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Reserve

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Degrés de protection des enveloppes pour l'appareillage à basse tension

Degrees of protection of enclosures for low-voltage switchgear and controlgear

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

DEGREES OF PROTECTION OF ENCLOSURES FOR LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR

FOREWORD

1) The formal decisions or agreements of the I.E.C. on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.

3) In order to promote this international unification, the I.E.C. expresses the wish that all National Committees having as yet no national rules, when preparing such rules, should use the I.E.C. recommendations as the fundamental basis for these rules in so far as national conditions will permit.

4) The desirability is recognized of extending international agreement on these matters through an endeavour to harmonize national standardization rules with these recommendations in so far as national conditions will permit. The National Committees pledge their influence towards that end.

5) The I.E.C. has not laid down any procedure concerning marking as an indication of approval and has no responsibility when an item of equipment is declared to comply with one of its recommendations.

PREFACE

This recommendation has been prepared by Sub-Committee 17 B: Low-voltage switchgear and controlgear, of Technical Committee No. 17: Switchgear and controlgear.

The work was commenced following the meeting of the Sub-Committee held in Moscow in 1957, when it was decided to ask an Experts' Committee to prepare a draft which would, when agreed, be an Appendix to two documents under consideration dealing with circuit-breakers and contactors.

The first draft was prepared for the meeting held in Stockholm in 1958. A new draft was discussed during the meeting held in Madrid in 1959, when it was decided that a final draft should be submitted to the National Committees for approval under the Six Months' Rule. This draft was circulated in March 1960. A number of comments were received on this draft, and an amended draft was submitted to the National Committees under the Two Months' Procedure in March 1961.

The following countries voted explicitly in favour of publication:

Austria
Canada
Czechoslovakia
Denmark
Finland
France
Hungary
Israel
Italy
Netherlands
Norway
Poland
Romania
Switzerland
United Kingdom
United States of America
Yugoslavia

Two other countries (Belgium and Germany) considered that it was premature to standardize symbols of protection for low-voltage switchgear and controlgear as they should be extended to apply to other electrical equipment such as rotating machines and transformers.

It is considered, however, that as this recommendation is intended primarily as an appendix to the recommendations for low-voltage circuit-breakers and low-voltage contactors, it should be published with this restricted scope and considered as a starting point for more general standardization on this subject.

It has not been found possible for the time being to reconcile all comments received, particularly those dealing with Sub-clauses 8.1, 8.3 and Clause 9, and further consideration will be given to these items for decision and inclusion in a later edition.

DEGREES OF PROTECTION OF ENCLOSURES FOR LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR

1. Scope

This recommendation covers:

— standard degrees of protection provided by enclosures for low-voltage switchgear and controlgear, as regards:

a) protection of persons against contact with live or moving parts inside the enclosure and protection of equipment against ingress of solid foreign bodies,

b) protection of equipment against ingress of liquid,

c) protection of equipment against mechanical damage (under consideration);

— markings regarding these degrees of protection;

— tests to be performed to prove that the equipment meets the requirements of this recommendation.

This recommendation does not apply to special degrees of protection, such as protection of equipment in an explosive atmosphere. Such equipment must comply with the recommendations prepared by I.E.C. Technical Committee No. 31: Electrical apparatus for explosive gas atmospheres. Neither does it cover protection against other unusual service conditions such as fungus and corrosive vapours.

This recommendation is intended to serve as a guide to the requirements for protective enclosures. The tests, however, are applicable only where practicable and where agreed between manufacturer and user.

The effects of stresses occurring during short-circuit operation are not covered by this recommendation, but are dealt with in an I.E.C. Publication under consideration.

2. Markings

Markings used to indicate the degree of protection consist of the letters IP, followed by two characteristic numerals signifying respectively conformity to the codes described in Clauses 3 and 4.

The first characteristic numeral designates the degree of protection of persons against contact with live or moving parts inside the enclosure and of equipment against ingress of solid foreign bodies.

Note. — A single characteristic numeral is used to designate the two means of protection mentioned above since it is understood that protection against ingress of solid foreign bodies implies a certain amount of protection of persons against contact with live or moving parts inside the enclosure and vice versa.

The second characteristic numeral designates the degree of protection against ingress of liquid.

Note. — A third characteristic numeral designating protection against mechanical damage is under consideration.

3. **Protection of persons against contact with live or moving parts inside the enclosure and protection of equipment against ingress of solid foreign bodies**

Protection against contact with moving parts inside the enclosure is limited to contact with moving parts inside the enclosure which might cause danger to persons.

First characteristic numeral	Degree of protection
0	No protection of persons against contact with live or moving parts inside the enclosure. No protection of equipment against ingress of solid foreign bodies.
1	Protection against accidental or inadvertent contact with live or moving parts inside the enclosure by a large surface of the human body, for example, a hand, but not protection against deliberate access to such parts. Protection against ingress of large solid foreign bodies. See test Sub-clause 7.1.
2	Protection against contact with live or moving parts inside the enclosure by fingers. Protection against ingress of medium size solid foreign bodies. See test Sub-clause 7.2.
3	Protection against contact with live or moving parts inside the enclosure by tools, wires or such objects of thickness greater than 2.5 mm. Protection against ingress of small solid foreign bodies. See test Sub-clause 7.3.
4	Protection against contact with live or moving parts inside the enclosure by tools, wires or such objects of thickness greater than 1 mm. Protection against ingress of small solid foreign bodies. See test Sub-clause 7.4.
5	Complete protection against contact with live or moving parts inside the enclosure. Protection against harmful deposits of dust. The ingress of dust is not totally prevented, but dust cannot enter in an amount sufficient to interfere with satisfactory operation of the equipment enclosed. See test Sub-clause 7.5.
6	Complete protection against contact with live or moving parts inside the enclosure. Protection against ingress of dust. See test Sub-clause 7.6.

4. **Protection of equipment against ingress of liquid**

Second characteristic numeral	Degree of protection
0	No protection.
1	Protection against drops of condensed water: Drops of condensed water falling on the enclosure shall have no harmful effect. See test Sub-clause 8.1.
2	Protection against drops of liquid: Drops of falling liquid shall have no harmful effect when the enclosure is tilted at any angle up to 15° from the vertical. See test Sub-clause 8.2.
3	Protection against rain: Water falling in rain at an angle equal to or smaller than 60° with respect to the vertical shall have no harmful effect. See test Sub-clause 8.3.
4	Protection against splashing: Liquid splashed from any direction shall have no harmful effect. See test Sub-clause 8.4.
5	Protection against water-jets: Water projected by a nozzle from any direction under stated conditions shall have no harmful effect. See test Sub-clause 8.5.
6	Protection against conditions on ships' decks (deck watertight equipment): Water from heavy seas shall not enter the enclosures under prescribed conditions. See test Sub-clause 8.6.
7	Protection against immersion in water: It must not be possible for water to enter the enclosure under stated conditions of pressure and time. See test Sub-clause 8.7.
8	Protection against indefinite immersion in water under specified pressure: It must not be possible for water to enter the enclosure. See test Sub-clause 8.8.

5. Protection of equipment against mechanical damage

Under consideration

6. Degrees of protection

The table below gives the most frequently used degrees of protection in accordance with the descriptions given in Clauses 3 and 4.

It is recommended that the characteristic letters and numerals be marked on the enclosure.

Character-istic letters	First characteristic numeral Protection against contact and ingress of foreign bodies	Second characteristic numeral Protection against ingress of liquid								
		0	1	2	3	4	5	6	7	8
IP	0	IP 00	—	—	—	—	—	—	—	—
	1	IP 10	IP 11	IP 12	—	—	—	—	—	—
	2	IP 20	IP 21	IP 22	IP 23	—	—	—	—	—
	3	IP 30	IP 31	IP 32	IP 33	IP 34	—	—	—	—
	4	IP 40	IP 41	IP 42	IP 43	IP 44	—	—	—	—
	5	IP 50	—	—	—	IP 54	IP 55	—	—	—
	6	IP 60	—	—	—	—	IP 65	IP 66	IP 67	IP 68

7. **Tests to prove protection of persons against contact with live or moving parts inside the enclosure and protection of equipment against ingress of solid foreign bodies**

These tests are type tests.

First characteristic numeral	Test conditions
0	No test is required.
1	The test is made with a sphere of 52.5 mm diameter. The test is deemed satisfactory if the sphere cannot touch live or moving parts inside the enclosure.
2	The test is made using a metallic contact finger such as the one shown in Figure 1, connected by an incandescent lamp to one pole of a supply of at least 40 V, the other pole of the supply being connected to the parts intended to be live in normal service, electrically connected together. The protection is deemed satisfactory if the lamp does not light when an attempt is made to touch the bare live parts or insufficiently insulated parts, with the test finger placed in every possible position and pushed without undue force. For these tests, the insufficiently insulated parts will be covered with a metal foil connected to those parts alive in normal service. Conducting parts covered only with varnish or enamel or protected by oxydation or by a similar process shall be considered as insufficiently insulated. In addition, the enclosure must not admit a ball of 12.5 mm diameter.
3	The test is made with a steel wire of 2.5 mm diameter. The test is deemed satisfactory if the wire cannot enter the enclosure.
4	The test is made with a steel wire of 1 mm diameter. The test is deemed satisfactory if the wire cannot enter the enclosure.
5	The test should preferably be made using the equipment shown in Figure 2, consisting of a closed test chamber in which talcum powder is maintained in suspension by an air current. The talcum powder used is to pass a square-meshed sieve whose nominal wire diameter is 50 μ and the nominal width between wires is 75 μ. The amount of talcum powder to be used is 2 kg per cubic metre of the test chamber. The equipment under test is hung inside the chamber and its enclosure is connected to a vacuum pump which maintains inside the enclosure a differential pressure equivalent to not more than a head of 200 mm water. The test is stopped at the end of 2 h if the volume of the air drawn in during this period is from 80 to 120 times the volume of air in the enclosure under test. If, with the vacuum equivalent to a head of 200 mm water, it is not possible to draw in 80 times the volume of air indicated above, the test must be continued until that value is attained; in no case should the test be longer than 8 h. The permissible amount of talcum powder penetration inside the enclosure is subject to agreement between manufacturer and user.
6	The test should preferably be made under the same conditions as given above for degree of protection 5. The test is deemed satisfactory if no deposit of dust is observable inside the enclosure at the end of the test.

8. Tests to prove protection of equipment against ingress of liquid

These tests are type tests.

Second characteristic numeral	Test conditions
0	No test is required.
1	(Under consideration).
2	The test should preferably be made by means of the equipment shown in Figure 3 using water, and adjusted so that the discharge is 3 mm of water per minute. The equipment under test is placed in its normal operating position under the dripping equipment, the base of which must be larger than that of the equipment under test. The equipment under test is tilted up to an angle of ±15° in respect to its normal operating position successively in two planes at right angles. The total duration of the test is 10 minutes. The test is deemed satisfactory if, on its conclusion, the amount of water which has entered the interior of the equipment is not capable of interfering with its satisfactory operation, and if no water has accumulated near the cable-end or entered the cable.
3	The test should preferably be made by means of the equipment shown in Figure 4. It consists of an oscillating tube formed into a semi-circle, the radius of which is as small as possible taking into account the dimensions of the equipment under test. This tube is oscillated so as to describe an angle of 60° from vertical in both directions. The duration of a simple oscillation is about 2 seconds. The water pressure corresponds to a head of about 10 m water. The equipment under test is mounted in its normal position on a turntable, the axis of which is vertical and the height of which may be regulated, located near the centre of the semicircle formed by the oscillating tube. The duration of the test is 10 minutes. The test is deemed satisfactory if, on its conclusion, the amount of water which has entered the interior of the equipment is not capable of interfering with its satisfactory operation, and if no water has accumulated near the cable-end or entered the cable.
4	The test should preferably be made as described above for degree of protection 3. The oscillating tube oscillates through an angle of almost 180° with respect to the vertical in both directions and at a speed of 90° per second. Moreover, the support for the equipment under test is grid-shaped in order not to act as a baffle. The test is deemed satisfactory if, on its conclusion, the amount of water which has entered the interior of the equipment is not capable of interfering with its satisfactory operation and if no water has accumulated near the cable-end or entered the cable.

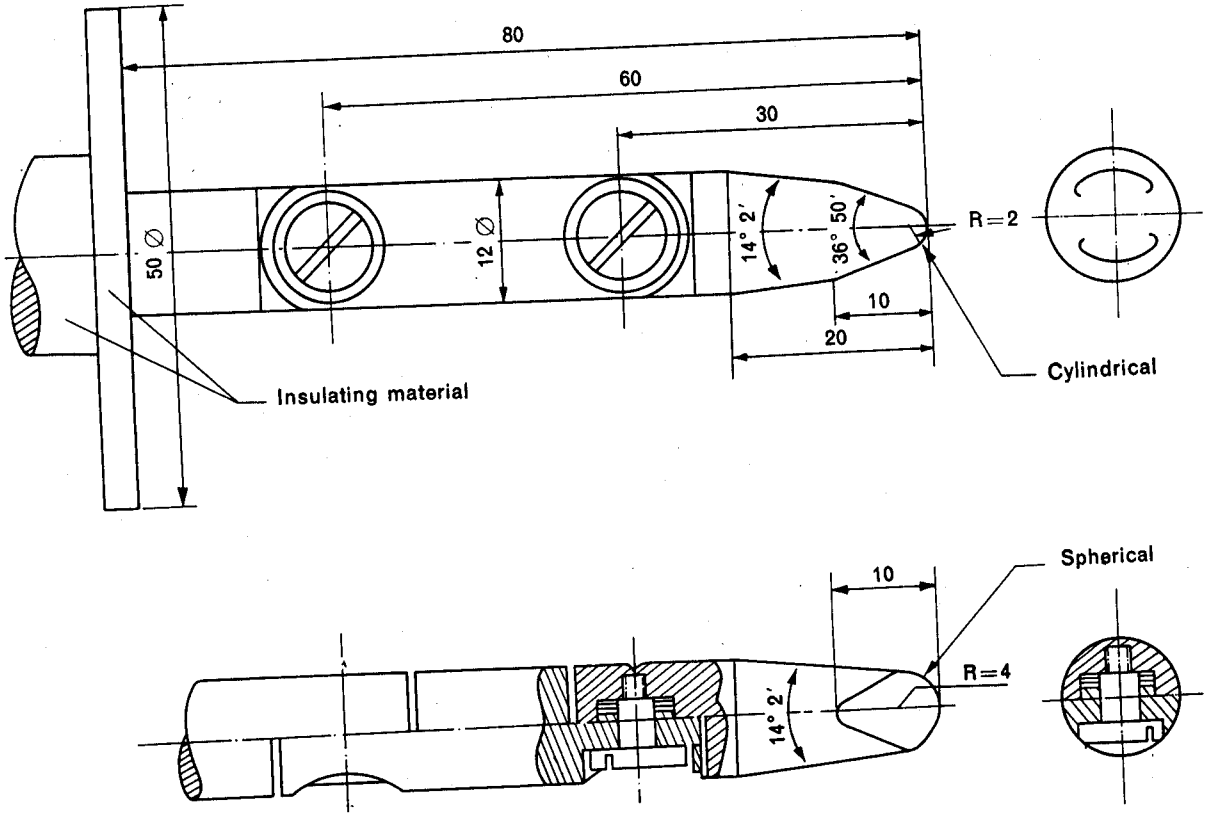
Second characteristic numeral	Test conditions
5	The test should preferably be made by applying a stream of water from a nozzle of 12.5 mm inside diameter on the equipment in all directions at a pressure corresponding to a head of about 10 m of water. The nozzle should be held at a distance of 3 m away from the equipment under test. The duration of the test is 15 minutes. The test is deemed satisfactory if, on its conclusion, the amount of water which has entered the interior of the equipment is not capable of interfering with its satisfactory operation and if no water has accumulated near the cable-end or entered the cable.
6	The test should preferably be made by applying a stream of water from a nozzle of 12.5 mm inside diameter on the equipment in all directions at a pressure corresponding to a head of about 10 m of water. The nozzle should be held at a distance of 1.5 m away from the equipment under test. The duration of the test is 15 minutes. The test is deemed satisfactory if, on its conclusion, no water has entered the interior of the equipment.
7	The test should preferably be made by completely immersing the equipment under test in water so that the head of water above the equipment is 1 m. The duration of the test is 30 minutes. The test is deemed satisfactory if, on its conclusion, no water has entered the interior of the equipment and if no water has accumulated near the cable-end or entered the cable. By agreement between manufacturer and user, this test can be replaced by the following one: The enclosure should be tested with an inside air-pressure corresponding to a head of about 1 m of water. The duration of the test is 1 minute. The test is deemed satisfactory if no air leaks out during the test. Air leakage may be detected either by submersion, the water just covering the equipment, or by the application of a solution of soap in water.
8	The test should preferably be subject to agreement between manufacturer and user.

Note. — For the tests according to degrees of protection 5, 6 and 7, the temperature of the equipment should not differ by more than 5°C from that of the water.

9. Tests to prove protection of equipment against mechanical damage

Under consideration.

Dimensions in millimetres



Tolerances

on angles	± 5′
on linear dimensions	
— under 25 mm	— 0.05
— over 25 mm	± 0.2

FIG. 1. — Standard test-finger.

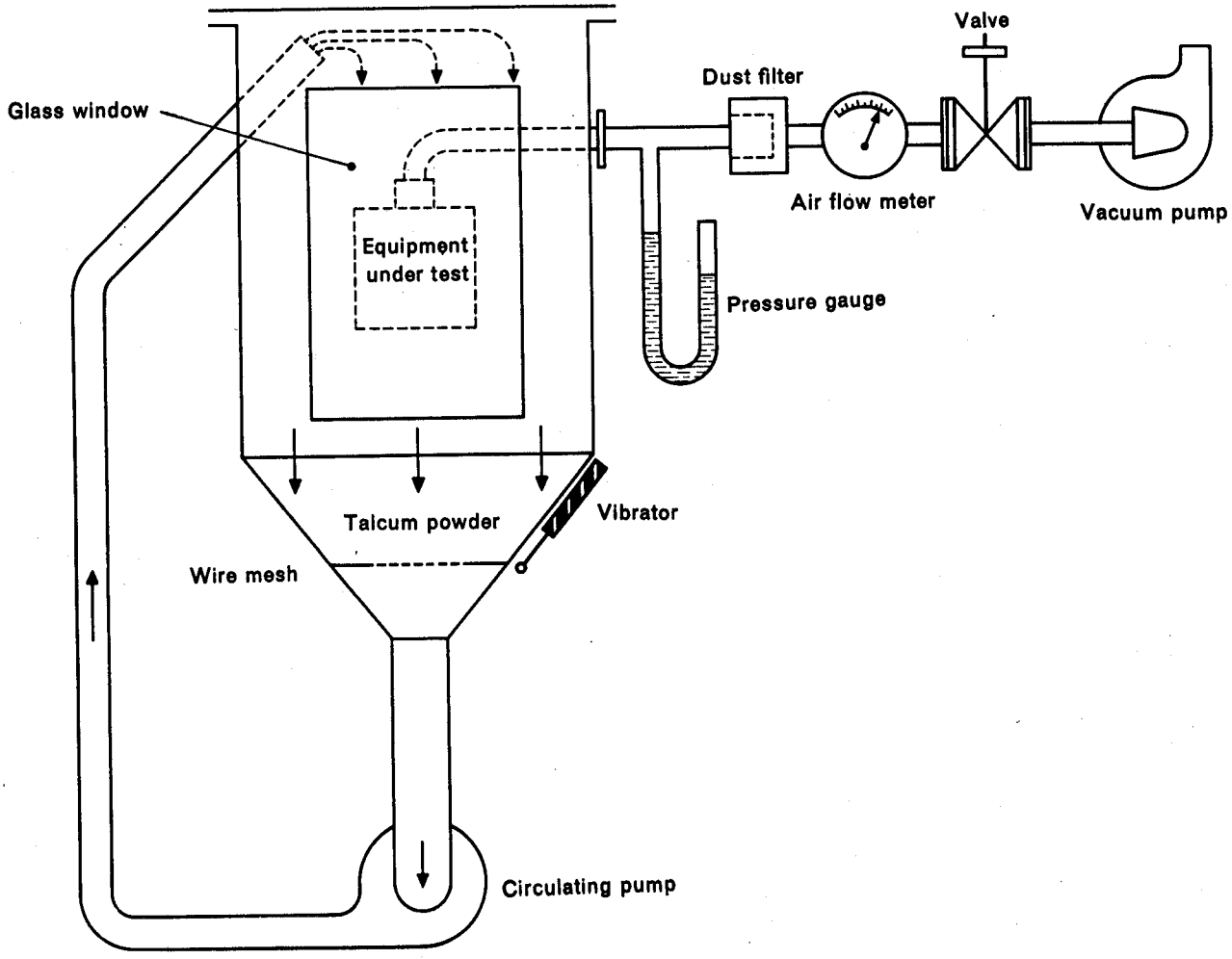
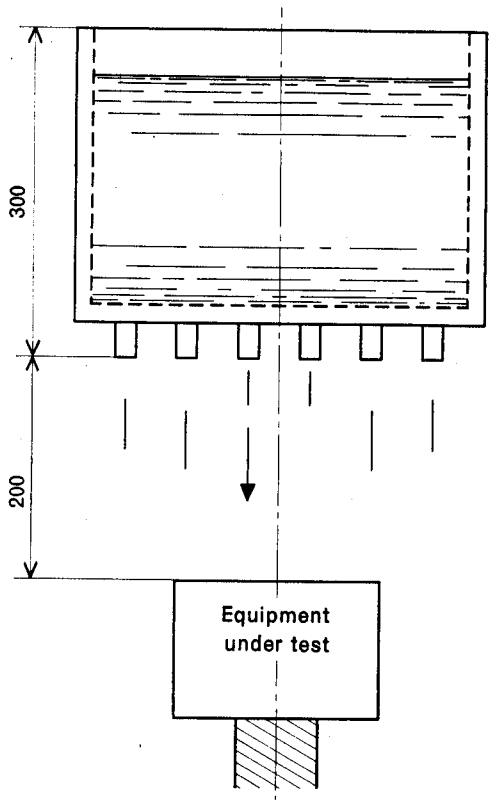
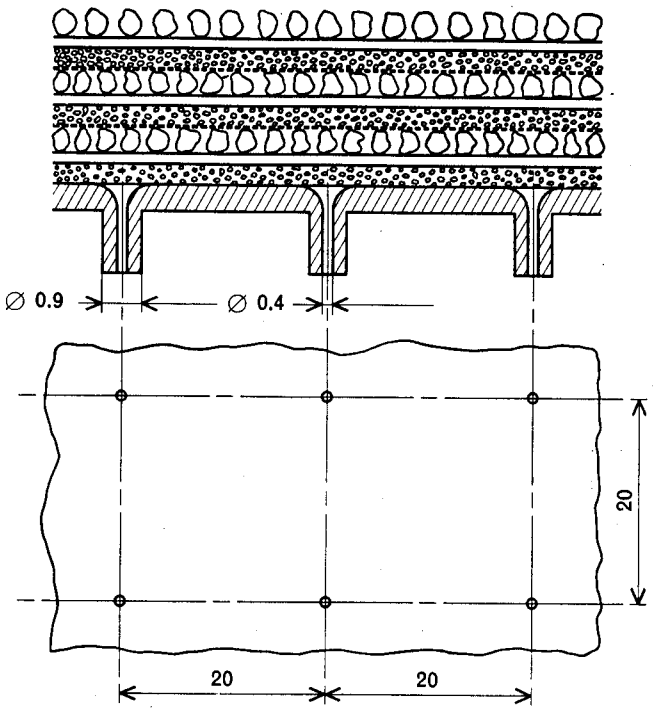


FIG. 2. — Equipment to prove protection against dust.

Dimensions in millimetres



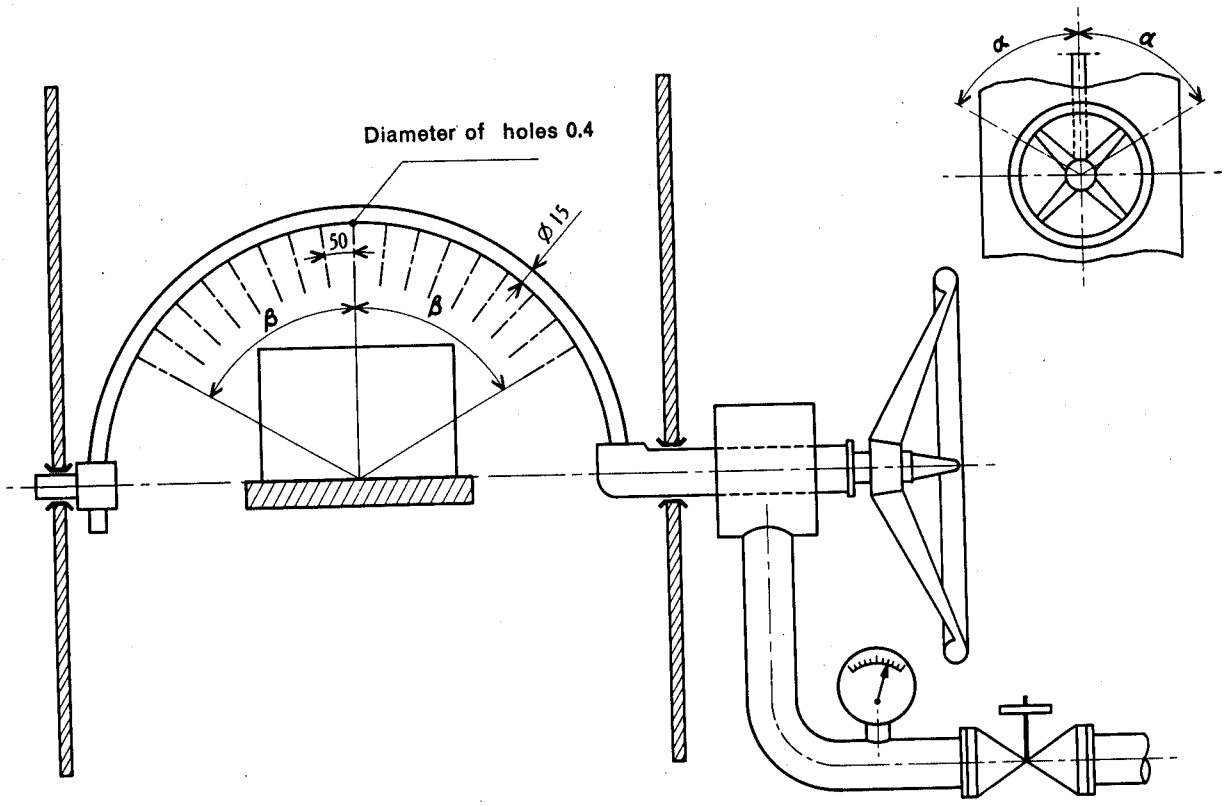
Layers of sand and gravel to regulate flow of water, these layers being separated by metallic gauze and blotting paper.



Note. — The support must be smaller than the equipment under test.

FIG. 3. — Equipment to prove protection against drops of liquid.

Dimensions in millimetres



Second characteristic numeral		3	4
	$\alpha =$	$\pm$ 60°	$\simeq \pm$ 180°
Open holes within half an angle of	$\beta =$	$\pm$ 60°	$\simeq \pm$ 90°

FIG. 4. — Equipment to prove protection against rain and splashing.