Infrastructure Commission (INFCOM)
Standing Committee on Measurements, Instrumentation and Traceability (SC-MINT)
Expert Team on Quality, Traceability and Calibration (ET-QTC)

Calibration of Precipitation Instruments

Part-2: Methods of Measurement and Rain Gauge Calibration

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Content

Part 1:

- Introduction to this unit and historical information
- Concepts and definitions

Part 2:

- **Methods of measurement**
- Calibration of rain gauges

Part 3:

- Calibration example #1
- Calibration example #2

Part 4:

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- Calibration example #4
- References and links

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Methods of measurement

- there are a lot of different measuring principles
  - the simple rain gauge
  - floating rain gauge
  - rain gauge recorder with rotating drum (semi-automation for recording every 24 hour)
  - tipping bucket rain gauge
  - rain gauge using a weighing unit
  - rain gauge with a combination of a tipping bucket and a weighing unit
  - rain gauge with vibrating wires
  - radar and ultrasonic devices
  - …

Methods of measurement

- Non-catching instruments:
  - are commonly used as disdrometers (radar, ultrasonic, Laser Precipitation-Monitor etc.) for the detection of droplet size distributions
  - rainfall intensity or amount can be calculated by mathematical integration over all particles passing a cross section in a certain time interval

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Methods of measurement

- Catching instruments:
  - it collects precipitation through an orifice of well-defined size and measure its water-equivalent volume or mass that has been accumulated in a certain amount of time
  - at present catching rain gauges are widely used in operational networks to measure rainfall amounts and intensities

Photo: DWD Mr. Bender

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Methods of measurement

- Catching instruments:
  - some of them are calibrated in the laboratory
  - they are able to measure Rainfall intensity (RI) within sampling time intervals ranging from a few seconds to several minutes or hours
  - they have finite resolution ranging from 0.001 mm to 1 mm
  - they have reasonably good reproducibility and long-term stability
  - they are widely used in operational practice and they are cost effective

Methods of measurement

- Catching instruments:
  - they are vulnerable to wind-induced catching losses (depending on appropriate wind shielding)
  - they are vulnerable to wetting and evaporation losses, especially in low relative humidity

windshield according to Tretyakov

Methods of measurement – very basic rain gauge

- often a very basic rain gauge is used

In the field

the orifice of the collector and the funnel

the collecting can

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Methods of measurement – very basic rain gauge

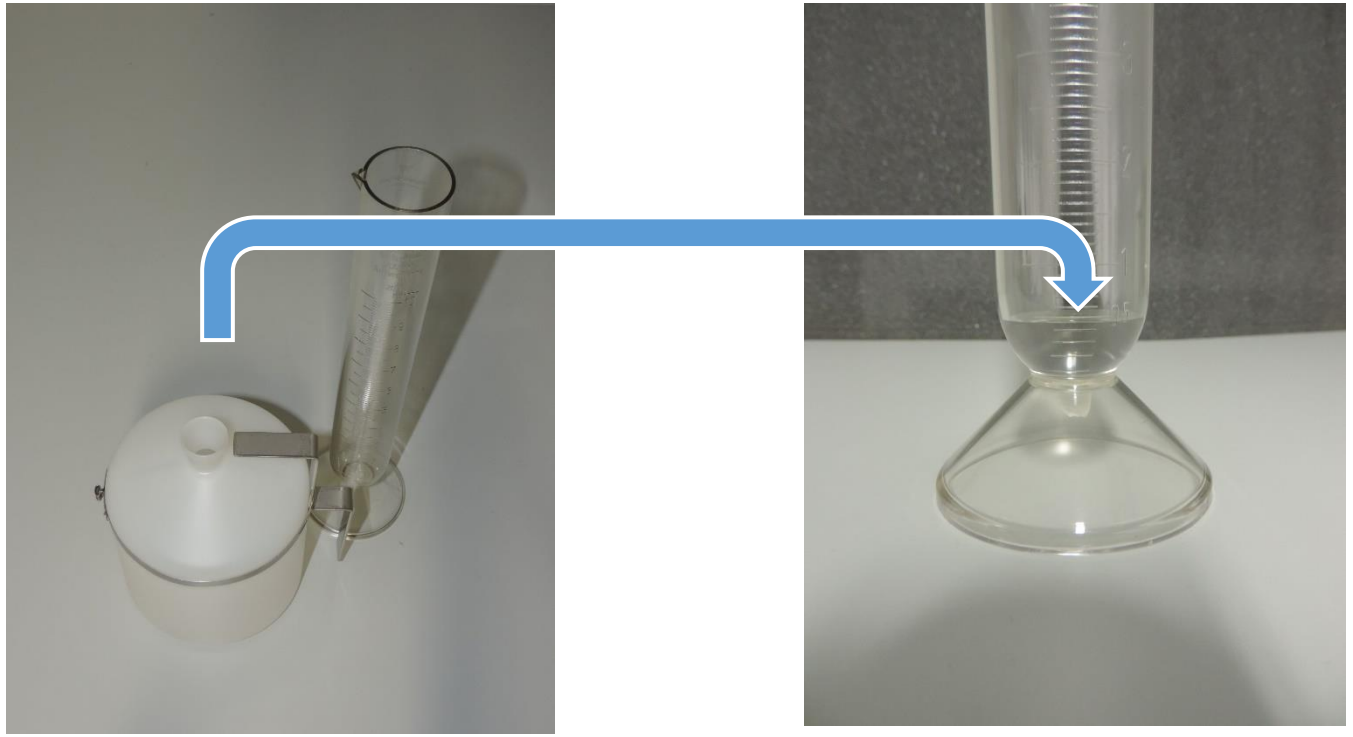
- these rain gauges are normally not calibrated
- as with all other rain gauges and all instruments, the choice of location and maintenance condition is very important
- the gauge, in particular the orifice, shall be undamaged

bite marks from a cow

- the observer **shall be very careful** to allow all the water to flow into the measuring cylinder and to ensure that nothing is spilled

Methods of measurement – very basic rain gauge

- the collected precipitation water is transferred into a measuring cylinder



collecting can and
measuring cylinder

an amount of rain
0.4 … 0.5 mm

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Calibration of rain gauges

- the calibration including the measurement uncertainty budget is shown for the following four examples

  - rain gauges with a weighing unit (part #3, example #1)
  - rain gauges with a combination of a tipping bucket and a weighing unit (part #3, example #2)
  - rain gauges with a tipping bucket (part #4, example #3)
  - rain gauges with a weighing unit (part #4, example #4)

Calibration of rain gauges

- requirements for environmental conditions:
    - to be able to work with calibration laboratory standards, it is required to specify, regulate and record the environmental conditions affecting measurements in a laboratory
    - a stable room temperature is required (air conditioner is necessary)
    - atmospheric pressure, temperature and humidity shall be recorded

environmental measurements: Temperature and relative humidity recorder

precision air conditioner

Calibration of rain gauges

- general requirements:
    - the laboratory employees shall be well trained
    - to avoid partiality, calibration staff shall not be involved in the repair or installation of rain gauges
    - need modern equipment designed to perform the calibration process
    - the quality of all equipment shall be determined according to the achievable measurement uncertainty of the laboratory and the budget resources
    - the standards shall be calibrated according to ISO17025
    - the calibration items shall be cleaned and in a calibratable condition
    - the workstations shall be clean and tidy
    - the calibration process shall be clearly described

Calibration of Rain Gauges
End of Part 2

Thank you.

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