NOAH IV(TM)

Total Precipitation Gauge

(With SC115 Flash Memory Data Collection Module)

Configured for the National Atmospheric Deposition Program

Technical Manual

ETi

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Technical Manual
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SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1 Description

The ETI NOAH IV Total Precipitation Gauge provides accurate, unattended measurement of rain and snow precipitation over the full range of temperatures and environmental conditions. The NOAH IV features:

- *Accurate Measurements* - A large capacity, highly stable load cell transducer combined with software algorithms provide extremely accurate measures of precipitation entering the collection chamber. Because the entire collection chamber is weighed, any precipitation accumulated on the chamber walls is accounted for. The gauge's precise measuring components deliver a resolution of 0.001 inch with an accuracy of + or - 0.01 inches.

- *Precise Detection of Precipitation Onset* - An internal optics sensor detects the first droplets of precipitation. This resets software measurement references to ensure that all precip falling into the chamber is measured. By using optics to detect precipitation onset, any spurious readings that might occur from temperature or wind-induced vibration transients are eliminated.

- *Simple Procedure for Data Collection* - Data is collected from the datalogger using an SC115 Flash Memory Data Collection Module via a RS232 cable connected to the CSIO port. The CR1000 datalogger rapidly uploads data to the Data Collection Module.

- *Low Maintenance* - The NOAH IV can operate unattended for long periods of time. Maintenance is required only to empty the collection chamber contents when the amount of collected precipitation makes it necessary.

- *Power* - A built-in AC float charger and 12 volt, 12 amp-hour battery provides power for the gauge, datalogger, and optics sensor. Average power drain of the gauge without optics is less than 1 milliamp; with the optics it draws around 90 milliamps average.

  The NOAH IV gauge is furnished with a 25 foot Frigid Flex power cord. An optional solar power system consisting of a solar panel, regulator, and battery is available from ETI. If the gauge is to be powered by AC power, a quality surge protector should be installed at the primary outlet box.

Major components of the NOAH IV include:

(1) An external housing with integrated infrared emitter and receiver optics.
(2) A base assembly that contains the datalogger, float charger, battery, optics electronics, load cell transducer and collection chamber platform.
(3) An inlet orifice that mounts on top of the external housing.
(4) A removable aluminum precipitation collection chamber.
(5) A datalogger that monitors both the optics and the load cell transducer to measure and record the amount of precipitation collected.
(6) An RS232 cable connected to the CSIO port to allow data collection via a Flash Memory Data Collection Module.

CAUTION!!!

REMOVE BATTERY PRIOR TO TRANSPORTING GAUGE!!!

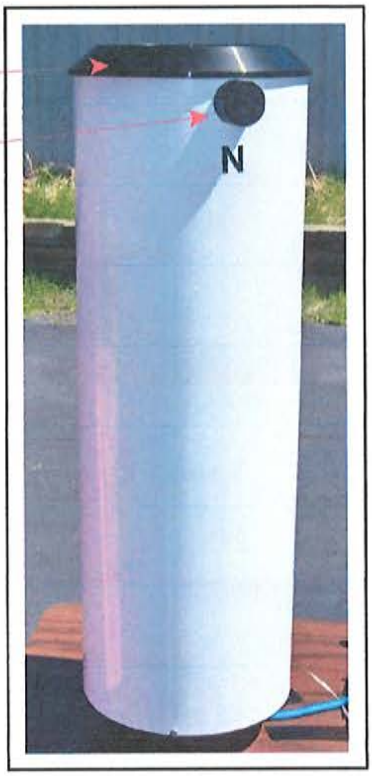
1.2 Functions of the NOAH IV's Major Components

1.2.1 The NOAH IV Housing. This cylindrical housing is 29 inches tall and 10 inches in diameter. It is open at the bottom and top with mounting holes near the top to accommodate the optics emitter and detector. When data is to be collected from the datalogger, an SC115 Flash Memory Data Collection Module is connected to an RS232 cable housed on the exterior of the gauge to retrieve data stored in the NOAH IV datalogger.

The inlet orifice presents an 8-inch diameter opening for the precipitation. It fits snugly into position by pressing it down onto the gauge outer housing. The 1¾-inch inside vertical wall of the inlet orifice exhibits a minimal area for precipitation to collect on.

Inlet orifice

Optics LED emitter
(Install the gauge so that the "N" faces North)



Precipitation is collected in the collection chamber and mixes with a charge of antifreeze to keep the contents from freezing.

1.2.2 The Base Assembly. Providing structural support and mounting for the NOAH IV's components is the base assembly. The pictures below show the placement of components on the base assembly.

Battery Side

Collection Chamber Platform

Load Transducer Assembly Plate

AC outlet box

Datalogger

Voltage Divider

Float Charger

Optics Electronics

Battery

Datalogger side

1.2.3 The Collection Chamber. The aluminum collection chamber can hold a maximum of 14 inches of liquid. The bottom of the collection chamber is fabricated to fit onto alignment guidepins on the load transducer platform.

Collection Chamber

Optics openings

Alignment guidepins fit into recessed ring in the bottom of the collection chamber

Chamber Bottom

Collection Chamber Platform

1.2.4 The NOAH IV's Power System—a Battery and AC Charger.

NOAH IVs are shipped with an AC float charger and battery. ETI also can supply an optional solar power system, which includes a solar panel, regulator, and an 12 amp-hour battery. This system will provide continuous unattended operation with very little required maintenance.

1.2.5 Windscreen. NOAH IV gauges can be fitted with an optional windscreen assembly designed for the gauge to improve collection efficiencies during light to moderately windy conditions.

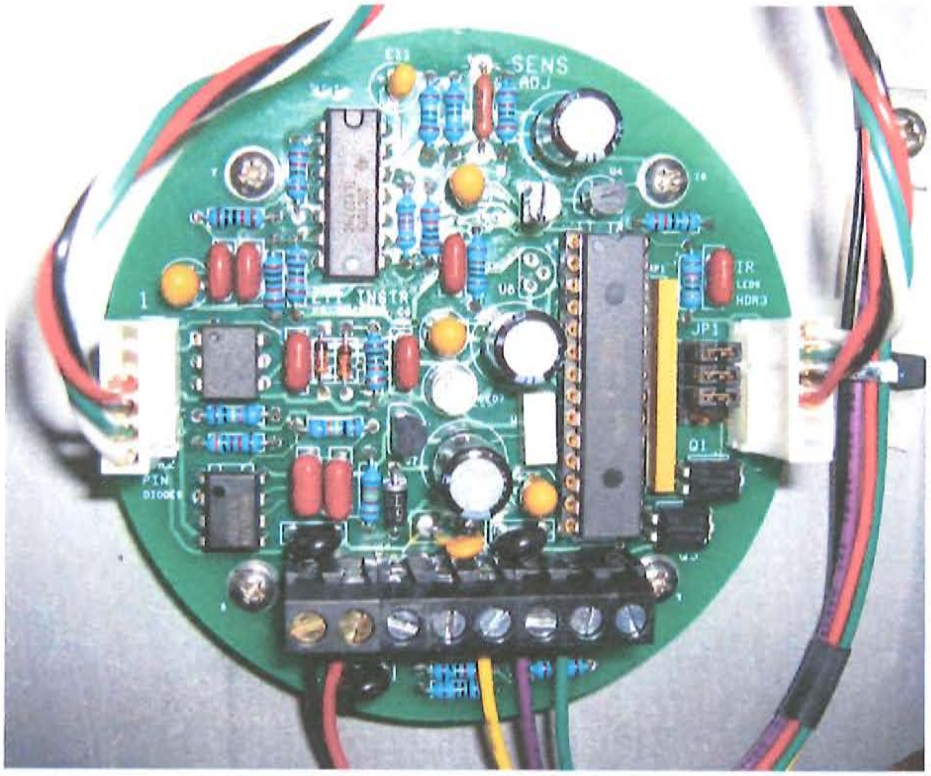
1.2.6 Datalogger Wiring. The unit comes with all wiring connections installed by the factory on the datalogger and OPD electronics. The following wiring list provides terminal position, wire color and function.

CR1000 Terminal	Wire Color and Function		
12V	Red, +12v to Optics		
G	Black, - (ground) to Optics		
P1	Purple, pulse input from optics		
SE-1	Sampler 1 battery	V	D
SE-2	Sampler 1 lid position	O	I
SE-3	Sampler 2 battery	L	V
SE-4	Sampler 2 lid position	T	I
SE-5	Sampler 3 battery	A	D
SE-6	Sampler 3 lid position	G	E
SE-7	Future Input	E	R
SE-8	Future Input		
SE-13	Yellow, optics status input		
SE-14	Green, optics blocked signal		
8H (differential in)	Red, load cell (+) input		
8L (differential in)	White, load cell (-) input		
G	Black, load cell ground		
E2	Green, load cell excitation		

CR1000 Datalogger

1.2.7 Optics Sensor Electronics Board Connections

The Optics Sensor Electronics Board connections include the terminal block at the bottom of the board and two six-pin connectors at each side. The following describes their connections and functions:



1.2.7.1 OPD Terminal Block (bottom of the board)

OPD Terminal	CR1000 Conn.	Function	Color
1	G	Common	(Black)
2	+12V	+12 volt power	(Red)
3		N/C	
4		N/C	
5	SE-13	Onset output	(Yellow)
6	P1	Pulses out	(Purple)
7	SE-14	Blocked signal	(Green)

1.2.7.2 Six-pin and Four-pin Connectors

HDR-2 and HDR-3 are six-pin gold connectors on the main OPD electronics board (see page 1-4) They are located along the right and left outer edges of the main board. HDR-1 is on the LED emitter board. HDR-4 is on the diode detector board. HDR-1 and HDR-2 are hard wired and are located on the small emitter and detector circuit cards inside the two black caps that protect the units.

LED Connections: HDR-1 to HDR-2

LED HDR-1	Main Board HDR-2	Description	Color
1	1	No connection	
2	2	No connection	
3	3	Circuit Power +5V	red
4	4	Gnd	black
5	5	25 KHz signal	green
6	6	Common	white

LED Connections: HDR-3 to HDR-4

Detector HDR-4	Main Board HDR-3	Description	Color
1	1	No connection	
2	2	No connection	
3	3	Circuit Power + 5V	red
4	4	Gnd	black
5	5	Signal out	green
6	6	Reference volts 2.5 V	white

Four-pin LED and Detector Interconnector (Located on the Load Transducer Assembly Plate)

Pin	Wire Color
1	red
2	black
3	white
4	green

1.3 Specifications

1.3.1 NOAH IV Precipitation Gauge

Sensor type:..... Electronic weighing-type gauge
Sensitivity:..... 0.0005 inches
Resolution:..... 0.001 inches
Accuracy:..... + or - 0.01 inches
Inlet Orifice:..... 8 inches
Operating temperature range:.....-30° to +50° C
Power Requirements:..... 12 VDC, 1 ma average current
Size:..... 10 inches diameter x 32 inches length

1.3.2 The Onset Precipitation Detector (OPD)

Emitters (dual beam):	GaAs infrared emitting diode
Source	Near Infrared
Wave length	950 nm
Radiant Intensity	> 80 mW/sr
Beam width	20 degrees
Operating temp	-50 C to +50
Detectors:	silicon planar PIN photodiode
Filter	Daylight
Wave length	950 nm
Photosensitivity	> 12.5 ua
Operating temp	-50 C to +50C

Electrical Operating Parameters:

Voltage	12 volts
Current	90 ma

Output Signals:

Precipitation onset	2.5 volt signal level
Pulses	5 volt pulses per detected particle
Blocked optics	5 volt signal level

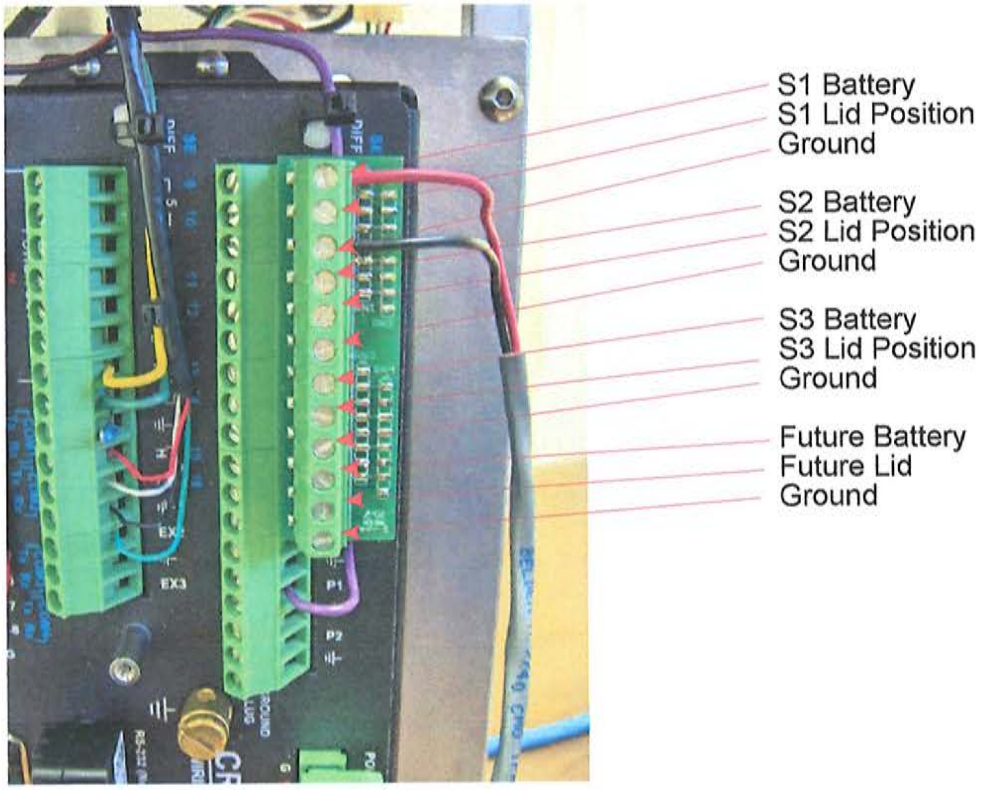
The OPD incorporates additional programmable functions as follows:

(a) Jumper Selectable Precipitation *Onset*:
2, 4, 8, or 16 particles per minute

SECTION 2
INSTALLATION

2.1 Field Connections for Sampler Wiring

The NOAH IV CR1000 program accepts up to three samplers. The 12V-to-2.5V voltage divider board connects to the CR1000 single-ended inputs 1 through 8 as shown in the photo below. (Note that the voltage divider board provides for a fourth pair of single-ended inputs for future configuration.)



(S1 Battery and Ground are shown connected in the photo.)

To Insert Sensor Wires Into Terminals in the Voltage Divider Board

Cut the sensor wires to a proper length and then strip off about ¼ inch of insulation. To install the wires into their terminals, insert a small-blade screwdriver into the terminal and loosen the screw. Then insert the wire into the opening just to the right of the screw. Refer to the photo on the previous page and note the red wire in S1 Lid terminal and the black wire in the S1 Ground terminal. *Make sure the bare wire is inserted fully into the terminal slot and that no part of the bare wire can touch the circuit on the voltage divider below the terminal.*

2.2 Site Preparation

Because of its sensitive measurement capabilities, the NOAH IV requires a stable mounting surface to reduce the effects of vibrations caused by wind and other environmental influences. The mounting surface for the base plate should be a concrete pad or other stable surface.

A template, which can be traced from the base brackets, will facilitate placement of the bolts in the platform. The template can then be used to locate the position of the three customer-supplied bolts required for mounting the gauge.

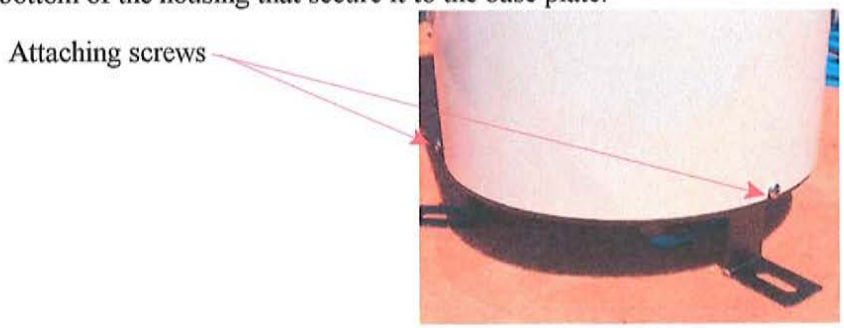
> ***Note: Position the gauge so that the black letter "N" just below the emitter near the top of the gauge faces North.***

2.3 Assembly and Installation

NOTE: Do not handle the gauge housing by the black LED emitters and detectors!

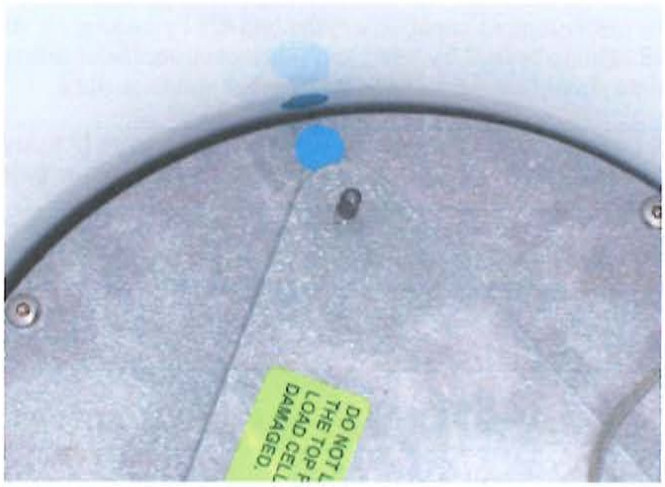
Installation of the gauge can be accomplished with minimum tools, including an instrument screwdriver and set of allen wrenches. Carefully follow the steps described below to ensure a successful installation.

1. Pour a concrete mounting pad (or prepare similar stable platform) and install mounting bolts.
2. The NOAH IV is shipped with the outer housing attached to the base assembly. Loosen the three screws at the bottom of the housing that secure it to the base plate.



   Taking care ***NOT*** to hold the gauge housing by the emitters and detectors, remove the outer housing from the gauge base assembly by raising the outer housing straight up.

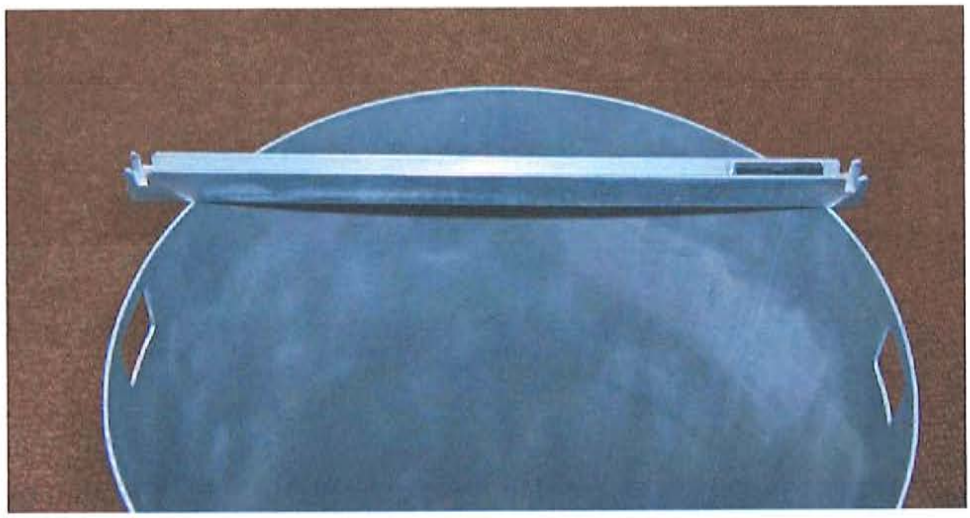
3. When concrete has set, mount the base assembly to the mounting bolts in the platform.
4. The bolts attaching the three gauge legs will need to be tightened once the gauge has been positioned over the mounting bolts in the concrete pad.
5. ***This step will activate the gauge!*** Install the battery and connect the red power lead to the (+) terminal on the battery. Connect the black power lead to the (-) terminal on the battery. Position battery so that the (-) terminal is to the outside edge.
6. Place the gauge outer housing over the base assembly and carefully slide it down to the base plate. Align the outer housing by matching the blue alignment dot on the inside of the gauge housing to the blue alignment dot on the top plate of the base assembly.



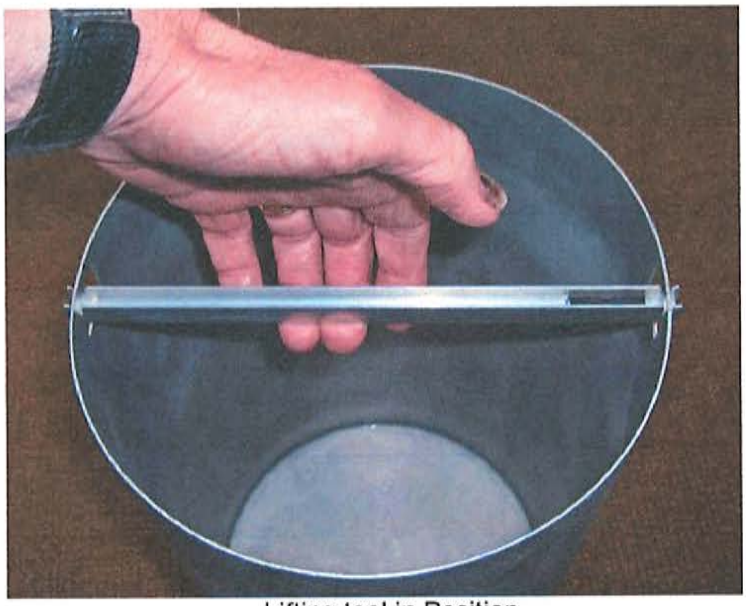
7. Tighten the three screws at the bottom of the housing, which secures the outer housing to the base plate.

8. Connect the cables from the optics emitters and detectors into their respective receptacles located in the top plate of the base assembly. Run the cable so they do not interfere with load plate.

9. The collection chamber can be handled by placing the lifting tool (shown below) into the two openings from the inside. Lift the collection chamber and insert it carefully down into the gauge housing and onto the platform. ***Make sure the chamber is not dropped onto the platform. This could cause irreversible damage to the load cell!***



Lifting Tool Shown Resting on Top of Collection Chamber



Lifting tool in Position

Three alignment guidepins on the load platform fit into the indented ring in the bottom of the chamber. A fourth guidepin fits into the center of the chamber. Rotate the chamber until the guideposts are registered into the ring. Then rotate the chamber until the vertical black alignment mark between the two LED emitters is exactly aligned with the vertical black alignment mark in the center of the opening on the chamber. ***The two LED emitters and the two LED detectors on the opposite side of the gauge must have an unobstructed view of each other through the two rectangular openings.***

Stand on the opposite side of the gauge from the LED emitters and make sure the two LEDs are centered in the chamber opening. Then stand on the other side of the gauge and observe the LED detectors, adjusting the position of the collection chamber as necessary.

10. Place the black inlet orifice over the housing, and press down on the inlet orifice until it registers onto the housing.

11. Plug the AC power cord into a GFI protected outlet.

The ETI NOAH IV Total Precipitation Gauge is now operational.

NOTE: The clear "Otter" box which protects the RS232 cable's DB9-pin connector can be mounted on the gauge in a manner appropriate for the site and at the customer's discretion.

SECTION 3

OPERATION AND SERVICING

3.1 Collecting Data

1. Bring the SC115 Flash Memory Data Collection Module to the gauge site to collect the gauge's data.

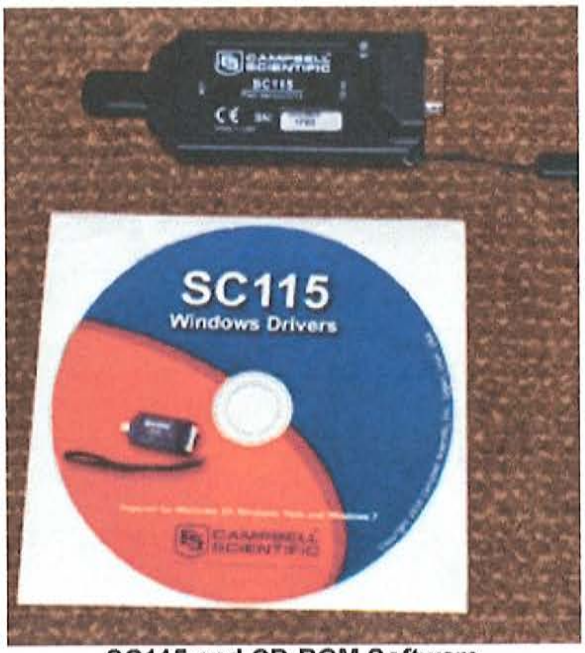
2. Open the "Otter" box on the exterior of the gauge and retrieve the RS232 DB9-pin connector that is connected to an cable. (NOTE: The "Otter"box is designed for extreme conditions and the lid is made to fit very tightly and requires some degree of force to open the latch.)

3. Connect the SC115 to the DB9 connector. An LED on the SC115 will begin to flash, indicating data transfer. When the LED ceases to flash, wait about 10 seconds to ensure data transfer is complete, then disconnect the SC115 from the DB9-pin connector.

4. Return the RS232 DB9-pin connector to the "Otter" box, making sure the lid is securely closed.

5. The collected data on the SC115 can be downloaded to a PC that is configured with software on a CD-ROM that is provided with SC115. To load this CD-ROM software onto the PC, just insert the CD-ROM into the PC's CD-ROM drive and follow the configuration instructions. Also, the SC115 Technical Manual can be downloaded as a pdf file from the Campbell Scientific website: www.campbellsci.com/sc115.

The pictures below and on the following page depict the SC115 Flash Memory Data Collection Module, the RS232 DB9-pin connector and cable, and the "Otter" box that houses the RS232 DB9-pin connector during normal operation between data collection sessions.

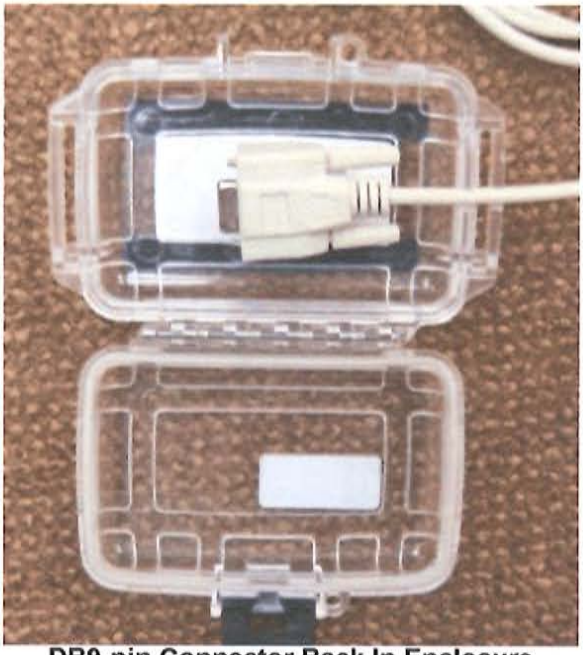


SC115 and CD-ROM Software

Gauge, SC115 Cable and Box

SC115 and DB9-pin Connector

SC115 Retrieving Data



DB9-pin Connector Back In Enclosure

3.2 Routine Servicing

Routine servicing of the NOAH IV automated gauge normally entails:

- Emptying and cleaning the collection chamber when sufficient precipitation is collected
- Removing spider webs and spiders from the gauge
- Adding antifreeze
- Inspecting the battery and power system

The following describes each of these service functions.

3.3 Emptying the Collection Chamber

The collection chamber holds up to a maximum of 14 inches of collected precipitation (including antifreeze) before it overflows.

Remove the inlet orifice and set aside, making sure the inlet orifice is right side up to avoid any damage to it. Clean trash off the "O" ring before re-installing the orifice.

Using the lifting tool inserted into the two openings of the collection chamber, carefully lift the collection chamber straight up. ***Make sure the collection chamber is not dropped onto the platform. This could cause irreversible damage to the load cell!***

Empty the collection chamber and insert it back inside the gauge housing and onto the platform. Again, be careful not to drop it onto the platform. Make sure the alignment guideposts are registered into the alignment ring on the bottom of the chamber. Align the black mark on the collection chamber with the black alignment mark between the two LED emitters. The emitters must have an unobstructed view of the detectors through the openings in the chamber. Remove the lifting tool.

Place the black inlet orifice over the housing, and press down on the inlet orifice until it registers onto the housing.

3.4 Spider Control

Spiders will spin webs very quickly across the opening of the orifice. Use a rag or paper towel to remove spider webs and spiders. There is a product called "Web-Away" from the "All Natural Company" in Ocala, Florida that offers some amount of effectiveness.

3.5 Replenishing Antifreeze

Add sufficient antifreeze to protect the contents from freezing during expected low temperature extremes. A 40/60 ratio of antifreeze to water should protect down to -35 degrees C.

3.6 Inspecting and/or Replacing the Battery

Prior to removing the outer housing, unplug the gauge power cable from its power source. The battery load is part of the float charger filter, conditioning the 12 volts power to the data logger and optics electronics.

To access the battery, first remove the inlet orifice and set it aside, being careful not to damage the top edge of the orifice.

Using the "lifter" inserted into the two opening of the collection chamber, carefully lift the collection chamber straight up. ***Make sure the collection chamber is not dropped onto the platform. This could cause irreversible damage to the load cell!***

Disconnect the two optics cables from their receptacles in the load plate by pulling on the connector and not the cable itself !

Remove the gauge housing from the base. Take care ***not*** to hold the gauge housing by the black emitters and detectors when removing the outer housing from the gauge base.

Check the battery voltage, which should never be below 12.2 volts. If it is, check the battery and the charging system.

Optional (If equipped with solar panel.) As the amount of sunlight increases during the day, the solar panel may charge the battery as high as 13 to 14 volts. To check the capacity of the battery, i.e., its ability to provide current for an extended period, cover the solar panel to simulate night conditions when the battery is receiving no charge. The battery voltage will begin to decrease. How fast it decreases and how far it decreases is an indication of the battery's condition. If there is a significant change from the last time you performed this test, the battery may have become weak or the charging system may need attention.

Check all connections on the solar panel (if equipped), regulator, and battery for corrosion and serviceablity.

Replace the battery if necessary.

Reassemble in the reverse order as described above, being careful not to drop the collection chamber onto the platform.

APPENDIX A

WINDSCREEN ASSEMBLY INSTRUCTIONS

1. Insert the three windscreen arms into the receptacles on the windscreen base.

2. Mount the NOAH IV onto the three bolts in the windscreen base.

3. Install one of the three windscreen sections into the receptacle in the upper end of one of the windscreen arms. See photo for which way to face baffles. Tighten the allen screw with an allen wrench.

4. Install the remaining two windscreen sections in a similar manner.