



FISCHER–PORTER UPGRADE (FPU)

RECORDING PRECIPITATION

GAUGE

FPU OBSERVER INSTRUCTIONS

APR 18, 2005

**U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service - Cooperative Weather Observer Program
Office of Climate, Water, and Weather Services
Observing Services Division - W/OS7**



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1. Introduction:

1.1 FPU Equipment Cluster: The cluster is comprised of three components; the new precipitation sensor is located behind the door of the bucket housing (Fig 1.1) ; the data logger is located inside the stainless steel box mounted on new pole; and the solar power panel is also mounted to the new pole.



Fig 1.1

1.2. Data Logger Enclosure: This is the stainless steel box. It houses the data logger, battery, and the data key writing device, see Fig 1.2 , right. To open the box, unfasten the spring clip located on the right-hand side of the enclosure's front panel.

Your NWSREP will affix a reference card showing the ten notation codes to the inside of the door panel.



Fig 1.2

1.3. Data Logger Display: Press the <ENT> button on the data logger's keypad to wake-up the green fluorescent display. The user display (Fig 1.3) is situated together with the data logger's 16-button pad.

The keypad's user commands are called-up by pressing the <Up-arrow> and <Down-arrow> buttons.



Fig 1.3

The keypad menus let you: change the date and time, change the displayed units of measurement, and enter a note into the data like when you drew a line and entered the "ON date/time" to a new Punch Tape. To return to the default data display, continue pressing the <Up-arrow> button until the current readings appear.

Data is displayed for five seconds at a time in an alternating pattern to show the current bucket level and then the precipitation for the 24 hours ending last midnight. If the keypad is not used for 5 minutes, it will return to the ‘sleep mode’, and the green fluorescent characters will not appear on the display – the screen goes dark.

2. Routine Checks

2.1. Rain Parameter: This is the current level of liquid in the bucket, not just precipitation, from whenever the bucket was last serviced. The **Rain** display (Fig 2.1) is a data reading that updates every 10 seconds.

03 / 08 / 26	14:18:25
Rain:	2.47 in
Temp:	89 F
Shaft:	135.00 ft

Fig 2.1

Note: The **Rain** parameter gives the total amount of liquid in the bucket, including any antifreeze or oil. Special instructions apply if you have emptied the gauge bucket in the middle of the month. See Section 7, ‘FPU Bucket Draining’.

2.2. 24RainDiff Parameter: This is the difference between the **Rain** reading of the most recent midnight, and the **Rain** reading from the preceding day’s midnight. The **24RainDiff** display (Fig 2.2) is a data reading that updates once every 24 hours.

03 / 08 / 26	14:18:25
24RainDiff:	0.04 in
Temp:	89 F
Shaft:	135.00 ft

Fig 2.2

Caution: Never use the **24RainDiff** parameter when filling in the B-91 report, because midnight is invalid as your station’s standard observation time. Also, there are several conditions when the **24RainDiff** will not be valid (i.e., bucket drained on same day).

3. Notation Codes Instead of “ON/OFF Times: Previously, any time you suspended the F&P gauge from its 15-minute timer or each month when you removed the Punch Tape from the sprockets, you were required to write down the ‘OFF Date/Time’, as well as your Station ID (i.e., 23-4652), your Station Name (i.e., Lake City), and your State (i.e., MO) in felt tip marker to your Punch Tape. You then had to draw a straight line (i.e., a “time line”) across the width of the Punch Tape, to stand as an unmistakable reference to show where the interruption began.

With the FPU however, the data logger continues to run un-interrupted while you perform the critical monthly task of downloading precipitation data to the red plastic data key. So, you do **not** need to personally account for an “OFF” time, and “ON” when you collect the data. While the FPU has no Punch Tape for you to enter “ON/OFF” times, it does have a user interface, the keypad, where you may enter a 3-digit code for the record, to remark how a certain action interrupted the continuity of the data record!

There are FPU actions you may take, upon the direction of the NWSREP, that will affect the weight of the collection bucket, or somehow interrupt the logging of valid data. For example any type of bucket draining or adding of antifreeze or oil will interrupt the continuity of data. For these actions you must first enter code 100, 'End of Valid Data,' prior to the task. This is analogous to the "OFF Date/Time" notation you entered on the F&P Punch Tape. When your task(s), are concluded you must always enter code 140, 'Start of Valid Data'. This is analogous to the "ON Date/Time" notation.

In addition, your NWSREP will enter a Notation Codes when he conducts a maintenance visit. For example, anytime he partially drains the bucket, code 116, 'partially emptied bucket' must be entered. Likewise, anytime antifreeze is added, code "118" must be is entered, and anytime oil is added, code "117" must be entered.

When the NWSREP enters the proper Notation Code to the keypad he inserts a valuable, unchangeable, and permanent note for the record. The National Oceanic and Atmospheric Administration archives the Notation Code as it is embedded with the precipitation data.

3.1 Notation Code List: To review your list of appropriate 3-digit codes, see Appendix B, of this instruction guide, and read the descriptions for the ten codes 100 to 140.

3.2 How to Add a Notation: To enter a notation, first access the FPU data logger's keypad and press <ENT> button in lower-right corner. This wakes up the display.



Fig 3.1

Now press either <Up-arrow> or <Down-arrow> buttons to cycle through the four menus (Sensor Notation, Current Date & Time, Current Units, Data Readings Status) until you reach the one labeled (Fig 3.2) "New Sensor Notation:".



Fig 3.2

For example: If you open the data logger enclosure to check on the health of the system, you should enter Code 104, 'Routine Gauge Check'.



Fig 3.3

Press the buttons < 1 >, < 0 >, < 4 >, and observe the numbers appear in the display (Fig 3.3). Press <ENT> button, the display will show, 'Value Accepted'.



Fig 3.4

This notation now becomes a permanent, irrevocable record embedded into the data file sent to NWS and NCDC.

Notice you did not have to enter a date and time like you did on the Punch Tape, because the FPU appends date/time to every sensor notation before each gets stored to memory. To return to the data readings display, a few presses of the <Up-arrow> button will cycle you back.

3.3 Checking Date or Time: At the keypad illustrated in Fig 3.1, wake up the green phosphorescent display by pressing the <ENT> button. View the current readings of precipitation they always appear underneath a date and time heading (see Fig 3.5, below).

Understand that the time is always kept in **Standard** time, this is also known as 'sun time'. So, do not adjust to daylight savings time. If you notice the **minutes** are off by more than 10 minutes, then phone your NWSREP to inform him. The NWSREP would then need to analyze the system to correct the problem.

Caution: The date format is **YEAR** / Month / Day. Data will become useless if you accidentally input another arrangement of this order!

Example:

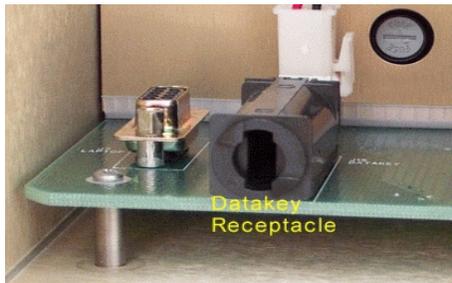
05/06/18	15:06:26
Rain:	2.47 in
Temp:	89 F
Shaft:	135.00 ft

Fig 3.5

Explanation: In the above example the, **05/06/18**, is the proper display for 2005, June 18th, 2005. Specifically, the **05/** signifies year 2005; the **/06/** signifies month of June; and the **/18**, signifies the 18th day of June. The time, **15:06:26**, is the proper display for 3:06pm local Standard time in the 24 hour convention.

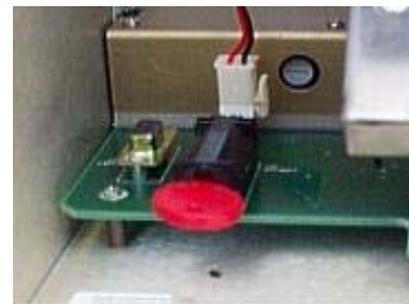
4. Monthly Data Retrieval. In the first five days of each month (**but never before the first day of the month!**) on a day that is rain-free and snow-free, open the data logger housing's door, and wake up the keypad's green fluorescent display, then pick-up the red plastic Data Key from beside the data key receptacle. This is the black plastic receptacle on the green circuit panel a couple of inches to the left of the keypad. Insert the Data Key into the key receptacle. Follow the prompts that appear on the user display and then remove key when prompted. This outdoor procedure might take 5 minutes.

4.1. Insert Data Key: Insert red plastic data key into the Data Key receptacle (Fig 4.1) while the green fluorescent display is active. Turn the data key one-quarter turn clockwise (Fig 4.2).



Red datakey (right) is inserted into datakey receptacle (above) and turned to the right in order to transfer the rain data from the GMA into the datakey.

Fig 4.1



Red data key remains in this position for several minutes, until data logger download completes. When keypad instructs "Please Remove Data Key" turn to left and remove it.

Fig 4.2

4.2. Monitor the Display. When the system recognizes that the Data Key has been inserted and turned (Fig 4.2), it automatically loads the data to it.

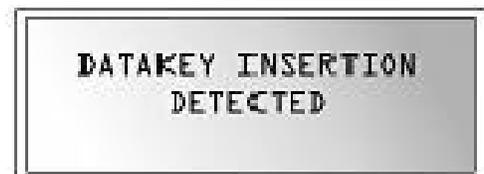


Fig 4.3

If the user display fails to give the message in Fig 4.2 'data key insertion detected', remove the red data key and wipe it clean with a paper towel, and then reinsert to the receptacle.

Note: If you entered the data key to the tumbler without having woken-up the keypad display, then first remove the key, then press the <ENT> button to wake up the display. Now reinsert the data key and turn the key one quarter turn to the right.

4.3. Verify the Start of Download: Monitor the display to verify a successful download to the data key. The display gives a running percentage (Fig 4.4) of the portion of data copied to the data key until 100% complete. This process might require five minutes to complete.



Fig 4.4

4.4. Remove Key: Monitor the display for a notice that key download is completed (Fig 4.5) and that it requests removal of the data key.



Fig 4.5

Note: After download has completed and if you forget to remove the data key from the receptacle and 5 minutes have elapsed, you will notice the display times-out and goes dark. You will also realize that pressing the <ENT> in this state will not wake-up the display. So, first remove the data key, then press <ENT> to wake-up the display. Finally, confirm that alternating readings of **Rain** and **24RainDiff** appear every five seconds.

5. Review the Month: Were there any operations anomalies or maintenance performed on your system that involved an interruption to the data logger of more than 15 minutes? If so, ensure you write a brief description to printed sheet, for an example see Appendix D, for an FPU Observer Log Sheet, used by some NWS stations. Mail it with your data key to your NWSREP.

6. Mail the Data Key: By the 7th day of month mail the red plastic Data Key to your NWSREP in the same type of envelope you used to mail the Punch Tape records to your Weather Forecast Office (WFO).

Note: You should keep the primary Data Key inside the data logger enclosure, so it is readily available at time of download. If you are missing your data key, phone your NWSREP (see point of contact phone number in Appendix C) at your earliest convenience.

7. FPU Bucket Draining: The same bucket is used for FPU as was for the F&P Punch Tape system. It holds the same volume of fluids, with a capacity to measure about 20 inches of precipitation (or 4.9 gallons). When you observe your daily **Rain** readings to exceed **15.00 inches**, phone your NWSREP to inform him the collection bucket needs to be drained within four (4) weeks. He will schedule it when there is a stretch of dry weather, when no precipitation is expected either the day prior to, or the day of, this important maintenance.

If your NWSREP has approved you to conduct the bucket draining or emptying, then first go to the keypad and enter Notation Code, '100' (End of Valid Data), and then follow the printed instructions he will provide you.

8. Inspect the Hardware: Periodic inspection of hardware is a best practice that will help ensure good system performance and quality representation of precipitation data.

8.1. Visual Check List: Ensure there are no obstructions that block the aperture of the gauge bucket. Ensure that all access doors and their hinges, latches, and locks, are working properly. After clearing obstructions, use a damp cloth or paper towel with gloves to wipe clean exterior surfaces.

A. FPU Hood, Funnel and Bucket: each free and clear of debris.

B. Data Logger Access Door, hinges, latch, and lock is functional.

C. Solar Panel, fastened tight, free and clear of debris. Ensure the cable and cable plugs are properly positioned and appear in good physical condition. Ensure the photovoltaic panel is not covered by dust, bird droppings, or obstructed by any loose objects.

9. NWSREP Seasonal Maintenance: Your NWSREP will plan seasonal maintenance for your site and coordinate with you in advance of his visit.

Note: The FPU Observer is advised not to open the door to the lower bucket assembly where the gauge weighing sensor is located. The NWSREP shall be responsible for visual checks and maintenance on the weighing sensor unit.

SEMIANNUAL CHECK BY NWSREP

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 GSA nonflammable liquid detergent.
2. Weather Stripping around Base Plate and Cylindrical Door.	Check for breaks or general deterioration. Weather stripping is used around Base Plate of the Model 1558 and 1559 gauges only.	Replace as needed: Weather Stripping or Door Gasket. Cut base plate weather stripping to about 50 inches in length.

<p>3. Horizontal Flexures in the FPU Weighing Mechanism.</p>	<p>A casual glance will reveal the condition of all four horizontal flexures. If any are bent, broken, or binding it might effect gauge calibration. Horizontal flexures which are 'v-shaped' must be replaced. The <u>upper-rear flexure</u> is most susceptible to bending.</p>	<p>Use the smallest test weight of the D111-500TE set to ensure the Rain parameter shows a change in current reading. If it does not change, the flexure should be repaired. Under no circumstances should any flexures, except the <u>upper-rear flexure</u> be replaced at the observer site.</p>
<p>4. Collection Bucket</p>	<p>The collection bucket is to be emptied whenever the keypad Rain display gives a reading in excess of 15.00 inches.</p>	<p>Remove any foreign material in the collection bucket and clean. Enter notation 100, 'End of Valid Data,' before charging collection bucket.</p>
<p>A. Emptying and charging collection bucket</p>	<p>Collection bucket is charged for warm weather operation by adding approximately one half quart of SAE 10 non-detergent or multi viscosity oil to retard evaporation.</p>	<p>SAE10, non-detergent oil available.</p> <p>Enter notation 115 'Bucket completely emptied'; or enter 116, 'Partially drained bucket'.</p> <p>Then enter notation 117, 'Added oil to bucket'.</p> <p>Finally, enter notation 140, 'Start of Valid Data,' if you are done with all actions on the bucket.</p>
<p>B. Charging Collection Bucket – Cold Weather Operation</p>	<p>When collection bucket is emptied and charged for cold weather operation, add two quarts of pre-mixed antifreeze and oil.</p>	<p>Antifreeze, propylene glycol base. Less antifreeze may be required if temperature is mild and precipitation is expected to be light.</p>

<p>5. Funnel</p>	<p>During the period of year when snow or freezing weather is expected, remove funnel from the conical upper housing and store.</p>	<p>Enter notation 118, 'Added antifreeze to bucket', and then enter notation 117, 'Added oil to bucket.'</p> <p>Then enter notation 140, 'Start of Valid Data', when you have completed all re-charging actions with the bucket.</p> <p>Enter notation 126, 'Removed Funnel'.</p> <p>Reinstall funnel after cold weather season ends.</p>
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9.1 NWSREP Winterizes the FPU: Partially drain the FPU bucket (code 116) so as to retain the oil layer in the bucket. Remember to recharge with two quarts of antifreeze (code 118). Then if necessary, add oil (code 117). You never need more than ¼ inch surface oil layer in the Fischer Porter's 14 inch diameter bucket. Add one half quart of oil when completely replacing the charge.

Remove funnel: Remove the cone-shaped hood (Fig 1.1), tip it upside down and set it down. Rotate the funnel so its slots allow it to slide free from the three pins located on the base of the hood assembly. Enter notation 126, 'Removed Funnel.'

Further Considerations: Snowfall and high-rate rainfall events can lead to a layer of snow, ice, or fresh rainwater that rests on top of the oil layer. For these events stir the bucket with a mixing stick. This will prevent freezing and possible equipment damage.

9.2 NWSREP Summerizes the FPU: Remove the cone-shaped 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 ¼ inch film of oil on the surface to inhibit evaporation. If the **Rain** 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 antifreeze if local conditions require.

Install the funnel: Remove the conical housing, 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 (Fig 1.1). Enter operator notation 125, 'Installed Funnel.' and enter code 140 'Start of Valid Data'. The installed funnel will collect any debris (i.e., leaves) that might fall into the gauge.

10. Rain Gauge Supplies: These quantities will vary as a function of the amount of precipitation a site receives in a given season. Please contact your NWSREP if you are responsible for keeping any of these items at your cooperative observer station.

- A. One quart of oil might be consumed each year.
- B. A two-quart container of Propylene Glycol antifreeze might be consumed each year.
- C. One 5 gallon sealable plastic container available to discard bucket fluids.

The National Weather Service Headquarters expresses special thanks David Jacobs, DAPM/MLB, and Ralph Troutman, DAPM/OHX, for photographing equipment and drawing the illustrations.



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APPENDIX A : ACRONYMS

COOP	Cooperative Observer Program
CSSA	Cooperative Station Service Accountability Database
CWA	County Warning Area
DAPM	Data Acquisition Program Manager
ENT	Keypad Data Entry Button [ENTER]
FPU	Fischer-Porter/Belfort Upgrade
F&P	Fischer & Porter Punch Tape Gauge
GMA	Gauge Modification Assembly
HMT	Hydrometeorological Technician
LST	Local Standard Time
MIC	Meteorologist-In-Charge
NCDC	National Climatic Data Center
NDS	NWS Directives System
NLSC	National Logistics Support Center
NRC	National Reconditioning Center
NWS	National Weather Service
NWSREP	National Weather Service Representative at the WFO
OPL	Observing Program Leader at the WFO
OPR	Office of Primary Responsibility
ORE	Operational Readiness Evaluation
PCA	Printed Circuit Board Assembly
POC	Point of Contact
RCPM	Regional COOP Program Manager
SRG	Standard Rain Gage (non-mechanical, 8" aperture)
VFD	Vacuum Fluorescent Display
WFO	Weather Forecast Office
WSH	Weather Service Headquarters

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APPENDIX B : OPERATOR NOTATIONS

Use the numeric keypad in the data logger enclosure to enter the valid three digit code to account for the Observer performed checks or maintenance activities.

<u>Value</u>	<u>Meaning of value</u>
100	End of Valid Data
103	Time is more than 15 minutes fast/slow
104	Routine Gauge Check
115	Emptied bucket - bucket completely emptied
116	Partially emptied bucket - some liquid left in bucket
117	Added Oil to bucket
118	Added Antifreeze to bucket
125	Installed funnel
126	Removed funnel
140	Start of Valid Data



Fig B.1 Use the data logger keypad to tell us if you made a routine check on the gauge. Enter code number 104.

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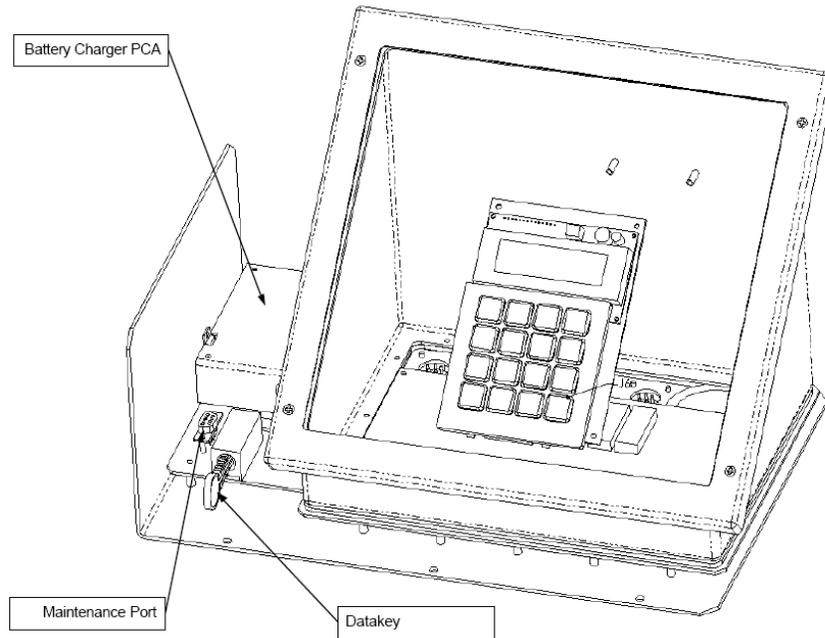


Fig B.2 Diagram of FPU data logger to show location of data key receptacle where monthly download is performed.

APPENDIX C – MAILING ADDRESS FOR DATA KEY TO WFO

1. Where is your local WFO? _____
WFO Name

Street Address

Town, State, Zip Code

Phone Number

2. Who is your NWSREP? _____
First and Last Name

Phone Number

E-mail at WFO

3. Does your NWSREP have an alternate? _____
First, Last Name

Phone Number

E-mail at WFO

Note: Please log all significant operations and maintenance anomalies or system maintenance actions and print them to a sheet for mailing to the NWSREP when you mail the monthly Data Key to the WFO. You may want to keep on station the most recent three month’s log sheets to track the date and time of monthly downloads, routine maintenance, and unanticipated system outages. Please notify your NWSREP if there are issues noted.

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APPENDIX D

FPU OBSERVER LOG SHEET - OPTIONAL

COOP Station Number : i.e., 23-4377 Your Name : i.e., John Williams If Organization, then Name : i.e., U.S. Army Corp of Engineers

LOG DATE	DATA TO KEY	BUCKET LEVEL	ANTIFREEZE / OIL	FUNNEL IN / OUT	SPECIAL NOTES:
Today's Date : i.e., Apr 15, 2005	Date and time of your last <u>Data Key</u> download.	Date and time <u>bucket</u> was last partially or completely <u>drained</u> .	Date and time <u>antifreeze</u> and or <u>oil</u> was last added.	Date and time <u>funnel</u> was removed for winter ; or installed for summer.	Any <u>anomaly</u> or <u>outage</u> event? Give date and the elapsed time of outage. Describe the problem.
Apr 15, 2005	9:15am Apr 6, 2005	2pm Mar 14, 2005	11am Oct 9, 2004, for antifreeze	Installed 2pm Mar 14, 2005	None to report. Routine gauge check (i.e., Code 104) done on Wed Apr 6 th .

NWSREP Name : _____

NWSREP Phone : _____

Instructions: Write the significant events that happen each month. Always phone your NWSREP if there is an FPU system outage or an anomaly that might adversely affect the integrity of the power system, the data logger, or the data itself. Your Observing Station may design its own worksheet to suit its needs with the intention to account for the same areas of operation as indicated above. If NWSREP approves, you may regularly mail your Observer Log Sheets to your NWSREP.