PG2 & PG2R Rain Gauge

PG2 is the highest-performance rain gauge with **200 cm²** captation surface on the market today for the measurement of accumulated precipitation and of its intensity per minute. It's accurate, it indicates any malfunctions before they cause interruption of measurement and it's usable without a power supply also at low temperatures thanks to the heated rain gauge version: **PG2R**.

RESPONSE PRECISION AND SPEED

PG2 and PG2R measure liquid **precipitation** and, in the heated version, water equivalent of solid precipitation, with an **output resolution of 0.1 mm**. The **accuracy of the PG2 product class is better than 3% up to 700 mm/h, maximum 5% between 700 and 1000/h, maximum 10% between 1000 and 1200 mm/h**. On request it is possible to make selections of more performing products. Unlike that guaranteed by the most popular sensors based on weight technology, PG2 and PG2R measure with this degree of accuracy **from the first minute following the phenomenon detected**, thus being particularly **suitable for the timely measurement of downpours**.

Each type is also available in its UNI version, which includes a calibration certificate produced according to the **UNI EN 17277:2020 standard**. CAE rain gauges are certifiable in "**Class A**", that is they are included in the top (most precise and accurate) category of sensors for rain intensity measurement available on the market.

LOW TEMPERATURES (PG2R)

PG2 does not require any mains power, even in the heated version PG2R, since with the sole aid of battery and solar panel it can measure the water equivalent of solid precipitations down to very low temperatures. The extremely low power consumption of the heating elements positioned in the various areas of the sensor is optimised thanks to the management electronics, which use various diagnostic thermometers in the instrument, as well as the choice of materials used and careful shape design.

EASY MAINTENANCE AND "ZERO BREAKDOWN STRATEGY”

Thanks to the tipping technology, PG2 and PG2R **don't need to be emptied** and require **very little and easy maintenance**. The sensing element is a reed which is redundant to ensure continuity of operation in case of failure. The sensor is also the only one in its category to implement **diagnostics**, with the objective of **reducing downtime due to faults**. Among these are:

- The correct functioning of the heaters (PG2R);
- The check for clogging of the funnel that directs the water into the tipping mechanisms;
- The “electronic spirit level” for correct inclination of the mouth of the instrument with respect to the ground;
- The correct functioning of the sensing elements (reeds) that count the movements of the tipping mechanism;
- The good condition of the tipping group and the moving parts.

It comes with an **RS485 serial port with SDI-12 standard protocol**; this sensor is available with 2 alternative mounting brackets for greater installation convenience: on a 48 mm diameter pole , or fitted directly to a plinth.

CUMULATED RAINFALL MEASUREMENT

The PG2 and PG2R rain gauges enable an accurate measurement of cumulated rainfall.

During the precipitation, water caught in the funnel flows into a container. Once this container has been filled, it starts to tip. As in all tipping bucket rain gauges, the mechanical system requires a certain amount of time to complete the movement. During this short time, water keeps falling, so that a normal tipping bucket rain gauge underestimates precipitations.

Thanks to the quality of materials and production processes used by our company for sensor production, CAE has been able to verify the systematic nature of the phenomenon and calculate the exact error curve of the instrument due to the kinematic effect.

On-board electronics calculate the correction factor to be applied each time the container tips, in order to obtain the correct rain intensity value. At low rain intensity

RAIN GAUGE PG2 & PG2R

the correction factor is close to 0, while it increases when intensity reaches 50 mm/h or higher; this correction by the software makes it possible to compensate the inherent error of tipping bucket rain gauges up to high intensities.

RAIN INTENSITY MEASUREMENT

The intensity of rain, measured by the sensor based on the tipping of the container, indicates the real intensity of rain every minute, expressed in mm/h, with an output resolution of 0.1 mm/h.

The intensity reading calculated by the instrument is based on the average intensity in a minute, then referred to an hour to calculate the mm/h.

In this case too, the algorithm within the rain gauge, by measuring the time between each tip and the next, calculates the correction factor to be applied **and provides the most accurate rainfall intensity output every 60 seconds.**

Sensor type	Tipping bucket
Collecting area	200 cm^2
Measurement range	Up to 1200 mm/h
Output Resolution	0.1 mm
Accuracy	Max 3% <700mm/h Max 5% 700÷1000 mm/h Max 10% 1000÷1200 mm/h
Connection with data-logger	Interface RS-485 with SDI-12 protocol
Temperature Range	PG2: 32°F / 140°F (0°C/60°C) and PG2R: 14°F / 140°F (-10°C/60°C)
Consumption	PG2 and PG2R @ 12,5V: < 1mA PG2R when heater is on: 60W @12,5V *
*Heaters power on only during snowfalls. Each of the 3 heaters powers off individually when it reaches the suitable temperature to melt the solid precipitation. So average energy consumption can be estimated based on the annual solid precipitations expected at the installation site.	

THE UNI EN 17277:2020 STANDARD

In 2020 the UNI EN 17277:2020 standard was approved as part of the European standards, which incorporates a large part of the UNI 11452: 2012 standard previously in force in Italy and regulates the meteorological requirements for sensors dedicated to measuring intensity of liquid precipitation at ground level. It defines a classification criterion for sensors, based on the assessment of measuring accuracy.

This standard is the first European reference for defining the performance of rain gauge sensors. It is the result of the experience gained by the Italian Air Force Meteorological Service and the University of Genoa during the activities performed within the framework of World Meteorological Organization (WMO).

According to the norm, each rain gauge sensor can be classified in a specific category based on specific performance accuracy, expressed in terms of maximum error detected.

The standard defines 3 reference classes: A, B and C. **PG2 and PG2R** models, manufactured and tested by CAE in accordance with such procedures, are **certifiable in class A,** thus representing the best available technology on the market.

THE TESTING MACHINE

In order to certify the effective and correct calibration of its rain gauges in compliance with the new standard, CAE has produced an "automatic" machine for calibration of rain gauges that implements the provisions of the UNI EN ISO 10012:2004 standard.

First of all, thanks to a reference generator, that is device that generates constant water flows, the machine makes it possible to know the exact time taken to tip each container, thereby allowing a perfect balancing of the two pans.

Therefore, it is possible to verify the output of the rain gauge at constant flows, setting the machine at several different intensities of simulated rain, as stated in the standard. The testing machine allows CAE to certify rain gauges delivered to its clients with a complete calibration certificate and consequently provide clients with the certainty that they are buying a high quality, precise and reliable sensor.

CAE
monitoring your world.

CALIBRATION CERTIFICATE

Object	Rain gauge
Manufacturer	CAE S.p.A. Via Colunga, 20 – 40068 San Lazzaro di Savena (BO) – Italy
Type	PM825
Serial number	41407
Date of issue	01/10/2013 16:36:16
Certification	First calibration
Measuring interval	0-300 mm/h
Class	A
Measuring interval	
Class	

This certificate is the result of tests performed in accordance with standard UNI 11452: 2012 "Measurement of rainfall intensity (liquid precipitation)" that it regulates the metrological requirements and test methods for catching rain gauges. It is prepared in accordance with the requirements specified by the UNI EN ISO 10012:2004.

Calibration and environmental conditions

Air temperature	24,1	°C
Air relative humidity	54	%
Atmos. pressure	1002	hPa
Water temperature	22,3	°C

Calibration method

The class is assigned executing several tests at various rain intensities as described in the UNI 11452:2012. The test results are attached at the end of this document. The flow is produced by a calibration equipment for at least 30 minutes and it is measured by calculating ratio between period test and accumulated water weight in a balance. The weight is measured by KERN type DS30K0.1 s.n. W1211195 and on the other hand test period is measured from the MHAS s.n. 0001. The rainfall measurements are made by an electronic module inside the rain gauge and after that the values are sent by a serial communication to the calibration equipment. In addition this procedure is a test for bucket balance. The separation between electronic module and tipping bucket will invalidate this calibration certificate. The uncertainty of the flow is less than 1%. It is recommended to repeat a laboratory metrological confirmation at least every 5 years, and in any case if the rain gauge has been damaged or tampered with.

Date	Laboratory manager	Head of the laboratory
01/10/2013		

CAE tech

CAE S.p.A-Via Colunga 20
40068 San Lazzaro di Savena (BO) - Italy
tel.: +39 051 4992711|fax: +39 051 4992709
www.cae.it