MONTEREY BAY UNIFIED AIR POLLUTION CONTROL DISTRICT

STANDARD OPERATING PROCEDURES
FOR
MET ONE METEOROLOGICAL SENSOR FOR WIND DIRECTION, MODEL 020C

Accepted by:

Name: _____ (Supervising Air Monitoring Specialist)

Date: _____

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3.19 MET ONE METEOROLOGICAL SENSOR FOR WIND DIRECTION, MODEL 020C

3.19.1 GENERAL INFORMATION FOR WIND DIRECTION SENSOR, MODEL 020C

3.19.1.1 Introduction

The purpose of this Standard Operating Procedure (SOP) is to document the MET One Meteorological Sensor for Wind Direction, Model 020C guidelines and follow recommended guidelines set forth by the Air Quality Surveillance Branch of the California Air Resources Board (ARB). The goal of this SOP is for the purpose of installation, configuration and operation procedures in order to ensure comparability among all MET One Meteorological Sensors for Wind Direction, Model 020C. The MET One Meteorological Sensor for Wind Direction Model 020C Operation Manual contains a significant source of information pertinent to the operation, maintenance and understanding of this instrument.

3.19.1.2 Theory

Wind direction sensors provide information on the azimuth angle from which the wind is blowing. Positioned is a tail assembly on a vertical shaft. When the wind blows, it will apply a force to the tail assembly, and the tail assembly will turn the shaft seeking a position of minimum force. Low friction precision grade bearings support the shaft, and connect to a low torque potentiometer. The potentiometer will yield a voltage output proportional to the wind direction. The relationship of shape, size, and distance from the axis of rotation of the tail assembly to the bearings and potentiometer torque requirements control the starting threshold.

The proper orientation of the sensor to TRUE NORTH, efficient operation of bearing assemblies, and correct potentiometer function are factors which can affect the quality of wind direction data. Calibration of the wind direction sensor is necessary every six months to assure the correct function of the components.

3.19.1.3 System Description

The Met One 020 Wind Direction Sensor uses a lightweight, airfoil vane and micro torque potentiometer to produce an analog voltage output proportional to wind direction. An internal heater maintains the sensor interior at a positive pressure, which provides positive aspiration through the bearings and contributes to extended bearing life.

The Met One 1190 Translator Module converts the output of the Met One 020 Wind Direction Sensor into a 0-360 degree output. In typical use, the translator module provides +12 volts direct current (VDC) for sensor power. The sensor's internal heater requires a separate source of 12 volts.

There are built-in zero and half-scale test switches in the front of the translator module. Two analog output signals are available from the output of the translator module.

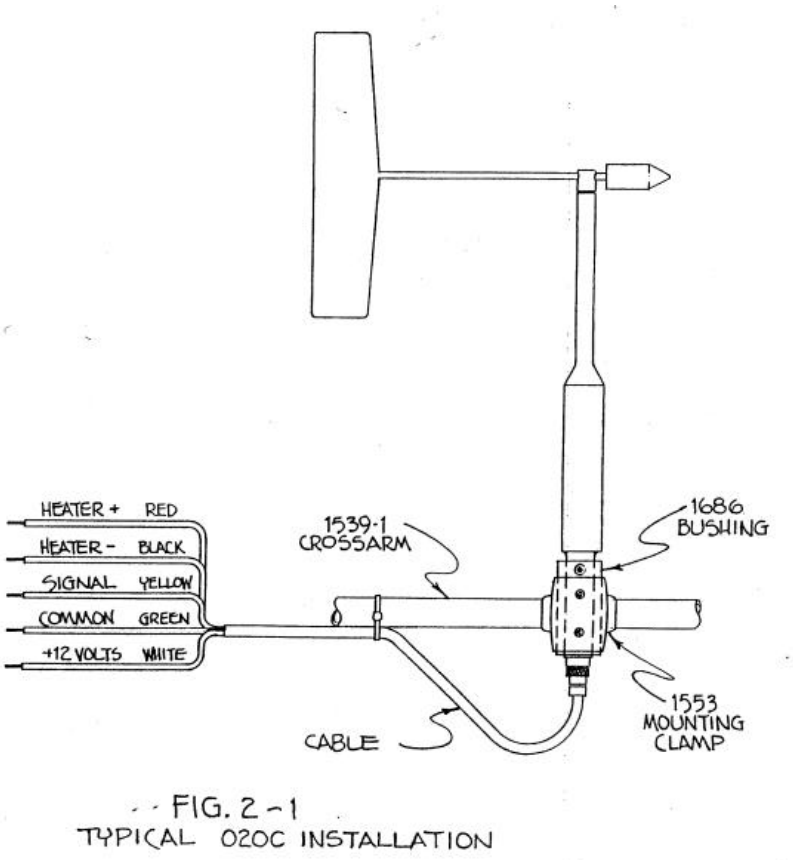

Figure 3.19.1

3.19.2 ROUTINE SERVICE CHECKS

3.19.2.1 General Information

Perform the following checks on wind direction sensors at the intervals specified in the service schedule. Perform checks at the prescribed intervals, but if preferred you can perform more frequently. Document all of the results and maintenance on the Monthly Quality Control Maintenance Check Sheet (Figure 3.19.2).

3.19.2.2 Weekly Checks

1. Review data logger and strip chart data for correct operation of the wind direction sensor.

2. Perform a visual inspection of the wind direction sensor to ensure that the vane is turning and there is no visible damage.

3. Activate built-in zero and half-scale test switches in the front of the translator module and record the data logger outputs on the Monthly Quality Control Maintenance Check Sheet (Figure 3.19.2).

3.19.2.3 Monthly Checks

1. Monthly Quality Control Maintenance Check Sheet

2. Each month, after completing the final week's checks, forward the check sheet to your supervisor and to file.

3.19.2.4 Semi-Annual Checks

1. Multipoint Sensor Calibration (Figure 3.19.3)
Calibrate the wind direction sensor at least once every six months of operation, upon relocation, and after major repairs. Record the date of the most recent calibration on the Monthly Quality Control Check Sheet. See the calibration procedure in section 3.19.5.3.

3.19.2.5 Semi-Annual Preventative Maintenance

1. At the cross arm assembly, disconnect the quick disconnect plug from the sensor (leave the cable secured to the cross arm) and remove the sensor from the cross arm assembly.

2. Loosen the setscrew holding the vane assembly. Support the rotating hub of the sensor with one hand and pull the vane assembly free.

3. Visually inspect the wind vane assembly to ensure that the wind vane and counterweight attached to the wind vane rod are secure. Ensure that the setscrew in the top edge of the rotating hub is holding the rod in place as well. Inspect the vane for cracks and breaks.

4. Slide the sensor cover down to expose the potentiometer assembly and signal conditioning module.

5. Inspect the interior of the sensor for any signs of corrosion and/or dust buildup.

6. Inspect the potentiometer for loose wires, cracks, and corrosion.

7. Inspect the circuit board assembly for cracks and corrosion around soldered connections.

8. Inspect the shaft coupler for proper position. Check alignment of marks on the rotating hub and the column assembly, and that all special setscrews are tight.

9. Rotate the sensor hub assembly to make sure that it turns freely, and that there is no damage to the sensor bearings.

10. Make sure that the potentiometer assembly is rigid in its holder.

11. Apply a small amount of silicone lubricant. (Dow-Corning DC-33 or equivalent) to the sensor O-ring seals; slide the cover up over the sensor and wipe off any excess lubricant.

12. Support the rotating hub of the sensor with one hand and mount the wind vane assembly on the hub. The keyed wind vane assembly fits the pin on the hub. Tighten the setscrew in the bottom edge of the vane hub.

13. A moisture vent is located on the base of the sensor; make sure that the vent is clear.

14. Re-install sensor and verify its proper operation.

FILE # _____

MONTEREY BAY UNIFIED AIR POLLUTION CONTROL DISTRICT
MONTHLY QUALITY CONTROL MAINTENANCE CHECK SHEET

MET ONE METEOROLOGICAL INSTRUMENT

LOCATION: _____ MONTH/YEAR: _____
STATION AIRS NUMBER: _____ TECHNICIAN: _____
ANALYZER ID# _____

DATE	VISUAL	WIND SPEED		WIND DIRECTION		AMBIENT TEMPERATURE	
		ZERO	SPAN	ZERO	SPAN	ZERO	SPAN

1. DAILY VISUAL (RECORD WEEKLY) CHECK DAS

2. WEEKLY PERFORM ELECTRONIC CHECKS AND RECORD RESULTS

3. SEMI ANNUALLY:

Date last calibrated _____ Next calibration due _____ 6 Months

TYPE	ID#
WIND SPEED	
WIND DIRECTION	
AMBIENT TEMPERATURE	

DATE	COMMENTS OR MAINTENANCE PERFORMED

REVIEWED BY _____ DATE _____

Form #508 rev. 08/08/11 (word)

Figure 3.19.2

FILE # _____

MONTEREY BAY UNIFIED AIR POLLUTION CONTROL DISTRICT
METEOROLOGICAL SENSOR CALIBRATION FORM
ASIS _____ FINAL _____

LOCATION: _____ DATE: _____

STATION AIRS NUMBER: _____

TRANSLATOR ID# _____ LAST CALIBRATION DATE: _____

PARAMETER	UNITS	SOURCE VALUE	DATA LOGGER RESPONSE	
			READING	ERROR
WIND DIRECTION TORQUE _____g <7.5g	0 - 360 DEGREES <5.0 E combined accuracy and orientation error	0		E
		90		E
		180		E
		270		E
WIND SPEED TORQUE _____g <0.35g	0 - 50 MILES PER HOUR <0.6 MPH			MPH
				MPH
				MPH
AMBIENT TEMPERATURE	0 - 100 DEGREES F +/- 0 .9 EF			EF
				EF
				EF

CALIBRATION STANDARDS USED

Wind Direction	CROSS ARM ORIENT. DEGREES_____DECLINATION_____ TS 529 TRANSIT MODEL # 40-1400 WARREN-KNIGHT FORESTER COMPASS
TS 239 WS 300 RPM	SYNCHRONOUS MOTOR ID # 049C-1 SN# J9093-300 CALIB. DATE:
TS 240 WS 600 RPM	SYNCHRONOUS MOTOR ID # 049C-2 SN # J9094-600 CALIB. DATE:
TEMPERATURE	ID# MODEL # SERIAL# CALIB. Date

MET ONE METEOROLOGICAL SENSOR MODEL AND SERIAL NUMBERS

WD	ID#	MODEL #	SERIAL #
WS	ID#	MODEL #	SERIAL #
ATM	ID#	MODEL #	SERIAL #

Comments:

_____

_____

_____

CALIBRATED BY _____

REVIEWED BY _____ DATE _____

Form #517 rev. 08/08/11 (word)

Figure 3.19.3

3.19.3 DETAILED MAINTENANCE AND ALIGNMENT PROCEDURES

3.19.3.1 The Met One 020 Wind Direction Sensor's design provides years of service. Constructed of noncorrosive materials it requires little maintenance. The only components likely to need replacement due to normal wear are the precision bearings and the potentiometer. Provided below are general maintenance requirements. Refer to the sensor operating manua1 for detailed instructions on maintenance procedures.

1. Inspect and lubricate the sensor cable connections with silicon-based grease, as necessary.

2. Keep set screws lubricated with anti-seize compound for easy removal.

3. Record any maintenance, malfunctions, repairs, and actions taken to prevent recurrences of malfunction on the Monthly Quality Control Maintenance Check sheet and in the Meteorological Sensor Instrument Log.

3.19.4 TROUBLESHOOTING

3.19.4.1 General Information
Troubleshooting should attempt to isolate the source of the malfunction and reduce maintenance time. If a problem exists check the following items.

3.19.4.2 Troubleshooting Guide

1. Visually inspect the wind direction sensor, checking for damage and verifying that the vane is turning freely.

2. Check for loss of voltage supply.

3 Check for proper operation of the sensor bearings. Bad bearings may affect starting threshold.

4. Verify that the cable connections are secure.

5. Measure the outputs from the wind direction sensor and/or translator using the voltmeter.

6. Verify proper data logger initialization.

3.19.5 CALIBRATION PROCEDURE

Wind direction sensors should be calibrated every six months, or more frequently in corrosive environments. Calibrations consist of system and component accuracy checks. A system accuracy check tests the system as a whole and verifies that the sensor mount is accurate with respect to True North. Component accuracy checks test for errors within the system. These tests consist of a starting torque test, as well as an accuracy test with respect to a known standard.

Normally, only remove sensors from the mast when they are undergoing maintenance, repairs or for calibration. Thus, sensors should be in the same condition as when placed on the mast. Before beginning the calibration, document the following "AS-IS" conditions of the sensor in the Wind Direction Calibration Datasheet (Figure 3.19.3).

1. Site declination
2. Vane or cross arm orientations (relative to true north)
3. Data logger output (sensor held to true north, if possible)
4. Sensor condition
5. "AS-IS" Azimuth (Computed from 1, 2 & 3)

During the wind direction calibration, look for problems which could affect the operation of the sensor such as, dirty components, and loose, worn, or broken parts. Document any noted problems on the Wind Direction Calibration Datasheet (Figure 3.18.3). If a sensor should fail any section of the following calibrations, complete the other calibration procedures if possible.

This "AS-IS" condition will provide information to verify data validity between calibration periods. Fill out an "AS-IS" Wind Direction Calibration Datasheet when an "AS-IS" calibration is performed. A "FINAL" calibration form is also required if the sensor is repaired or changed.

3.19.5.1 Apparatus:

1. Met One 040 Degree Wheel and Pointer

2. R.M. Young 18312 Cup-Wheel Torque Disc with Slotted Center with 1.0 gram screws

3. Compass with tripod for sensor orientation

4. Calibration report forms (Figure 3.19.3).

3.19.5.2 "As Is" Calibration

OTHER THAN ROUTINE CHECKS, ANALYZER REPAIRS OR ADJUSTMENTS SHOULD NOT BE MADE PRIOR TO THE "As Is" CALIBRATION.

1. Starting Torque Test

The starting threshold speed of the wind direction sensor is influences the design of the vane assembly. Wind direction sensor should have a starting threshold speed of less than 0.5 meters/second. They originally built the sensors to meet the specification. The sensor should be replaced if the maximum torque in gram-centimeters (gm-cm), listed in each sensor's appropriate section is exceeded.

a. Remove the vane assembly and attach the modified R.M. Young 18312 cup-wheel torque disc with slotted center. Place the sensor in a horizontal position (the edge of a table will work), so that it is parallel with the floor.

b. There are two types of weights provided with the disc, black nylon screws (0.1 gram), and stainless steel screws (1.0 gram). Combine the he screws at different radii to provide a total torque.

c. Orient the disc such that the holes for the screws are parallel to the floor. There are a total of 10 holes on the disc; only use five holes on one side for the torque test. Screw in a 1.0 gram weight in the fourth hole from the center. This equals 4.0 grams-centimeters (gm-cm), which is the minimum force required to move a new sensor hub. If the disc does not turn, move the weight to the fourth hole on the disc.

d. Turn the disc to at least four additional starting points on the hub shaft. The disc should turn at all new starting points. If not, add additional weight and retry at the four starting points. Verify if the bearings are good for the complete 360 degrees of motion in both the clockwise (CW) and counterclockwise (CCW) directions.

e. Record the highest torque required to turn the hub on the Wind Direction Calibration Datasheet. If the torque exceeds 7.0 gm-cm at any starting point, replace the sensor. Perform the wind direction accuracy calibration prior to replacing the sensor.

f. If the sensor is replaced repeat steps a through e.

g. Once the starting torque test is complete, proceed to Wind Direction Accuracy Calibration.

2. Wind Direction Accuracy Calibration

Perform the wind direction accuracy calibration to determine if the sensor output is correct at a minimum of four known direction orientations.

a. Remove the wind direction vane assembly from the sensor. Slide the degree wheel over the sensor with the numbered side facing towards the top of the sensor. Align the 180-degree mark on the degree wheel to the scribed mark that is on the outside of the sensor shaft. Tighten screw to hold the degree wheel in place.

b. After removing the wind vane assembly, install the pointer of the degree wheel on the shaft. Assure that the pointer is close enough to the degree fixture to accurately read the degree values.

c. Rotate the pointer to the following degree settings on the degree wheel: 000, 090, 180, 270, and 360. Record the data logger display on the Wind Direction Calibration Datasheet for each point.

d. Record the analyzer identification numbers and any other pertinent information on the calibration worksheet.

e. If any of the data logger readings are off by more than three degrees at any degree setting, the wind direction translator printed circuit board and/or repair or replace the sensor.

3.19.5.3 "Final Calibration"

If any part of the "As Is" Calibration fails to meet specifications, repair or replace the sensor and perform a "Final Calibration" using the steps defined above for the Starting Torque Test and the Wind Speed Accuracy Test.

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