WBEA – Standard Operating Procedure

SOP Title	**Tipping Bucket Continuous Precipitation Gauge**
SOP Number	**WBEA SOP-MET-004**
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Revision History

Revision #	Date	Description	Author

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Introduction and Background

This procedure is intended to convey the knowledge required to operate and maintain tipping bucket type precipitation sensors. Hourly total precipitation data is collected at various stations in the WBEA ambient air monitoring network.

Some of the Forest Meteorological towers also collect this data on an hourly frequency

Principle of the Method

Tipping bucket rain gauges function as they are named. A heated funnel reduces an area of 200 cm2 into a bucket which tips at a certain calibrated level. Each tip is output as a pulse from a magnetic reed switch which is then counted on the Datalogger as the calibrated volume for that tipping bucket, typically 0.2 mm of wet precipitation. Heating enables the unit to collect precipitation year round.

Measurement Range and Sensitivity

Each tip is calibrated to 0.2 mm of wet precipitation. The unit has an ambient temperature range of -20 to + 50 °C and a humidity range of 0 to 100%.

Equipment and Apparatus

There are two commercially available sensors that are currently used by WBEA in this method:

RM Young Model 52202-L

Met One Model 375 heated gauge

Interferences

Below are some items that may interfere with accurate precipitation measurements from a tipping bucket precipitation gauge:

- Improper placement - the sensor should be as level as possible as it may be possible for a tip to occur prematurely and effect accuracy, also, if the sensor is located in a position that is not open in all directions it may be cut off from rain fall.
- Temperatures below -20 °C may exceed the heaters ability to melt the precipitation.
- Very intense rainfall may cause the tipping bucket to “miss” some of the potential tips due to overflow of the bucket.
- Dust and debris tends to build up in the funnel and can interfere with the precipitation making it through to the bucket.

Precision and Accuracy

The measurement precision is generally considered to be the "repeatability of the measurement". Precision of the data output by the instrument is established by the manufacturer. Routine checks of the tips using a calibration bottle verify the precision. See the calibration section later in this document.

The accuracy of the sensor is generally considered the "deviation from true". This means how close it is to what it should be. The 52202 has a stated accuracy of 2% up to 25 mm h^{-1}, and 3% up to 50 mm h^{-1}. All gauges are checked routinely with the calibration bottle. See the calibration section later in this document.

Site Requirements

Site location of precipitation monitoring gauges should be in an open are not to be influenced by obstacles. See section A-2 of the AESRD Air Monitoring Directive (AMD) for further information. A wind screen surrounding the tipping bucket sensor, helps to minimize missed readings in high winds.

Typically in the WBEA network, the precipitation gauges are installed on the roofs of existing monitoring stations.

Currently WBEA Air Monitoring Stations 1, 6, 8, 14 and 15 use a tipping bucket style precipitation monitor.

Installation Requirements

All the installation requirements as specified by the manufacturer in the installation procedures as well as the general requirements below must be followed.

- As the precipitation gauge is designed to measure wet precipitation continuously the unit must be sited in an area as open as possible. Obstructions, such as buildings, trees and vegetation may affect the measurements if the unit is not properly positioned.
- The unit must be placed a minimum of 30 cm above ground.
- User must supply a 1-inch IPS pipe to be clamped to the unit
- When a suitable location on site has been chosen attach the sensor unit to the support mount.
- Use the bulls-eye bubble level to find the horizontal position using the leveling screws, once leveled properly tighten the set screws to ensure it is secure.

Operating Parameters and Instrument Configuration

The tipping bucket precipitation gauges output a simple contact closure every time the bucket in the sensor tips. This contact closure is counted in the datalogger as one of the calibrated increment (typically 0.2 mm of precipitation). This signal wire needs to be connected to a digital input channel of the datalogger to record these totals.

The heater of the funnel and base is typically powered by 110VAC. This as well needs to be run into the station and connected as appropriate.

For detailed information on programing the datalogger and configuration and set up of the gauges, please refer to the operators' manual for specific needs.

Operational and Maintenance Requirements

Routine maintenance is required on the precipitation gauges.

Monthly

Cleaned the funnel and screens with water

Remove the lid and; check the level of the sensor, clean the bucket if necessary, ensure the bucket is tipping freely

Inspect the wiring connections outside to ensure there are no cracks or deterioration in the protective cover.

Annually

Challenge the gauge with the calibration bottle. See the operations manual for detailed instructions.

Calibration Requirement

During annual function testing if the tips do not match the expected values, calibration is required. This procedure involves adjusting the bucket stops located on the gauge base underneath each bucket. This is a lengthy procedure. Please refer to the calibration procedures in the operations manual.

Data Collection and Management

Data collected for the precipitation gauges is in the form of counts to a total per hour. The datalogger should be configured, based on the operations manual of the output of the particular gauge. Each hour, the total should reset to zero so that a total number of tips is recorded for each hour collected.

Reference Documents

- *52202 ELECTRICALLY HEATED RAIN AND SNOW GAUGE*, Campbell Scientific Canada Corp, Operations Manual
- *Met One model 375, Operations Manual*
- *Alberta Environment Air Monitoring Directive 1989*