear Vertical Flexure to the inside face of the bracket. This point requires access from inside the weighing mechanism. Place the flexure directly onto the bracket then add the plate clamp. Then thread each screw with its lock washer snugly into the bracket.

5. Upon completing step 4, the rear Horizontal Flexure will lie flat against the Mounting Bracket. This is easy to access. Place a plate clamp on top of the Horizontal Flexure, align the two holes, and thread each screw (visible) with its lock washer into the bracket. Thread each screw to fit snugly.

   Remove the string or any other support you had for the Arm.

6. Install the Lower Lever Arm in the same exact manner. Follow the Steps #1 – 5, above.

3.6 Tighten all Screws Sequentially:

Both arms need to be installed to the weighing assembly with screws threaded 'snugly' before this procedure is possible. You will tighten all 32 flexure screws in a pattern going from one arm's flexure to the next arm's alternate side flexure.

1. Horizontal Flexures: Start with the two left-side screws on the lower rear Horizontal Flexure and move to the two right-side screws in the upper front Horizontal Flexure. Then tighten the two right-side screws on lower rear Horizontal Flexure and move to the two left-side screws in the left-side of the upper front Horizontal Flexure.

2. Vertical Flexures: Tighten the four screws in an X pattern on each flexure. Start with the lower rear flexure and move to the upper front flexure. Then do the upper rear flexure and move to the lower front flexure.

   NOTE: Be careful not to exceed 8 lb-in (± 1 lb-in) as the final torque.

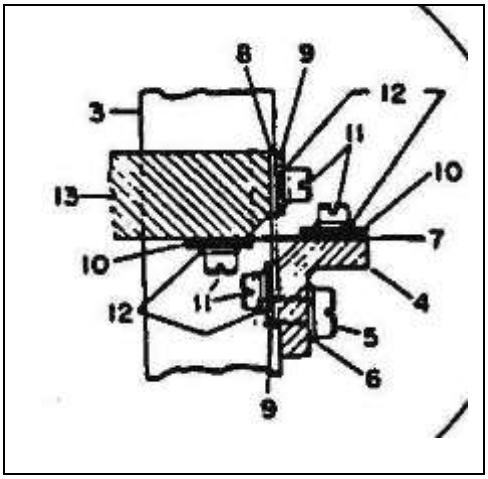


Figure D-14. Location of Flexure Screws (Item #11). Four per each Flexure

APPENDIX E - SAMPLE FPR LOG SHEET

FPR LOG SHEET

Forecast Office (SID): TFX **COOP Station Name:** Silverstar (24-7610) **Your NWSREP Name:** J. Brown .

Date	Time	Amount	Routine Actions	Special Notes (i.e., displayed error messages, etc.)
03/28/2011	Start: 10:15 am Stop: 10:45 am	15.47 02.75	☐ Add Oil ☐ Add FGPG ☐ Empty Bucket ☒ Partial Drain Funnel - ☒ In ☐Out	
06/14/2011	Start: 4:15 pm Stop: 4:45 pm	8.72 8.72	☐Add Oil ☐ Add FGPG ☐ Empty Bucket ☐ Partial Drain Funnel - ☐In ☐Out	'Error 4027' message displayed. Phoned NWSREP.
09/28/2011	Start: 2:30 am Stop: 2:45 am	10.39 10.39	☐ Add Oil ☐ Add FGPG ☐ Empty Bucket ☐ Partial Drain Funnel - ☐In ☒Out	Wiped down the F&P shell to remove dust.
10/15/2011	Stop: 11:15 am Stop: 12:15 pm	14.35 0.35	☒ Add Oil ☐ Add FGPG ☒ Empty Bucket ☐ Partial Drain Funnel - ☐In ☐Out	Removed pinecone, cleaned bucket, and then added one half quart of oil.
12/21/2011	Start: 9:30 am Stop: 9:30 am	6.14 6.43	☐ Add Oil ☒ Add FGPG ☐ Empty Bucket ☐ Partial Drain Funnel - ☐In ☐Out	Very cold month – had to add 2 quarts of FGPG to prevent ice damage.

Instructions: Before you start your action, enter the date and then at time of maintenance, enter current time (standard time, not daylight time) on the 'Start' line in Column 2. Then press the Display button to view the Amount in bucket. Write this value in Column 3 (Amount). Then mark appropriate box(es) in Column 4 (Routine Actions) to indicate your actions. If not a routine action, write your comments in Column 5 (Special Notes). When you have completed your action, go back to Column 2, and enter current time (standard time, only) into the 'Stop' line. Always phone your NWSREP if an error message displays or display fails to light-up on command. Always mail your Log Sheets to your NWSREP. Keep spare sheets inside shelter.

APPENDIX F – FPR-D LOWEST REPLACEABLE PARTS

FPR-D Lowest Replaceable Parts				
General Name	**Short Description**	**Long Description**	**ASN**	**SMR**
Load Cell Assembly	Load Cell Assembly, FPR	Load Cell Assembly, FPR, complete with load cell block, cell, and 4 long Allen head machine screws. Sutron, Corp.	**D111D-1A1**	PADDD
Screws, Load Cell Mounting	Screws, Load Cell mounting, FPR	Screws Load Cell mounting, FPR, set of 4 with washers.	**D111D-1A1M1**	PAOZZ
Plunger	Post, FPR, load cell.	Anvil or post for FPR load cell, mates F&P gauge to load cell. Sutron Corp.	**D111D-1A2**	PAOZZ
Precip Recorder	Precip Recorder with Bracket.	Precip Recorder Assembly for F&P Gauge Rebuild, includes Sutron data logger, solar panel regulator, display keypad, SD card interface, manual, housing and mounting bracket. Sutron Corp.	**D111D-2A1**	PAODD
Sutron FPR Manual	Manual, FPR, OEM, Sutron	Manual, FPR, OEM, Sutron	**D111D-2A1D1**	PAOZZ
Battery	Sealed 12V Battery	Battery, 12V, 7AH, Sealed Lead Acid, spade terminals, 4 lbs, Genesis. (Sutron or Open Market)	**D111D-2B1 or** **017-B-2-32**	PAOZZ
Battery Spade Connectors	Push-on Spade Connectors	Spade connectors (F2), push-on, Female, crimp, or equivalent. Needed only if the battery does not already have spade terminals (i.e., Sutron battery).	**017C-E-1825**	PAOZZ
Battery Cable	Battery Cable for FPR	Battery Cable, FPR system, to accommodate the installation of spade cable-end connectors needed for battery with F2 (spade) terminals.	**D111E-2CBL1**	PAOZZ
Solar Panel	Solar Panel, 2W, 12V nom, @0.133A, no regulator.	Solar Panel, 2W, with Diode, 12V nom. @0.133A, no regulator, metal frame, with 15 feet cable, hardware and mounting bracket (two hose clamps, SS, #24, series 68). (Sutron or PowerUp Co.)	**D111D-3**	PAODD

Explanation of Source, Maintenance, and Recoverability Codes (SM&R) Acronyms

PADDD: You must return these parts (i.e., faulty regulator) 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 'DD' signifies the part must be shipped to the depot (NRC) together with its integral component(s) for disassembly and be repaired by the depot (NRC); and the final 'D' signifies that just the depot (NRC) is authorized to repair, condemn, or dispose of this part.

PAODD: You must return these parts (i.e., faulty GMA) to 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 (i.e., 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.

Reference: EHB-1, *Instrumental Equipment Catalog* (Issuance 1996-1), Section 2.3, Source, Maintenance and Recoverability Code (SM&R).