NEON PREVENTIVE MAINTENANCE PROCEDURE: WET DEPOSITION COLLECTOR

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See configuration management system for approval history.

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Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	12/08/2016	ECO-04273	Initial Release
B	08/04/2017	ECO-04906	Multiple changes and updates
C	05/27/2019	ECO-06078	Updated procedure in collaboration with new contract laboratory, updated procedure photos, updated sampling, packaging, and shipping material, additional content updates, and minor corrections. Updated to new document template. Input from Field Science.
D	04/12/2022	ECO-06798	Update to reflect change in terminology from relocatable to gradient sites
E	05/06/2022	ECO-06825	Included more detail in subsampling for Isotope Analysis, section 5.6.6. Included more detailed guidance in shipping and handling of Chemistry and Isotope samples in Section 7.2.3.
F	06/28/2022	ECO-06839	Fixed typo and formatting errors.
G	08/21/2023	ECO-07035	• Re-order section 5 to better reflect the workflow • Removed wording about sample collected = NO being used for a dry sample • Moved procedure for adjusting moving lid and chimney heights to appendix • Moved changing moving cover seal procedure to appendix • Changed hold time to 16 days to follow NADP guidance • Changed language from biweekly to 14 days to have more concrete timing guidance • Added tables for timing and timing contingencies

			• Moved sample timing procedure from the appendix to section 5 • Added instructions to add barcodes before heading to the field • Removed some unnecessary and/or broken links • Updated ERs to reflect External lab name change • Updated section references to correspond with document moves

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1 DESCRIPTION

1.1 Purpose

The National Ecological Observatory Network (NEON) employs terrestrial and aquatic sensors to collect measurements from air, wind, soil, sun, and water across the United States (to include Alaska, Hawaii, and Puerto Rico). Regular maintenance of these sensors and their infrastructure is necessary for the continued operation of the observatory and identify problems before they escalate.

This document details the procedures necessary for the preventive maintenance of the **Wet Deposition Collector (N-CON TM 00-127-07)**.

1.2 Scope

Preventive Maintenance is the planned maintenance of infrastructure and equipment with the goal of improving equipment life by preventing excess depreciation and impairment. This maintenance includes, but is not limited to, inspecting, adjusting, cleaning, clearing, lubricating, repairing, and replacing, as appropriate. The procedures in this document are strictly preventive.

This document specifically addresses the preventive procedures to maintain the **Wet Deposition Collector (N-CON TM 00-127-07)** for the NEON Project's Terrestrial Instrument System (TIS) and Aquatic Instrument System (AIS) sites.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

The following Applicable Documents (AD) contain mandatory requirements and/or supplementary information that are directly applicable to the topic and/or procedures herein. Visit the NEON Document Warehouse for electronic copies of these documents.

AD [01]	NEON.DOC.004300	NEON Environmental, Health, Safety and Security (EHSS) Policy, Program And Management Plan
AD [02]	NEON.DOC.004301	NEON Environmental, Health, Safety and Security (EHSS) Environmental Protection Manual
AD [03]	NEON.DOC.004316	Operations Field Safety and Security Plan
AD [04]	NEON.DOC.050005	Field Operations Job Instruction Training Plan
AD [05]	NEON.DOC.004257	NEON Standard Operating Procedure (SOP): Decontamination of Sensors, Field Equipment And Field Vehicles
AD [06]	NEON.DOC.002768	TIS Subsystem Architecture, Site Configuration and Subsystem Demand by Site - SCMB Baseline
AD [07]	NEON.DOC.002767	AIS Subsystem Architecture, Site Configuration and Subsystem Demand by Site - SCMB Baseline
AD [08]	NEON.DOC.001427	TIS Hut, Rack DAS and PDS Interconnect
AD [09]	NEON.DOC.001436	TIS Comm Interconnect Mapping
AD [10]	NEON.DOC.001972	AIS Comm Interconnect Mapping
AD [11]	NEON.DOC.004886	NEON Preventive Maintenance Procedure: Aquatic Portal & AIS Device Posts
AD [12]	NEON.DOC.001421	NEON Sensor Command, Control and Configuration – Wet Deposition Collector Assembly
AD [13]	NEON.DOC.003968	Instruction, Assembly/Configuration/Test of Wet Deposition Collector
AD [14]	NEON.DOC.001693	Site Acceptance Test Procedures: Wet Deposition Collector (NADP and Isotope)
AD [15]	NEON.DOC.004878	NADP Sampler Schematic and Trouble Shooting
AD [16]	NEON.DOC.004453	Formal Verification Procedure - Subsystem, Wet Deposition Collector (NADP)

2.2 Reference Documents

The Reference Documents (RD) listed below may provide complimentary information to support this procedure. Visit the NEON Document Warehouse for electronic copies of these documents.

RD [01]	NEON.DOC.000008	NEON Acronym List
RD [02]	NEON.DOC.000243	NEON Glossary of Terms
RD [03]	NEON.DOC.000705	NEON Bolt Torque Specifications
RD [04]	NEON.DOC.000769	Electrostatic Discharge Prevention Procedure

RD [05]	NEON.DOC.004638	AIS Verification Checklist
RD [06]	NEON.DOC.004637	TIS Verification Checklist
RD [07]	NEON.DOC.003519	How-To: Turn on a Communication Box Relay
RD [08]	NEON.DOC.004464	PDS TIS Formal Verification Procedures
RD [09]	NEON.DOC.000804	Site Flora and Fauna Maintenance Plan
RD [10]	NEON.DOC.001886	AOS Protocol and Procedure: Stable Isotope Sampling in Surface and Ground Waters
RD [11]	CD06920000	Subsystem, Wet Deposition Collector, Tower
RD [12]	NEON.DOC.005242	Wet Deposition Container Overflow Rework
RD [13]	NEON.DOC.005224	Shipping Ecological Samples and Equipment

2.3 External References

The External References (ER) listed below may contain supplementary information relevant to maintaining specific standards and/or commercial products pertaining to the Wet Deposition Collector. These documents are external to the NEON project and Battelle Ecology. If an issue with a product requires the involvement of the manufacturer, NEON Headquarters (HQ) will contact the manufacturer or provide Field Science (FSCI) the authority to contact via the NEON Issue Management System.

ER [01]	N-CON Systems Company, Inc. *Precipitation Sampler MDN 00-125 & TM 00-127 Installation & Operations Manual*, TM-MDN Manual v12-31-2013.pdf SHA1 Checksum: afbf0fdcfc401007b9c619bdc8e9a94ca76f0629
ER [02]	N-CON Systems Company, Inc. (Main Website – Precipitation Samplers) URL: http://www.n-con.com/
ER [03]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Cleaning and Preparation of NEON Supplies*, Document Number: PR-0093
ER [04]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Tracking NEON Supplies*, Document Number: PR-0094
ER [05]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Domain Shipping*, Document Number: SS-0095
ER [06]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Determination of pH*, Document Number: AN-0023
ER [07]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *The Determination of pH on the Easy PREP TitrEC*, Document Number: AN-0090;
ER [08]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *pH Electrode Evaluation*, Document Number: SS-2026
ER [09]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP)

	• *Determination of Conductivity*, Document Number: AN-0019
ER [10]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Determination of Calcium, Magnesium, Sodium, Potassium by Inductively Coupled Plasma-Optical Emission Spectroscopy - Agilent 5100 SVDV*, Document Number: AN-0082
ER [11]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Determination of Cl, NO_3^-, and SO_4^{2-}- Using Dionex ICS-2000/5000 Ion Chromatographs and Chromeleon Software,* Document Number: AN-0018
ER [12]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Determination of Ammonia (Phenolate) by Flow Injection Analysis*, Document Number: AN-0014
ER [13]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Determination of Orthophosphate by Flow Injection Analysis*, Document Number: AN-0021
ER [14]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *IPD/CPD Calculations for Atmospheric Deposition Samples*, Document Number: DA-0067
ER [15]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Final Review and Reporting NEON Wet Deposition Data*, Document Number: DA-0096
ER [16]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Standard Operating Procedure for 4.3 Quality Control Check Sample Preparation*, Document Number: PR-0000
ER [17]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Preparation for Internal QA/QC Blinds*, Document Number: QA-0043
ER [18]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Preparation of QA/QC Samples*, Document Number PR-0045
ER [19]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Determination of the Method Detection Limit*, Document Number: QA-0020
ER [20]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) • *Reanalysis Procedures for NEON*, Document Number QA-0049
ER [21]	Gartman, N., *Quality Assurance Plan*, Central Analytical Laboratory, National Atmospheric Deposition Program, Illinois State Water Survey, Champaign, IL, May 2014, http://nadp.isws.illinois.edu/lib/qaplans/qapCal2014.pdf, accessed June 2, 2017

ER [22]	Gartman, N., *Quality Assurance Report*, National Atmospheric Deposition Program: 2015, Illinois State Water Survey, http://nadp.isws.illinois.edu/lib/qa/cal_qar_2015.pdf, accessed June 2, 2017
ER [23]	MSDSOnline (NEON Project Access) https://msdsmanagement.msdsonline.com/ec04e43d-e72d-4174-9369-c81635eb9493/ebinder/?nas=True
ER [24]	Health and Environmental Application Laboratory– University of Illinois | Standard Operating Procedure (SOP) *Sample Receiving and Processing for NEON*, Document Number: PR-1070

2.4 Acronyms

Acronym	Explanation
A/R	As Required
AIRMoN	Atmospheric Integrated Research Monitoring Network
AIS	Aquatic Instrument System
AOS	Aquatic Observation System
CVAL	Calibration, Validation and Audit Laboratory
DI	Deionized
DSF	Domain Support Facility
EPROM	Electrically Erasable Programmable Read-Only Memory
ESD	Electrostatic Discharge
GAW	Global Atmospheric Watch
GNIP	Global Network in Precipitation
HDPE	High Density Polyethylene
HQ	Headquarters
ID	Identification
IR	Infra-red
IAEA	International Atomic Energy Agency
IRMS	Isotope-Ratio Mass Spectrometry
JSA	Job Safety Analysis
LC	Location Controller
LED	Light Emitting Diode
LOGWAR	Logistics Warehouse
NADP	National Atmospheric Deposition Program
NTN	National Trends Network
PoE	Power Over Ethernet
PRT	Platinum Resistance Thermometer
PVC	Polyvinyl Chloride
QR	Quick Response
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
TIS	Terrestrial Instrument System
WMO	World Meteorological Organization

2.5 Symbols

$\delta^{2}H$	delta 2 H(ydrogen); aka δD or delta deuterium
$\delta^{18}O$	delta 18 O(xygen)

2.6 Terminology

The use of common names for NEON instrumentation and subsystems varies across departments and domains. Equipment, tools, and instrumentation have one technically accurate name, and at times one or more "common" names describing the same item.

This section aims to clarify and associate "common" names with the technical names herein.

SYNONYMOUS AND COMMON NAME(S)	NEON TECHNICAL REFERENCE NAME
NADP; Wet Dep	Wet Deposition Collector
Thistle tube; capillary tube	Thistle tube

3 SAFETY AND TRAINING

Personnel working at a NEON site must be compliant with safe fieldwork practices as outlined in AD [01] and AD [04].

The Field Operations Manager and the Lead Field Ecologist have primary authority to stop work activities based on unsafe field conditions; however, all employees have the responsibility and right to stop their work in unsafe conditions. All technicians must complete required safety training and protocol-specific training for safety and implementation of this protocol as required in AD [04].

Refer to the site-specific EHSS plan(s) and procedure-specific Safety Data Sheet (SDS) via the NEON Project's account on MSDSOnline or via the NEON Safety document portal for electronic copies. Conduct the appropriate Job Safety Analysis (JSA) before conducting any preventive maintenance.

Preventive maintenance of TIS and AIS sensors and infrastructure may require the use of a special equipment to access the sensor subsystem assemblies. Follow Domain site-specific EHS plans via the Network Drive and NEON safety training procedures when conducting maintenance activities. Conduct a Job safety Analysis (JSA) prior to accessing the sensor subsystems onsite. Reference the Safety Office SharePoint portal for JSA templates and additional hazard identification information.

In the event the current methods to conduct the procedures herein are no longer safe for use due to unforeseen or unknown site dynamics, consult with the NEON Safety Office via the NEON Project's Issue Management and Reporting System (i.e., ServiceNow) for alternative methods to conduct TIS and AIS preventive/corrective maintenance and Sensor Refresh procedures.

3.1 Hazard Communication Safety Data Sheets (SDS)

Safety Data Sheets (SDS)s can always be accessed via the NEON Project's account on MSDSOnline.

If in the field and have internet connectivity, access to MSDSOnline can also be accessed via the following Quick Response (QR) code.

Neon Inc.

Scan to access an MSDS

4 SENSOR OVERVIEW

4.1 Associated Equipment

4.1.1 External Components

- Environmental Enclosure with Chimneys
- Moving Cover
- Splash Shield
- Precipitation Sensor
- Thermo-electric Chiller Unit
- Thermo-electric Chiller Power Supply
- Concord GRAPE 24V
- Overflow drains (if installed)

4.1.2 Internal Components

- Temperature Controller – heater set point
- Temperature Controller – chiller set point
- Power Box
- Glass Sample Trains (glass funnel, glass thistle tube, Keck clip)
- Circulating Fan
- Plastic Sample Bottle for Isotope Analysis
- Plastic Sample Bottle for Chemical Analysis
- Platinum Resistance Thermometers (PRT)
- Thermo-electric Chiller/Heater
- Sample bottle tray holder
- Overflow catch basins (if installed)
- Funnel strip heater

4.2 Description

4.2.1 Wet Deposition Overview

The Wet Deposition Collector (N-CON TM 00-127-07) collects wet atmospheric deposition samples. Atmospheric deposition is a process where solid and liquid airborne particles and gases are deposited on the earth's surface by two general mechanisms: dry deposition and wet deposition. Dry deposition is a mechanism where airborne particles settle to the earth's surface either via impaction, molecular diffusion, interception, turbulence, or gravity. Wet deposition occurs when raindrops, snow, or ice drag these airborne particles with them as they fall to the surface.

NEON is employing similar practices from existing environmental and ecological data collection networks, such as the National Atmospheric Deposition Program (NADP), to monitor precipitation chemistry. NADP obtains wet deposition samples from a combination of the National Trends Network (NTN) and the Global Atmospheric Watch (GAW) program, which are programs of the World Meteorological Organization (WMO). NEON analyzes and archives wet deposition samples (see Section 4.2.4.2) using third party laboratories for chemistry and stable isotopes analysis.

Wet Deposition Collectors are located at specific Terrestrial and Aquatic sites (**Table 1** and **Table 2**).

Table 1. NEON Terrestrial sites with wet deposition collectors.

Domain	Site Identification (ID)	Site Name	Site Type
1	HARV	Harvard Forest	Core
1	BART	Bartlett Experimental Forest	Gradient
2	SCBI	Smithsonian Conservation Biology Institute	Core
2	BLAN	Blandy Experimental Farm	Gradient
2	SERC	Smithsonian Environmental Research Center	Gradient
3	OSBS	Ordway-Swisher Biological Station	Core
3	JERC	Jones Ecological Research Center	Gradient
4	GUAN	Guanica Forest	Core
5	UNDE	University of Notre Dame Environmental Research Center	Core
5	STEI	Steigerwald Land Services	Gradient
6	KONZ	Konza Prairie Biological Station	Core
6	UKFS	The University of Kansas Field Station	Gradient
7	ORNL	Oak Ridge National Laboratory	Core
7	GRSM	Great Smoky Mountains National Park, Twin Creeks	Gradient
7	MLBS	Mountain Lake Biological Station	Gradient
8	TALL	Talladega National Forest	Core
8	DELA	Dead Lake	Gradient
8	LENO	Lenoir Landing	Gradient
9	WOOD	Woodworth	Core
9	NOGP	Northern Great Plains Research Laboratory	Gradient
10	CPER	Central Plains Experimental Range	Core
10	STER	North Sterling, CO	Gradient
10	RMNP	Rocky Mountain National Park, CASTNET	Gradient
11	CLBJ	LBJ National Grassland	Core
11	OAES	Klemme Range Research Station	Gradient
12	YELL	Yellowstone Northern Range (Frog Rock)	Core
13	NIWO	Niwot Ridge Mountain Research Station	Core

13	MOAB	Moab	Gradient
14	SRER	Santa Rita Experimental Range	Core
15	ONAQ	Onaqui-Ault	Core
16	WREF	Wind River Experimental Forest	Core
17	SJER	San Joaquin Experimental Range	Core
18	TOOL	Toolik	Core
18	BARR	Utqiaġvik	Gradient
19	BONA	Caribou Creek - Poker Flats Watershed	Core
19	HEAL	Healy	Gradient
20	PUUM	Pu'u Maka'ala Natural Area Reserve	Core

Table 2. NEON Aquatic sites with wet deposition collectors.

Domain	Site ID	Site Name	Site Type
4	CUPE	Rio Cupeyes	Core
4	GUIL	Rio Yahuecas	Gradient
10	ARIK	Arikaree River	Core
11	BLUE	Blue River	Gradient
11	PRIN	Pringle Creek	Core
14	SYCA	Sycamore Creek	Core
15	REDB	Red Butte Creek	Core

4.2.2 Stable Isotopes Overview

Stable isotopes analysis is an additional form of analysis NEON is conducting on precipitation samples collected from the Wet Deposition Collector. Stable isotopes naturally occur in the environment; natural abundances vary depending on the environmental condition. Common stable isotopes are outlined in **Table 3** below. The partitioning or ratios of stable isotopes of a substance may characterize biological, geological, and hydrological processes from the past and present.

Table 3. Common stable isotopes.

Common Stable Isotopes	
Hydrogen	$^{2}H/^{1}H$
Carbon	$^{13}C/^{12}C$
Nitrogen	$^{15}N/^{14}N$
Oxygen	$^{18}O/^{16}O$

NEON is focusing on the stable isotopic signatures of water ($\delta^{18}O$ and $\delta^{2}H$) from precipitation samples and employing best practice guidelines from the Global Network of Isotopes in Precipitation (GNIP), the International Atomic Energy Agency (IAEA), and the WMO.

4.2.3 Collector Overview

The Wet Deposition Collector, Model N-CON TM 00-127-07, encompasses a white powder coated environmental enclosure with internal insulation and dual sample chimneys at the top of the enclosure to allow for the collection of two simultaneous "wet only" precipitation samples. The collector is an automated, temperature controlled, collector of both liquid (i.e., rain) and frozen (e.g., snow, hail, ice) precipitation. It is designed to only collect samples during precipitation events using a precipitation sensor. When the precipitation detector on the collector senses precipitation, a motor driven cover opens to allow for the collection of samples. It closes when precipitation ceases.

The internal temperature range of the enclosure is set at 3° C (37.4° F) and 25° C (77.0° F) and internal thermostats command and control the thermo-electric chiller unit. An additional five-inch-long Thermometrics PRT independently monitors enclosure temperature, and an internal fan circulates air to aid in maintaining the temperature range.

Table 4. Overview of the N-CON TM 00-127-07 Wet Deposition Collector.

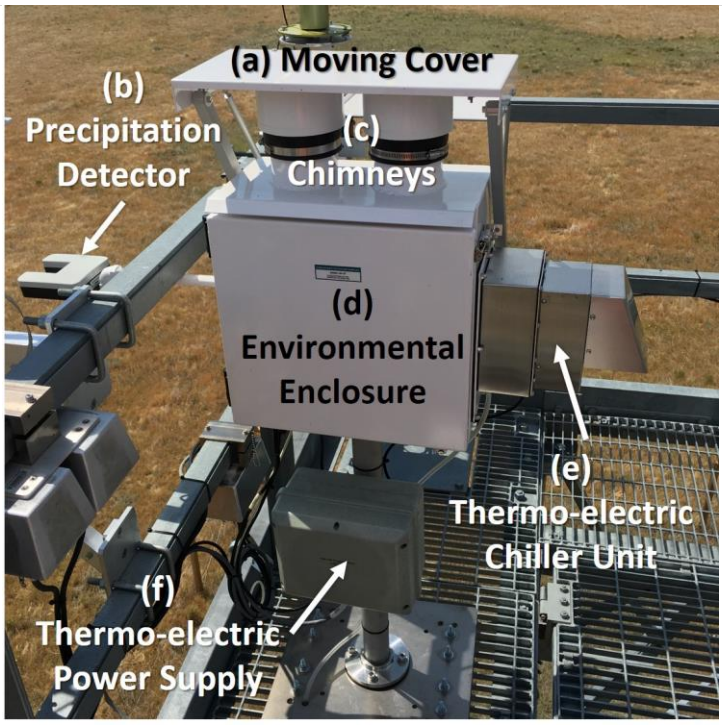


Figure 1. A front view of the main components of the N-CON TM 00-127-07 wet deposition collector. See also **Figure 2** and **Figure 3**.

(a) Moving cover

(b) Precipitation detector

(c) Two collection chimneys

(d) Environmental enclosure

(e) Thermo-electric chiller unit

(f) Thermo-electric power supply

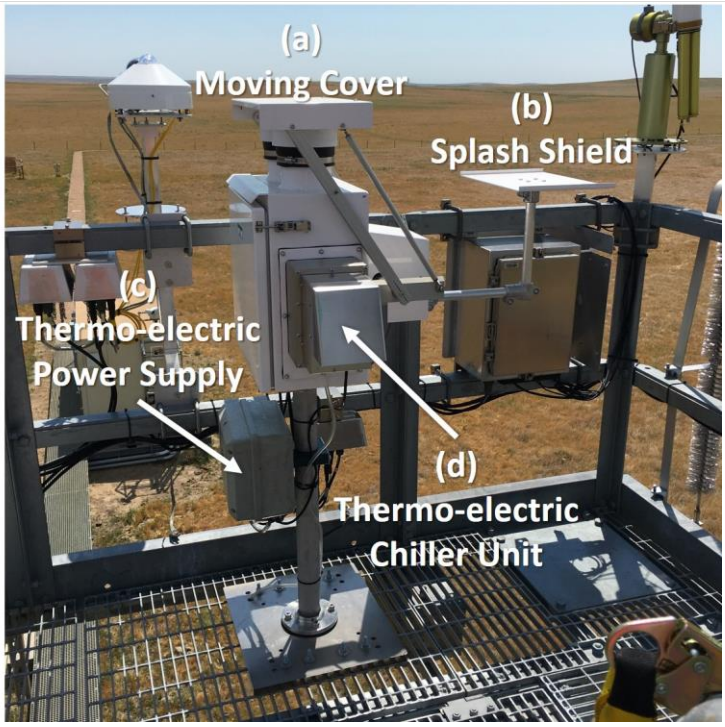


Figure 2. A side view of the main components of the N-CON TM 00-127-07 wet deposition collector. See also **Figure 1** and **Figure 3**.

(a) Moving cover

(b) Splash shield

(c) Thermo-electric power supply

(d) Thermo-electric chiller unit

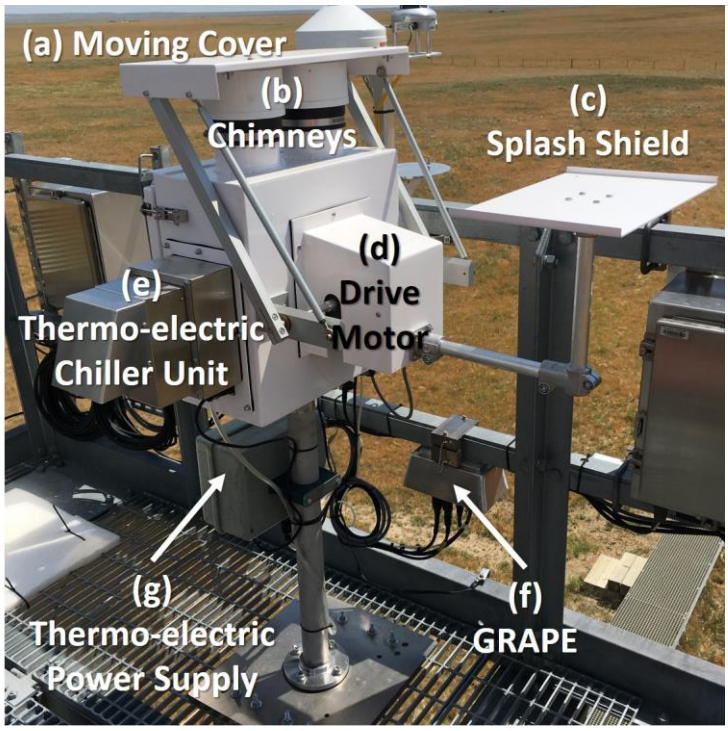


Figure 3. A rear view of the main components of the N-CON TM 00-127-07 wet deposition collector. See also **Figure 1** and **Figure 2**.

(a) Moving cover

(b) Two collection chimneys

(c) Splash shield

(d) Drive motor

(e) Thermo-electric chiller unit

(f) Associated Grape

(g) Thermo-electric power supply

Figure 4. A view of the precipitation detector. This unit is typically located on an extension arm projecting from the environmental enclosure.

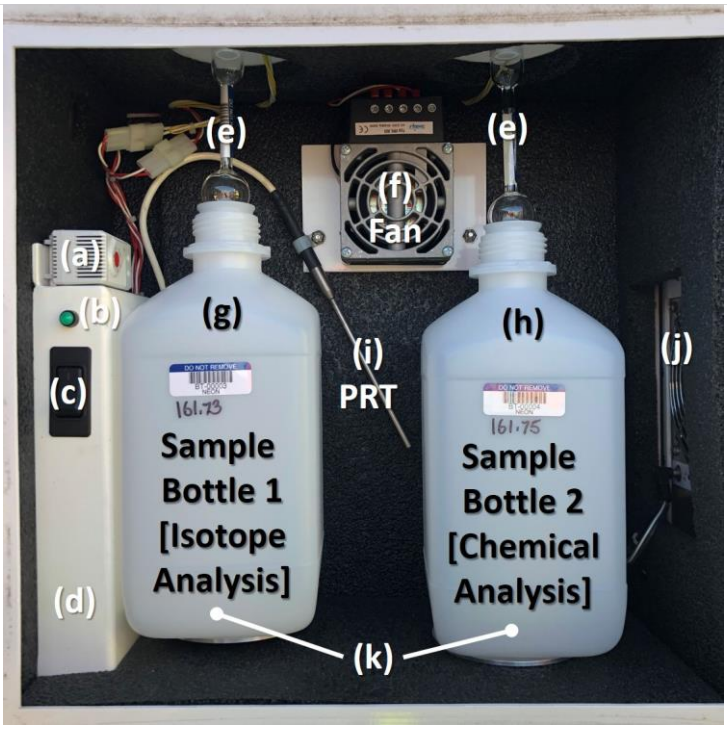


Figure 5. The inside view of the environmental enclosure.

(a) Temperature Controller

(b) Power on light emitting diode (LED)

(c) Power Switch

(d) Power Supply

(e) Glass Sample Train

(f) Fan

(g) Sample Bottle 1 – for Isotope Analysis

(h) Sample Bottle 2 – for Chemical Analysis

(i) PRT

(j) Thermo-electric Chiller Unit

(k) Sample Bottle Tray Holder

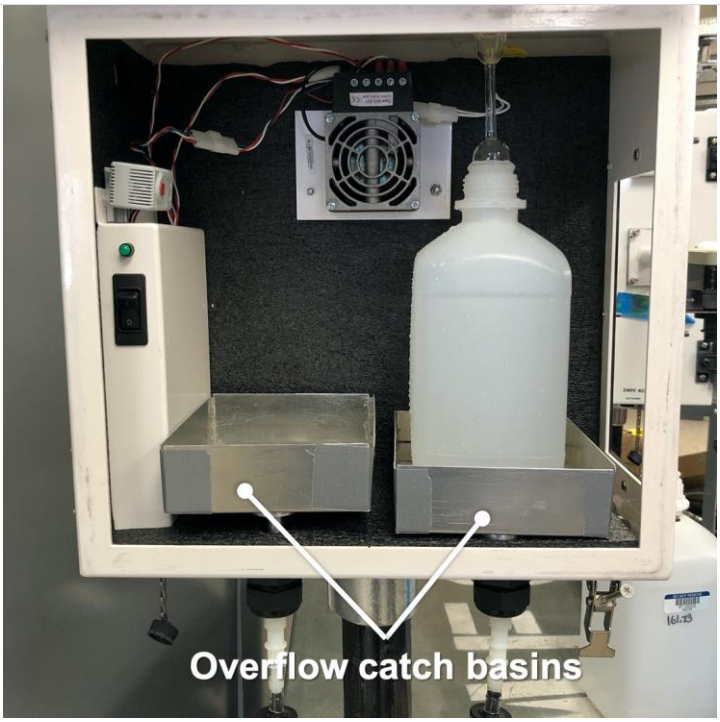


Figure 6. Overflow catch basins placement.

NOTE: Domains 03, 04, 08, 16, and 20 may require the installation of overflow catch basins to accommodate overflow during heavy rainfall events (e.g., hurricane season, heavy seasonal rains).

NOTE: The overflow catch basins have a hole and a drain port at the bottom that allows for draining of any overflowed water.

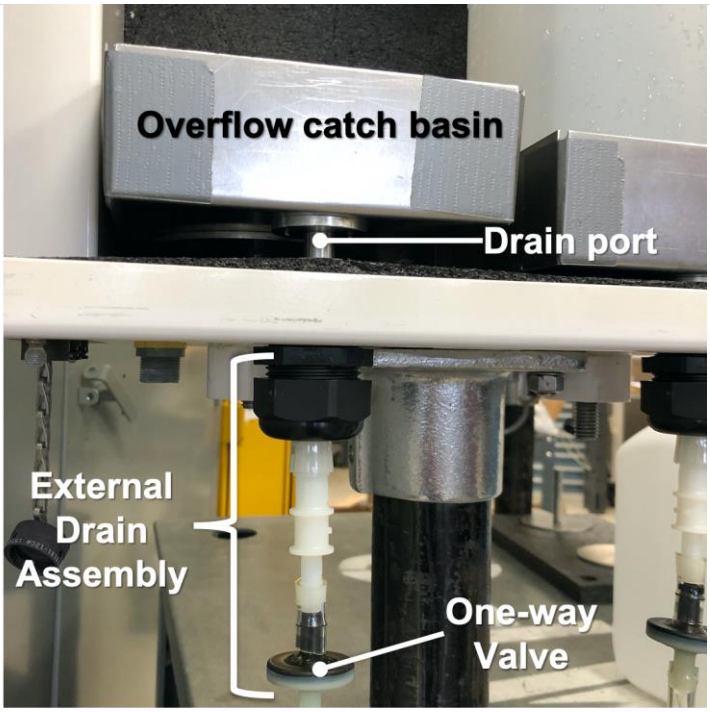


Figure 7. Close up of overflow catch basin and drain assembly.

The drain port is attached to the catch basin and rests within a wide drain hole. This allows the overflow catch basin to be raised and lowered as needed and not interfere with the external drain assembly.

The one-way valve is to help prevent insects from entering the enclosure from the drain assembly.

Figure 8. Inside each chimney is an automated silicon strip heater. This heater melts snow accumulation within the glass funnel.

Figure 9. A view of one of the internal Temperature Controllers. See **Figure 5** for the location of this Temperature Controller.

This temperature controller has the set point temperature for heater activation.

The temperature scale here is in Fahrenheit (°F).

Figure 10. View of the Thermo-electric chiller unit from inside the enclosure (see **Figure 5** for its location).

Notice there is a Temperature Controller in the lower right. This Temperature Controller has the set point temperature for when the chiller will activate.

The temperature scale here is in Fahrenheit (°F).

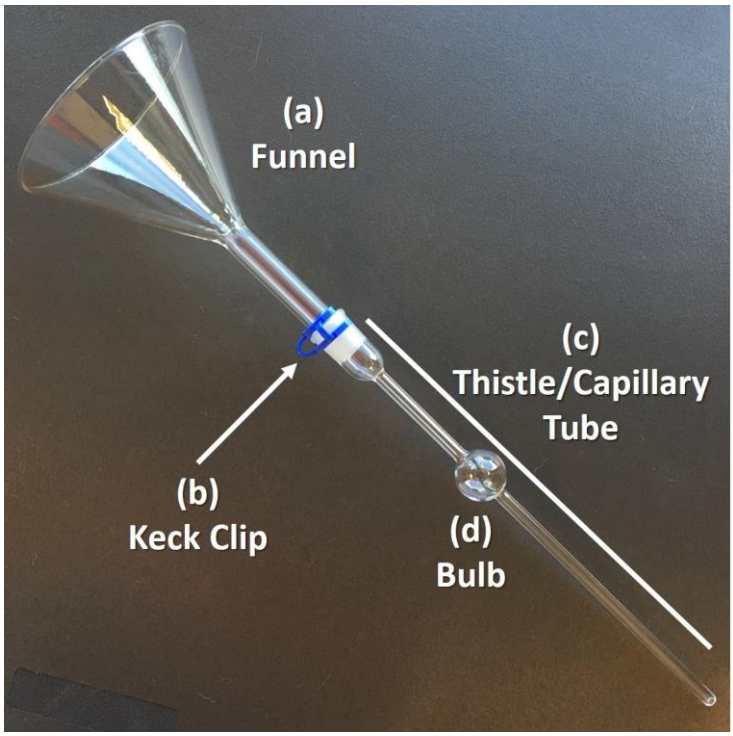


Figure 11. A fully assembled glass sample train includes:

(a) Funnel

(b) 19/22 Keck Clip

(c) Thistle/Capillary Tube (hereafter referred to only as thistle tube)

(d) Bulb of Thistle/Capillary Tube

The funnel and thistle tube have frosted glass ends that mate together, and are held together by the Keck clip.

The 19/22 signifies the joint size of the Keck clip.

The parts of the sample train should come from the external lab cleaned and packaged separately. Retain Keck clips at the site. These are NOT returned to the external lab. See also **Figure 12**.

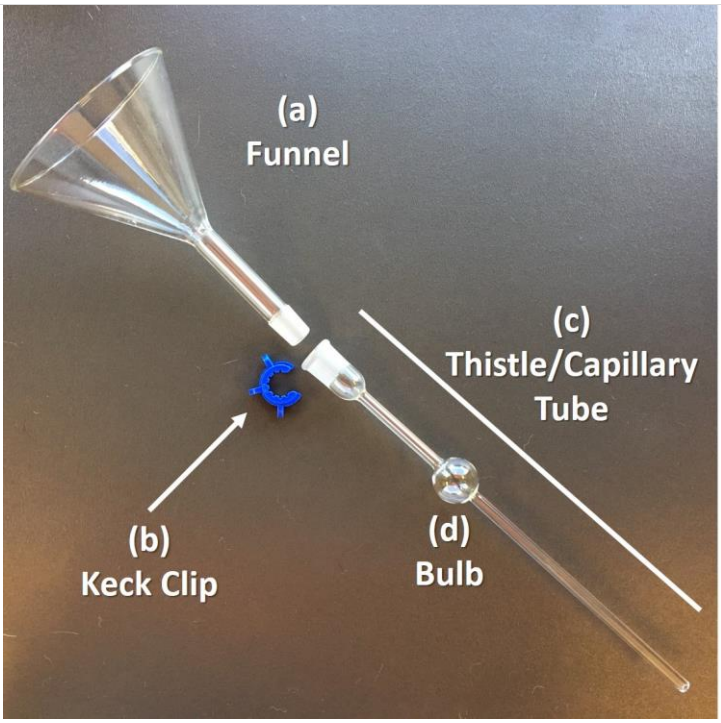


Figure 12. Expanded view of the glass sample train.

(a) Funnel

(b) 19/22 Keck Clip

(c) Thistle/Capillary Tube

(d) Bulb of Thistle/Capillary Tube

See also **Figure 11** for a fully assembled glass sample train.

The glass parts of the sample train should come from the external lab cleaned and packaged separately. Retain keck clips at the site. These are NOT returned to the external lab.

4.2.4 Sample Overview

The collection of two samples occurs during each precipitation event. Samples from one sample bottle (see Figure 5) are sub-sampled and sent to a contract laboratory for isotopic analysis (see Section 4.2.4.1 Isotope Analysis). Samples from the *other* sample bottle (see **Figure 5**) are sent to a second contract lab for chemical analysis (see Section 4.2.4.2 Chemical Analysis).

4.2.4.1 Isotope Analysis

Analysis is performed on a sub-sampling of a wet deposition sample using isotope-ratio mass spectrometry (IRMS) for the stable isotopes of ^{2}H and ^{18}O in water.

4.2.4.2 Chemical Analysis

Several types of chemical analyses are performed on the collected water samples depending on the amount of available sample returned to the contract laboratory (see **Table 5**):

Table 5. Precipitation sample volume and chemical analysis performed.

Sample Volume	Analysis
For samples < 30 mL of precipitation	Analysis performed progressively, as sample volume allows, following the order listed below: 1. Ammonium concentration flow injection analysis colorimetry 2. Anion concentrations by ion chromatography 3. Cation concentrations by inductively-coupled plasma optical emission spectroscopy 4. pH and conductivity
For sample > 30 mL of precipitation	Perform the full suite of analyses (total dissolved chemical ion concentrations of SO_4^{2-}, NO_3^-, Cl^-, Br^-, NH_4^+, PO_4^{3+}, Ca^{2+}, Mg^{2+}, K^+, Na^+, and pH/Conductivity) and archive samples if any precipitation is left over after chemical analysis.

4.3 Sensor Specific Handling Precautions

IMPORTANT: To avoid contamination of the samples, clean powder-free nitrile gloves **must** be worn at all times (specifically when conducting maintenance on the unit, and/or handling of the sample train or sample bottles). Avoid touching the inside of the sample train funnel, the inside of the bottle, or the inside of the bottle cap. Avoid handling the end of the thistle tube below the bulb.

4.3.1 Grapes and Platinum Resistance Thermometer (PRT)

The Wet Deposition Concord Grape (24V) and PRT contain electrostatic discharge (ESD) sensitive parts; therefore, the Grape and PRT require ESD (antistatic) packaging and handling during inter- and intra-site transport, reception, and storage. As a rule, when handling (installing, removing, and servicing) these electrical components, all Technicians must ground themselves. Wear an anti-static wristband and frequently touch grounded metal objects (such as unpainted metal with clear ground path) to redirect electrostatic discharge away from sensitive devices.

4.4 Operation

When there are at least five drops of precipitation by the unit's infra-red (IR) precipitation sensor, the internal drive motor moves the cover and exposes the two sampling chimneys.

The collection of precipitation that falls into the two sampling chimneys occurs via two glass sample trains, and two 84 oz. high density polyethylene (HDPE) plastic square sample bottles. A silicon strip heater resides within each chimney stack to assist in melting any frozen precipitation accumulation.

The collector lid closes the cover after 25 seconds of sensing no precipitation.

5 INSPECTION AND PREVENTIVE MAINTENANCE

NOTE: If precipitation is occurring (e.g., raining, snowing, hailing) during the scheduled routine maintenance of the system, wait until it stops and the cover of the collector closes before proceeding. If precipitation is imminent and likely to start while performing maintenance on this system, stop and conduct maintenance at a time when it could be performed without interruption. Weighing the bottles, and sub-sampling of the isotope sample bottle could be performed inside the Instrument Hut during times of unfavorable weather conditions.

NOTE: FOG – Fog is inevitable at some sites and/or during certain times of the year. Preventive maintenance can occur during times with fog, but extra care is needed to prevent sample contamination (shield the collecting surface of the funnel, and the sample bottle inlets from mist/fog accumulation). Weighing the bottles and sub-sampling of the isotope sample bottle can be performed inside the Instrument Hut during times with fog to prevent contaminating the collected samples.

5.1 Preventive Maintenance Procedure

Begin preventive maintenance by first reviewing **Table 6** below and then Section 5.2, to understand the order of the procedure.

Table 6. Preventive Maintenance Frequency and Schedule.

Maintenance	Bi-Weekly	Annual	As Needed	Type	Notes
EXTERIOR					
Visual Inspection					
Mounting Hardware	X			P	
Cables and Connectors	X			P	
Moving Cover Lid Seal	X			P	
Chimney Gaskets	X			P	
Precipitation Sensor	X			P	
Moving Cover	X			P	
Thermo-Electric Chiller	X			P	
Clean					
Exterior	*X*			P/R	
Splash Shield	*X*			P/R	
Moving Cover Lid Seal	X			P/R	
Chimney Gaskets	*X*			P/R	
Thermo-Electric Chiller	*X*			P/R	
Precipitation Sensor	X			P/R	

Maintenance	Bi-Weekly	Annual	As Needed	Type	Notes
Adjustments					
Moving Cover			X	R	
Replacement					
Grape - Concord 24V		X	X	P/R	Requires annual calibration and validation (Sensor Refresh)
Moving Cover Motor			X	R	
Moving Cover Lid Seal		X	X	P/R	Twice a year
Chimney Gaskets			X	R	
Mounting Hardware			X	R	
Thermo-Electric Chiller			X	R	
INTERIOR					
Visual Inspection					
Interior	X			P	
Door Seals	X			P	
Glassware - Sample Trains	X			P	
Plastic Sample Bottles	X			P	
Overflow Catch Basins	X			P	If applicable
Insulating Foam	X			P	
Funnel Strip Heaters	X			P	
PRT (not touching back panel)	X			P	
Temperature Set Points	X			P	
Temperature Validation					
PRT validation with thermometer	X			P	If internal thermometer is not visible (due to temperatures being too cold and LCD is black), this step can be skipped until next maintenance bout.
Clean					
PRT	X			P/R	
Adjustments					
Temperature Set Points			X	R	
Replacement					
Glassware - Sample Trains	X			P	
Plastic Sample Bottles	X			P	
PRT			X	R	
Chimney Gaskets			X	R	

Maintenance	Bi-Weekly	Annual	As Needed	Type	Notes
Insulating Foam			X	R	
Mounting Hardware			X	R	
Funnel Strip Heaters			X	R	
Internal Fans			X	R	
Door Seals			X	R	

NOTE: The biweekly and annual inspections should be carried out regardless of whether they coincide or not. P = Preventive, R = Repair, *X* = Indicates preventive maintenance task time interval may increase due to environmental (season/weather) or unforeseen/unanticipated site factors.

5.2 Preventative Maintenance Procedural Sequence

The sequence for routine preventative maintenance of the Wet Deposition Collector is, as follows:

1. Preparation for the site visit.
    a. Check preventive maintenance schedule (Section **Table 6**)
    b. Inspect glassware (Section 5.3.1)
    c. Assemble supplies and consumables (Section 5.3.2 and 5.3.3)
2. Initial Inspection (Section 5.6.2)
3. Cross-check internal enclosure temperature (Section 5.6.3)
4. Verify operation of the Moving Cover (Section 5.6.3)
5. Inspect the Thermo-Electric Chiller Unit (Section 5.6.5)
6. Remove sample bottles and sample trains (Section 5.6.6)
7. Record sample condition information in (TIS_AIS) Wet Deposition COLLECT[PROD] Fulcrum application.
8. Verify temperature set points (Section 5.6.7)
9. Clean the collector (Section 5.6.8)
10. Inspect the funnel strip heaters (Section 5.6.9)
11. Deploy new sample bottles and sample trains (Section 5.6.10)
12. Restart the collector (Section 5.6.11)
13. Weigh sample bottles and record weights in (TIS_AIS) Wet Deposition COLLECT[PROD] Fulcrum application.
    a. Sub-sampling for water isotope analysis (Section 5.6.7)
        i. Note: this step can be performed in the hut or in the DSF after bottle collection.
14. Fill out the Set information in (TIS_AIS) Wet Deposition COLLECT[PROD] Fulcrum application.
15. Ship samples (appendix and NEON.DOC.005224)

5.3 Preparation for Site Visit

5.3.1 Inspect Glassware and Plastic Sample Bottles

An external contract laboratory cleans and delivers pre-cleaned and pre-packaged glass sample train components (funnels and thistle tubes) as well as plastic sample bottles and caps.

5.3.1.1 Glass Sample Train Components and Plastic Sample Bottles

1. Verify that the shipping containers have been received from the contract laboratory and that no external damage is present. A damaged box could indicate broken glassware inside.
2. Inspect the outside of the cardboard shipping containers for the "Use By" label (see) and ensure the date is not past.
    - Glassware and sample bottles that are past the "Use By" date on the label should be sent back to the lab for cleaning.

    Glassware is analytically clean and useable within a year of cleaning.
3. Open the shipping container holding the pre-cleaned and pre-packaged glass sample train components (see **Figure 17**).

Figure 13. Use By date on glassware and plastic sample shipping boxes.

Put on a new and clean pair of powder-free nitrile gloves *BEFORE PROCEEDING.*

4. **Do not remove the glass sample train components or sample bottles from their plastic packaging!**
    - Verify there are two of each sample train component, and two plastic sample bottles. Each component is individually packaged in sealed plastic bags.
        i. If any appear to be broken, obtain a piece from a backup set.
            - Email the contract laboratory with a picture of the barcode (make sure the number is visible) from the broken piece of glassware. You do not have to send the broken piece back to the lab.
              Email: cal@isws.illinois.edu
        ii. If any appear to be dirty or suspect possible contamination, do not use that piece. Obtain a piece from a backup set.
            - Send the piece of glassware back to the contract laboratory for cleaning and replacement.
    - Verify that each piece of glassware (thistle tubes and funnels) have a readable barcode.

i. If there are no attached barcodes, do not use that piece of glassware. Obtain a piece from the backup set that does have a barcode.
   - Send the piece of glassware back to the contract laboratory for cleaning and replacement.

- Inspect the two plastic sample bottles.
  i. The contract laboratory should have written the tare weight on the side of the bottle in permanent marker.
     - If there is no tare weight on the side of the bottle, do not use the plastic bottle. Obtain a piece from the backup set, and send the plastic bottle back to the lab.
  ii. There should also be a barcode on each sample bottle.
     - If there is no barcode on the bottle, do not use the plastic bottle. Obtain a piece from the backup set, and send the plastic bottle back to the lab.

5. Return inspected glassware back into their shipping containers, and stage with equipment for the site.
6. Repeat Steps 1-5 above for the second set of glassware (your backup set).

NOTE: Due to the delicate nature of glass sample train components, and the possibility of glass contamination during maintenance, ensure two full sets of clean sample train components and plastic sample boxes are brought to each site visit. You can maintain a backup set within the tower hut but be sure to rotate the glassware to ensure it is used before the “Use By” date.

5.3.2 Preparing Supplies for the Field

Staff should prepare for the field by adhering barcodes to one bag containing an HDPE bottle for the chemistry sample and one 16 mL glass vial for isotope subsampling. Apply barcodes approximately 30 minutes prior to use to ensure adherence. These barcodes should be scanned into the appropriate fields in the Wet Deposition COLLECT fulcrum application.

5.3.3 Assemble Supplies and Consumables

This maintenance procedure requires the use of several items and consumables. See Section 5.4 Equipment for a list of items.

IMPORTANT: Be sure to have at least 3-6 NEON Type I Barcodes when doing this preventive maintenance procedure.

5.4 Equipment

Table 7. Tools, Consumables, and Resource Lists for preventive maintenance.

P/N	Description	Quantity
	Tools	
Generic	Laptop with Network Connection & Data Monitoring Software	1
Generic	Handheld Mobile Recording Device or Tablet	1
Generic	Allen Wrench set (including 3/16th & 1/8th in.)	1
	Consumable items	
Generic	Multi-surface Cleaner (e.g. Formula 409, Simple Green) (32 oz. spray bottle)	A/R
Generic	Distilled or Deionized water (Squirt/Spray Bottle)	A/R
Generic	Lint-free Cloths or Microfiber Towels (4.5" x 8.5")	A/R
Generic	Powder-free Nitrile Gloves	5-6 pairs
Generic	Trash bag(s)	A/R
Generic	Rags or Roll of Paper Towels	A/R
Generic	Soft Bristle Brushes (various sizes)	A/R
Generic	Anti-static wrist band	1-2 (A/R)
Generic	NEON Type I Barcodes	3-6 (A/R)
Generic	16 milliliter (mL) Clear Glass Vial with Black Phenolic Cap and 14B Liner	2
Generic	60 mL syringes, with Luer-Lok tip, 1 mL graduations	2
MX109591	Syringe Filter, Nonsterile, Nylon, 0.20µm, Diameter: 33 millimeter (mm)	4
Generic	Paraffin Film	A/R
S-10835	ULINE – 16 X 16”, 3 Mil, Slider Zip Bags • For 84 oz. Plastic Sample Bottles	2 (A/R)
S-3122	ULINE – 8 x 12", 4 Mil, Resealable Bags • For Funnels	2 (A/R)
S-6961	ULINE – 4 X 15”, 4 Mil, Resealable Bags • For Thistle Tubes	2 (A/R)
S-1302	ULINE – 4 X 6”, 4 Mil, Resealable Bags • For Isotope Sample Vials • For Isotope Sample Vials	2-4 (A/R)
37230	Loctite QuickStix Silver Anti-Seize LB 8060 (for TIS Infrastructure)	1 (A/R)
80337	SAF-T-LOK SAFTEZE Food/Drug Grade Anti-Seize (for AIS Infrastructure)	1 (A/R)
	Durable Items	
	Portable Digital Scale (5 kilogram (kg) capacity) • OHAUS CS Series Compact Scale, Model CS5000	1
00613MB	Indoor Thermometer and Humidity Monitor • AcuRite, Model 00613MB https://www.acurite.com/humidity-temperature-monitor-00613.html	1
	84 oz. Kautex HDPE Plastic Narrow Neck Square Bottle [Color: Natural] •	2
	45 mm Blue PP Plastic Kautex Tamper-Evident Caps •	2
	Glass Sample Funnel Sensor Acsry, Sample Train Funnel	2

	Glass Thistle Tube, Sensor Acsry, Thistle Tube	2
	19/22 Keck Clip Sensor Acsry, Keck Clip - Funnel/Thistle Tube Connector	2
	Overflow Catch Basins ○ Contact HQ to order parts if needed ○ See also RD [12] for assembly instructions	2
Shipping Containers		
S-19764	ULINE Magnum Bottle Shippers – 2 Bottle Pack • Shipping of glass funnels (Qty. 2 funnels sent per box).	1
S-13291	ULINE 11 x 11 x 5” Corrugated Box • Shipping of plastic sample bottles and caps (Qty. 2 per box)	1
S-1617	ULINE Snap-Seal Tubes - 1 1⁄2 x 15", .060" thick • Shipping of thistle tubes (Qty. 1 per tube)	2

5.5 Subsystem Location and Access

The subsystem is located at the top of the tower at terrestrial (TIS) sites, and on the ground at aquatic (AIS) sites.

5.6 Maintenance Procedure

See **Table 6** for the Preventive Maintenance Frequency and Schedule.

IMPORTANT: All work for maintenance and collection should be recorded in the (TIS_AIS) Wet Deposition COLLECT [PROD] application while work is being performed. Data entry should not occur post-processing as it leads to transcription error and improper data management.

5.6.1 Timelines and Conditions

Table 8. Sample Timing

Procedure	Timing	Notes
Collection	14 Days, 26 bouts / year	Collections > 21 days are discarded
Chemistry Shipping	Hold time up to 16 days	Hold at 4C
Isotope Subsampling	Within 24 hours of collection	Helps reduce isotopic fractionation due to evaporation
Isotope Shipping	Bimonthly with Aquatic Isotope samples	Can be stored at room temperature

Table 9. Sample Timing Contingencies

Event	Action	Impact on sample
Sample window < 14 days	None, proceed with collection	None
Sample window >14 days < 21 days	Collect sample	Not ideal, sample has likely undergone excessive nitrogen transformation and evaporation in collector
Sample window >21 days	Discard sample, Create Incident	Level of potential degradation too great, invalid sample
Isotope not subsampled within 24 hours	Continue to isotope subsample, Submit Incident Ticket	Sample subject to more evaporation in headspace of HDPE bottle
Chemistry sample not shipped within 16 days	Ship sample, submit INC for guidance	Continued nitrogen transformations and degradation of sample

1. Perform sampling every 11-16 days. The National Atmospheric Deposition Program and the World Meteorological Organization strongly discourage sampling greater than 8 days apart. NEON recognizes that site visits are expected on a biweekly basis and has lowered this requirement. **Samples should only exceed 14-day collection windows in extenuating circumstances.** If samples are left in the collector for >21 days, discard them and submit an Incident Ticket.
2. Isotope H_2O samples.
    a. Filter and process samples as soon as possible in the field or upon return at the Domain Support Facility (DSF). This threshold should **not exceed 24 hours.**
    b. Samples should be shipped Ground every 2 months per CLA (collections and laboratory analysis) schedule.
3. Chemistry samples
    a. Complete all field related data entry in the field. If samples are weighed and processed in the lab, complete sample processing data entry at the DSF.
    b. Ship chemistry samples via ground after each sampling event, with a hold time up to 16 days if stored in +4C.
    c. **IMPORTANT:** If a chemistry sample is trace/dry, still ship it with a barcode and a manifest. If the sample has been discarded due to exceeding the allowable time in the collector, make a note that sample bottle is being sent for cleaning, and do not include a manifest or a barcode.

5.6.2 Initial Inspection

1. Observe the immediate area surrounding the collector if any conditions are found that may affect the integrity of the samples (e.g., insect or bird nests nearby, fire in the vicinity, windstorm, vandalism, dirt, pollen, or debris accumulation).
    a. Record these observations on the (TIS_AIS) Wet Deposition COLLECT [PROD] Fulcrum app.
2. Inspect the exterior for any damage.
    a. Record damage on the datasheet and/or the mobile recording app.
3. Inspect connections and ensure they are secure.
    a. Use caution for electrical connections: power down the sensor via removing the Ethernet cable from the Concord Grape to de-energize the Grape to mitigate damage to the equipment or switch off the communications box in the tower top breaker, then power down the sensor and check connections to Grape or Sensor for corrosion at connection site, over-heating, dust and/or debris.

    NOTE: Disconnecting the Grape does NOT disconnect the 240VAC.

    b. Remove dust by dabbing electronic areas (e.g. Precipitation Detector, Chiller Unit) with a lint free cloth. Wiping may cause static, which imposes a risk in the event the power is not off.
    c. Do not use compressed air around power supply units or breaker terminals.
4. If there is snow accumulation on the instrument, use a clean soft bristle brush to sweep away the snow from:
    a. Splash Shield
    b. Moving Cover
    c. Top of the Precipitation Detector
    d. Area around the dual chimneys
5. Inspect the arms of the Moving Cover and ensure there is no debris blocking its operation.
6. Inspect the internal PRT and make sure it is not touching the enclosure foam, the plastic sample bottles, or (if installed) the overflow catch basins.

5.6.3 Cross-Check Internal Enclosure Temperature

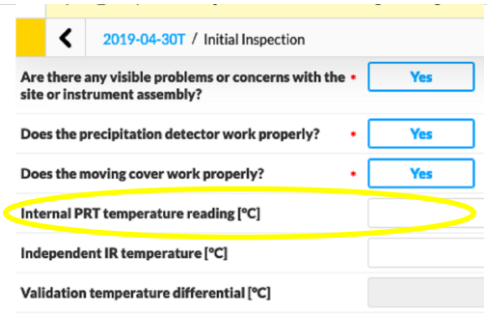
Cross-check internal PRT temperature of the environmental enclosure against the outside temperature via an external, independent temperature sensor. Monitor the internal PRT using a laptop with Network connection and active data monitoring software.

The internal PRT is calibrated only ONCE (before deployment) and it is not returned and recalibrated yearly (like the other PRT sensors). The PRT within the enclosure is a check on the heater and cooling system and whether those units are functioning as expected. This temperature is not a data product but

is used in conjunction with heater and cooler on/off status to determine if these systems are functioning correctly.

A temperature cross-check of the PRT is therefore done to make sure the PRT is functioning properly.

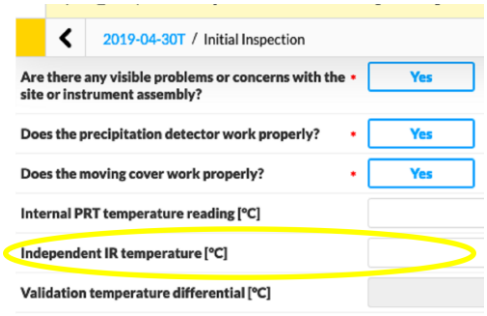
Table 10. Procedure to cross-check the internal enclosure temperature.

	**Step 1.** Connect laptop to the internal network, and using your data monitoring software, call up the PRT temperature from the Wet Deposition Collector. NOTE: Temperature can also be referenced post collection using L0 data viewers.
	**Step 2.** Enter the internal PRT temperature into the Fulcrum app. NOTE: Temperature can also be referenced post collection using L0 data viewers.
	**Step 3.** Unlatch the two latches on the closed door and open the door.

Step 4. Record the temperature showing on the indoor thermometer placed within the enclosure.

Record this temperature in Celsius (°C).

NOTE: Record the temperature as quickly as possible.



Step 5. Enter the internal (independent) temperature recorded above into the Fulcrum app.

NOTE: The Fulcrum app calculates the temperature differential once the internal PRT temperature and independent temperature readings are entered.

If the temperature differential is > 3°C, submit a ticket via the NEON project's issue reporting system.

5.6.4 Verify Operation of the Moving Cover

Table 11. Procedure for verifying the operation of the moving cover.

Step 1. Wave fingers or hand slowly vertically in-and-out of the Precipitation Detector until the Moving Cover begins to open.

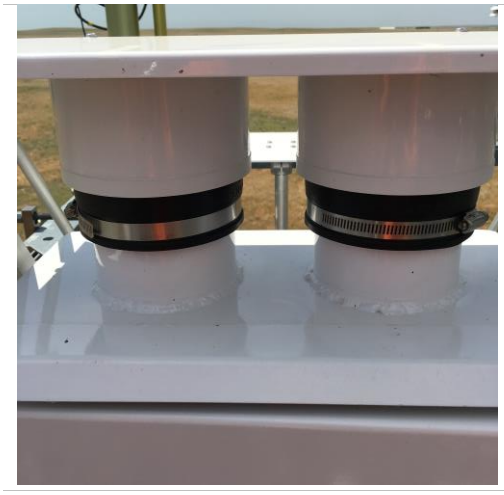
Moving a hand vertically in-and-out of the detector simulates a precipitation event and opens the Moving Cover.

NOTE: The Fulcrum App asks, "Does the optical precipitation sensor work properly?" You can select "No" and then further explain the problem in "Remarks on equipment problems or concerns" section.

Step 2. As the Moving Cover opens, observe its full range of motion. Movement should be smooth and consistent.

The Moving Cover should move all the way to the Splash Shield without touching it.

NOTE: If no precipitation occurs within 25 seconds, the sensor starts to close, so additional hand movements may be needed to have the lid open fully.



Step 3. Observe the Moving Cover as it closes. Again, the movement should be smooth and consistent.

The Moving Cover stops on top of the two sample chimneys when fully closed.

NOTE: The Fulcrum App asks, "Does the Moving Cover work properly?" You can select "No" and then further explain the problem in "Remarks on equipment problems or concerns" section.

Step 4. Inspect the seal between the bottom of the Moving Cover and the top of the two chimneys.

The bottom of the seal should rest snugly on top of the two chimneys without a gap.

If there is a gap, see Section 7.7 on Adjusting the Alignment of the Moving Cove, or Section 7.8 on Adjusting the Chimney Heights.

Step 5. Inspect the black rubber gasket and the hose clamp.

Ensure the rubber is not cracked or ripped, and the hose clamp holds the rubber gasket snugly to the chimney. If so, replace the black rubber gasket.

Step 6. Inspect the arms of the moving cover. Gently twist the rear arms, they should move slightly and should not be seized.

If these are extremely difficult to move, or seized, see next Step.

	**Step 7.** Inspect the four spherical ball joints at the end of the rear Moving Cover arms. There should be some movement when the arms are slightly twisted (previous Step).

If there are issues with the Moving Cover, the arms, and/or the operation of the drive motor, please make a note within the Wet Deposition COLLECT App and submit a ticket via the issue reporting system.

5.6.5 Inspect the Thermo-Electric Chiller Unit

Table 12. Procedure to inspect the thermo-electric chiller unit.

	**Step 1.** Look underneath the shroud of the thermo-electric chiller unit. Inspect the fan and heatsink fins. Remove obstructions, if present.

5.6.6 Remove Sample Bottles and Sample Trains

Two identically configured glass sampling trains and plastic sample bottles are employed in the Wet Deposition Collector. The preventive maintenance procedure below is the same for both. For

consistency, conduct these procedures from the right sample to left sample. This will align with the instructions in **Table 13** below.

Table 13. Procedure for removing glass sample bottles and sample trains.

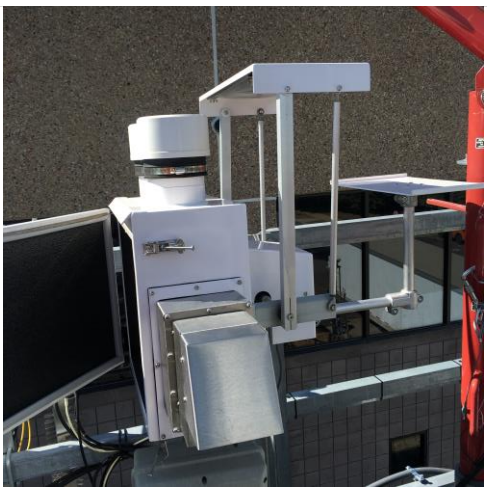
	**Step 1.** Unlatch the two latches holding the closed door and open the door.
Step 2. Put on clean pair of powder free nitrile gloves.	
	**Step 3.** Inspect the condition of two sample bottles. Make a note on each separate sample, or both if their conditions are the same. Make note of sample conditions in the Fulcrum application

Step 4. If using overflow catch basins, and evidence of overflow on the sample bottles exist, ensure the overflow basin drained properly. Note condition in the fulcrum application.

If the overflow basins did not drain properly, make a note and submit a ticket via the NEON Program's issue reporting system.

NOTE: There is a drain hole at the bottom of each catch basin, excessive overflowed water should have drained to the outside.

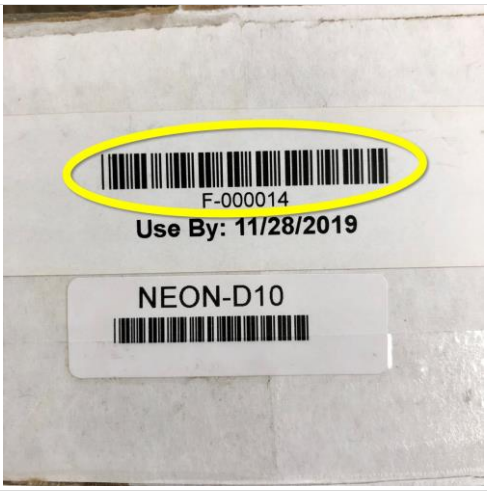
Step5. Slowly wave a hand (with fingers spread open) vertically in-and-out of the Precipitation Detector until the Moving Cover begins to open.



Step 6**.** Allow the Moving Cover to open until it is about halfway to fully open, or until the funnels are fully uncovered, and flip the power switch (see **Figure 5**) to the off position.

Turning the power off stops the Moving Cover in place.

NOTE: The Moving Cover must provide enough clearance for unobstructed removal of the glass sample trains.

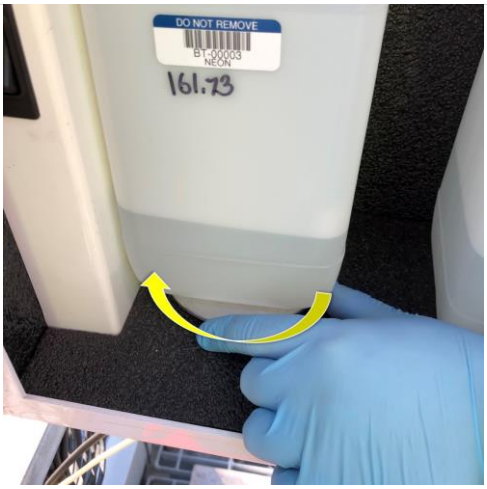


Step 7. Locate the lab provided barcode on the shipping boxes (there is one on each box), and scan with the mobile recording app, or record the number on the datasheet.

There is a barcode on each box:

1. Glassware shipping box (white box)
2. Plastic sample bottles box (brown box)

NOTE: Follow **Step** through **Step** for chemistry and isotope bottles.



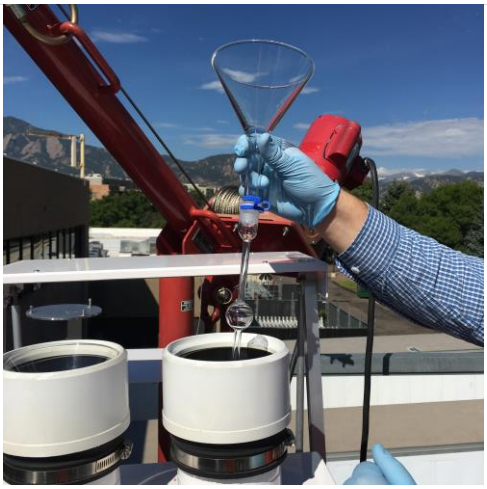
Step8. Lower the plastic sample bottle by rotating the metal bottle holder tray **clockwise** until the bottom of the bulb of the thistle tube clears the opening of the sample bottle.

Step 9. Carefully grasp and lift the thistle tube up.

Lift it high enough to safely grab the outside of the funnel from of the top of the chimney.

Step 10. With the other hand, grasp the outside of the funnel.

NOTE: Dirty glassware does not need to be handled by the outsides only, but it is a good habit to do so anyway so you do not accidentally touch the inside of a clean funnel.

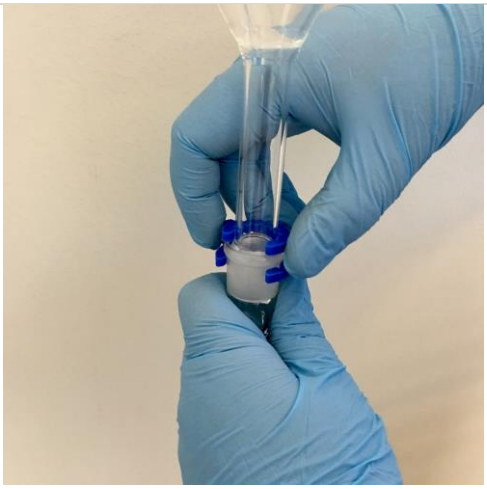


Step 3. Lift out the entire glass sample train from the chimney.

NOTE: Try to pull the sample train as straight as possible to avoid hitting the sides of the sample bottle, and the insides of the chimney.

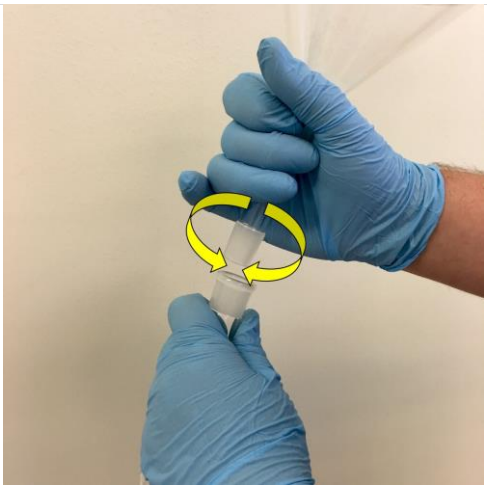
Step 12. Remove a clean bottle cap from its plastic bag.

Step 13**.** Tighten the cap on to the sample bottle.



Step 14. Carefully remove the Keck clip from the assembled sample train and set aside.

NOTE: Keck clips remain with the Domain. Use the Keck clips again with the new cleaned sample trains. Do not ship any Keck clips to the lab for cleaning.



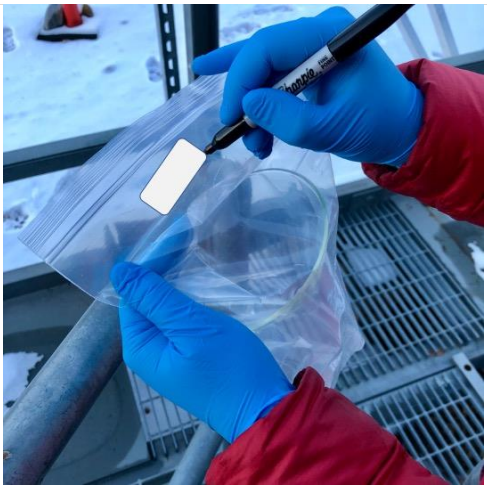
Step 15. With a slight twisting motion, carefully disassemble the funnel from the thistle tube.

Step 16**.** Locate the lab-provided barcode on the funnel, and scan with your mobile recording app, or record the number on the datasheet.

NOTE: Make note as to whether this was used in the Chemistry or Isotope collection.

Step 17. Place the funnel into a 8 X 12”, 4 mil, resealableplastic bag and seal.

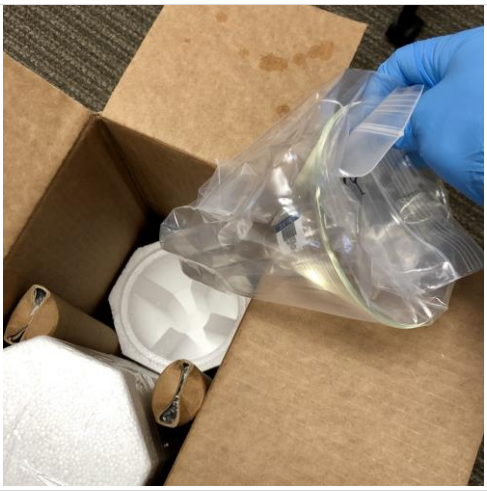
NOTE: If glassware is excessively dirty, it should be rinsed before being shipped to the lab. Contamination should also be noted in the data entry application.



Step 18**.** Label the plastic bag, or use some other form of mark or tag (e.g. tape, flagging) to indicate the glass sample train is dirty or used. You may also want to use a “C” for chemistry or “I” for isotopes, to avoid confusion.

Do NOT write “Dirty” on bags – this confuses the lab.

Immediate labeling of the plastic bags mitigates confusion between clean glassware.



Step 19. Place bagged funnel into ridged half of the Styrofoam case. Place funnel so narrow end fits within the center of the ridges of the Styrofoam.

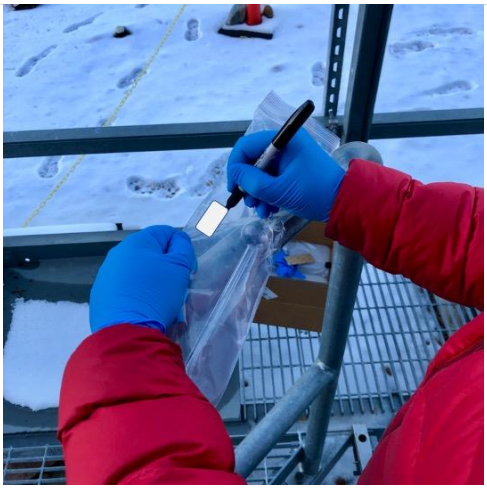
NOTE: There are two halves of the Styrofoam case. Insert the narrow end of the funnel into the ridged portion of the Styrofoam case (see Figure 21).

Step 20. Place the other Styrofoam case half over the half with the funnel.

Step 21**.** Locate the lab provided barcode on the thistle tube, and scan with your mobile recording app, or record the number on the datasheet.

NOTE: Make note as to whether this was used in the Chemistry or Isotope collection.

Step 22. Place the thistle tube into a 4 X 15”, 4 mil, resealableplastic bag and seal.

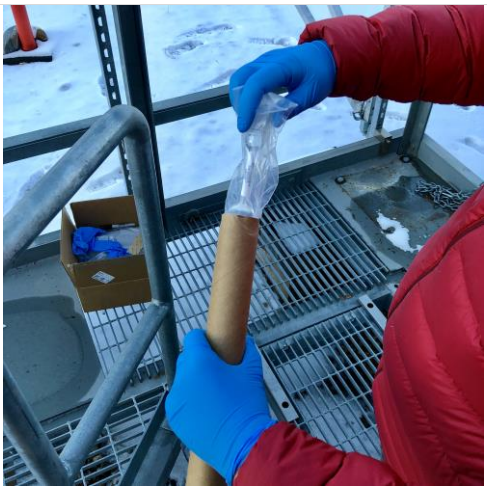


Step 23**.** Label the plastic bag, or use some other form of mark or tag (e.g. tape, flagging) to indicate the glass component is dirty or has been used. You may also want to use a “C” for chemistry or “I” for isotopes, to avoid confusion.

Do NOT write “Dirty” on bags – this confuses the lab.

Immediate labeling of the plastic bags mitigates confusion between clean glassware.

Step 24. Carefully roll or fold the around the thistle tube so it will fit inside the cardboard shipping tube.



Step 25. Place the thistle tube into the cardboard shipping tube, place small amounts of bubble wrap at the ends, and fold the ends over.

To prevent damage to the thistle tube, make sure a small amount of bubble wrap or foam is present at each end of the shipping tube.

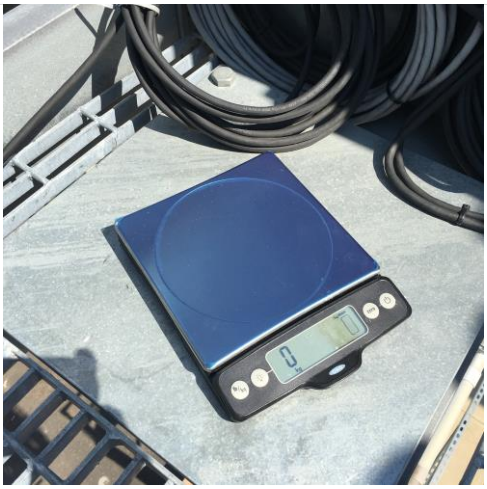
NOTE: If the tube does not easily fit, do not force it, rather reroll the bag tighter and try again.

Step26. Fold the tube ends over and place the packed cardboard tube into the shipping box.

Step 27. Locate the lab provided barcode on the sample bottle, and scan with your mobile recording app, or record the number on the datasheet.

NOTE: You will need to make note as to whether this was used in the Chemistry or Isotope collection.

Complete Steps 27 through 34 in the Hut or back at the Domain Support Facility (DSF) lab.



Step28. Remove the field scale from its travel case and turn on. Place in a stable, flat and level location and zero the scale.

NOTE: Set the scale so the units are grams.

Steps 27 through 35 can be completed in the Hut or back at the DSF lab.

Step 29**.** Place the capped sample bottle on the scale and record the weight (in grams to the hundredths place).

Step 30**.** Record the tare weight written on the side of the sample bottle in the fulcrum app or datasheet.

NOTE: Written tare weight is in grams.

Step 31**.** Record the tare weight etched on the cap.

NOTE: Etched tare weight is in grams.

If you measured the sample weight with the lid on, check the "Did you take the Ending Chemistry Bottle Mass with the cap on?" box in the Fulcrum app, and enter the weight in the field that appears.

Step 32. Place the labeled and sealed glass sample bottle into a 16 X 16", 4 milresealable resealable zip slider plastic bag and seal.

Step 33. Confirm Lab barcodes for chemistry sample are with the bag that has attached NEON barcode.

NOTE: **No barcode is needed on the bag for the isotope bottle. Avoid writing "Dirty" on this bag as per external lab request.** ***PRO TIP:*** *Labeling the outside of the bag with sample ID may be helpful for domain sample management: Chemistry bottle ID:WDP.SITE.YYYYMMDD.CHM*

Step 34 Secure the cap by wrapping some parafilm around the cap and the neck of the bottle.

This prevents the lid vibrating loose during shipment.

Step 35. Place the bagged sample bottle inside the shipping box.

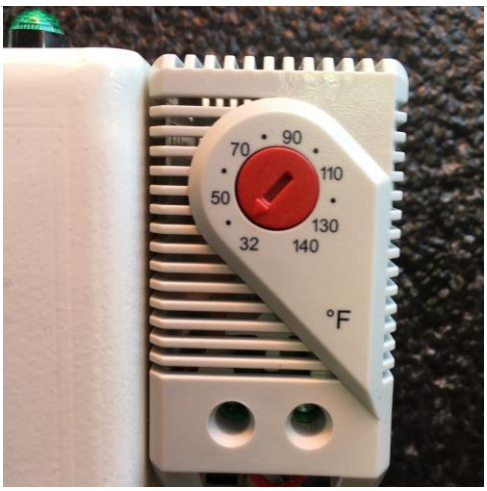
Step 36. Repeat Step 7 through **Step** for the second sample bottle.

IMPORTANT: After capping, weighing, and recording all relevant data the Isotope bottle needs to be subsampled for analyses. See **Section** 5.6.12 **Verify Temperature Set Points**

The temperature range within the environmental enclosure is set to 3° C (37.4° F) and 25° C (77.0° F). Two Temperature Controllers are located within the environmental enclosure to control this temperature range. One is located on top of the power supply (see **Figure 5**), which controls for the temperature set point to active the heaters. The other is located on the Thermo-electric chiller unit (see **Figure 5**, and **Figure 10**).

Verify the temperature set points during each maintenance interval to ensure they are accurate. This allows Technicians to identify any issues and mitigate any accidental changes (particularly, the temperature controller on the Thermo-electric chiller unit) when collecting samples from the instrument enclosure.

Table 14. Procedure for verifying the temperature set points.

	**Step 1.** Verify the set point is ~37 °F via the Temperature Controller on top of the power supply (see **Figure 5**).

Step 2. Verify the set point is ~77 °F on the Temperature Controller on the Thermo-electric chiller (see **Figure 5** and **Figure 10**).

5.6.7 Cleaning the Collector

After removing the samples and glassware from the enclosure, access to the main components of the collector are ready for cleaning. Clean the external surfaces of the collector with a multi-surface cleaner (e.g., Formula 409, Simple Green); however, surfaces that may lead to the potential contamination of samples/sample areas, use distilled/deionized water or ethanol in colder climates/seasons with a lint-free or microfiber cloths.

NOTE: Ethanol is acceptable to use for cleaning external surfaces in cold or freezing weather. Since the use of ethanol to clean increases the degradation of rubber and plastic surfaces, minimize its use unless it is under conditions that warrant it (cold and/or freezing temperatures).

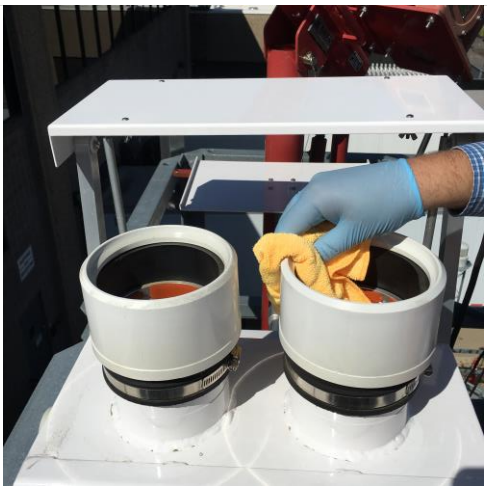
Always spray the multi-surface cleaner/ethanol and/or distilled/deionized water directly onto a cloth. **Do not spray any cleaning materials directly on the surface of the collector**. Multiple changes of powder-free nitrile gloves and frequent discarding of lint-free cloths are necessary to conduct the next set of procedures; ensure ample supply of these items are available.

Table 15. Procedure for cleaning the sensor body and associated components.

Step 1. Put on a new pair of powder-free nitrile free gloves.

Step 2. Spray the multi-surface cleaner on to a clean lint-free cloth.

NOTE: Considerable buildup of dirt may occur on the external surfaces of the collector. If the lint-free cloth becomes excessively dirty, please exchange the cloth for a new one and repeat as necessary.



Step 3. Clean both white chimney caps by wiping down the neck of the chimneys. Start from the top of the chimney down. Re-apply cleaner to the lint-free cloth, if necessary.

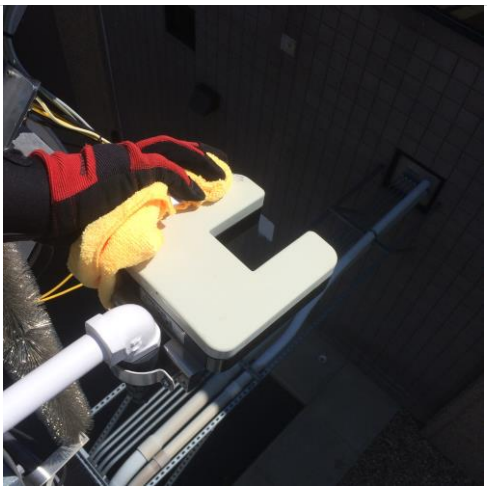
Step 4. Remove the PVC cap and inspect the gasket. Clean if necessary.

Ensure the rubber is not display evidence of wear, such as cracks or rips. Ensure the hose clamp holds the rubber gasket snugly to the chimney.

Step 5. Clean the top surface of the body of the collector, and wipe down the sides, as well. Re-apply cleaner to the lint-free cloth, if necessary.

Step 6. Clean the top surface of the Moving Cover.

Step 7. Clean the top surface of the Splash Shield.



Step 8. Clean the Precipitation Sensor. Top, sides, bottom, as well as within the "U" shaped part of the sensor.

Step 9. Discard all dirty gloves. It is OK to re-use microfiber or lint-free cloths on another bout after washing them.

Step 10. Put on a new pair of powder-free nitrile free gloves and ready a fresh lint-free cloth.

	**Step 11.** Spray/squeeze distilled/deionized water onto the lint-free cloth.
	**Step 12.** Clean the underside of the seal on the Moving Cover with the distilled/deionized water. **IMPORTANT: Do not use multi-purpose cleaner on the lid seal, only use distilled/deionized water**. Ethanol is OK to use during freezing temperatures. While cleaning, inspect the condition of the seal material for cracks and/or tears. *If there are issues with the seal, replacement may be necessary. Submit a ticket via the NEON Program's issue reporting system.*

5.6.8 Inspecting the Funnel Strip Heaters

Inspect the two funnel strip heaters. Do not conduct this procedure until after removing the sample glassware and cleaning of the exterior housing.

A silicon strip heater resides within both chimney stacks to melt frozen precipitation within the glass sample funnel.

Table 16. Procedure to inspect the funnel strip heaters.

Step 1. Check the condition of the strip heaters within each chimney stack. Look for whether the heaters are pulling away from the inside of the chimney.

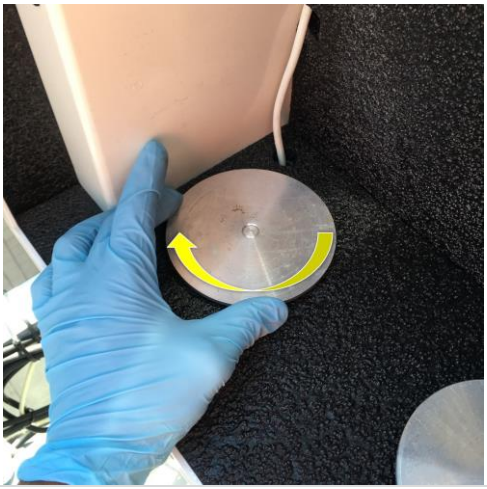
If there are issues with the funnel strip heaters, submit a ticket via the NEON Program's issue reporting system.

5.6.9 Deploying New Sample Bottles and Sample Trains

This section provides procedures on installing new sample bottles and sample trains. Conduct this procedure after procedures Section 5.6.1 through Section 5.6.9 are complete. Start with deploying the sample bottle located on the right of the enclosure, and do not move on to the left until completely installing each component to the right (the glass sample train). Repeat the process on the left. This streamlines the installation process, which aligns with the procedures outlined below.

Table 17. Procedures to deploy new sample bottles and sample trains.

Step 1. Put on a new pair of powder-free nitrile free gloves.



Step 2. Lower the sample bottle holder by turning it clockwise until it is all the way down.

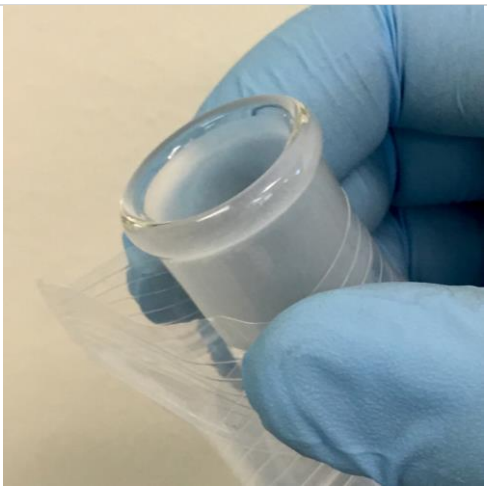
Step 3. Remove a clean plastic sample bottle from its plastic bag and place it on the bottle holder.

Step 4. While still inside the plastic bag, orient the narrow end of the funnel so it is facing towards the resealable bag opening.

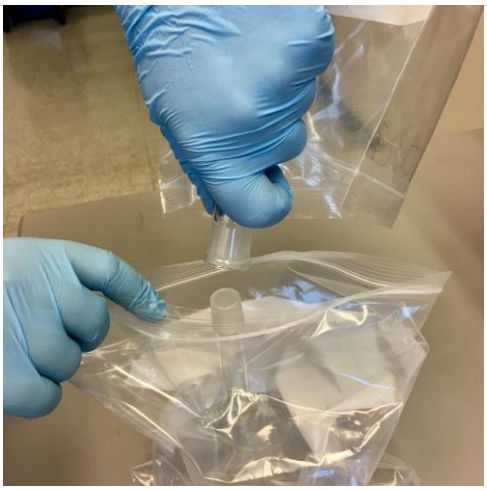
The funnel may already come from the contract laboratory in the correct orientation.

Step 5. Place the funnel with the wide end at the bottom on a stable surface, and open the plastic bag, but do not remove the funnel just yet.

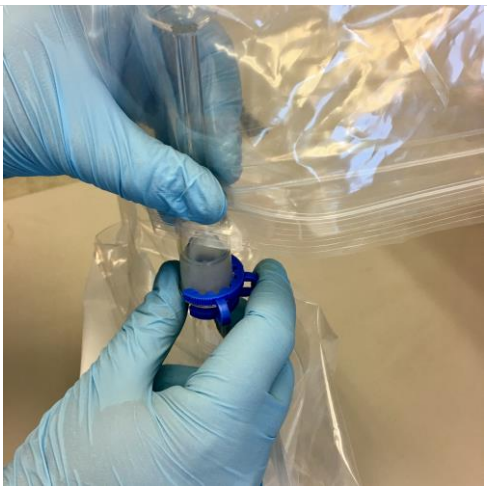
NOTE: Never touch the inside of the funnel. Only handle the funnel from its outside surfaces.



Step 6. Open the plastic bag holding the thistle tube and have the frosted glass end pulled out. Keep rest of thistle tube within the bag.



Step 7. While holding the funnel and thistle tube, attach the thistle tube to the funnel.



Step 8. Hold the thistle tube in place and attach the Keck clip.

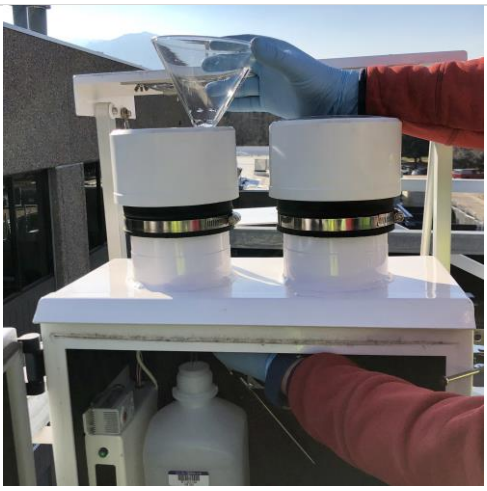
Step 9. Hold the assembled sample train so the funnel is up and remove the plastic bag that is over the funnel only.

NOTE: **When handling clean glassware, never touch the inside of the funnel.** Only handle the glass sample train from its outside surfaces.

Step 10. Carefully hold the glass sample train by the funnel and remove the bottom plastic bag.

Step 11. Gently place the sample train into the same chimney that the sample bottle is under.

NOTE: Try to insert the sample train in as straight as possible. Avoid hitting/bumping the sides of the chimney or the outside of the plastic sample bottle.



Step 12. Guide the thistle tube into the sample bottle and help settle the funnel into the chimney.

NOTE: Only handle the thistle tube above the bulb. This will help prevent sample contamination.

Step 13. Turn the bottle holder counter-clockwise to raise the bottle until the mouth of the bottle touches the thistle bulb.

Ensure the top of the sample bottle is touching the thistle bulb – **not** lifting the thistle tube up.

Step 14. The thistle bulb should be resting snugly within the opening of the glass sample bottle.

Ensure the top of the sample bottle is touching the thistle bulb – **not** lifting the thistle tube up.

Step 15. Ensure the top of the funnel is below the top of the chimney sides as displayed in the corresponding photo.

NOTE: The funnel must be resting within the chimney – **not** above the sides of the chimney.

When the funnel is above the chimney edges, damage to the sample train will likely occur. See Section 7.8 for additional way to adjust the chimney height, as well as Section 7.7 to adjust the Moving Cover.

Step 16. Repeat **Error! Reference source not found.** through **Error! Reference source not found.** for the second sample bottle and second sample train.

5.6.10 Restarting the Collector

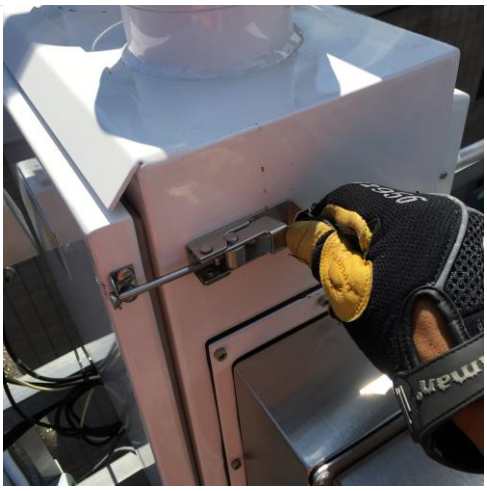
Table 18. Procedure for restarting the collector.

Step 1. Turn the power back on.

This will cause the Moving Cover to close.

Step 2. Check the seal between the Moving Cover and the top of the chimneys once more.

Ensure the seal is complete and snug. If not, adjustments to the Moving Cover may be necessary (see Section 7.7)



Step 3. Close and secure the door to the collector.

Record the date and time of the installation/deployment of the new sample glassware on the Setting section of the Wet Deposition COLLECT App.

Sub-sampling for Water Isotope Analysis below.

5.6.11 Verify Temperature Set Points

The temperature range within the environmental enclosure is set to 3° C (37.4° F) and 25° C (77.0° F). Two Temperature Controllers are located within the environmental enclosure to control this temperature range. One is located on top of the power supply (see **Figure 5**), which controls for the temperature set point to active the heaters. The other is located on the Thermo-electric chiller unit (see **Figure 5**, and **Figure 10**).

Verify the temperature set points during each maintenance interval to ensure they are accurate. This allows Technicians to identify any issues and mitigate any accidental changes (particularly, the temperature controller on the Thermo-electric chiller unit) when collecting samples from the instrument enclosure.

Table 14. Procedure for verifying the temperature set points.

	**Step 1.** Verify the set point is ~37 °F via the Temperature Controller on top of the power supply (see **Figure 5**).
	**Step 2.** Verify the set point is ~77 °F on the Temperature Controller on the Thermo-electric chiller (see **Figure 5** and **Figure 10**).

5.6.12 Cleaning the Collector

After removing the samples and glassware from the enclosure, access to the main components of the collector are ready for cleaning. Clean the external surfaces of the collector with a multi-surface cleaner (e.g., Formula 409, Simple Green); however, surfaces that may lead to the potential contamination of samples/sample areas, use distilled/deionized water or ethanol in colder climates/seasons with a lint-free or microfiber cloths.

NOTE: Ethanol is acceptable to use for cleaning external surfaces in cold or freezing weather. Since the use of ethanol to clean increases the degradation of rubber and plastic surfaces, minimize its use unless it is under conditions that warrant it (cold and/or freezing temperatures).

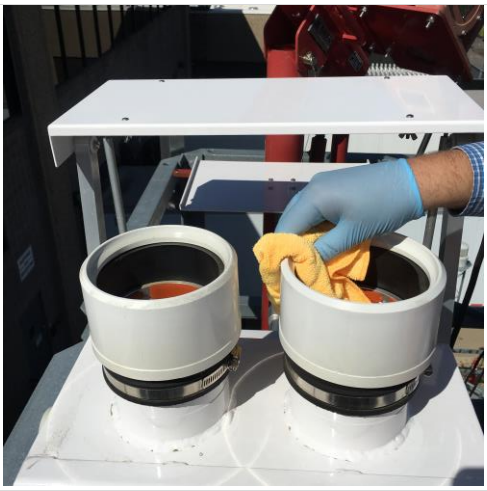
Always spray the multi-surface cleaner/ethanol and/or distilled/deionized water directly onto a cloth. **Do not spray any cleaning materials directly on the surface of the collector**. Multiple changes of powder-free nitrile gloves and frequent discarding of lint-free cloths are necessary to conduct the next set of procedures; ensure ample supply of these items are available.

Table 15. Procedure for cleaning the sensor body and associated components.

Step 1. Put on a new pair of powder-free nitrile free gloves.

Step 2. Spray the multi-surface cleaner on to a clean lint-free cloth.

NOTE: Considerable buildup of dirt may occur on the external surfaces of the collector. If the lint-free cloth becomes excessively dirty, please exchange the cloth for a new one and repeat as necessary.



Step 3. Clean both white chimney caps by wiping down the neck of the chimneys. Start from the top of the chimney down. Re-apply cleaner to the lint-free cloth, if necessary.

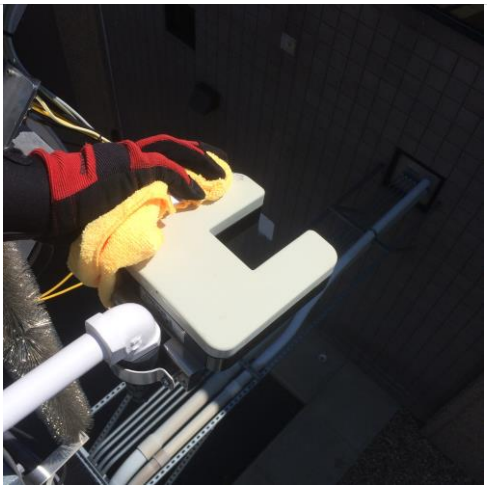
Step 4. Remove the PVC cap and inspect the gasket. Clean if necessary.

Ensure the rubber is not display evidence of wear, such as cracks or rips. Ensure the hose clamp holds the rubber gasket snugly to the chimney.

Step 5. Clean the top surface of the body of the collector, and wipe down the sides, as well. Re-apply cleaner to the lint-free cloth, if necessary.

Step 6. Clean the top surface of the Moving Cover.

Step 7. Clean the top surface of the Splash Shield.



Step 8. Clean the Precipitation Sensor. Top, sides, bottom, as well as within the “U” shaped part of the sensor.

Step 9. Discard all dirty gloves. It is OK to re-use microfiber or lint-free cloths on another bout after washing them.

Step 10. Put on a new pair of powder-free nitrile free gloves and ready a fresh lint-free cloth.

Step 11. Spray/squeeze distilled/deionized water onto the lint-free cloth.

Step 12. Clean the underside of the seal on the Moving Cover with the distilled/deionized water.

IMPORTANT: Do not use multi-purpose cleaner on the lid seal, only use distilled/deionized water. Ethanol is OK to use during freezing temperatures.

While cleaning, inspect the condition of the seal material for cracks and/or tears.

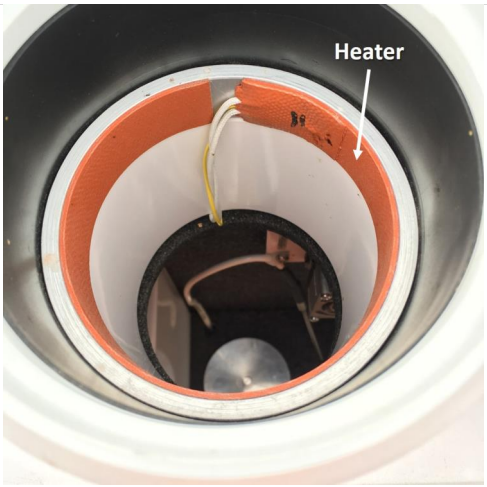
If there are issues with the seal, replacement may be necessary. Submit a ticket via the NEON Program's issue reporting system.

5.6.13 Inspecting the Funnel Strip Heaters

Inspect the two funnel strip heaters. Do not conduct this procedure until after removing the sample glassware and cleaning of the exterior housing.

A silicon strip heater resides within both chimney stacks to melt frozen precipitation within the glass sample funnel.

Table 16. Procedure to inspect the funnel strip heaters.



Step 1. Check the condition of the strip heaters within each chimney stack. Look for whether the heaters are pulling away from the inside of the chimney.

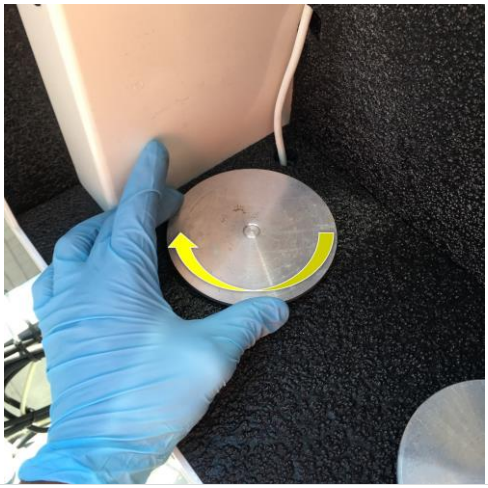
If there are issues with the funnel strip heaters, submit a ticket via the NEON Program's issue reporting system.

5.6.14 Deploying New Sample Bottles and Sample Trains

This section provides procedures on installing new sample bottles and sample trains. Conduct this procedure after procedures Section 5.6.1 through Section 5.6.9 are complete. Start with deploying the sample bottle located on the right of the enclosure, and do not move on to the left until completely installing each component to the right (the glass sample train). Repeat the process on the left. This streamlines the installation process, which aligns with the procedures outlined below.

Table 17. Procedures to deploy new sample bottles and sample trains.

Step 1. Put on a new pair of powder-free nitrile free gloves.



Step 2. Lower the sample bottle holder by turning it clockwise until it is all the way down.

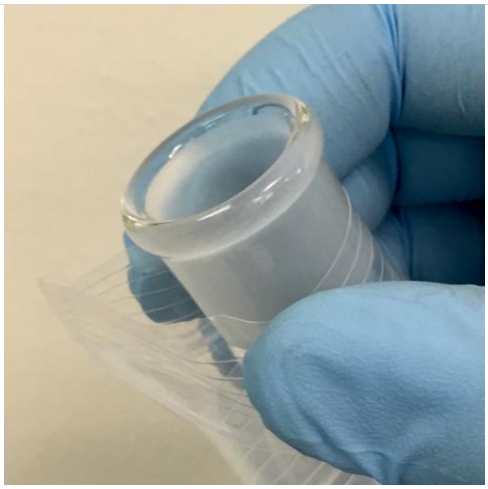
Step 3. Remove a clean plastic sample bottle from its plastic bag and place it on the bottle holder.

Step 4. While still inside the plastic bag, orient the narrow end of the funnel so it is facing towards the resealable bag opening.

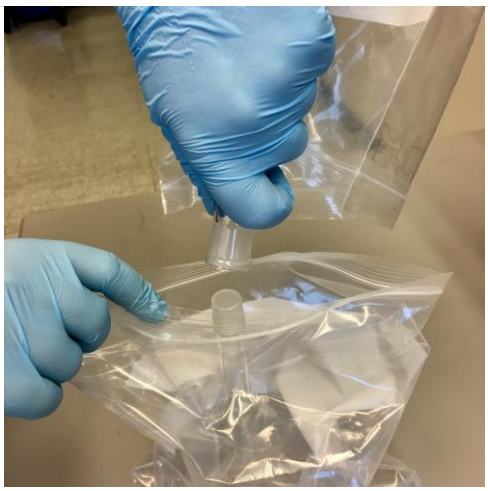
The funnel may already come from the contract laboratory in the correct orientation.

Step 5. Place the funnel with the wide end at the bottom on a stable surface, and open the plastic bag, but do not remove the funnel just yet.

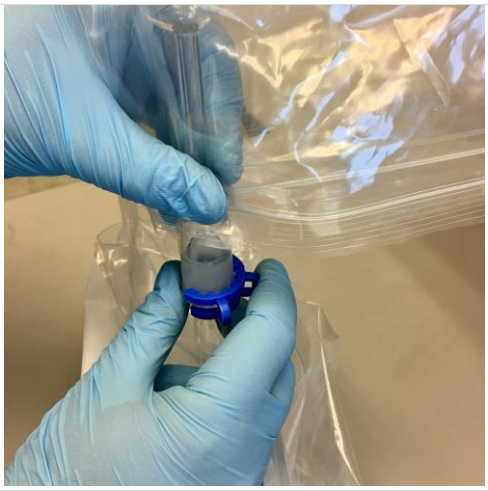
NOTE: Never touch the inside of the funnel. Only handle the funnel from its outside surfaces.



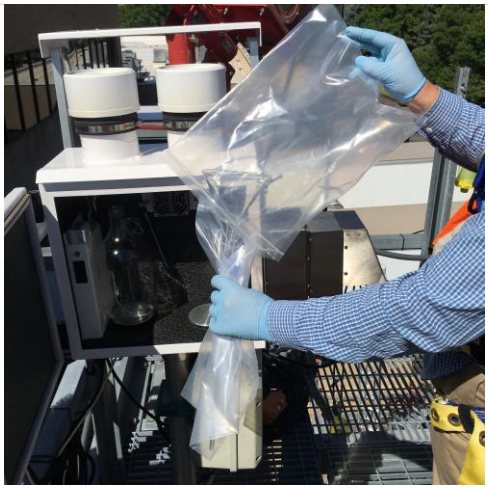
Step 6. Open the plastic bag holding the thistle tube and have the frosted glass end pulled out. Keep rest of thistle tube within the bag.



Step 7. While holding the funnel and thistle tube, attach the thistle tube to the funnel.



Step 8. Hold the thistle tube in place and attach the Keck clip.



Step 9. Hold the assembled sample train so the funnel is up and remove the plastic bag that is over the funnel only.

NOTE: **When handling clean glassware, never touch the inside of the funnel.** Only handle the glass sample train from its outside surfaces.

Step 10. Carefully hold the glass sample train by the funnel and remove the bottom plastic bag.

Step 11. Gently place the sample train into the same chimney that the sample bottle is under.

NOTE: Try to insert the sample train in as straight as possible. Avoid hitting/bumping the sides of the chimney or the outside of the plastic sample bottle.

Step 12. Guide the thistle tube into the sample bottle and help settle the funnel into the chimney.

NOTE: Only handle the thistle tube above the bulb. This will help prevent sample contamination.

Step 13. Turn the bottle holder counter-clockwise to raise the bottle until the mouth of the bottle touches the thistle bulb.

Ensure the top of the sample bottle is touching the thistle bulb – **not** lifting the thistle tube up.

Step 14. The thistle bulb should be resting snugly within the opening of the glass sample bottle.

Ensure the top of the sample bottle is touching the thistle bulb – **not** lifting the thistle tube up.

Step 15. Ensure the top of the funnel is below the top of the chimney sides as displayed in the corresponding photo.

NOTE: The funnel must be resting within the chimney – **not** above the sides of the chimney.

When the funnel is above the chimney edges, damage to the sample train will likely occur. See Section 7.8 for additional way to adjust the chimney height, as well as Section 7.7 to adjust the Moving Cover.

Step 16. Repeat **Error! Reference source not found.** through **Error! Reference source not found.** for the second sample bottle and second sample train.

5.6.15 Restarting the Collector

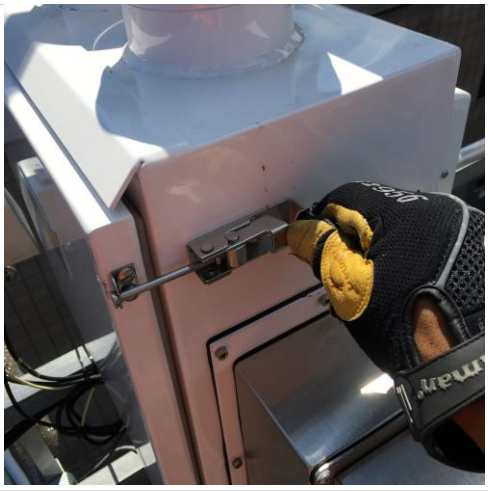
Table 18. Procedure for restarting the collector.

Step 1. Turn the power back on.

This will cause the Moving Cover to close.

Step 2. Check the seal between the Moving Cover and the top of the chimneys once more.

Ensure the seal is complete and snug. If not, adjustments to the Moving Cover may be necessary (see Section 7.7)



Step 3. Close and secure the door to the collector.

Record the date and time of the installation/deployment of the new sample glassware on the Setting section of the Wet Deposition COLLECT App.

5.6.16 Sub-sampling for Water Isotope Analysis

NOTE: Field Science Technicians may conduct the sub-sampling of the collected water in the Isotope bottle in either the Instrument Hut or back at the DSF lab.

IMPORTANT: The absolute minimum volume of water sample necessary for the contract laboratory to conduct the isotope analysis is 0.5 mL. However, this amount leaves the lab with little ability for re-analysis in case of problems. Try to ship at least 1.0 mL of sample, if possible**. If there is less than 5 mL of water within the isotope water sample bottle, do not rinse the syringe, filter and vial. Filter the sample straight into the sample vial.**

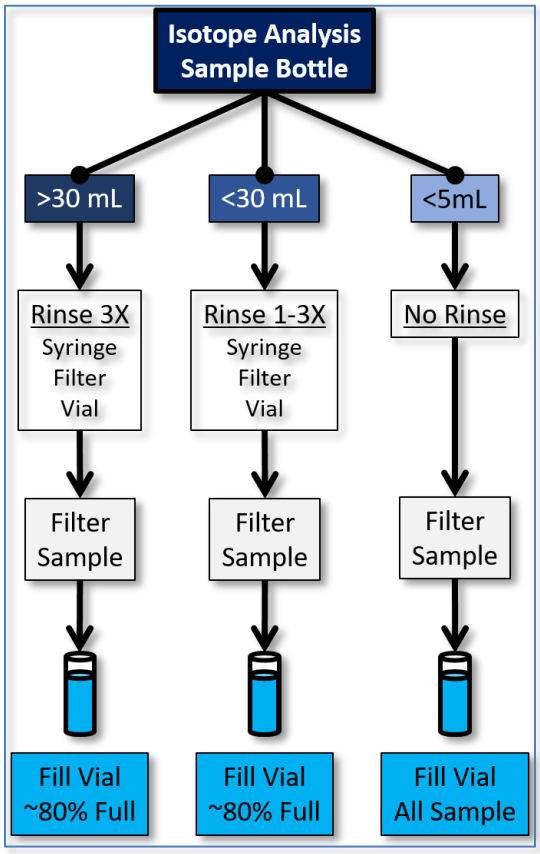
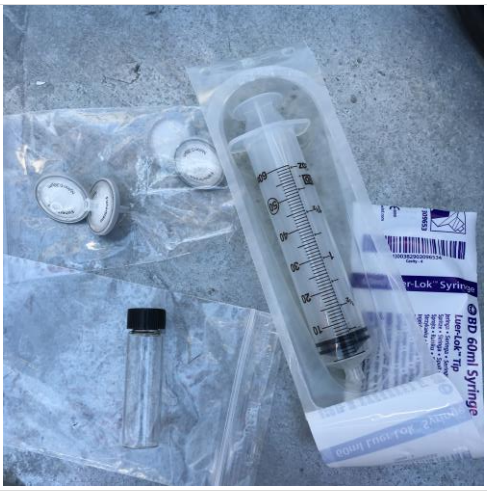


Figure 14. Flow Diagram for Isotope Sub-Sampling.

Table 19. Sub-sampling procedure for water isotope analysis.



Step 1. Locate and stage the 16 mL glass sample vial, 60 mL syringe, and a couple of the 0.2 µm filters in a clean location. NOTE: Depending on the condition of the sample (clean versus contaminated with particulates), or organic material, more than one filter may be necessary. Bring extra filters, just in case.

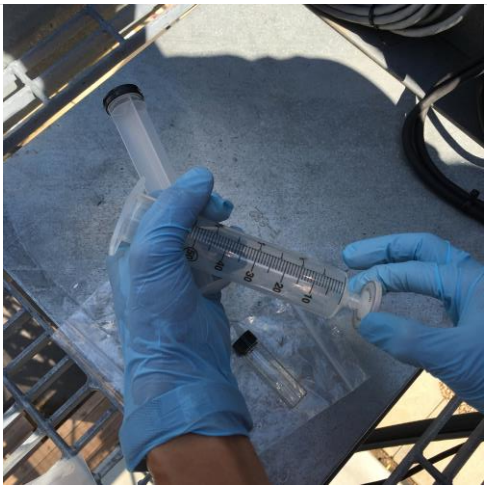
IMPORTANT: Isotope sampling must be done within **24 hours** of sample collection.

Step 2. Put on a new pair of powder-free nitrile gloves.

Step 3. Remove the 60 mL syringe from its packaging and pull the plunger out by pulling firmly. Hold the syringe plunger in the same hand as the syringe.

NOTE: Do not allow the plunger or the tip of the syringe to touch anything. Avoid touching the inside of the syringe.

NOTE: If there is >30 mL of sample, a syringe can be reused following a thorough triple rinse with sample water.

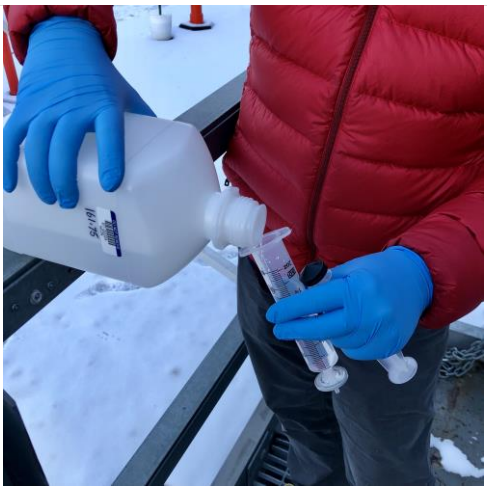


Step 4. Attach the 0.2 µm filter and secure to the Luer-Lok tip at the end of the syringe. Continue holding the syringe plunger in the same hand.

Step 5. ***If*** the sample volume in the isotope sample bottle is greater than 30 mL ***and*** a used syringe is being used, rinse the syringe with sample water from the isotope sample bottle at least once and up to three times with sample. To rinse syringe, pour in water, cap with plunger and shake for 15 seconds. After rinsing syringe push sample water through filter to saturate the filter.

Step 6. Rinse sample vial with filtered water by adding a small portion to the vial, capping and shaking. Repeat three times.

NOTE: If performing procedure on the tower top, discard rinse water on the non-boom side of the tower.



Step 7. Fill the syringe to the 30 mL mark. If there is not enough of the collected sample to fill to the 30 mL mark, pour in the entire sample.

NOTE: The sample bottle may be full or too heavy to manage with one hand. In this case, plan or acquire help from a fellow technician. If help is not available, tip the sample bottle from a location in the enclosure or railing to aid in filling (see picture to the left).

Step 8. Place the plunger back on to the syringe.

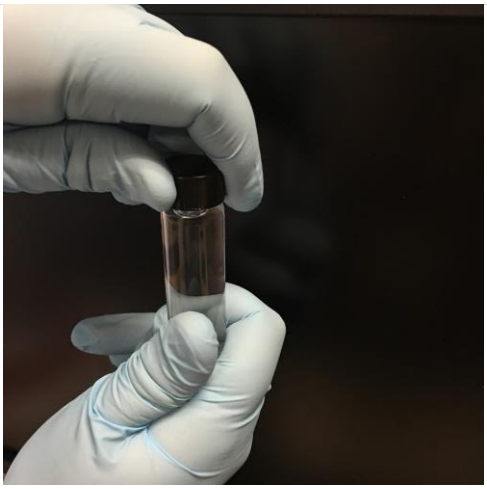
Step 9. Tip the syringe up and push on the plunger to squeeze out excess air.

NOTE: Less air in the syringe enables easier filtering of the sample; it also reduces the extension of the plunger for easier handling.

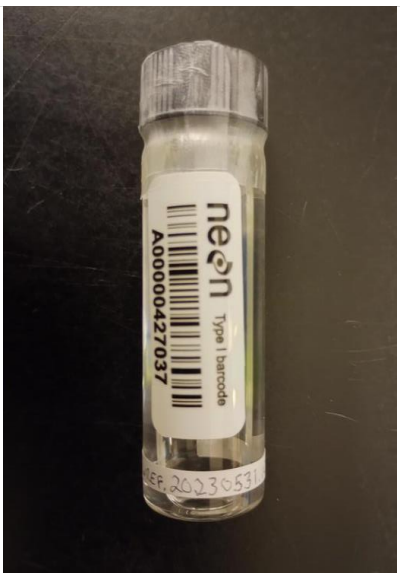
Step 10. Apply even pressure plunging the sample through the filter into the glass vial.

Step 11. Fill the bottle so it is ~80% full[1] (~20% headspace). This is 12-13 mL of sample.

NOTE: Minimizing the headspace is important to reduce additional isotopic fractionation of the water. However, to prevent issues with frozen samples during transport and shipping, having ~20% of headspace is suitable.



Step 12. Tighten the vial's cap and secure the lid to the vial using several wraps of parafilm.



Step 13. Confirm barcode entered at sample prep is accurately reflected in mobile recording app. Add handwritten sample ID WDP.SITE.YYYYMMDD.ISO.TEST and wrap in Parafilm.

PRO TIP: *Labeling the outside of the bag with sample ID may be helpful for domain sample management.*
Isotope vial ID: WDP.SITE.YYYYMMDD.ISO

Step 14. Discard any leftover sample from the isotope collection.

Step 15. Place the empty isotope analysis sample bottle back into a 16 X 16”, 4 mil, resealableplastic zip bag and seal.

NOTE: **No barcode is needed on the bag for the isotope bottle.**

Step 16. Place the bagged sample bottle inside the shipping box.

Step 17. Rinse the syringe and plunger with deionized (DI) water three times, and let dry completely for the next collection.

Step 18. Discard the used filter, and gloves.

5.6.17 Package Sample Bottles and Sample Train Components

See Appendix 7.3, Receipt of Wet Deposition Glassware and Plastic Sample Bottles from external lab and repacking for return to external lab.

5.6.18 Sample Shipment

See Appendix 7.2, Sample Shipment

6 REMOVAL AND REPLACEMENT (SUBSYSTEM ONLY)

6.1 Equipment

Table 20 contains a list of equipment to conduct Sensor Refresh at TIS and AIS sites for specific instrumentation and/or subsystem components that require calibrations and validations. (Equipment recommendations and applicability may adjust over time as the implementation of NEON Program sensors and subsystems mature.)

The Wet Deposition Concord Grape (24V) is the only component requiring annual calibration and validation for this sensor; swap it annually as part of both TIS and AIS site Sensor Refresh. No routine or scheduled calibration and validation requirements are necessary for the collector itself or the PRT after initial installation.

Table 20. Removal and Replacement Equipment List.

P/N	Description	Quantity
Tools		
Generic	3/16” & 5/32” Allen Wrenches	1
Consumable items		
Generic	Dirty ESD Bag or Grape dust caps (to transport non-decontaminated equipment back to the Domain or use dust caps)	A/R
See AD [05]	Decontamination supplies per AD [05].	A/R

PRO TIP: *Carry back-up tools and consumables up the tower in the event of dropping the original tools/consumables.*

NOTE: Maintain original product packaging, if possible, for use in future sensor swaps (calibration and validation), temporary storage, or to return faulty equipment.

The heavy-duty motor for the Moving Cover is rated for 20 years of typical service. All parts are easy to replace without special tools. If the sensor subsystem is inoperable due to unforeseen circumstances, document and report the incident via the NEON Program Issue Reporting System for specific corrective action, guidance, and procedures.

6.2 Removal and Replacement Procedure

The FOPS Domain Manager is responsible for managing the removal and replacement of the sensors on site for preventive maintenance and/or sensor swaps and manages field calibration and validation of sensors, as appropriate. The NEON project Calibration, Validation and Audit Laboratory (CVAL) is responsible for the calibration and validation of select sensors and manages Domain sensor refresh (swap) schedules.

The Wet Deposition Concord Grape (24V) is the only component requiring annual calibration and validation, it is swapped annually as part of the site sensor refresh. No routine or scheduled calibration and validation requirements are necessary for the collector itself or the PRT after initial installation.

The Wet Deposition Concord Grape (24V) mounts to the tower top railing next to the collector at TIS tower sites. For AIS sites, the Grape mounts to the Wet Deposition's pedestal, below the main housing/enclosure. **Figure 15** displays examples of each location.

Figure 15. Wet Deposition Concord Grape (24V) with Grape Shield.

6.2.1 Grape Removal and Replacement

NOTE: Always remove the Ethernet cable from the Grape prior to connecting and disconnecting sensor cables; this de-energizes the Grape (data acquisition device) to prevent damage to the mechanism.

1. Disconnect the Ethernet Cable (RJF/Eth to Comm on AIS or TIS Interconnect Mapping) from the Concord Grape.
2. Remove the four screws that affix the Grape to the Grape Shield (or bread pan) using the Allen wrenches listed in **Table 20**. It may be easier to remove the Grape Shield(s) from the Unistrut on the tower top to prevent losing the four screws that secure the Grape to the shield. Use a 3/16" hex wrench to remove the entire assembly with the Grape.
3. Store un-decontaminated Grapes without caps in a dirty ESD bag (not a clean one that ships back to HQ, CVAL).
4. Reinstall the new Concord Grape into the Grape Shield by threading the four screws that affix the Grape to the Grape Shield using the same Allen wrench.

5. Remove dust caps on sensor connectors and Eth-To-Comm connector. Use the dust caps from the new Concord when shipping back the old Concord for Sensor Refresh, after cleaning the connectors for dirt/biologics.
6. Re-connect sensor and armored Ethernet cable in accordance with AD [09] or AD [10].
7. Dress any cables and replace zip ties, as applicable.

Note: Field Science must not transport non-decontaminated sensors in the same shipping and packing materials that are for shipping decontaminated sensors to CVAL. Use a plastic liner to protect the shipping materials from site biologics.

6.3 Cleaning & Packaging of Returned Sensor

Field Science staff decontaminate, package, and ship sensors back to the CVAL at the NEON project HQ (Battelle) for annual Sensor Refresh (swap)/calibration requirements. (Please note: if a sensor is defective, submit an incident in the NEON Program's Issue Reporting and Management System and affix a red tag with the incident number on it). The Wet Deposition Collector itself does not require Sensor Refresh; however, the Grape that powers this system requires annual calibration. ***Reference NEON.DOC.005038 for the standard operating procedures for the annual Sensor Refresh process and delineation of sensor, administrative and logistical requirements.***

NOTE: Asset tags for each sensor or subsystem Grape must return with the shipment to HQ. If an asset tag is missing for a sensor, contact the NEON HQ property management office for guidance and awareness for when the shipment arrives at HQ.

IMPORTANT: DO NOT tamper with, change, or reassign asset tags from Data Generating Device (DGDs) without direct consent from HQ property management office. This prevents chain of custody and/or data issues that tie to asset tags.

NOTE: For any Non-CVAL initiated sensor returns, please notify CVAL of the return via the program's issue management system.

Complete an External Transfer Request (ETR), Bill of Lading and Site Manifest pack list per in accordance with RD [08] or via the Issue Management System and return to the NEON program HQ. **Only include sensors/subsystems for Sensor Refresh.** Additional equipment must ship separately as they may require attention from other NEON HQ departments. Sensor Refresh shipments go direct to CVAL. If sensors are shipping to HQ to address a trouble ticket, per guidance via the Issue Reporting System, return to the NEON project HQ using the following address with an ETR and a red defective tag:

6.4 Sensor Refresh Record Management of Assets

In addition to the physical movement of devices, the sensor refresh process requires dedicated and accurate record management of asset movement and location. ***Reference NEON.DOC.005038 for the***

standard operating procedures for the annual Sensor Refresh process and delineation of sensor, administrative and logistical requirements.

6.4.1 NEON Asset Management and Logistic Tracking System Requirements

Field Science must update the instrumentation records via the NEON's project Asset Management and Logistic Tracking System (MAXIMO). NEON HQ must maintain accurate record keeping on the location, date, and time offline of an instrument to ensure NEON HQ, Computer Infrastructure, Data Products, and CVAL are aware to apply the correct algorithms, calibrations, and processing factors. Reference RD [08] for additional information on Sensor Refresh administrative procedures. Ensure the CFG location reflects the current site of the sensor. All devices leaving a CFGLOC must move to SITE first, then DxxSUPPORT and TRANSIT when in transit back to HQ.

Note: In general, to minimize errors for CI, all devices leaving a CFGLOC must move to SITE first, then DxxSUPPORT, and finally TRANSIT.

Note: An important exception when assigning CFG locations are Grape data loggers. Grapes remain at the SITE level (a four-letter site code) or a more specific location within the hierarchy. Do not assign Grapes to a CFG location using the "CFGLOC" prefix. Grapes are data loggers and log data from sensors from specific CFG locations.

After installation of the sensors or subsystem Grapes, verify sensor data state of health (Data Product) the next day.

7 ISSUE REPORTING OUTPUTS

Table 21. Metadata output checklist.

Issue Reporting Datasheet		
Datasheet field	**Entry**	
NEON Site Code		
Maintenance Date		
Maintenance Technician		
Preventive Maintenance	**Issue Noted**	**Issue Summary**
Environmental Information Surrounding Area Check	☐	
Exterior Damage	☐	
Cables & Connectors Condition Check	☐	
Snow/Ice Accumulation	☐	
Funnel Strip Heater	☐	
Moving Cover Operation	☐	
Moving Cover Lid Seal	☐	
Black Chimney Gaskets	☐	
Moving Cover Arms	☐	
Thermo-Electric Chiller Unit	☐	
Cross-check Internal Temperature	☐	Internal PRT Temperature: _____°C Handheld IR Temperature: _____°C Temperature Differential: _____°C
Sample Present	☐	☐ Yes ☐ No

Issue Reporting Datasheet		
Sample Condition	☐	☐ Bird droppings ☐ Cloudy or discolored ☐ Soot/ash/dirt particles ☐ Insects/animal matter ☐ Leaves/twigs/pollen/plant matter ☐ Handling contamination
Glassware Shipping Case – Lab Barcode	☐	Barcode #:_____
Sample Bottle Shipping Case – Lab Barcode	☐	Barcode #:_____
Used Funnel – Lab Barcode	☐	Barcode #: _____
Used Thistle Tube – Lab Barcode	☐	Barcode #: _____
Chemical Analysis Sample Bottle	☐	Sample + Cap + Bottle Weight: _____g Sample Only Weight: _____g Bottle Tare Weight: _____g Cap Tare Weight: _____g Lab Barcode #: _____
Chemical Analysis Sample ID	NEON Sample Barcode #: _____	

Issue Reporting Datasheet		
Isotope Analysis Sample Bottle	☐	Sample + Cap + Bottle Weight: _____g Sample Only Weight: _____g Bottle Tare Weight: _____g Cap Tare Weight: _____g Lab Barcode #: _____
Isotope Analysis Sample ID	NEON Sample Barcode #: _____	
Isotope Analysis Sub-Sample ID	NEON Sample Barcode #: _____	
Temperature Set Points	☐	☐ 37 °F or Other: _____ ☐ 77 °F or Other: _____
Sensor Body Cleaned	☐	
New Sample Bottles and Trains Deployed	☐	☐ Chemistry Analysis ☐ Isotope Analysis
Sensor Turned Back on	☐	
Notes		

For Wet Deposition Sensor/Subsystem corrective actions, ensure proper tracking of the asset via the NEON issue management and tracking system (e.g., ServiceNow) to establish a chain of custody of the asset between Engineering Repair Laboratory and CVAL.

Conduct the following tasks to ensure the proper management of the asset between sites:

1. For each issue where NEON, HQ is replacing a defective instrument/subsystem at a site, create an incident task in the NEON Issue Management and Reporting System for the defective asset from the reported issue. Resolution of an incident does not occur with the installation of a replacement, but with the root cause analysis of the issue deriving from the defective asset.

2. Ship all defective equipment/assets with a red "Rejected" tag. **Figure 16** displays the minimum information requirements for each tag.

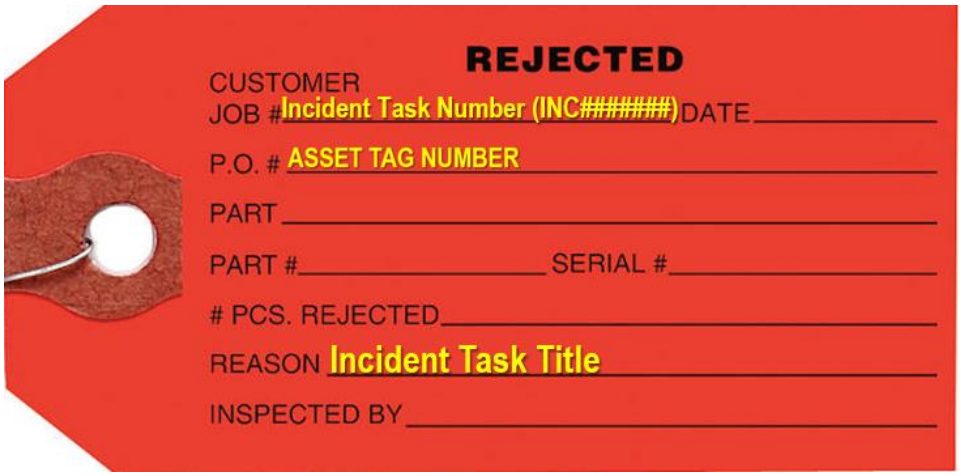


Figure 16. Red Rejected Tag for Defective Assets (MX104219).

APPENDIX

- **7.1 -** Glassware and Shipping Container Requirements per Collector
- **7.2** - Sample Shipment
- **7.3** - Receipt of Wet Deposition Glassware and Plastic Sample Bottles from external lab and repacking for return to external lab
- **7.4** - Remote Monitoring Tips
- **7.5** - Troubleshooting
- **7.6** – Changing the moving cover lid
- **7.7** – Adjusting the Alignment of the Moving Cover
- **7.8** – Adjusting the chimney Heights

7.1 Glassware and Shipping Container Requirements per Collector

- (3) sets[2] of complete sample trains, 84 oz. plastic sample bottles, and caps.
    - (1) Active set – inside collector.
    - (1) Swap set – set that will be swapped during scheduled preventive maintenance.
    - (1) Back-up set – in case of any breakage/contamination during scheduled preventive maintenance.

7.2 Sample Shipment

Information included in this SOP conveys science-based packaging, shipping, and handling requirements, not lab-specific or logistical demands. For that information, reference the CLA 'Shipping Information to External Facilities document on CLA's NEON intranet site.

7.2.1 Handling Hazardous Material

N/A

7.2.2 Supplies/Containers

1. Isotope H_2O sub-samples
    a. Store samples at room temperature until shipment. Samples will be shipped every two months on a schedule set by CLA for each domain.
    b. Ensure you have wrapped plastic paraffin film around the lids to keep them secure during shipping.
    c. Pack glass bottles for isotope H_2O samples in a plastic bag and in liquid absorbent packing material for protection from breaking and leakage. After bottles have absorbent material packed securely around them, any remaining space can be filled with regular packing material.
    d. Glass bottles can be packaged and shipped in a secure box to isotope lab. "Up" arrows can be affixed to the secure box.
    e. Prepare a shipping manifest using the Fulcrum shipping app, detailing the contents of the shipment. Include a printed copy of the manifest in the shipment box.
    f. Complete packing slip, address shipment, and ship ground to the destination(s) specified in the CLA "Shipping Information for External Facilities" document.

[2] A set is two of each item

g. Email a digital copy of the Shipping Manifest to the external lab and NEON's CLA contact by submitting the shipment in the Stork Shipment Verification Tool.

2. Chemistry samples
    a. Samples should be shipped Ground as soon as possible after each sampling event with a hold time up to 16 days if stored in +4C.
    b. Prepare a shipping manifest using the Fulcrum shipping app, detailing the contents of the shipment. Include a printed copy of the Manifest in the shipment box.
    c. Complete packing slip, address shipment, and ship ground to the destination(s) specified in the CLA "Shipping Information for External Facilities" document.
    d. Email a digital copy of the Shipping Manifest to the external lab and NEON's CLA contact by submitting the shipment in the Stork Shipment Verification Tool.

7.2.3 Grouping/Splitting Samples

Organize by Site ID, if applicable.

7.2.4 Return of Materials or Containers

Return shipping labels are not necessary for chemistry samples as the external lab will analyze and clean containers and redistribute to various domains. For isotope shipping containers, include return shipping label with WBS code if these need to be returned to the domain support facility.

7.2.5 Shipping Manifest

Whenever samples are shipped, they must be accompanied by a hard-copy Shipping Manifest enclosed within the shipping container. In addition, a corresponding electronic version of the Shipping Manifest (*.csv file) must be emailed to the taxonomic ID facility and NEON's CLA contact using the Stork Shipment Verification Tool as soon as possible after the samples have been shipped. For locations to which to ship samples, and CLA contract information, please reference CLA's NEON intranet site, available through the sampling support library.

Navigate to the "Shipping Information for External Facilities" document on CLA's NEON intranet site.

Prepare a shipping Manifest detailing the contents of the shipment, using the Shipment Creation and Shipment Review applications. Include a printed copy of the Manifest in the shipment box (downloaded from the Stork Shipment Verification Tool).

Complete packing slip, address shipment, and ship ground to the destination(s) specified in the CLA "Shipping Information for External Facilities" document.

Email a digital copy of the shipping manifest emailed to the appropriate contact at the receiving analytical laboratory as well as the NEON CLA contact on the day that samples ship by submitting the shipment in the Stork Shipment Verification Tool.

7.2.6 Laboratory Contact Information and Shipping/Receipt Days

See CLA's NEON intranet site, available through the sampling support library.

7.3 Receipt of Wet Deposition Glassware and Plastic Sample Bottles from external lab and repacking for return to external lab

The shipping boxes and internal shipping materials for the wet deposition glassware and plastic sample bottles were specifically selected to ensure proper protection and minimize the changes of glassware breakage. There are two shipping boxes, one for the glassware (funnels and thistle tubes), and the other for the plastic sample bottles. Keck clips should not be shipped but kept at the DSF or in the hut at each site.

Table 22. Glassware and Sample Bottle packaging and repacking for return to external lab.

Figure 17. The glassware and plastic sample shipping boxes.

Figure 18. Each shipping box from the contract laboratory will have a "Use By" date.

Figure 19. Internal packaging for the glassware shipping boxes.

- (2) Styrofoam bottle shippers (funnels)
- (2) Cardboard tubes with snap ends (thistle tubes)

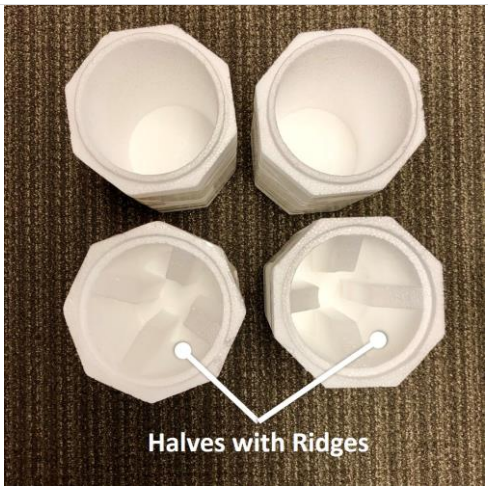


Figure 20. The Styrofoam bottle shippers have two halves, one with ridges, and the other without.

Figure 21. The narrow end of the funnels will go inside the half with the ridges.

Figure 22. The half without the ridges will go over the funnel side and then packed into the shipping box (see **Figure 25**).

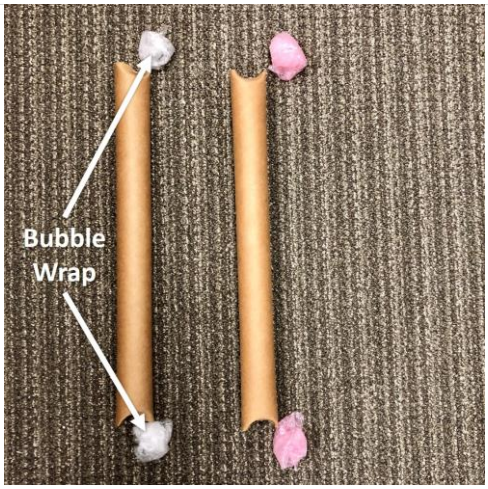


Figure 23. The cardboard tubes will have bubble wrap or foam bits at each end to minimize the movement of the thistle tube within the cardboard tube.

Figure 24. The thistle tubes are placed inside a plastic bag and then within the cardboard tube.

Figure 25. Placement of the Styrofoam shippers and the cardboard tubes within the glassware shipping box.

Figure 26. The plastic shipping bottles are packed within plastic resealable bags and side-by-side within their own shipping box.

NOTE: The bottle caps are shipped within separate bags when coming from the contract laboratory.

7.4 Remote Monitoring Tips

This section is the result of discussions and suggestions from Field Operations technicians.

- **Power status** - Collector power on/off status is active (streams) only when there is a change in status. If there is a status change while you are NOT at the site then power has gone out.
    - Access this status using Grafana
- **Lid Status** - Same as power status, only streams when the lid moves to open or moves to close. There have been a few precipitation sensor malfunctions across the observatory already. If this stream is active while it is raining. Or not active when it is not raining then you have a problem.
    - Access this status using Grafana
- **Internal temperature via PRT** - Check the PRT internal temperature of the Wet Deposition collector.
    - Check with Grafana

7.5 Troubleshooting

Problem	Possible Cause	Check	Action	Notes
System will not power on	No power to device	Fuses, power connections	Replace or reconnect as necessary	
	Motor cable not connected	Motor cable connection	Check connection or reconnect	Motor cable must be properly connected to the base of the unit for the instrument to power on
Moving Cover will not open	No power to device	Fuses, power connections	Replace or reconnect as necessary	
	Power switch is OFF	Power switch position	Turn to ON position	See Figure 5
Moving Cover will not open (but power is ON)	Rain sensor not functioning	Check rain sensor	1. Turn power OFF 2. Remove sensor arm via the four wing nuts 3. Disconnect the Molex connector 4. Attach Sensor Simulator 5. Turn power ON 6. Activate Simulator switch - If unit opens, rain sensor is faulty	See ER [01], page 17
	Drive motor faulty	Check driver motor	Replace as necessary	
Moving Cover does not rest on chimneys	Misalignment of moving cover	Alignment of the moving cover	Adjust Moving Cover or Chimneys	See Section 7.8, and Section 7.9
Thistle tube too long	Thistle too neck made too long	Funnel sticks up above	• Lower bottle holder stage • Adjust Chimneys	• See **Error! Reference source not found.**, **Error! Reference source not found.** • See Section 5.6.10
Sample freezing in collection bottles	Heater is malfunctioning	Check heater	Replace heater (see note about not adjusting heater above specified set point.	Heater elements have been updated. Specified set point should not

Problem	Possible Cause	Check	Action	Notes
				be adjusted. If so, then get new heater.

7.6 Changing the Moving Cover Lid Seal

Replace the Moving Cover Lid Seal twice a year, or as needed if damaged.

Table 23. Procedure to change the moving cover lid seal.

	**Step 1.** Slowly wave a hand (with fingers spread open) vertically in-and-out of the Precipitation Detector until the Moving Cover begins to open.
	**Step 2.** Allow the Moving Cover to open until it is about halfway to fully open, or until the lid is vertical, and flip the power switch (see **Figure 5**) to the off position. Turning the power off stops the Moving Cover in place.

Step 3. Loosen (but do not remove) the wing nuts on one side of the seal.

The wing nuts secure aluminum bars that hold the seal in place.

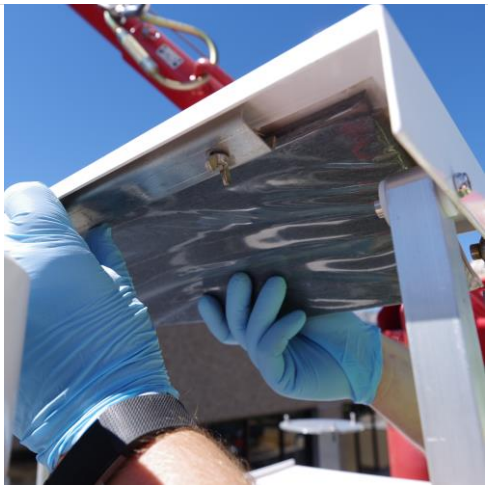
PRO TIP: *Bring extra hardware in case any hardware falls from the tower top platform or lay down a tarp.*

Step 4. Loosen and remove the wing nuts on the other side along with the aluminum bar.

The seal will drop down but should still be held in place by the other side.

Step 5. Remove the lid seal.

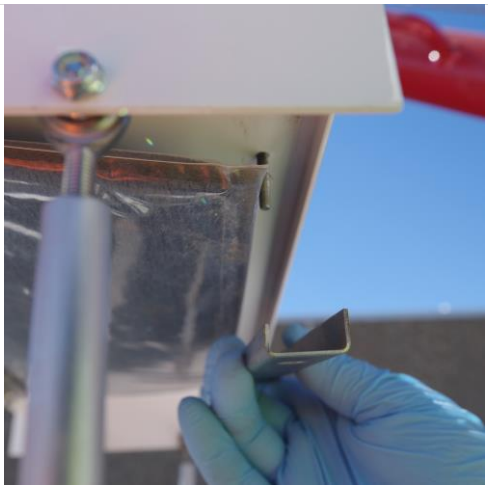
Step 6. Put on a new pair of powder-free nitrile free gloves and ready a fresh lint-free cloth.



Step 7. Smooth out the new lid seal and slide it under the aluminum bar that was loosened in **Step 3** above.

Align the seal and tighten the wing nuts.

NOTE: The metal plate side faces the underside of the Moving Cover, while the foam and plastic side faces the chimneys.



Step 8. Press the lid seal towards the other side and hold in place with the aluminum bar from **Step 4** above.

NOTE: The shorter side of the aluminum bar is towards the seal.

Step 9. Hold the aluminum bar in place and hand tighten on the wing nuts.

Step 10. Spray or squeeze distilled or DI water onto the lint-free cloth.

Step 11. Clean the underside of the lid seal with the distilled/deionized water, or ethanol in cold weather.

⚠**IMPORTANT:** Only clean the lid seal with distilled or DI water, or ethanol in cold/freezing weather.

Step 12. Turn the power back on.

This will cause the Moving Cover to close.

Step 13. Check the seal between the Moving Cover and the top of the chimneys once more.

Ensure the seal is complete and snug. If not, adjustments to the Moving Cover (Section 7.8) or the Chimney heights (Section 7.9) may be needed.

NOTE: The funnel must be resting within the chimney – **not** above the sides of the chimney.

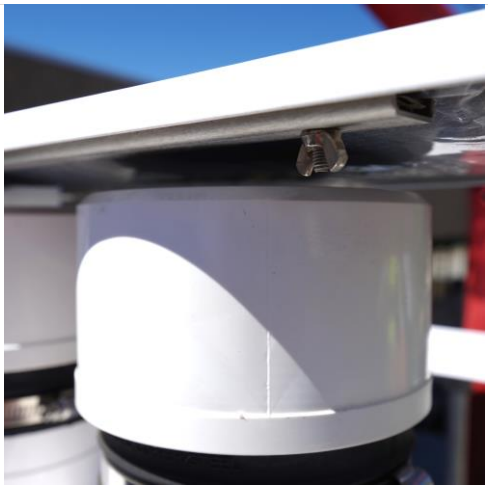
7.7 Adjusting the Alignment of the Moving Cover

Table 24. Procedure to adjust the alignment of the Moving Cover.

Step 1. Slowly wave a hand (with fingers spread open) vertically in-and-out of the Precipitation Detector until the Moving Cover begins to open.

Step 2. Allow the Moving Cover to open just a few inches, and flip the power switch (see **Figure 5**) to the off position.

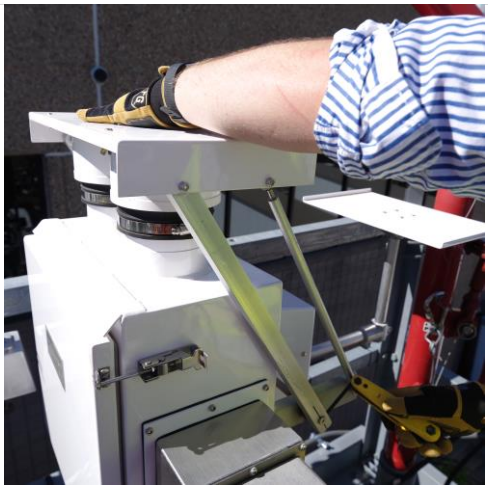
Turning the power off stops the Moving Cover in place.



Step 3. Turn the system back on. The cover will begin to close, and when the lid is about a ½ inch above the chimney tops, turn power off again.

The cover should now be about a ½ inch over the chimney tops.

Step 4. Loosen the 4 cap screws holding the drive arms to the motor axles so the lid comes down on top of the chimneys.



Step 5. Hold the lid firmly on top of the chimneys and retighten the cap screws firmly to secure the drive arms.

Step 6. Repeat opening and closing the Moving Cover to ensure that the lid seals properly on the chimneys.

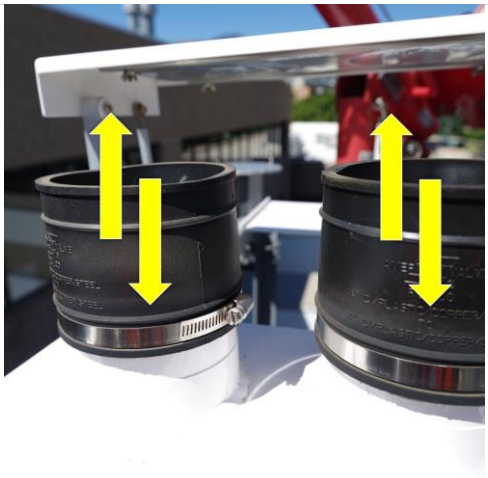
Lid seal should completely and evenly seat on the chimneys.

7.8 Adjusting the Chimney Heights

Table 25. Procedure for adjusting the chimney heights.

	**Step 1.** Slowly wave a hand (with fingers spread open) vertically in-and-out of the Precipitation Detector until the Moving Cover begins to open.
	**Step 2.** Allow the Moving Cover to open until it is about half-way to fully open, or until the lid is vertical, and flip the power switch (see **Figure 5**) to the off position. Turning the power off stops the Moving Cover in place.
	**Step 3.** Remove the PVC cap from each chimney.

Step 4. Loosen the hose clamp enough to the rubber gasket up and down.



Step 5. Once the hose clamp is loosened, pull up on the gasket to raise, or push down on the gasket to lower.

Step 6. Once adjusted to the appropriate height, tighten the hose clamps.

Step 7. Replace the PVC cap on each chimney.