CLARK COUNTY DEPARTMENT OF AIR QUALITY

Monitoring Division

PROCEDURE NUMBER 500

METEOROLOGICAL EQUIPMENT

Revision number 0

12/10/15

APPROVALS:

[redacted]
Monitoring Manager — 12/11/2015 Date

[redacted]
Assistant Manager — 12/11/2015 Date

[redacted]
Monitoring Supervisor — 12/11/2015 Date

[redacted]
Monitoring Supervisor — 12/14/2015 Date

[redacted]
Author — 12/14/2015 Date

Revision History

No.	Date	Author	Description of Change	Affected Pages
0	12/10/15	Paul Fransioli	Original issuance	All

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ACRONYMS AND ABBREVIATIONS

Acronyms

DAQ	Clark County Department of Air Quality
DAS	Data Acquisition Systems
EPA	U.S. Environmental Protection Agency
NCore	National Core Multipollutant Monitoring Network
SLAMS	State and Local Air Monitoring Stations
QC	Quality control (operational group in DAQ Air Monitoring Division)

Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
mb	millibars
ml	milliliters
mph	miles per hour
%	percent

1.0 PURPOSE

The purpose of this procedure is to establish a uniform process for calibration and quality control (QC) testing of meteorological equipment operated by the Monitoring Division of the Clark County Department of Air Quality (DAQ).

2.0 SCOPE/APPLICABILITY

This procedure provides methods for testing meteorological equipment in the field or laboratory associated with installation, removal, and scheduled routine testing tasks. It also provides basic guidance on sensor calibrations. The Quality Assurance Project Plan (QAPP) for Meteorology and NCore Air Quality Monitoring (DAQ, 2014) describes the meteorological monitoring program.

3.0 DEFINITIONS

There are no specific definitions for this SOP. Acronyms and abbreviations are provided above.

4.0 ROLES AND RESPONSIBILITIES

It is the responsibility of the Quality Control (QC) Technicians to perform all tests performed by DAQ in this procedure.

It is the responsibility of the Quality Control (QC) Supervisor to inspect and verify that work performed follows all applicable Standard Operating Procedures (SOP).

It is the responsibility of the Quality Assurance (QA) Supervisor to evaluate the operations applicable to this SOP.

5.0 PROCEDURE

5.1 Summary of Method

Sensors tested by DAQ are either placed in a testing mode or operated collocated with standard test equipment. Either way, sensors are connected to a data acquisition system (DAS) capable of displaying current results (refer to the MQO Guide for acceptance criteria).

Results are entered in version-controlled QC workbooks in specific worksheets with tabs labeled by measurement. Equipment being tested and corresponding standards are identified in the worksheets (note: the worksheets contain formulas to calculate differences and display if the results pass or fail the acceptance criteria).

Calibrations are either performed by DAQ staff, typically in the office laboratory, or by contracted vendors.

5.2 Health and Safety Warnings

When working on meteorological equipment at field stations, be aware of:

- falling hazards associated with working on the station roof
- physical danger from pinching or crushing of hand while the tower is being raised or lowered.

5.3 Equipment and Supplies

Testing the meteorological equipment requires the following standards and support equipment:

- Calibrated thermometer, accuracy ±0.2°C (±0.36°F)
- Calibrated relative humidity standard, accuracy ±2%
- Calibrated barometer, accuracy ±1 mb
- Commercial grade laboratory-grade 100 milliliter cylinder
- Strong plastic bag to fit over sonic anemometer and means to block two transducers

5.4 Field Procedures

Enter operating and standards equipment information in the appropriate worksheet file (refer to the MQO guide for acceptance criteria) for QC testing.

5.4.1 Outside air temperature and relative humidity

1. Put the temperature, humidity and wind measurements off line and lower the sensors.
2. When changing the air temperature/humidity sensor's aspirated shield, make as-found readings prior to the change and as-left readings after the change of sensors.
3. Operate the thermometer and/or relative humidity standard so the standard's sensor is near the air inlet to the system shield, taking care to keep it out of the sunlight. Record the thermometer results as the standard readings in the appropriate worksheet.
4. Record the corresponding system result in the appropriate worksheet (note: the worksheets contain formulas to calculate differences and display if the results pass or fail the acceptance criteria).
5. Attach the signal substitute device (such as the Met One Model 045B) to the signal cable at the sensor end. Apply the tests according to switch positions shown in the appropriate worksheet and record results, noting system performance.
6. Return the system to operating condition and resolve problems, if necessary.

5.4.2 Barometric pressure

1. Operate the standard barometer near the system sensor. Record the results as the standard reading in the appropriate worksheet, noting system performance (note:

the worksheets contain formulas to calculate differences and display if the results pass or fail the acceptance criteria).

2. Record the corresponding system result in the appropriate worksheet and resolve problems, if necessary.

5.4.3 Wind speed and direction

1. Prior to lowering the wind sensor, observe its orientation.
    a. Stand at an appropriate location along a primary compass quadrant direction (true directions of N, E, S or W) relative to the wind sensor. Compare the sensor alignment to the established direction.
    Note: for each 60 feet of distance from the base of the tower, one foot either side of the known position is approximately one degree of angular difference, up to approximately eight degrees.
    b. Record the corresponding system result in the appropriate worksheet (note: the worksheets contain formulas to calculate differences and display if the results pass or fail the acceptance criteria).
2. Put the temperature, humidity and wind measurements off line and lower the sensors.
3. When changing the wind sensor, make as-found readings prior to the change and as-left readings after the change.
    Note: The sonic wind sensor can be changed without changing orientation by not moving the ring that holds the sensor in the cross-arm.
4. Cover the wind sensor with the bag, taking care to allow a few inches of space around the sensor transducers. Read the zero result from the system sensor and record the result in the appropriate worksheet. Remove the bag.
5. In turn, cover one N/S, one E/W, and then one each N/S and E/W transducers and observe the corresponding full-scale speed and direction system results. Record the result in the appropriate worksheet (note: the worksheets contain formulas to calculate differences and display if the results pass or fail the acceptance criteria).
6. Return the system to operating condition, and resolve problems, if necessary.

5.4.4 Precipitation

1. Put the precipitation measurement off line and remove the gauge cover.
2. Carefully pour water through the inner full so the buckets tip twice and do not leave residual water in a bucket. Count the tips made toward the total number of counts if this occurs during the same time interval as the volume test.
3. Beginning with 100 ml of water, carefully pour water through the inner funnel so the buckets tip ten times slowly enough that minimal water is still being poured as

the buckets tip. Record the volume of water used in the appropriate spreadsheet form.

4. Record the indicated precipitation during the measured water pouring for ten tips.
5. Return the system to operating condition, and resolve problems if necessary.

5.5 Lab Procedures

5.5.1 Internal tests in lab

The field tests in the previous section may also be performed in the laboratory without the steps related to on line monitoring equipment mounted on a tower.

5.5.2 Internal calibrations of temperature and humidity sensors

Perform internal temperature and humidity sensor calibrations in the DAQ lab using suitable test environments and guides.

5.5.3 Wind sensor calibrations

Wind sensor calibrations are performed by an independent contractor with wind tunnel capabilities.

6.0 RECORDS MANAGEMENT

All work conducted must be documented as noted in the appropriate instrument and station electronic logs (refer to SOP 100 Monitoring Stations Operations and Logbook Entries).

Record the testing results in the QC workbook file for the given site or laboratory testing location and current year. The worksheets have spaces for as-found and as-left results, and will show whether the results pass or fail the acceptance criteria. When additional tests are performed within the same year, make a copy of the worksheet in the existing workbook appropriate for the measurement.

Any documentation of work conducted on the instrument should be saved to the DAQ network drive using the proper naming convention. All electronic records stored on the DAQ network drive are considered to be the official record of activity. This location allows for review by QC Technicians, Supervisors, QA Technicians, and Management.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

7.1 Regulatory background and acceptance criteria

Testing methods and measurement quality objectives associated with meteorological monitoring at the State and Local Air Monitoring (SLAMS) and NCore stations are based on Environmental Protection Agency (EPA) guidance in Volume IV of the EPA Quality Assurance Handbook series (EPA, 2008).

System performance tests of the meteorological equipment operated in support of the DAQ ambient air quality monitoring program are performed annually except for the Jerome Mack NCore station, which is tested semi-annually. The systems are also tested for both as-found and as-left results when sensors are changed.

7.2 Review and corrective actions

1. Perform troubleshooting and repair for results that exceed the acceptable differences.
2. Provide the completed appropriate spreadsheet form to a QC senior technician or supervisor for review and corrective actions, if necessary.

8.0 REFERENCES

Clark County Department of Air Quality, Quality Assurance Project Plan (QAPP) for Meteorology and NCore Air Quality Monitoring, 2014.

US EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV, Meteorological Measurements, Version 2.0 US EPA OAQPS. EPA-454/B-08-002, March 2008.

Additional Documents:

Guides

MQO Guide

SOPS

SOP 100 Monitoring Stations Operations and Logbook Entries