Met One Meteorological Equipment

MARAMA Air Quality Monitoring Training Workshop

November 19, 2019

Swarthmore, PA

Tom Wolf, Governor

Patrick McDonnell, Secretary

Agenda

- Old Met Equipment
- New Met Equipment
- Two Configurations
- Certifications/SOPs/PMs/QA
- Issues So Far
- Good/Bad

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Air Monitoring Museum

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Met One Components

AIO 2 Sonic Weather Sensor

- Wind Speed
- Wind Direction
- Ambient Temperature
- Relative Humidity
- Barometric Pressure

Apogee Solar Radiation

- Silicon-cell Pyranometer
- Measures 350-1100 nm (80%)
- Estimates Total Spectrum

Model 365 Heated Rain Gauge

- Tipping Bucket Style
- 0.01 inch/tip

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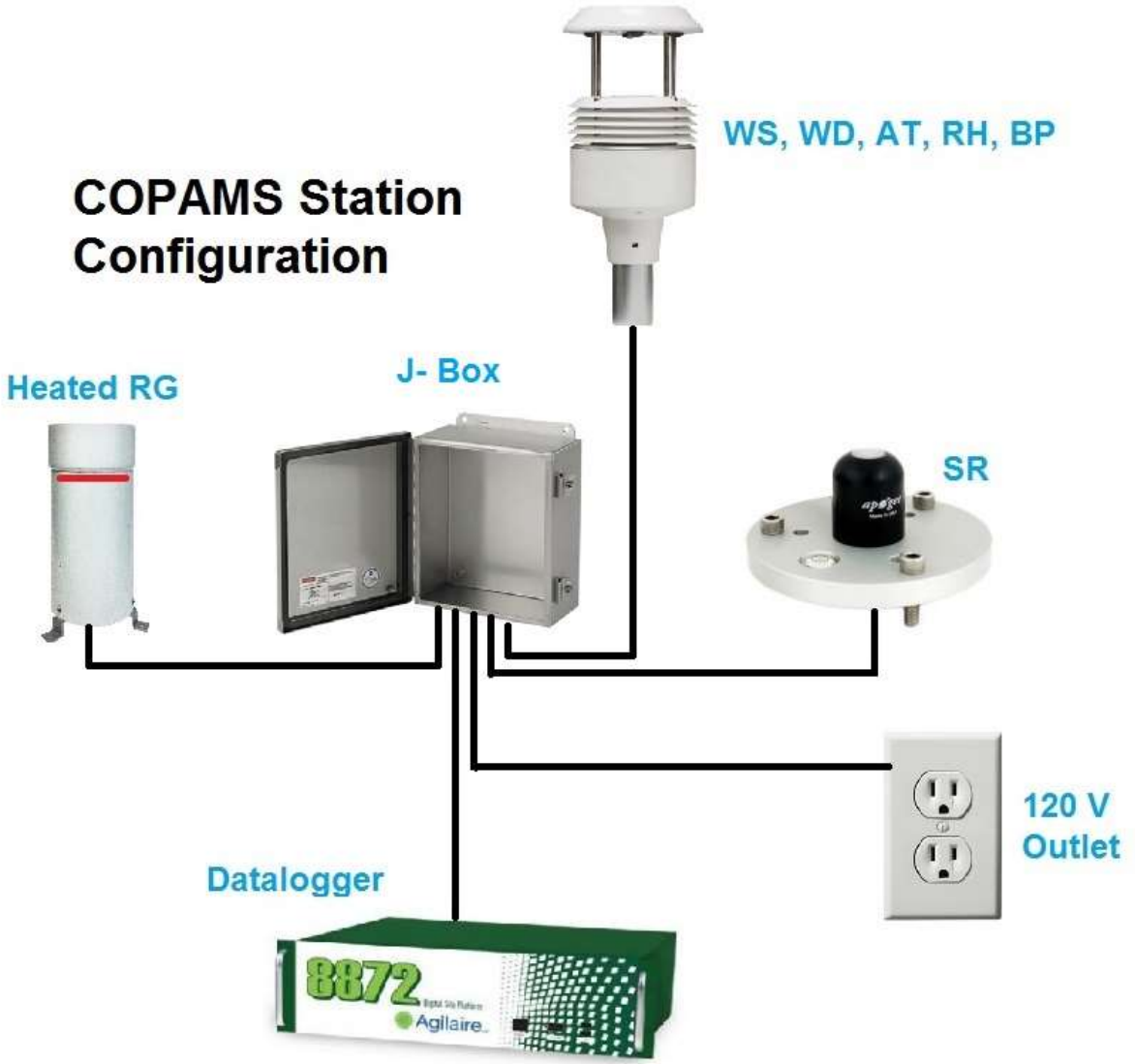
Configuration 1



10 Meters

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Configuration 2

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COPAMS Configuration

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AIO 2 Sensor

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Solar Radiation

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Rain Gauge

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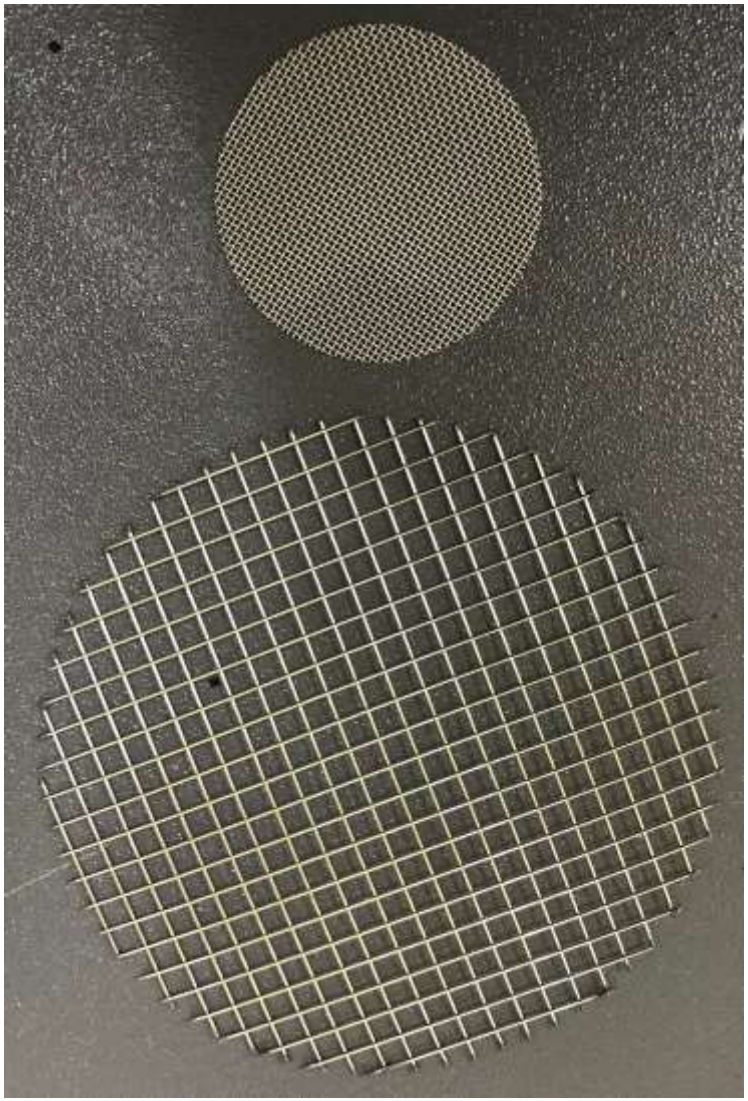
Rain Gauge



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Station Wire Port

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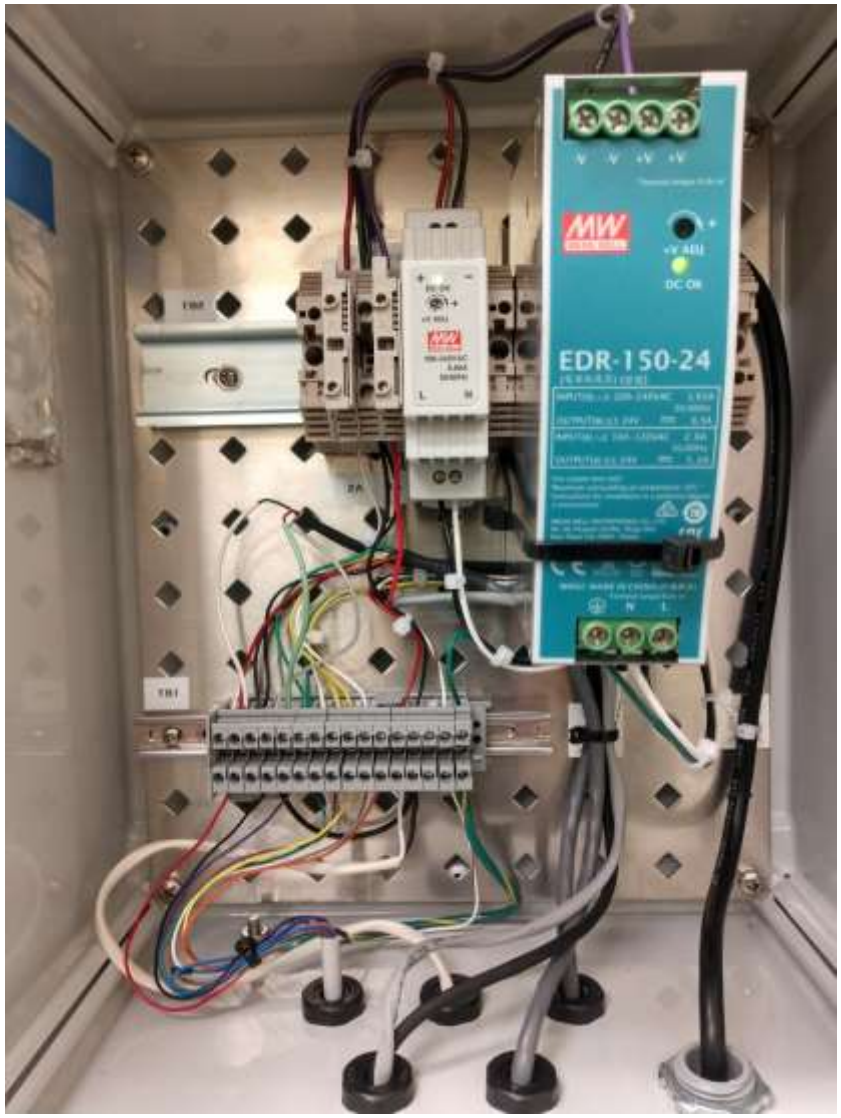
COPAMS J-Box Inside Station



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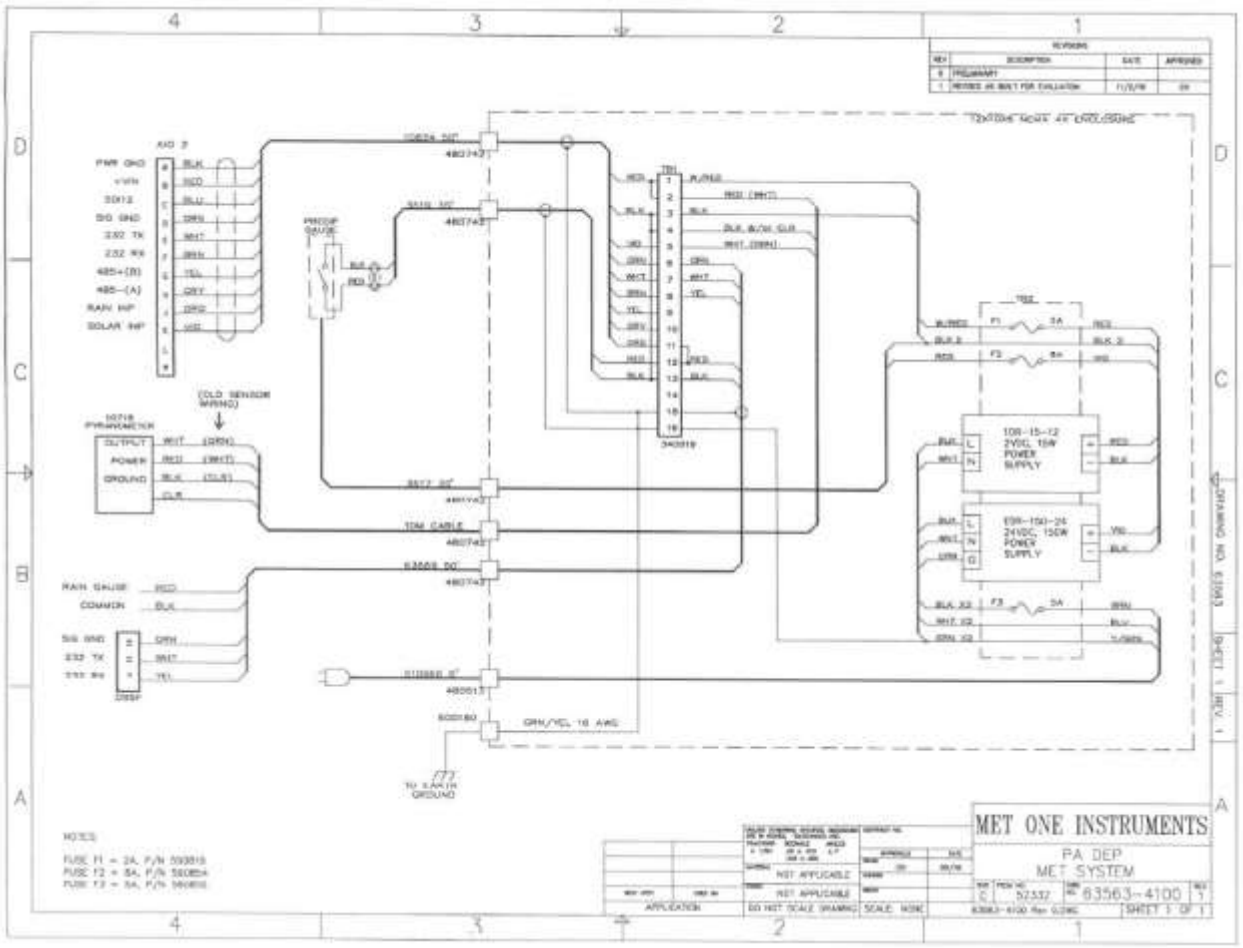
COPAMS J-Box Inside Station



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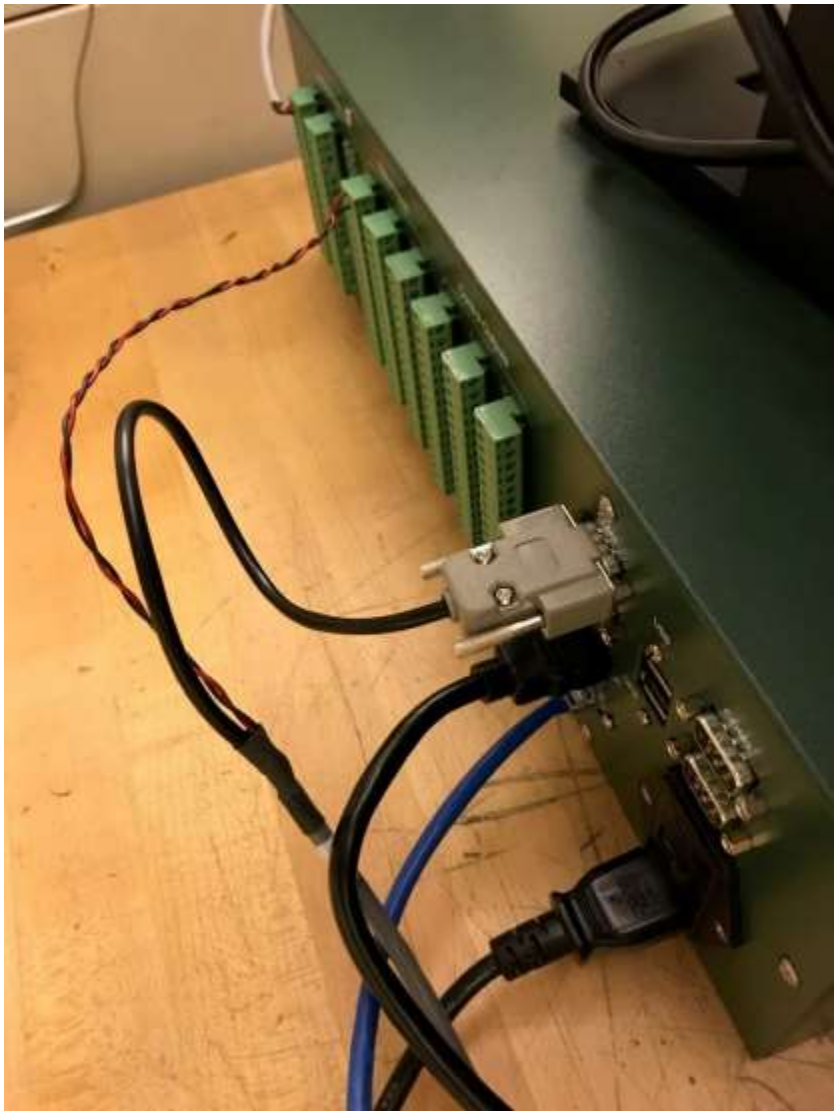
Simple Wiring to 8872 Datalogger



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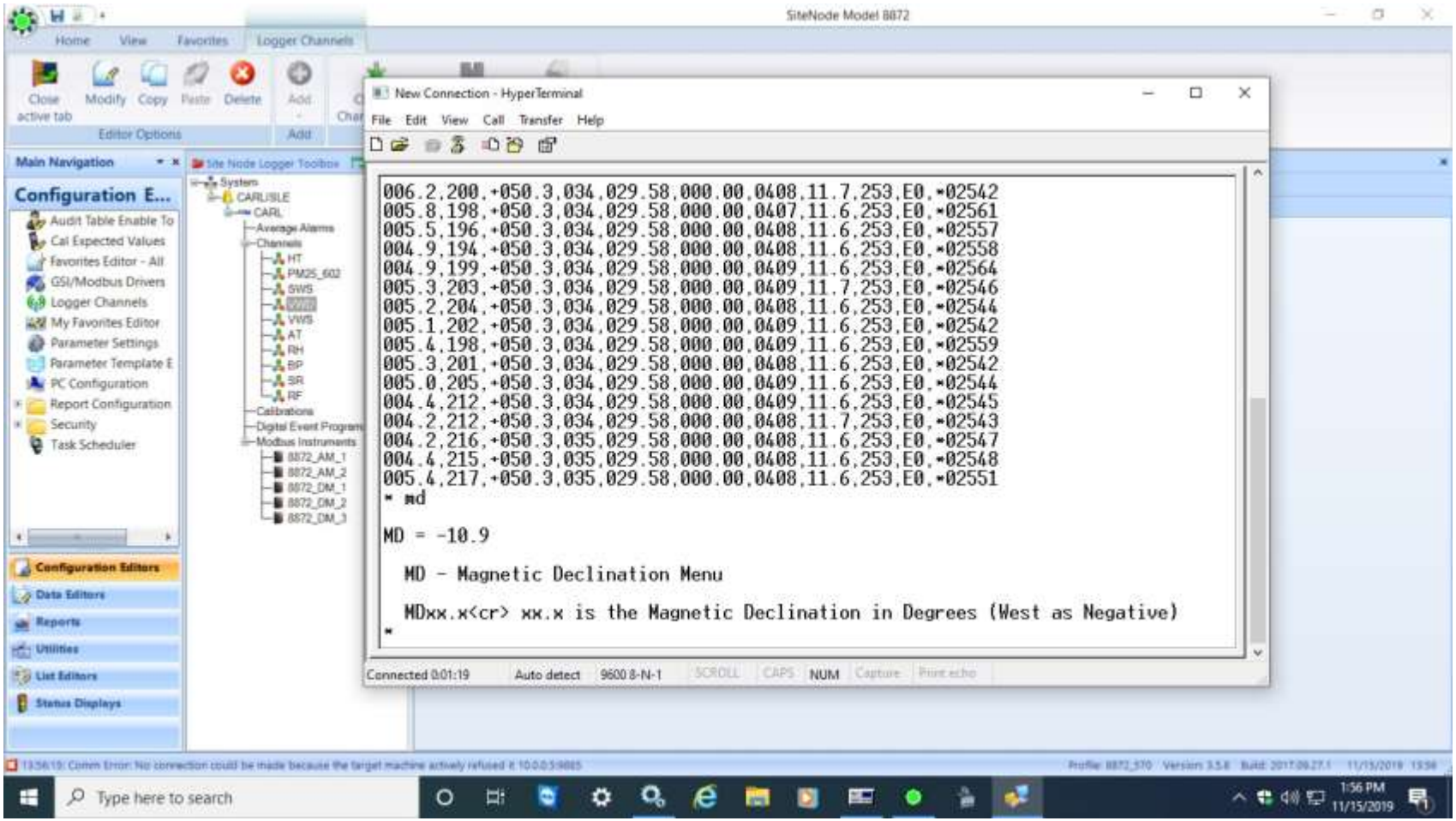
8872 Hyperterminal



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Solar Configuration

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Solar Configuration

Solar Configuration

Cloud Service

PENNSYLVANIA DEP
Comet Cloud Service
CCS Modem - SN: X24461
AIO 2

Map

Current Reading

WS	3.7 mph
WD	188 Deg
AT	38.3 °F
RH	54 %
BP	30.1 inHg
RN	0.0 in
SR	480.0 W/m2

https://tinyurl.com/MOIX24461

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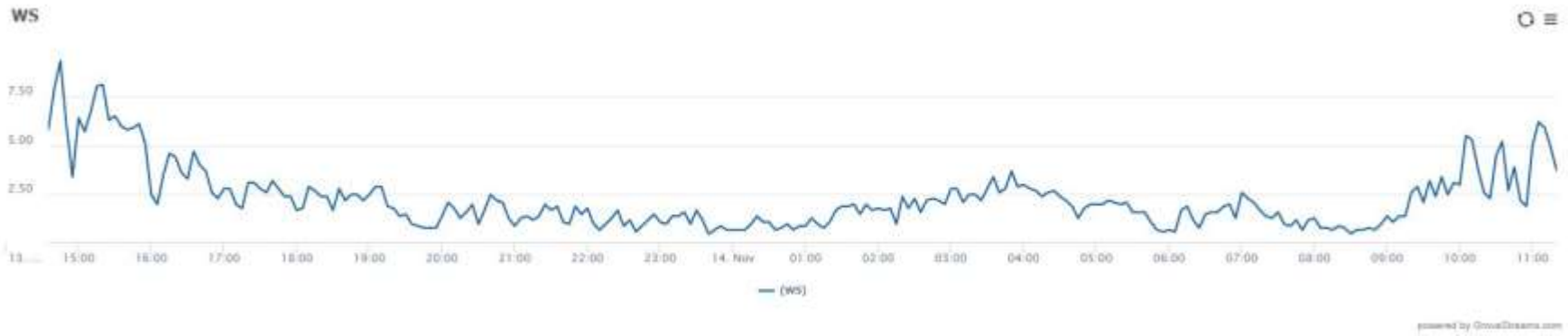
Cloud Service

Historical Data

Time	WS	WD	AT	RH	BP	RN	SR
2019-11-14 11:20	3.7mph	188Deg	38.3°F	54%	30.06inHg	0.00in	480W/m2
2019-11-14 11:15	4.9mph	192Deg	37.1°F	55%	30.06inHg	0.00in	422W/m2
2019-11-14 11:10	5.9mph	174Deg	36.3°F	55%	30.07inHg	0.00in	292W/m2
2019-11-14 11:05	6.2mph	180Deg	36.4°F	54%	30.07inHg	0.00in	323W/m2
2019-11-14 11:00	5.0mph	171Deg	36.6°F	53%	30.08inHg	0.00in	347W/m2
2019-11-14 10:55	1.9mph	190Deg	36.7°F	53%	30.08inHg	0.00in	347W/m2
2019-11-14 10:50	2.2mph	184Deg	35.7°F	54%	30.08inHg	0.00in	348W/m2



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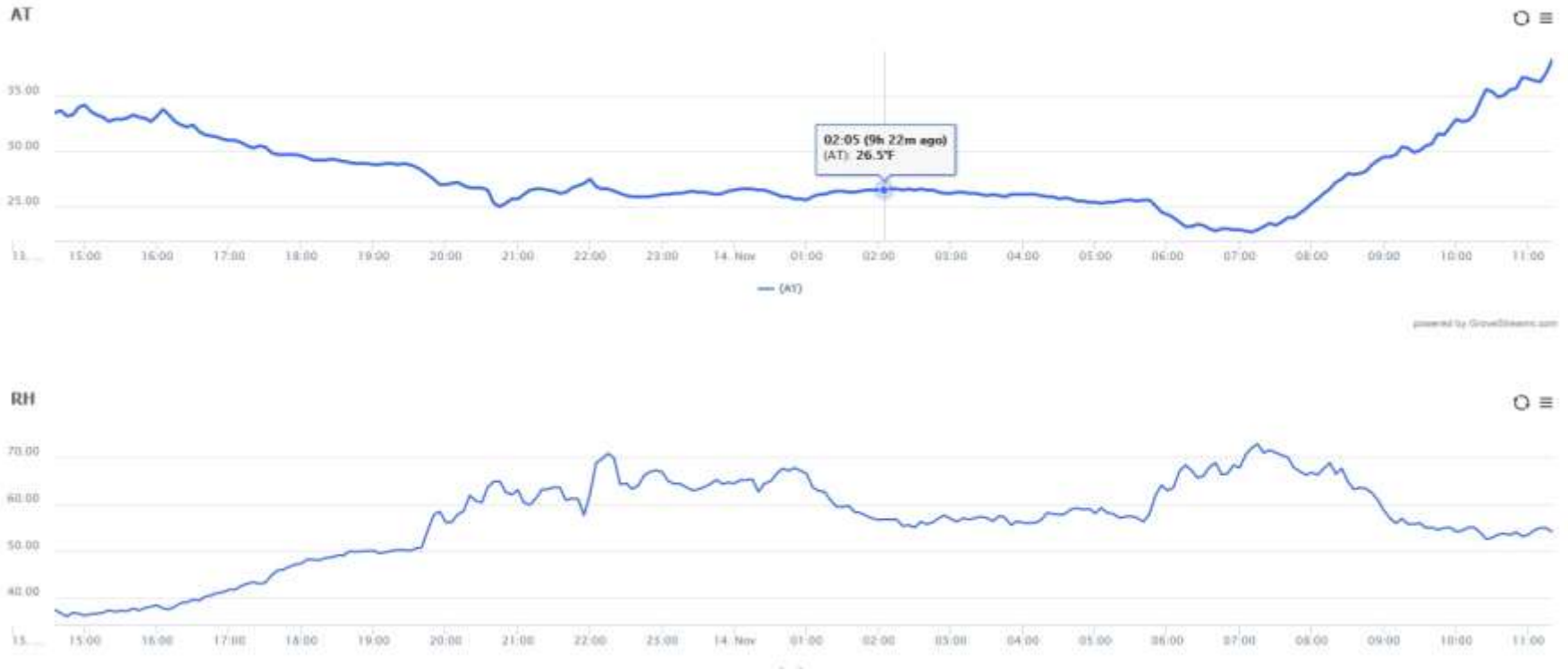
Cloud Service



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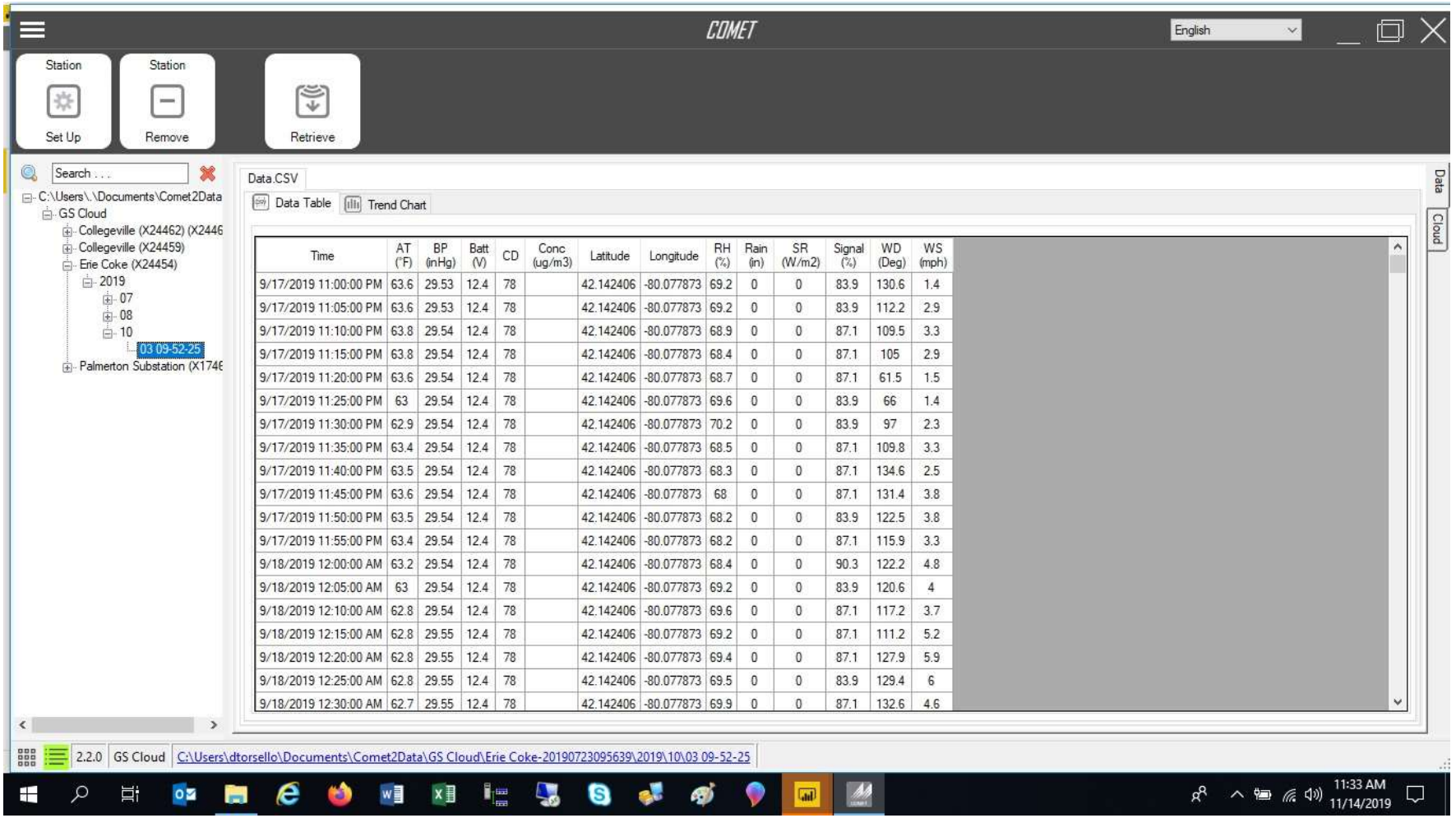
COMET Software



Time	AT (°F)	BP (inHg)	Batt (V)	CD	Conc (ug/m3)	Latitude	Longitude	RH (%)	Rain (in)	SR (W/m2)	Signal (%)	WD (Deg)	WS (mph)
9/17/2019 11:00:00 PM	63.6	29.53	12.4	78		42.142406	-80.077873	69.2	0	0	83.9	130.6	1.4
9/17/2019 11:05:00 PM	63.6	29.53	12.4	78		42.142406	-80.077873	69.2	0	0	83.9	112.2	2.9
9/17/2019 11:10:00 PM	63.8	29.54	12.4	78		42.142406	-80.077873	68.9	0	0	87.1	109.5	3.3
9/17/2019 11:15:00 PM	63.8	29.54	12.4	78		42.142406	-80.077873	68.4	0	0	87.1	105	2.9
9/17/2019 11:20:00 PM	63.6	29.54	12.4	78		42.142406	-80.077873	68.7	0	0	87.1	61.5	1.5
9/17/2019 11:25:00 PM	63	29.54	12.4	78		42.142406	-80.077873	69.6	0	0	83.9	66	1.4
9/17/2019 11:30:00 PM	62.9	29.54	12.4	78		42.142406	-80.077873	70.2	0	0	83.9	97	2.3
9/17/2019 11:35:00 PM	63.4	29.54	12.4	78		42.142406	-80.077873	68.5	0	0	87.1	109.8	3.3
9/17/2019 11:40:00 PM	63.5	29.54	12.4	78		42.142406	-80.077873	68.3	0	0	87.1	134.6	2.5
9/17/2019 11:45:00 PM	63.6	29.54	12.4	78		42.142406	-80.077873	68	0	0	87.1	131.4	3.8
9/17/2019 11:50:00 PM	63.5	29.54	12.4	78		42.142406	-80.077873	68.2	0	0	83.9	122.5	3.8
9/17/2019 11:55:00 PM	63.4	29.54	12.4	78		42.142406	-80.077873	68.2	0	0	87.1	115.9	3.3
9/18/2019 12:00:00 AM	63.2	29.54	12.4	78		42.142406	-80.077873	68.4	0	0	90.3	122.2	4.8
9/18/2019 12:05:00 AM	63	29.54	12.4	78		42.142406	-80.077873	69.2	0	0	83.9	120.6	4
9/18/2019 12:10:00 AM	62.8	29.54	12.4	78		42.142406	-80.077873	69.6	0	0	87.1	117.2	3.7
9/18/2019 12:15:00 AM	62.8	29.55	12.4	78		42.142406	-80.077873	69.2	0	0	87.1	111.2	5.2
9/18/2019 12:20:00 AM	62.8	29.55	12.4	78		42.142406	-80.077873	69.4	0	0	87.1	127.9	5.9
9/18/2019 12:25:00 AM	62.8	29.55	12.4	78		42.142406	-80.077873	69.5	0	0	83.9	129.4	6
9/18/2019 12:30:00 AM	62.7	29.55	12.4	78		42.142406	-80.077873	69.9	0	0	87.1	132.6	4.6

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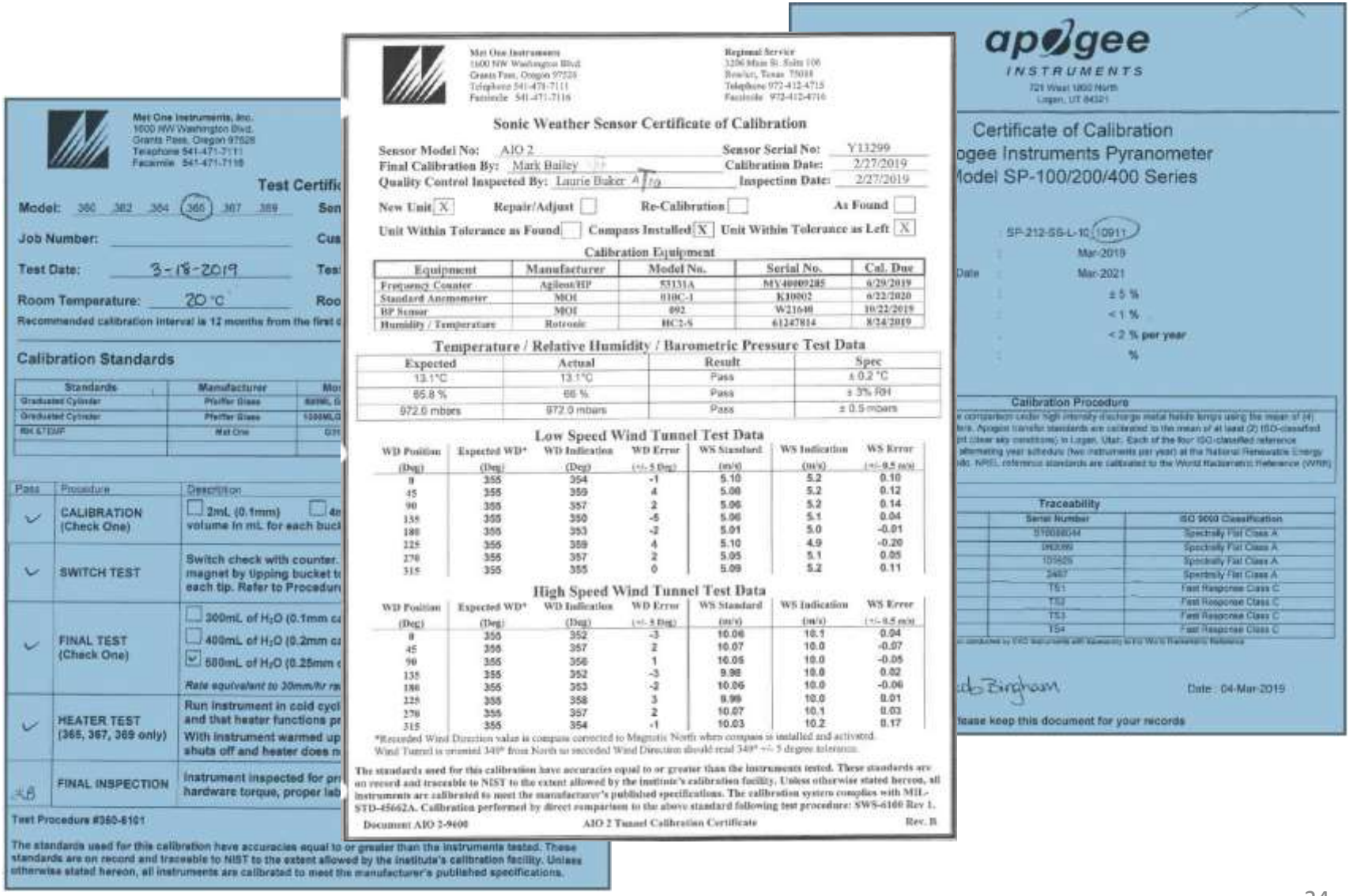
Factory Certifications



Met One Instruments, Inc.
1600 NW Washington Blvd.
Grants Pass, Oregon 97526
Telephone 541-471-7111
Facsimile 541-471-7116

Test Certific

Model: 380 382 384 (386) 387 389 Sen

Job Number: Cus

Test Date: 3-18-2019 Tes

Room Temperature: 20 °C Roo

Recommended calibration interval is 12 months from the first c

Calibration Standards

Standards	Manufacturer	Mo
Graduated Cylinder	Pfeiffer Glass	500ML G
Graduated Cylinder	Pfeiffer Glass	1000ML G
RH 6710AF	Met One	G31

Pass	Procedure	Description
✓	CALIBRATION (Check One)	☐ 2mL (0.1mm) ☐ 4n volume in mL for each bucl
✓	SWITCH TEST	Switch check with counter. magnet by tipping bucket t each tip. Refer to Procedur
✓	FINAL TEST (Check One)	☐ 300mL of H_2O (0.1mm ca ☐ 400mL of H_2O (0.2mm ca ☑ 500mL of H_2O (0.25mm c *Rate equivalent to 30mm/hr ra*
✓	HEATER TEST (365, 367, 369 only)	Run instrument in cold cycl and that heater functions pr With instrument warmed up shuts off and heater does n
JLB	FINAL INSPECTION	Instrument inspected for pr hardware torque, proper lab

Test Procedure #360-6101

The standards used for this calibration have accuracies equal to or greater than the instruments tested. These standards are on record and traceable to NIST to the extent allowed by the institute's calibration facility. Unless otherwise stated hereon, all instruments are calibrated to meet the manufacturer's published specifications.

Met One Instruments
1600 NW Washington Blvd
Grants Pass, Oregon 97526
Telephone 541-471-7111
Facsimile 541-471-7116

Regional Service
1206 Main St. Suite 106
Bowler, Texas 75088
Telephone 972-412-4715
Facsimile 972-412-4716

Sonic Weather Sensor Certificate of Calibration

Sensor Model No: AIO 2 Sensor Serial No: Y13299
Final Calibration By: Mark Bailey Calibration Date: 2/27/2019
Quality Control Inspected By: Laurie Baker Inspection Date: 2/27/2019

New Unit [X] Repair/Adjust [ ] Re-Calibration [ ] As Found [ ]
Unit Within Tolerance as Found [ ] Compass Installed [X] Unit Within Tolerance as Left [X]

Calibration Equipment

Equipment	Manufacturer	Model No.	Serial No.	Cal. Due
Frequency Counter	Agilent/HP	53131A	MY40009285	6/29/2019
Standard Anemometer	MOI	010C-1	KJ0002	6/22/2020
RP Sensor	MOI	092	W2164R	10/22/2019
Humidity / Temperature	Rotronic	HC2-S	61247814	8/24/2019

Temperature / Relative Humidity / Barometric Pressure Test Data

Expected	Actual	Result	Spec
13.1°C	13.1°C	Pass	± 0.2 °C
66.8 %	66 %	Pass	± 3% RH
972.0 mbars	972.0 mbars	Pass	± 0.5 mbars

Low Speed Wind Tunnel Test Data

WD Position (Deg)	Expected WD* (Deg)	WD Indication (Deg)	WD Error (+/- 5 Deg)	WS Standard (m/s)	WS Indication (m/s)	WS Error (+/- 0.5 m/s)
0	355	354	-1	5.10	5.2	0.10
45	355	359	4	5.08	5.2	0.12
90	355	357	2	5.06	5.2	0.14
135	355	350	-5	5.06	5.1	0.04
180	355	353	-2	5.01	5.0	-0.01
225	355	359	4	5.10	4.9	-0.20
270	355	357	2	5.05	5.1	0.05
315	355	355	0	5.09	5.2	0.11

High Speed Wind Tunnel Test Data

WD Position (Deg)	Expected WD* (Deg)	WD Indication (Deg)	WD Error (+/- 5 Deg)	WS Standard (m/s)	WS Indication (m/s)	WS Error (+/- 0.5 m/s)
0	355	352	-3	10.06	10.1	0.04
45	355	357	2	10.07	10.0	-0.07
90	355	356	1	10.05	10.0	-0.05
135	355	352	-3	9.98	10.0	0.02
180	355	353	-2	10.06	10.0	-0.06
225	355	358	3	9.99	10.0	0.01
270	355	357	2	10.07	10.1	0.03
315	355	354	-1	10.03	10.2	0.17

*Recorded Wind Direction value is compass corrected to Magnetic North when compass is installed and activated.
Wind Tunnel is oriented 340° from North so recorded Wind Direction should read 340° +/- 5 degree tolerance.

The standards used for this calibration have accuracies equal to or greater than the instruments tested. These standards are on record and traceable to NIST to the extent allowed by the institute's calibration facility. Unless otherwise stated hereon, all instruments are calibrated to meet the manufacturer's published specifications. The calibration system complies with MIL-STD-45662A. Calibration performed by direct comparison to the above standard following test procedure: SWS-6100 Rev 1.

Document AIO 2-9600 AIO 2 Tunnel Calibration Certificate Rev. B

apogee
INSTRUMENTS
721 West 1800 North
Logan, UT 84321

Certificate of Calibration
ogee Instruments Pyranometer
Model SP-100/200/400 Series

SP-212-SS-L-10 10911
Mar-2019
Date Mar-2021
± 5 %
< 1 %
< 2 % per year
%

Calibration Procedure
e comparison under high intensity discharge metal halide lamps using the mean of (4) ters. Apogee transfer standards are calibrated to the mean of at least (2) ISO-classified ght clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference alternating year schedule (two instruments per year) at the National Renewable Energy ab, NREL reference standards are calibrated to the World Radiometric Reference (WRR)

Traceability

Serial Number	ISO 9060 Classification
51008004	Spectrally Flat Class A
040099	Spectrally Flat Class A
101626	Spectrally Flat Class A
3467	Spectrally Flat Class A
TS1	Fast Response Class C
TS2	Fast Response Class C
TS3	Fast Response Class C
TS4	Fast Response Class C

ds Bingham Date: 04-Mar-2019

lease keep this document for your records

SOP's Available at a Good Price

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Version 10/30/19

AV Trend Settings for Met One Met Gear

Related SOPs
Installing Met One Met Gear with a Solar Configuration
Installing Met One Met Gear at a COPAMS Site

Install Met-One Gear

1. Install the Met-One meteorological equipment using SOP "Installing Met One Met Gear at a COPAMS Site".

If COPAMS Station is a Brand New Site or Never Had Met Gear

1. All Parameter and Channel Settings will be new.
2. The settings work can be done in Air Vision, where settings can be copied and pasted from other sites. From Air Vision, the settings can be downloaded to AVTrend on the datalogger.
3. The channel numbers should start at the next available channel number at the site and be in this order (only if possible): SWS, VWD, VWS, AT, RH, BP, SR, RF.

If COPAMS Station is an Existing Site with Old-Style Met Gear

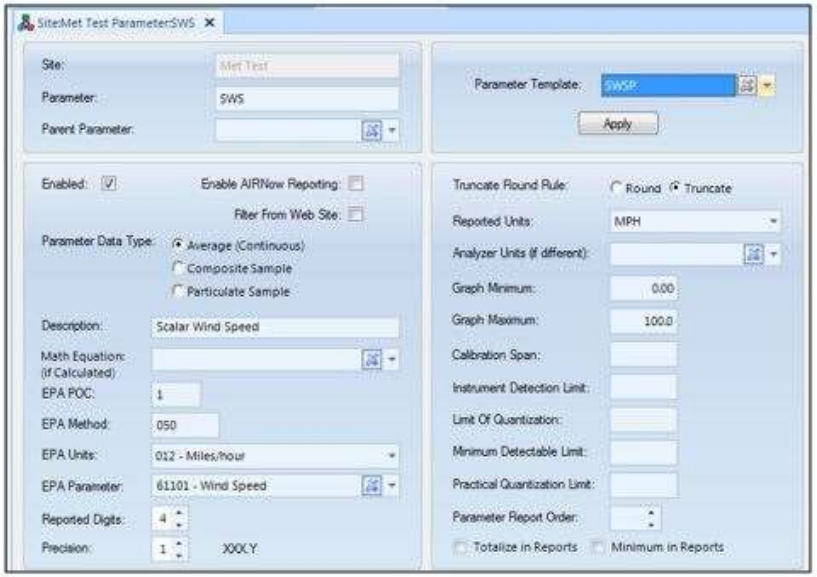
1. Some Parameter and Channel settings will be new (such as rainfall, BP, RH).
2. For existing channels (such as VWS, VWD, VWS, SR), first note the exact channel name and number first, then delete those channels, then reinstall those channels (using the same channel name and number). Note: Just delete the channel, not the parameter!

Wind Speed and Wind Direction Parameters and Channels

1. Create SWS and VWD paramters and channels first, before creating VWS channel
2. This is due to some channels being linked together (companion channels).
3. In the steps below, channels under the Misc tab:
    a. SWS channel will have no companion channel.
    b. VWD channel will have a companion channel of VWS.
    c. VWS channel will have a companion channel of VWD.

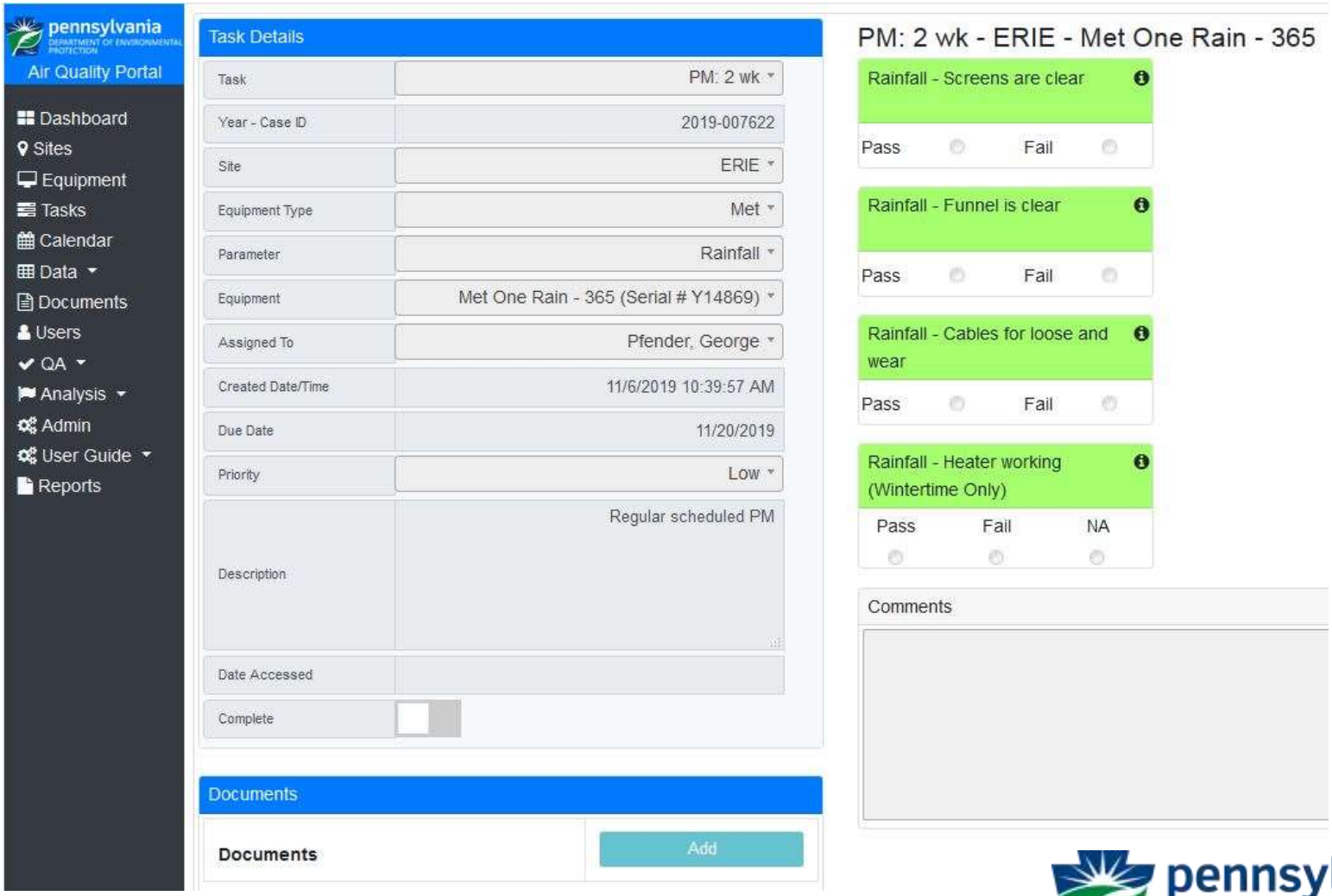
Scalar Wind Speed (SWS)

1. If Scalar Wind Speed is a new parameter and channel:
    a. Under Configuration Editor, go to Parameter Settings
        i. Right click on the site name, select Add Paramenter
            1. Under Parameter Template, select SWSP from the dropdown, then hit the Apply button.
            2. Under the Parameter Field, type SWS.
            3. All other fields should match the below screenshot.



b. Under Configuration Editor, go to Logger Channels
    i. Expand the site name in the tree
    ii. Right click on the logger mnemonic, click Add, click Add Channel, choose Scalar Wind Speed (GSI)
        1. Under the Channel Tab, all settings except the channel number should look like the below screenshot. The parameter field is in the format of SiteName : SWS

Preventative Maintenance



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Quality Assurance

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Issues So Far

- **Bad sensors from the factory**
  - Ten AIO 2: 40+ mph spikes, 1 hr. long
  - One AIO 2: Relative humidity failure
  - All were fixed or replaced under warranty
- **Sonic Shortcomings**
  - Hard driving rain affects some AIO 2 sensors
  - Birds?
- **Cloud Service**
  - Webpage not user-customizable
  - All stopped at the same time

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Good/Bad

- Can customize
- Tech support decent
- Do honor warranty
- WD self-aligning
- Simple connections to datalogger

- Some bad sensors
- Long repair time
- Sonic shortcomings
- WS/WD checks harder

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