
Hydrometry — Catching-type liquid precipitation measuring gauges

*Hydrométrie — Appareils de mesure de précipitations liquides de type
collecteur*

STANDARDSISO.COM : Click to view the full PDF of ISO 23350:2021



STANDARDSISO.COM : Click to view the full PDF of ISO 23350:2021



COPYRIGHT PROTECTED DOCUMENT

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Instrument specifications	1
4.1 General	1
4.2 General gauge specifications	2
4.3 Environment	2
4.3.1 General	2
4.3.2 Temperature	2
4.3.3 Relative humidity	3
5 Recording	3
5.1 Recording format	3
5.2 Recording interval	3
6 Environmental protection and housing	3
7 Installation	4
8 Estimation of measurement uncertainty	4
8.1 General	4
8.2 Factors of measurement uncertainty	4
8.3 Type-A estimation	7
8.4 Type-B estimation	7
8.5 Combined uncertainty	7
Annex A (Informative) Catching-type liquid precipitation measuring gauges	8
Annex B (informative) Uncertainties of catching-type liquid precipitation measuring gauges	15
Bibliography	18

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 113, *Hydrometry*, Subcommittee SC 5, *Instruments, equipment and data management*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Rainfall totals and intensity rates are measured at frequencies ranging from seconds to months, and the data are required by the user on timescales ranging from immediate to several weeks. This document covers instrumentation that measures rainfall accumulation and rainfall intensity (RI) by collecting the volume of water that falls on a fixed area. The gauge user should decide on the gauge design, measurement unit, period of rainfall and network purpose.

Unlike many other meteorological instruments, there is no absolute physical standard against which a raingauge (hereafter called catching-type liquid precipitation measuring gauges) can be compared. Many different types, shapes and sizes of catching-type liquid precipitation measuring gauges are acceptable for the measurement of rainfall and rainfall depth, each reflecting a specific requirement. Most consist of a circular collecting device, delineating the fixed area of the sample, and a funnel leading into a storage reservoir or measuring system, or both. Some types of automatic gauges do not require a funnel. Since various sizes and shapes of orifice and gauge heights are used in different countries, the measurements are not strictly comparable.

This document provides general information on the functions of catching-type liquid precipitation gauges. The annexes in this document provide guidance on the types of catching-type liquid precipitation measuring gauges currently available (see [Annex A](#)) and the measurement uncertainty associated with them (see [Annex B](#)). Although advances in measurement electronic technologies and smart instruments have led to the development of optical and hybrid type liquid precipitation measuring gauges, they are not included in this document.

NOTE 1 This document specifies only the general functions of catching-type liquid precipitation measuring gauges. For in-depth and extensive information on precipitation measuring gauges, see References [1] and [2].

NOTE 2 For detailed information on measurement unit and period of rainfall, see Reference [1].

NOTE 3 For detailed information on the design of a reference raingauge pit as well as installation, see Reference [3].

[STANDARDSISO.COM](https://standardsiso.com) : Click to view the full PDF of ISO 23350:2021

Hydrometry — Catching-type liquid precipitation measuring gauges

1 Scope

This document specifies the typical requirements of instrumentation for measuring liquid precipitation, primarily for the purpose of hydrological and meteorological observation. This document is applicable to both non-recording and recording catching-type precipitation gauges for the measurement of liquid precipitation. This document covers design criteria for the gauges and elements to be considered in their construction. This document does not include specification, design and installation conditions.

NOTE Since the measurement of solid precipitation is outside the scope, the disadvantages of solid precipitation apply to all gauges listed in [Annex A](#). The measurement of solid precipitation and associated disadvantages are well documented in Reference [1].

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 772, *Hydrometry — Vocabulary and symbols*

BS 7843-3, *Acquisition and management of meteorological precipitation data from a gauge network — Part 3: Code of practice for the design and manufacture of storage and automatic collecting raingauges*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 772 and BS 7843-3 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 Instrument specifications

4.1 General

Catching-type liquid precipitation measuring gauges are classified as non-recording and recording types. The non-recording type has ordinary and storage gauges. The recording type has weighing, tipping-bucket and floating types. Catching-type liquid precipitation measuring gauges have a resolution of 0,1 mm to 1 mm, and can measure rainfall intensities of 0,1 to 1 000 mm·h⁻¹ or higher. Measurement errors can occur according to installation conditions, the measurement environment, solid precipitation and rainfall intensity.

A catching-type liquid precipitation measuring gauge shall be a circular orifice and shall be formed perpendicular to the outer slope and the inner surface with sharp edges. The diameter of the edge of the collecting device should not differ by more than 0,2 % of the stated diameter in any direction. Furthermore, the collector should be designed to prevent rain from splashing in and out. This can be achieved if the vertical wall is sufficiently deep and the slope of the funnel is sufficiently steep (at least 45 %). The container should have a narrow entrance and be sufficiently protected from radiation to

minimize the loss of water by evaporation. The surface of the funnel shall consist of a stable, durable material such that the water drop is not retained by surface tension, is freely moved towards the orifice and is passed to the measuring mechanism.

NOTE This document specifies the functional requirements of catching-type liquid precipitation measuring gauges. Consideration of the siting and exposure of gauges is also important. More specifically, the installation conditions, measurement environment and solid precipitation (see Reference [1] and BS 7843-3).

4.2 General gauge specifications

The gauge manufacturer should provide general specifications that can impact the measurement of precipitation which include, but are not limited to:

- a) range;
- b) resolution;
- c) accuracy;
- d) size of orifice area;
- e) standardized communication interfaces and protocols for data transmission;
- f) power supply and consumption;
- g) height of gauge (including rim height placement to avoid interference from deposited snow or other materials near the gauge);
- i) gauge materials.

Requirements for uncertainty, range and resolution for precipitation measurements should be considered. It should be noted that, in some countries, trace observations are officially given a value of zero, thus resulting in a biased underestimate of the seasonal precipitation. This problem is minimized with weighing-type gauges since even very small amounts of precipitation will accumulate over time.

4.3 Environment

4.3.1 General

Liquid precipitation measuring gauges shall operate within the ranges of temperature in 4.3.2 and the ranges of relative humidity in 4.3.3. Wind should be taken into consideration in areas that are prone to inclement weather conditions.

4.3.2 Temperature

Catching-type liquid precipitation measuring gauges should function in their intended manner in the following environmental conditions.

Operating temperature for non-recording type and recording type gauges:

- maximum temperature: +60 °C;
- minimum temperature (catching-type liquid precipitation measuring gauges, excluding heating or weighing gauge without antifreeze): 0 °C;
- minimum temperature (catching-type liquid precipitation measuring gauge, with heating or weighing gauge with antifreeze): -40 °C.

4.3.3 Relative humidity

Catching-type liquid precipitation measuring gauges shall operate within the following relative humidity range.

Operating relative humidity for non-recording type and recording type gauges:

- maximum relative humidity: 100 % RH;
- minimum relative humidity: 0 % RH;

5 Recording

5.1 Recording format

For recording and non-recording type liquid precipitation gauges, the time stamp of each record to be stored in a data storage gauge or manual recording shall be at least eight digits for the year, month and day; and eight digits for the hour, minute, second and millisecond (e.g. 2019/12/31 09:00:00:00). For rainfall accumulation, there shall be at least five digits (e.g. 000,00 mm h⁻¹), not including the decimal place, for the liquid precipitation amount.

5.2 Recording interval

The recording interval for catching-type liquid precipitation measuring gauges shall be specified by the network operator to ensure regional and climatological constraints are taken into consideration that could affect the accuracy and precision of recorded measurements.

For recording type gauges, the measurement record of liquid precipitation should be transmitted to the recording device instantaneously or at a specified time according to the gauge user. The recording intervals are commonly hourly or every minute depending on gauge design and network purpose.

Non-recording type liquid precipitation gauges should be read manually at a specified interval to acquire the data. Ordinary and storage gauges should be emptied in line with network operating principles, commonly daily or monthly depending on gauge design and network purpose. Liquid precipitation is reported per unit of time. The manufacturer or network operator should specify the volume of liquid precipitation and time interval recorded in its most granular form.

6 Environmental protection and housing

The catching-type liquid precipitation measuring gauge should be constructed in a material that is durable and can endure natural weathering without changes to its surface characteristics. Sound watertight seams should be used throughout. The collecting funnel should fit firmly over the top of the measurement mechanism but should be removable without undue force. The gauge should be designed to minimize ingress by small animals and insects. The outer housing of the gauge should also prevent water from entering the measuring component of the gauge, apart from through the inlet funnel. Electrical connections for power supplies and outgoing signals should be provided using water-resistant plugs or terminals, suitable for the environmental conditions in which the gauge is deployed. [6] Any marking identifying connectors should be weather-resistant and remain legible for the expected lifetime of the catching-type liquid precipitation measuring gauge.

7 Installation

The manufacturer shall provide clear instructions for the installation of catching-type liquid precipitation measuring gauges. As mentioned in 4.1, the position and exposure of raingauges should be taken into consideration.

NOTE Measurements will be influenced by rim height, either through individual gauge design or local deployment to allow for factors such as snow depth where close to ground level deployment is not practical. All gauge types are expected to be positioned to ensure operation within the manufacturer's design.

The rim of the gauge should be installed parallel to the ground surface. The design should maintain plane of rim level to within $\pm 2^\circ$ of the base plane. Failure to ensure that the rim is level will introduce a systematic error into the measurement. The measurement mechanism of the gauge, for example, a tipping bucket mechanism, should be level to ensure there are no systematic errors.

The gauge should be installed securely to ensure that it remains stable. Impacts such as frost heave and changes in ground conditions should be taken into account.

The gauge should be placed to ensure that the surrounding surface minimizes splashback that can result in an over-catch. A surface of gravel or short grass is typical; and surfaces such as concrete should be avoided.

8 Estimation of measurement uncertainty

8.1 General

The uncertainty of a value derived from primary measurements can be due to:

- a) signal noise which affects the value being measured (variation by the precipitation intensity);
- b) resolution of the measurement process;
- c) other factors (wetting, splashing, evaporation, wind induced under-catch, volume-mass conversions, time interval, etc.).

Type A and Type B are two methods of measurement uncertainty estimation for relating the dispersion of values to the probability of "closeness" to the mean value (see Reference [7]).

NOTE Although installation and environmental factors are major sources of uncertainties, they are outside the scope of this document.

8.2 Factors of measurement uncertainty

In practice, there are many possible sources of uncertainty in a measurement, including:

- a) incomplete definition of the measurement;
- b) imperfect realization of the definition of the measurement;
- c) nonrepresentative sampling – the possibility that the sample measured is not representative of the defined measurement;
- d) inadequate knowledge of the effects of environmental conditions on the measurement or imperfect measurement of environmental conditions;
- e) personal bias in reading analogue instruments;
- f) finite instrument resolution or discrimination threshold;
- g) inexact values of measurement standards and reference materials;

- h) inexact values of constants and other parameters obtained from external sources and used in the data-reduction algorithm;
- i) approximations and assumptions incorporated in the measurement method and procedure;
- j) variations in repeated observations of the measurand under apparently identical conditions.

[Table 1](#) is adapted from Reference [1], Annex 1.A. Operational Measurement Uncertainty Requirements and Instrument Performance Requirements and provides an example of operational measurement uncertainty requirements and instrument performance requirements.

STANDARDSISO.COM : Click to view the full PDF of ISO 23350:2021

Table 1 — Operational measurement uncertainty requirements and instrument performance requirements

1 Variable (precipitation)	2 Range	3 Reported resolution	4 Mode of measurement/ observation	5 Required meas- urement uncer- tainty	6 Instrument time constant	7 Output averaging time	8 Achievable measurement uncertainty	9 Remarks
Amount (daily)	0 mm–500 mm	0,1 mm	T	0,1 mm for ≤ 5 mm 2 % for > 5 mm	n/a	n/a	The larger of 5 % or 0,1 mm	Quantity based on daily amounts. Measurement uncertainty de- pends on aerodynamic collection efficiency of gauges and evapora- tive losses in heated gauges.
Depth of snow	0 m–25 m	1 cm	I	1 cm for ≤ 20 cm 5 % for > 20 cm	< 10 s	1 min	1 cm	Average depth over an area rep- resentative of the observing site.
Thickness of ice accretion on ships	not specified	1 cm	I	1 cm for ≤ 20 cm 10 % for > 20 cm				
Precipitation intensity	0,02 mm h ⁻¹ – 2 000 mm h ⁻¹	0,1 mm h ⁻¹	I	(trace)/n/a for 0,02–0,2 mm h ⁻¹ 0,1 mm h ⁻¹ for 0,2–2 mm h ⁻¹ 5 % for > 2 mm h ⁻¹	< 30 s	1 min	Under constant flow conditions in laboratory: 5 % above 2 mm h ⁻¹ , 2 % above 10 mm h ⁻¹ . In field: 5 mm h ⁻¹ and 5 % above 100 mm h ⁻¹ .	Uncertainty values for liquid precipitation only. Uncertainty is seriously affected by wind. Instruments may show signifi- cant non-linear behaviour. For < 0,2 mm h ⁻¹ ; detection only (yes/no) instrument time constant is significantly affected during solid precipitation using catchment type of gauges.
Precipitation duration (daily)	0–24 h	60 s	T	n/a	60 s			Threshold value of 0,02 mm h ⁻¹ .

NOTE 1 Table 1 is adapted from Reference [1], Annex 1.A.

NOTE 2 In column 4:

I = Instantaneous: In order to exclude the natural small-scale variability and the noise, an average value over a period of 1 min is considered as a minimum and most suitable; averages over periods of up to 10 min are acceptable.

T = Totals: Totals over a fixed period, as specified by coding requirements.

8.3 Type-A estimation

Type-A estimation is a method of evaluation of uncertainty by the statistical analysis of series of observations. It stems from manual reading and evaporation and wetting of the instrument.

8.4 Type-B estimation

Type-B estimation is a method of evaluation of uncertainty by means other than the statistical analysis of a series of observations. It stems from resolution, aging and random error of the instrument.

8.5 Combined uncertainty

To determine the uncertainty of the derived value, U , it is necessary to combine the uncertainties of all primary measurements, u , thus:

$$U_c = \left[u_A^2 + u_B^2 \right]^{\frac{1}{2}} \quad (1)$$

where

U_c is combined uncertainty;

u_A^2 is the uncertainty of type-A;

u_B^2 is the uncertainty of type-B.

[Formula \(1\)](#) illustrates the method when combining the uncertainty of a reference precipitation datum value. Other components of measurement uncertainty are added by inclusion of their squared value within the brackets.

Annex A (Informative)

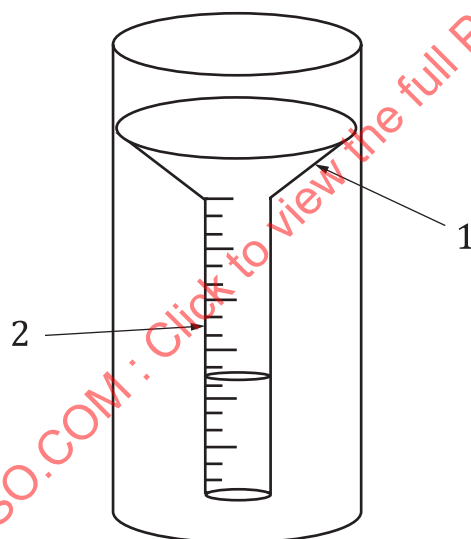
Catching-type liquid precipitation measuring gauges

A.1 Non-recording gauges

A.1.1 Ordinary gauge

A.1.1.1 Explanation

The ordinary gauge is composed of the collector orifice, a storage with a funnel shape and a bucket (Figure A.1). The size of the opening of the collector is important. A receiving area of 1 000 cm² is used in some countries, but an area of 200 cm² to 500 cm² will probably be most convenient. The area of the receiver can be made to equal 0,1 of the area of the collector. Storing rain or solid precipitation during the observation hours, the graduated cylinder shall be used to measure the accumulated precipitation.



Key

- 1 funnel
- 2 measuring gauge

Figure A.1 — Ordinary gauge

A.1.1.2 Materials

An ordinary gauge is made of various types of metal or plastic materials with proper thermal expansion coefficient. They should be manufactured to minimize errors due to wetting loss and evaporation.

A.1.1.3 Advantages

An ordinary gauge is easy to install. It can measure precipitation accurately at a low cost.

A.1.1.4 Disadvantages

Ordinary gauges must be read manually and cannot determine the exact start and end of the precipitation occurrence. The timing cannot be determined between individual events within the recording period. Uncertainty factors exist due to measurement time and scale indication. Evaporation can result in under-reading, particularly if measurements are taken less frequently than daily.

A.1.1.5 Uncertainties

The uncertainties of ordinary gauges are detailed in [Annex B](#).

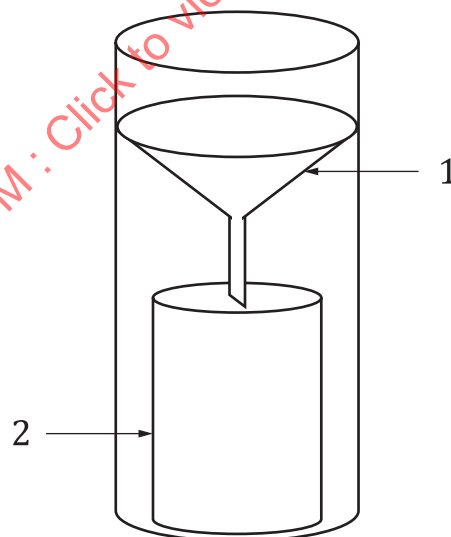
A.1.2 Storage gauge

A.1.2.1 Explanation

An observer of a storage gauge can either measure the weight or read the graduated cylinder of a bucket after collecting rainwater in the bucket for a certain period, such as measuring the total precipitation in a remote area.

The gauge is composed of a collecting part with a funnel and a storage part that can hold enough precipitation between scheduled readings (Figure A.2). Typically, proper oil of around 5 mm shall be put in a measuring bottle and a removable inner can for overspill to prevent the evaporation of water. This oil shall have a property to pass through collected water freely to prevent evaporation.

When a storage gauge is located far from the observer, the gauge requires special care in terms of operation and management. For example, the installation of a video camera can provide valuable information about the conditions at a gauging site. The extent of ice cover, periods of backwater due to ice, etc., can be documented by a camera.



Key

- 1 funnel
- 2 bucket

Figure A.2 — Storage gauge

A.1.2.2 Materials

Storage gauges are made of various types of metal or plastic materials with proper thermal expansion coefficient. They should be manufactured to minimize the loss of water by the wet error and evaporation.

A.1.2.3 Advantages

This type of gauge is easy to install and measure, and is available to accurately measure precipitation at a low cost.

A.1.2.4 Disadvantages

As it is not possible to measure in real-time and there exist many cases of poor accessibility, the gauge requires monitoring to check if the the funnel is plugged. In addition, this type of gauge requires oil or antifreeze to prevent evaporation, but such substances can cause environmental pollution.

Storage gauges must be read manually and cannot determine the exact start and end of the precipitation occurrence. The timing cannot be determined between individual events within the recording period. Uncertainty factors exist due to measurement time and scale indication. Evaporation can result in under-reading, particularly if measurements are taken less frequently than daily.

A.1.2.5 Uncertainties

The uncertainties of storage gauges are detailed in [Annex B](#).

A.2 Recording gauges

A.2.1 General

As the catching-type liquid precipitation measuring gauge with automatic recording has a higher time resolution than manual measurements, it is possible to reduce evaporation and wetting losses.

Recording gauges generally used are the weighing type, tipping-bucket type and floating type. Some weighing gauges can measure all types of precipitation without the need for additional heaters. Other recording-type liquid precipitation measuring gauges will require heaters fitted to the rim or funnel, or both, if they are required to measure frozen precipitation.

Alternative technologies for measuring precipitation without moving parts are emerging. These include condenser gauges, atmospheric pressure converters and optic or small radar gauges. They provide electronic signals in response to the precipitation amount or intensity, or both.

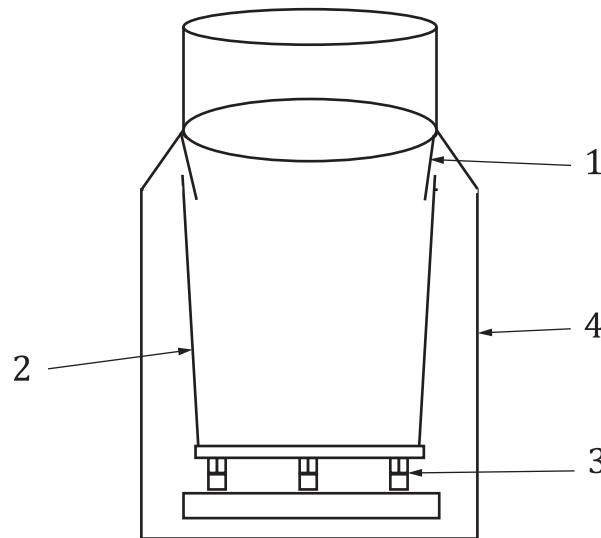
NOTE These technologies are not sufficiently developed for inclusion in this edition of this document.

Another important component of recording rain gauges is accurate time recording of the precipitation amount over a set interval. This will be carried out by a data logging device either within the gauge or through an external data logger. This is essential for providing accurate information on the timeliness of rainfall accumulation and calculation of rainfall intensity.

A.2.2 Weighing gauge

A.2.2.1 Explanation

A weighing gauge measures the weight continuously by a weight sensor or a load cell when rain or solid precipitation enters through the upper part of the receiver and fills the collection bucket that is placed inside the casing (Figure A.3). The gauge consists of a collection bucket to receive water and a gauge to measure weight. The weighing gauge can measure precipitation in the form of solid precipitation. Its operation has an advantage in that no special preparation processes are required except emptying the water in the collection bucket. A weighing gauge should be designed to prevent excessive evaporation losses, which can be reduced further by the addition of sufficient oil or other evaporation suppressing materials to form a film over the water surface. Evaporation does not necessarily need to be prevented if the gauge software takes into account the weight of the gauge when making calculations.

**Key**

- 1 receiving funnel
- 2 collection bucket
- 3 balance
- 4 casing

Figure A.3 — Weighing gauge**A.2.2.2 Materials**

The exterior of the gauge should be manufactured with a durable and corrosion-free material like stainless steel, which is commonly used. It is important to review the reliability of power supply since the gauge records measurements automatically.

A.2.2.3 Advantages

It is useful to measure both liquid and solid type precipitation such as snow, sleet and hail. This gauge provides precise measurements with fine resolution. In addition, the recording-type weighing gauge will require less maintenance since it has no funnel or moving mechanical parts and mechanical degradation can be significantly reduced.

A.2.2.4 Disadvantages

If the precipitation accumulated in the bucket exceeds the capacity of bucket, it shall be discharged automatically or manually. The automatic discharge type does not use antifreeze for its operation, but the manual discharge type needs antifreeze to avoid the water inside the bucket from freezing. In addition, in case of manual discharge type, the capacity of the bucket should be large and it needs an evaporation suppressor or gauge software.

The weighing gauge is not suitable to discern the types of precipitation. Errors can occur as the load cell can be affected by pressure from high winds. Another common fault with weighing gauges is wind pumping. This usually occurs during high winds when turbulent air currents passing over and around the catchment container cause oscillations in the weighing mechanism. Errors associated with such anomalous recordings can be minimized by averaging readings over short time intervals, usually ranging from 1 to 5 min.

A.2.2.5 Uncertainties

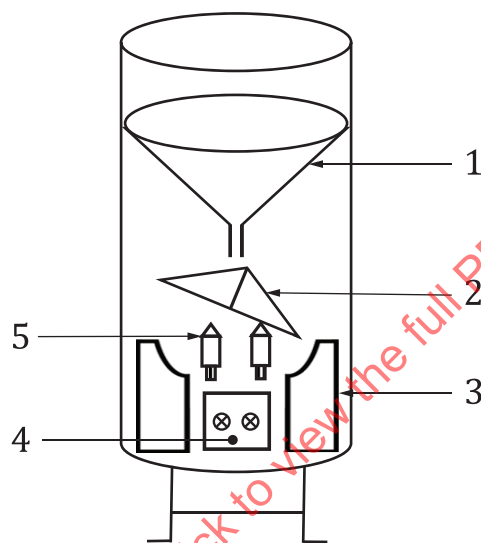
The uncertainties of weighing gauges are detailed in [Annex B](#).

A.2.3 Tipping bucket gauge

A.2.3.1 Explanation

Tipping bucket gauges measure the rate and total accumulated precipitation. Water collected in the receiver fills one of the two calibrated buckets with a predetermined amount of water (Figure A.4). Once the predetermined amount of water is collected in the bucket, it tips over on one side due to the weight of the water and the rainwater is drained. Tipping bucket gauges employ a contact closure (reed switch or relay contact), such that each tip produces an electrical impulse as a signal output. This output is typically recorded by a data logger or an ADC (data acquisition system equipped with reed switch reading ports). This mechanism provides a continuous measurement without manual interaction.

NOTE For further details on tipping bucket gauges, including the measurement of rainfall intensity, calibration, etc., see Reference [1].



Key

- 1 funnel
- 2 tipping bucket
- 3 drain cylinder
- 4 reed-relay switch
- 5 calibration adjuster

Figure A.4 — Tipping bucket gauge

A.2.3.2 Materials

The gauge should be manufactured with a durable and corrosion-free material like stainless steel.

A.2.3.3 Advantages

The gauge is relatively simple. As it is available for remote measurements and easy to produce digitized observation signals, the gauge has been widely used for automatic weather stations. It is suitable to measure the accumulated sum and rate of precipitation.

A.2.3.4 Disadvantages

The gauge has some limitations in catching high-intensity precipitation and, if the precipitation intensity increases, the accuracy of observed values declines. Although negligible, there is a possibility of evaporation loss in hot regions. It is impossible for the gauge to measure if counting elements fail

such as a reed switch, etc. If it is a heated type gauge, errors are possible due to the evaporation of water collected.

Although the time is short when the water is poured out from the bucket and returns to its original position, a small amount of precipitation can be missed during that time. Since a nonlinear error can occur during high rainfall intensities, the precision of the gauge cannot be guaranteed.

A.2.3.5 Uncertainties

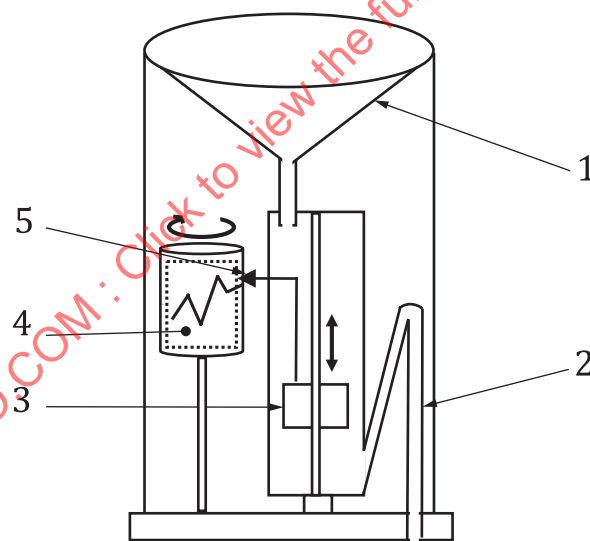
The uncertainties of tipping bucket gauges are detailed in [Annex B](#).

A.2.4 Float gauge

A.2.4.1 Explanation

Float-type gauges include a funnel for collecting precipitation, cylinder for storing precipitation, float in the cylinder and a recording device that measures and records the water level in the cylinder (Figure A.5). The recording mechanism can be a pen trace on a rotating drum or shaft encoder and data logger. When the cylinder nears capacity, the contents are emptied automatically by a syphon in a short time frame to prevent the disconnection of recording for the precipitation measurement even when continuous heavy precipitation occurs.

NOTE With advances in technology, some float gauges are fully digitalized and automated. This document does not focus on non-recording float gauges since they are not commonly used.



Key

- 1 funnel
- 2 siphon
- 3 float
- 4 recording paper
- 5 pen

Figure A.5 — Float gauge

A.2.4.2 Material

The gauge should be manufactured with a durable and corrosion-free material like stainless steel.

A.2.4.3 Advantages

A float gauge can measure in real time, meaning that data are available for recording or transmittal through telemetry, or both, as soon as the measurement is obtained.

A.2.4.4 Disadvantages

With a float gauge it is impossible to measure the precipitation during the siphon motion that drains the water. In cold temperatures, the possibility of frozen floats exists. It is necessary to have a steady power supply for recording and time meter motions.

A.2.4.5 Uncertainties

The uncertainties of floating gauges are detailed in [Annex B](#).

STANDARDSISO.COM : Click to view the full PDF of ISO 23350:2021