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High resolution performances of catching type rain gauges from the laboratory phase of the WMO Field Intercomparison of Rain Intensity Gauges

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The first WMO Field Intercomparison of RI gauges was started in September 2007 in Vigna di Valle, Rome (Italy). A total number of 39 instruments have been accepted in this Field Intercomparison, including catching and non-catching types of instruments. Installation of the instruments in the field was preceded by the laboratory calibration of all submitted catching type rain gauges at the University of Genoa.

This paper describes the results of the preliminary calibration phase performed in the laboratory, and compares them with those obtained during the WMO Laboratory Intercomparison of Rainfall Intensity Gauges held from September 2004 to September 2005 at the laboratories of the Royal Netherlands Meteorological Institute, Météo-France and the Department of Environmental Engineering at the University of Genoa, Italy (see www.wmo.int/web/www/IMOP).

The same methodology was indeed adopted, based on the generation of a constant water flow from a suitable hydraulic device within the range of operational use declared by the instrument's manufacturer. The water is conveyed to the funnel of the instrument under test in order to simulate a constant rainfall intensity. The flow is measured by weighing the water over a given period of time. The output of the instrument under test is measured at regular periods of time or when a pulse occurs. The two measurements are compared in order to assess the difference between the actual flow of water conveyed through the instrument and the "rain intensity" measured by the instrument itself. The relative difference between each measured and actual "rain intensity" fig-

ure is assumed as the relative error of the instrument for the given reference flow rate. This methodology provided a basis for the development of a standardized procedure for generating consistent and repeatable precipitation flow rates for possible adoption as a laboratory standard for calibration of catching type rainfall intensity gauges. At the laboratory of the Department of Environmental Engineering of the University of Genova, in particular, an automatic device was designed and realised as a prototype. The device, named Qualification Module for RI Measurement instruments (QM-RIM), is based on the principle of generating controlled water flows at a constant rate from the bottom orifice of a container where the water level is varied using a cylindrical bellow and the water level and the orifice diameter are controlled by software in order to generate the desired flow rate.

The QM-RIM calibration procedure is based on the capability of the system to produce a constant water flow. This flow is provided to the RI gauge under test and the duration and the total weight of water that flows through the instrument are automatically recorded by the acquisition system. The weight is determined using a precision balance. During the test the ensemble precision balance/weighing tank is protected by a plastic structure which also supports the RI gauges under calibration. The duration of the tests and the mass measurement are controlling factors for determining the uncertainty of the test. Therefore, mass and duration used for each test were chosen so that the uncertainty of the reference intensity was less than 1%, taking also into account the resolution of the instrument.

However, in this second laboratory calibration the tests were extended to cover the one-minute resolution instrument behaviour rather than just focusing on the average response under a constant reference flow rate, thus provide better insights into the measurement performances of such instruments. This was also due to the fact that, during the ongoing intercomparison in the field, the one-minute resolution rainfall intensity are considered under real world conditions, since this time resolution was adopted by CIMO-XIII as a recommendation for precipitation intensity measurements – with a maximum uncertainty of 5% – and published in the last revision of the WMO Guide to Instruments and Methods of Observation (WMO-No. 8, 7^{th} edition).