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Hydrometry — Measurement of the rainfall intensity (liquid precipitation): requirements, calibration methods and field measurements

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Hydrometry - Measurement of the rainfall intensity (liquid precipitation): requirements, calibration methods and field measurements

Mesurage de l'intensité pluviométrique (précipitations liquides) : exigences, méthodes d'étalonnage et mesures de terrain

Hydrometrie - Messung der Regenintensität (flüssiger Niederschlag): Anforderungen, Kalibrierverfahren und Feldmessungen

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Foreword

This document (CEN/TR 16469:2013) has been prepared by Technical Committee CEN/TC 318 “Hydrometry”, the secretariat of which is held by BSI.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

The Executive Council of the WMO, noting the working arrangements between the ISO and WMO formally adopted on 16 September 2008, recognised the wide ranging benefits to National Meteorological and Hydrological Services and user communities resulting from the implementation of common Standards relevant for meteorology and hydrology and the need to established the benefit/cost implication to WMO Members of elevating an existing Technical Regulation/Manual/Guide to a common Standard. The EC finally approved procedures to be followed in proposing common technical standards (Resolution 8, Abridged Final Report of the sixty-first session of the WMO Executive Council).

This document is not a European Standard but a Technical Report. It is a document to describe recent findings in rainfall intensity (RI) measurements and related accuracy aspects, following the results and outcomes of the most recent international RI gauges intercomparison organised by the World Meteorological Organisation (WMO). The Technical Report also provides informative documentation (in annexes) containing methods for laboratory calibrations, field tests and reference field measurements.

In consideration of the requirement for general standardization and homogeneity of precipitation intensity measurements and the need for instruments development to promote worldwide instrument compatibility and interoperability, the WMO Lead Centre on Precipitation Intensity “B. Castelli” (Italy) has been designated by the WMO Commission of Instruments and Methods of Observation (CIMO General Summary of the fifteen Session, Helsinki, Finland, 2 - 8 September 2011). The Lead Centre is intended as a Centre of Excellence for instrument development and testing which would be established with the purpose of providing the scientific community with specific guidance and standard procedures about instrument calibration and their achievable uncertainty, performing laboratory and field tests and the intercomparison of instruments, and providing research advances and technical developments about the measurement of precipitation intensity and the related data analysis and interpretation.

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Introduction

The need for, and the importance of accurate and reliable rainfall intensity (RI) measurements is ever increasing. This is the result of a number of factors, including the increased recognition of scientific and practical issues related to the assessment of possible climatic trends, the mitigation of natural disasters (e.g. storms and floods), the slowing down of desertification and the design of structures (buildings, construction works) and infrastructure (drainage). This has resulted in more rigorous and enhanced quality requirements for RI measurements.

The volume of rainfall received by a collector through an orifice of known surface area in a given period of time has traditionally been adopted as the reference variable, namely the rainfall depth. Under the restrictive hypothesis that rainfall is constant over the accumulation period, a derived variable, “the rainfall rate, or intensity (RI)”, can be calculated. The estimated RI should get closer to the actual flow of water ultimately reaching the ground as the recording time interval decreases. In view of the very high variability of RI, field measurements at short time scales (e.g. 1 min) are crucial to enable high quality measurement be taken to mitigate the impact of severe events and save lives, property and infrastructures. As the probability of heavy rainfall events is small, long-term records of RI are required to estimate the frequency of occurrence of very intense rainfall at a given location and time.

On completion of the most recent RI gauges intercomparison organised by the World Meteorological Organisation (WMO), it has been recommended that RI measurements should be covered by International Standards. These standards should be based on the knowledge obtained from those latest WMO intercomparison and other current research and good practice. The adoption of such an approach will assist rainfall data collection practitioners to obtain homogeneous and compatible data sets. The procedure adopted for performing calibration tests in the laboratory should become a standard method to be used for assessing the instruments’ performance. Acceptance tests could be based on the adopted laboratory procedures and standards. A classification of instrument performance should also be developed to help users in selecting the most appropriate instrument for their applications.

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1 Scope

This Technical Report describes a method for calibrating rainfall intensity (RI) gauges and the measurement requirements to obtain accurate and compatible data sets from hydro-meteorological networks, as a forerunner to the development of full hydro-meteorological data collection standards.

This Technical Report deals exclusively with catching-type RI gauges (see Clause 3). It concentrates on the generic calibration, performance checking and estimation of uncertainties for RI gauges. It does not cover specific gauge measurement principles, technical characteristics and technology adopted in the design of RI gauges

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13798, *Hydrometry – Specification for a reference raingauge pit*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
catching raingauge
a raingauge which collects precipitation through an orifice, often a funnel, of well-defined size and measure its water equivalent, volume, mass or weight that has been accumulated in a certain amount of time

Note 1 to entry: This type of gauge includes storage, level monitoring, tipping bucket and weighing raingauges. This is the most common type of recording raingauge in use in operational networks at the time of preparing this Technical Report.

3.2
delay time of the output of a RI measuring gauge
delay of the output message of some RI measuring raingauges

Note 1 to entry: The internal calculation of the rainfall intensity in some raingauges can cause a delay of the output data message (e.g. 1 minute) which can easily be shifted automatically to the correct time without any degradation in measurement accuracy. This is typical of software corrected tipping bucket raingauges through embedded electronic chips or interfaces. The delay time should not be confused with the time constant. If real-time output is not needed, software induced delay times are less critical than longer time constants or any other effects, because delay times can easily be corrected to retrieve the original RI information.

[SOURCE: Adapted from WMO – IOM 2009]

3.3
measurand
quantity intended to be measured

[SOURCE: VIM:2008]

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3.4
measurement uncertainty
non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used

[SOURCE: VIM:2008]

Note 1 to entry: The parameter may be, for example, a standard deviation called standard measurement uncertainty (or a specified multiple of it), or the half-width of an interval, having a stated coverage probability.

Note 2 to entry: Measurement uncertainty comprises, in general, many components. Some of these may be evaluated by Type A evaluation of measurement uncertainty from the statistical distribution of the quantity values from series of measurements and can be characterised by standard deviations. The other components, which may be evaluated by Type B evaluation of measurement uncertainty, can also be characterised by standard deviations, evaluated from probability density functions based on experience or other information:

a) Instrumental measurement uncertainty (VIM 2008): component of measurement uncertainty arising from a measuring instrument or measuring system in use.

   Instrumental measurement uncertainty is obtained through calibration of a measuring instrument or measuring system, except for a primary measurement standard for which other means are used.

   Instrumental uncertainty is used in a Type B evaluation of measurement uncertainty.

   Information relevant to instrumental measurement uncertainty may be given in the instrument specifications.

b) Achievable measurement uncertainty (WMO no. 8, Part I Annex 1.B): it is intended as the measurement uncertainty achievable in field and/or operational conditions.

3.5
non-catching raingauge
raingauge where the rain is not collected in a container/vessel

Note 1 to entry: The rainfall intensity or amount is either determined by a contact-less measurement using optical or radar techniques or by an impact measurement. This type of gauge includes optical disdrometers, impact disdrometers, microwave radar disdrometers, optical/capacitive sensors.

3.6
resolution
smallest change in a quantity being measured that causes a perceptible change in the corresponding indication

[SOURCE: VIM:2008]

3.7
step function / heaviside function or unit step function
an input signal that switches on at a specified time and stays switched on indefinitely for determining the response (output) of a dynamic instrument system

3.8
step response
the time-varying response of an instrument system to a step function (heaviside function)

3.9
step response time
duration between the instant when an input quantity value of a measuring instrument or measuring system is subjected to an abrupt change between two specified constant quantity values and the instant when a corresponding indication settles within specified limits around its final steady value

[SOURCE: VIM:2008]

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