
**Optics and photonics — Environmental
test methods —**

**Part 7:
Resistance to drip or rain**

*Optique et photonique — Méthodes d'essais environnementales —
Partie 7: Résistance au ruissellement ou à la pluie*



Reference number
ISO 9022-7:2005(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 9022-7 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 1, *Fundamental standards*.

This second edition cancels and replaces the first edition (ISO 9022-7:1994), which has been technically revised, and ISO 9022-7:1994/Cor.1:2001. Clause A.3 has been added to provide detail information about the rain gauge.

ISO 9022 consists of the following parts, under the general title *Optics and photonics — Environmental test methods*:

- *Part 1: Definitions, extent of testing*
- *Part 2: Cold, heat and humidity*
- *Part 3: Mechanical stress*
- *Part 4: Salt mist*
- *Part 5: Combined cold, low air pressure*
- *Part 6: Dust*
- *Part 7: Resistance to drip or rain*
- *Part 8: High pressure, low pressure, immersion*
- *Part 9: Solar radiation*
- *Part 10: Combined sinusoidal vibration and dry heat or cold*
- *Part 11: Mould growth*
- *Part 12: Contamination*
- *Part 13: Combined shock, bump or free fall and dry heat or cold*

- *Part 14: Dew, hoarfrost, ice*
- *Part 15: Combined digitally controlled broad-band random vibration and dry heat or cold*
- *Part 16: Combined bounce or steady-state acceleration and dry heat or cold*
- *Part 17: Combined contamination, solar radiation*
- *Part 18: Combined damp heat and low internal pressure*
- *Part 19: Temperature cycles combined with sinusoidal or random vibration*
- *Part 20: Humid atmosphere containing sulfur dioxide or hydrogen sulfide*
- *Part 21: Combined low pressure and ambient temperature or dry heat*

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Introduction

Optical instruments are affected during their use by a number of different environmental parameters which they are required to resist without significant reduction in performance.

The type and severity of these parameters depend on the conditions of use of the instrument (for example, in the laboratory or workshop) and on its geographical location. The environmental effects on optical instrument performance in the tropics and subtropics are totally different from those found when they are used in the Arctic regions. Individual parameters cause a variety of different and overlapping effects on instrument performance.

The manufacturer attempts to ensure, and the user naturally expects, that instruments will resist the likely rigours of their environment throughout their life. This expectation can be assessed by exposure of the instrument to a range of simulated environmental parameters under controlled laboratory conditions. The severity of these conditions is often increased to obtain meaningful results in a relatively short period of time.

In order to allow assessment and comparison of the response of optical instruments to appropriate environmental conditions, ISO 9022 contains details of a number of laboratory tests which reliably simulate a variety of different environments. The tests are based largely on IEC standards, modified where necessary to take into account features special to optical instruments.

It should be noted that, as a result of continuous progress in all fields, optical instruments are no longer only precision-engineered optical products, but, depending on their range of application, also contain additional assemblies from other fields. For this reason, it is necessary to assess the principal function of the instrument to determine which International Standard is to be used for testing. If the optical function is of primary importance, then ISO 9022 is applicable, but if other functions take precedence then the appropriate International Standard in the field concerned should be applied. Cases may arise where application of both ISO 9022 and other appropriate International Standards will be necessary.

Optics and photonics — Environmental test methods —

Part 7: Resistance to drip or rain

1 Scope

This part of ISO 9022 specifies methods for the testing of optical instruments and instruments containing optical components under equivalent conditions, for their ability to resist drip or rain.

The purpose of testing is to investigate to what extent the optical, thermal, mechanical, chemical and electrical performance characteristics of the specimen are affected by drip or rain. Contamination of drip or rain water due to impurities in the air shall be ignored for the purposes of this part of ISO 9022.

2 Normative references

The following referenced documents are indispensable for the application 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 9022-1:1994, *Optics and optical instruments — Environmental test methods — Part 1: Definitions, extent of testing*

3 General information and test conditions

At the beginning of exposure, the temperature of the water shall be below that of the specimen. During exposure the specimen shall be mounted in the possible operating positions on a rotary table which rotates at a speed of 1 r/min to 2 r/min about its axis perpendicular to the sprinkling area. Prior to testing, the required rain or drip rate shall be measured and set in the centre of the sprinkling area occupied by the specimen.

Measurement of the rain rate or drip rate shall be performed using a rain gauge of the type designed by Prof. Hellmann. See A.3 for detailed information. If various measuring areas exist and/or several measurement are performed, the mean value for all measurements shall lie within the limits specified in Tables 1 to 3 for the required rain rates.

4 Conditioning

4.1 Conditioning Method 72 — Drip

The drip shall be produced with the test apparatus shown in Figure 1. This size of the test apparatus and the dispenser plate (see Figure 2) shall be determined by the size of the specimens. Specimens requiring a dispenser plate of more than 1 m² may be tested in sections. The required water level above the dispenser plate shall be regulated by a float valve and/or overflows (see Figure 1). Decalcified or fully desalted water shall be used to prevent blockage of the fine holes in the dispenser plate. The distance between the specimen

and the dispenser plate shall not be less than 1 m. Care shall be taken to ensure that every point of the possible upper sides of the specimen are exposed to the drip during the test.

4.2 Conditioning Method 73 — Steady rain

The test shall be performed with tap water (drinking water) or with water prepared in accordance with 4.1. The shower heads used shall correspond to those shown in Figure 3. The swivelling shower heads shall be arranged in such a way that the required rainfall rate is evenly distributed over the sprinkling area. The measurement of the rain rate shall be performed in accordance with Clause 3. The number of shower heads depends upon the size of the specimen. The shower heads shall be positioned at least 2 m above the highest surface of the specimen. A recommended arrangement of the shower heads is given in the explanatory notes.

4.3 Conditioning Method 74 — Driving rain

The requirements of 4.2 shall apply for producing the rainfall. The wind generator shall be arranged so that the rain falls as evenly as possible on the specimen.

During the exposure, the rotary table bearing the specimen shall be erected approximately 2 m in the direction of the wind behind the centre of the sprinkled area which would be formed if no wind were applied.

Prior to insertion of the specimen in the test apparatus, the wind velocity and the rain rate shall be measured in the area where the centre of the specimen will be located during exposure. A rain-catching metal sheet as shown in Figure 4 shall be inserted in the rain gauge of the type designed by Prof. Hellmann.

5 Procedure

5.1 General

The test shall be conducted in accordance with the requirements of the relevant specification and with ISO 9022-1.

5.2 Preconditioning

If not specified in the relevant specification, the surface of the specimen shall be properly cleaned prior to exposure. To this end, only such neutral cleaning agents shall be used as do not leave a film on, or attack, the surface of the specimen. After cleaning, the specimen shall be restored to service condition, e.g. by the application of protective grease.

5.3 Recovery

If not specified in the relevant specification, the surface of the specimen shall be dried. Blowing with compressed air is not permitted. The temperature shall then be adjusted to ambient conditions.

5.4 Final test

After recovery, internal optical surfaces of the specimen may show a moisture film. This shall disappear in the time specified in the relevant specification.

In the event that penetrated water cannot be detected by visual inspection, a method of examining whether moisture has penetrated shall be specified in the relevant specification.

6 Environmental test code

The environmental test code shall be as defined in ISO 9022-1, giving a reference to ISO 9022 and the codes for the conditioning method chosen, the degree of severity and the state of operation.

EXAMPLE The environmental test of optical instruments for resistance to steady rain, conditioning Method 73, degree of severity 01, state of operation 1, shall be identified as:

Environmental test ISO 9022-73-01-1

Table 1 — Degrees of severity for conditioning Method 72 — Drip

Degree of severity		01	02	03	04	05	06	07	08	09	
Specimen temperature at beginning of exposure	°C	15 to 35									
Difference between specimen and water temperature at beginning of exposure	K	2 to 20									
Water level above dispenser plate	mm	10			40			75			
Drip rate	mm/min	1,5 ± 0,5			3,5 ± 1			5,5 ± 1			
Exposure time	min	1	5	15	5	15	30	5	15	30	
State of operation		0 or 1 or 2									

When degrees of severity are 01 to 06, fill the test apparatus prior to exposure in such a way that the water drips evenly from each hole. Only after this has been guaranteed shall the water level be lowered to the required volume, e.g. by opening the overflow. The use of surface-active agents is not permitted.

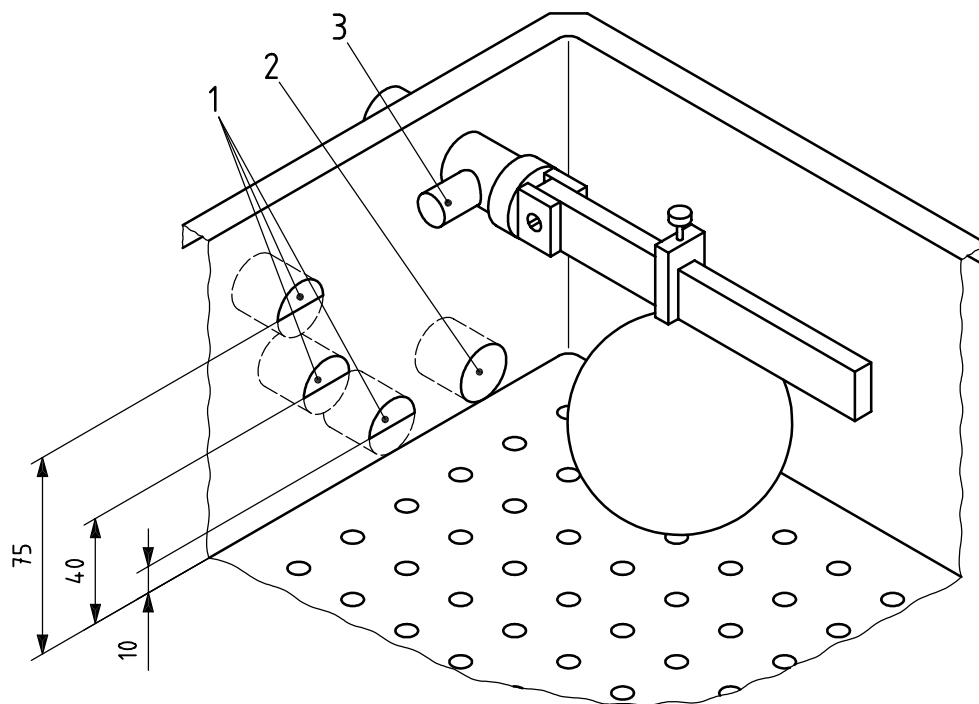
Table 2 — Degrees of severity for conditioning Method 73 — Steady rain

Degree of severity		01	02
Specimen temperature at beginning of exposure	°C	15 to 35	15 to 35
Difference between specimen and water temperature at beginning of exposure	K	2 to 20	2 to 20
Rain rate	mm/min	5 ± 2	20 ± 3
Exposure time	min	30 ± 2	30 ± 2
State of operation		0 or 1 or 2	

Table 3 — Degrees of severity for conditioning Method 74 — Driving rain

Degree of severity		01	02	03	04	05	06
Specimen temperature at beginning of exposure	°C	15 to 35					
Difference between specimen and water temperatures at beginning of exposure	K	2 to 20					
Wind velocities at specimen location	m/s	18 ± 3				33 ± 3	
Rain rate	mm/min	2 ± 1		10 ± 3		2 ± 1	
Exposure time	min	10	30	10	30	10	30
State of operation		0 or 1 or 2					

In the low rain rate required for degrees of severity 01, 02, 05 and 06, the water is not always distributed in the form of drops through the shower heads. This is, however, counteracted by the strong turbulence of the water caused by the high wind velocity.



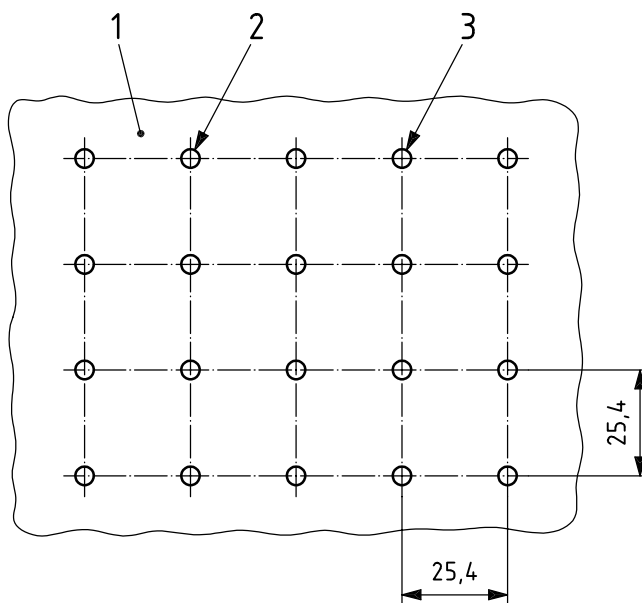
Key

- 1 overflows ($\varnothing > 20$)
- 2 outflow to empty apparatus after test
- 3 inflow

Any details not given should be chosen appropriately.

Figure 1 — Test apparatus for drip conditioning method

Dimensions in millimetres

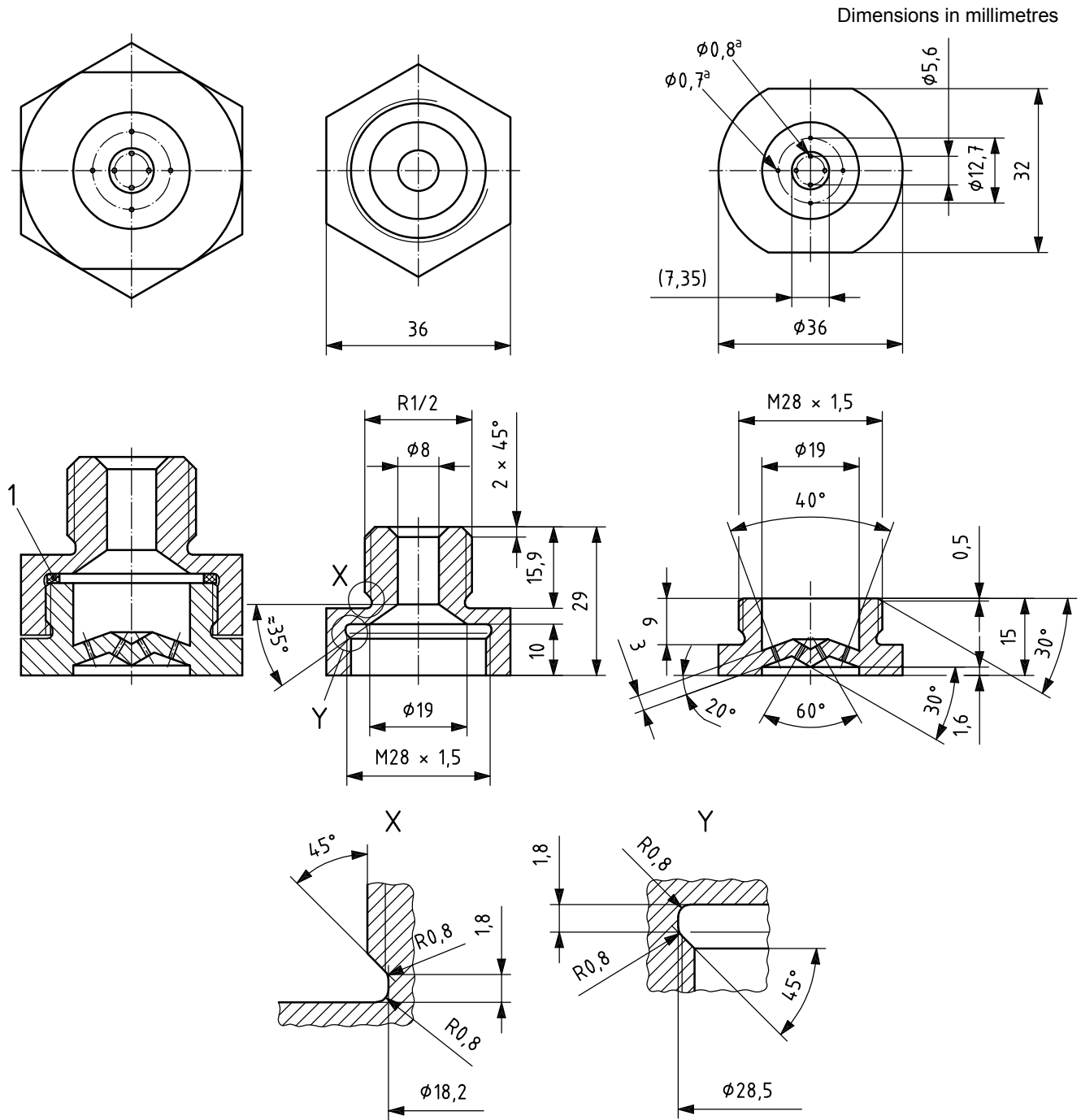


Key

- 1 plate made of CuZn alloy, 0,8 mm thick
- 2 holes with diameter of 0,35 mm bored through indentations in metal sheet
- 3 indentations produced with steel rod of 4,8 mm diameter, radius at tip 5 mm, pressed 1,5 mm into metal

Dimension mm	Tolerance mm
0,1 to 0,9 inclusive	± 0,02
0,9 to 6,0 inclusive	± 0,1
6,0 to 30,0 inclusive	± 0,2
30,0 to 120,0	± 0,3

Figure 2 — Section of dispenser plate



Key

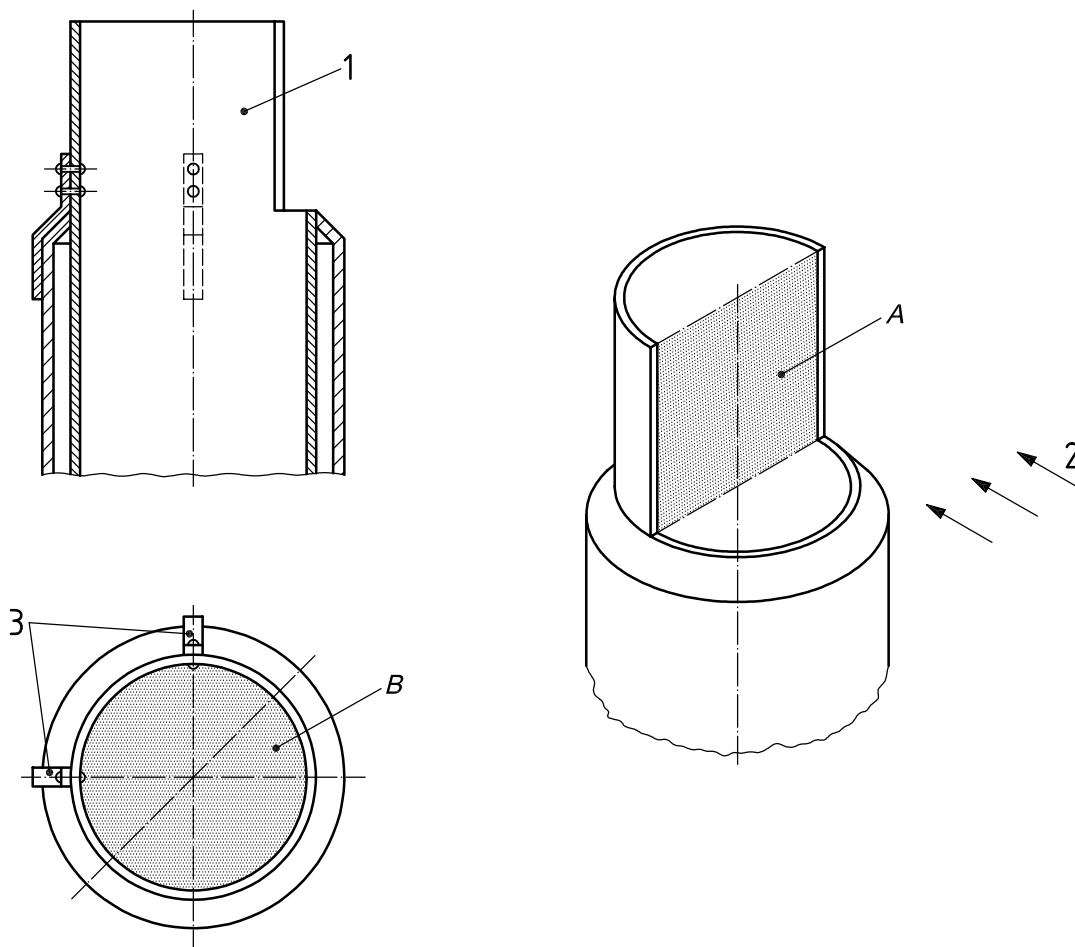
1 O-ring or gasket

^a holes without burr

Angular tolerance $\pm 3^\circ$

Dimension mm	Tolerance mm
0,1 to 0,9	$\pm 0,02$
> 0,9 to 6,0	$\pm 0,1$
> 6,0 to 30,0	$\pm 0,2$
> 30,0 to 120,0	$\pm 0,3$

Figure 3 — Shower head



Key

- 1 rain-catching sheet for measuring rate of driving rain, inserted in the Hellmann-type rain gauge
- 2 wind direction
- 3 two additional supports necessary due to wind pressure

The area of surface *A* shall be equal to the area of surface *B*.

Any details not given should be chosen appropriately.

Figure 4 — Rain-catching metal sheet

7 Specification

The equipment specification shall contain the following details:

- a) environmental test code;
- b) number of specimens;
- c) preconditioning of specimen if other than described in 5.2;
- d) type and scope of initial test;
- e) state of operation 2: determination of period of operation;

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- f) state of operation 2: method and scope of intermediate test;
- g) recovery if other than described in 5.3;
- h) type and scope of final test, unless specified in 5.4;
- i) criteria for evaluation, e.g. admissible amount of penetrated water, time within which moisture film should vanish;
- j) type and scope of test report.

Annex A (informative)

Explanatory notes

A.1 General

Rain, flooding such as that encountered on ships, water spray or splash and the effect of dripping water are some of the manifold environmental influences to which optical instruments are exposed during their lifetime in all states of operation. This part of ISO 9022 describes exposure to drip and rain. The ability to resist exposure to immersion and flooding can be established by ISO 9022-8.

Dripping water is used to simulate the influence on instruments of water dripping from above due to condensation or leaks. The size of the drops exceeds 2 mm. The drip test can, however, also be used to simulate the effect of a small amount of rain on instruments which may not normally be exposed to rain but which are protected against accidental, short exposure to rainfall, e.g. camera systems. The low drip rates of conditioning Method 72, degree of severity 01 or 02, are intended for exposure of this type.

The influence of rain on optical instruments is similar to that to which they are subjected during exposure to moisture as detailed in ISO 9022-2; the effects, however, are different. Thus water in the form of drops, due to its surface tension, tends to penetrate into the instrument or components thereof much less than is the case with water vapour. Unlike exposure to water vapour, potential corrosion phenomena are not taken into account in the rain test.

The effect of the rain increases the higher the speed, the smaller the size of the drops and the longer the exposure time. In order to facilitate the test measurement of the size of the drops and their constancy during the exposure time is not required by this part of ISO 9022. The shower head specified by this part of ISO 9022 produces rain with small drop sizes (< 2 mm).

The degrees of severity correspond to conditions such as are encountered in a natural environment. Conditioning Method 73 and degree of severity 01 simulate the maximum rain rate expected in Europe, i.e. 7 mm/min for a duration of 5 min. This period is extended to 30 min as the rain rates measured in Europe during cloudburst range between 3 mm/min to 7 mm/min for a duration greater than 30 min. The maximum global rate reaches 20 mm/min for a duration of 5 min and is covered by degree of severity 02. The time of exposure to degree of severity 02 has also been fixed at 30 min, not only in order to tighten the test but also to partly simulate the rainfall of less intensity but considerably longer duration experienced, for example, in India, Myanmar and Indonesia (600 mm within 24 h and 12 000 mm within one year).

The rain rate required for conditioning Method 74 is less than that specified for conditioning Method 73. However, due to the strong wind causing sprays and eddies when the rain impinges on the specimen, the stress acting on the latter is more severe during exposure to conditioning Method 74 than to conditioning Method 73.

A.2 Arrangement of shower heads in conditioning Methods 73 and 74

Figures A.1 and A.2 show a recommended arrangement of the shower heads for the rain test.

The arrangement shown in Figure A.2 is intended for testing strongly fissured specimens. The shower head in the centre of Figures A.1 and A.2 can be switched on separately from those in the corners and those in the centre of the sides. The shower heads and the supply pipes should be made of a corrosion-resistant material. The water is first cleaned by the connection of an appropriate filter. The required rain rate can be constantly adjusted within the admissible limiting deviations by the use of a booster pump with a pressure control valve

and a back-up supply, and a flow-meter. Any lime or sediment should be removed from the jet plates of the shower heads immediately after use and when dry, they should be stored separately.

Dimensions in metres

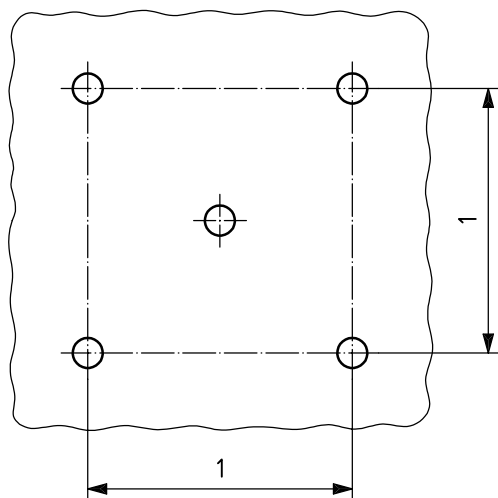


Figure A.1 — Top view of arrangement of one, four or five shower heads

Dimensions in metres

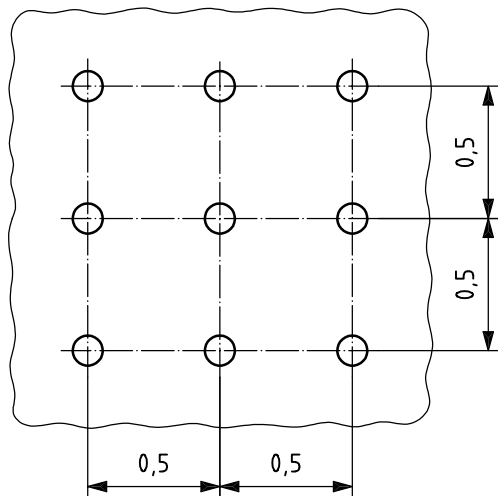
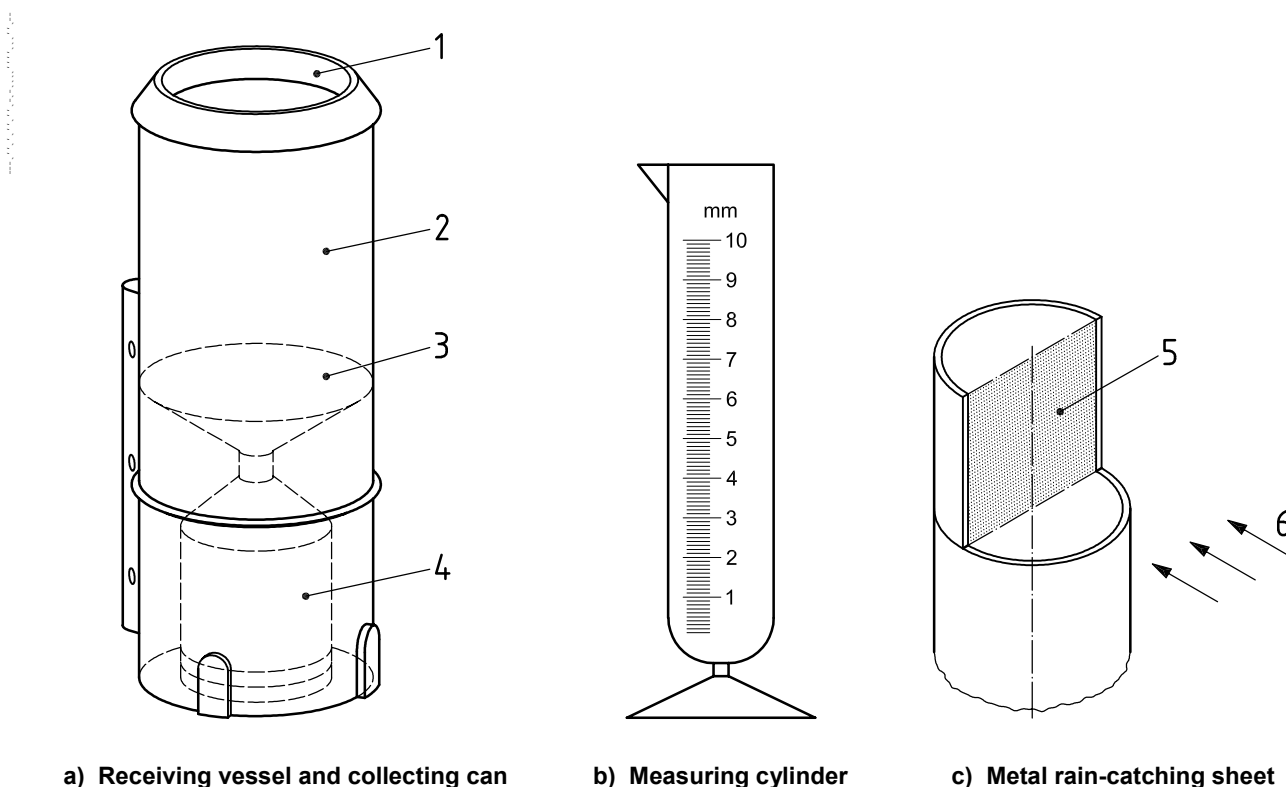


Figure A.2 — Top view of arrangement of nine shower heads

A.3 Hellmann rain gauge for measurement of the rain rate or drip rate

The gauge consists of receiving vessel (typically 200 cm² receiving aperture), collecting can and corresponding measuring cylinder graduated in millimetres. For measurement of the rate of driving rain, a rain-catching sheet of same collecting area as the receiving vessel is inserted. See Figure A.3 for a schematic representation. An example of suitable product available commercially is the rain gauge according to Hellmann, supplied by Wilh. LAMBRECHT GmbH, Meteorological Instruments, Germany, www.lambrecht.net¹⁾.



Key

- 1 receiving aperture
- 2 receiving vessel
- 3 collecting funnel
- 4 collecting can
- 5 rain-catching sheet for measuring rate of driving rain, inserted in the Hellmann-type rain gauge
- 6 wind direction

Figure A.3 — Schematic of Hellmann rain gauge

1) The rain gauge according to Hellmann is an example of a suitable product available commercially. This information is given for the convenience of users of this part of ISO 9022 and does not constitute an endorsement by ISO of this product.

Bibliography

- [1] ISO 9022-8:1994, *Optics and optical instruments — Environmental test methods — Part 8: High pressure, low pressure, immersion*
- [2] ISO 9022-2:2002, *Optics and optical instruments — Environmental test methods — Part 2: Cold, heat and humidity*

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