

Protective clothing against rain — Test method for ready made garments — Impact from above with high energy droplets

The European Standard EN 14360:2004 has the status of a
British Standard

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National foreword

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English version

Protective clothing against rain - Test method for ready made garments - Impact from above with high energy droplets

Vêtements de protection contre les intempéries - Méthode d'essai pour les vêtements prêt à porter - Impact de fortes précipitations

Schutzkleidung gegen Regen - Prüfverfahren für fertige Bekleidungsteile - Beaufschlagung von oben mit Tropfen von hoher Energie

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Foreword

This document (EN 14360:2004) has been prepared by Technical Committee CEN/TC 162 "Protective clothing including hand and arm protection and life jackets", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2005, and conflicting national standards shall be withdrawn at the latest by January 2005.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to support Essential Requirements of EU Directive 89/686/EEC Personal Protective Equipment.

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of the document.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies a test method for determining the rain tightness of clothing for protection against rain, using a static manikin exposed to artificial rain. It is applicable to the testing of jackets, trousers, coats and one or two piece suits.

This standard is not applicable to the testing of garments for resistance to other weather conditions, e.g. snow, hail-, or strong winds.

2 Normative references

Not applicable.

3 Terms and definitions

For the purposes of this European Standard, the following term and definition apply.

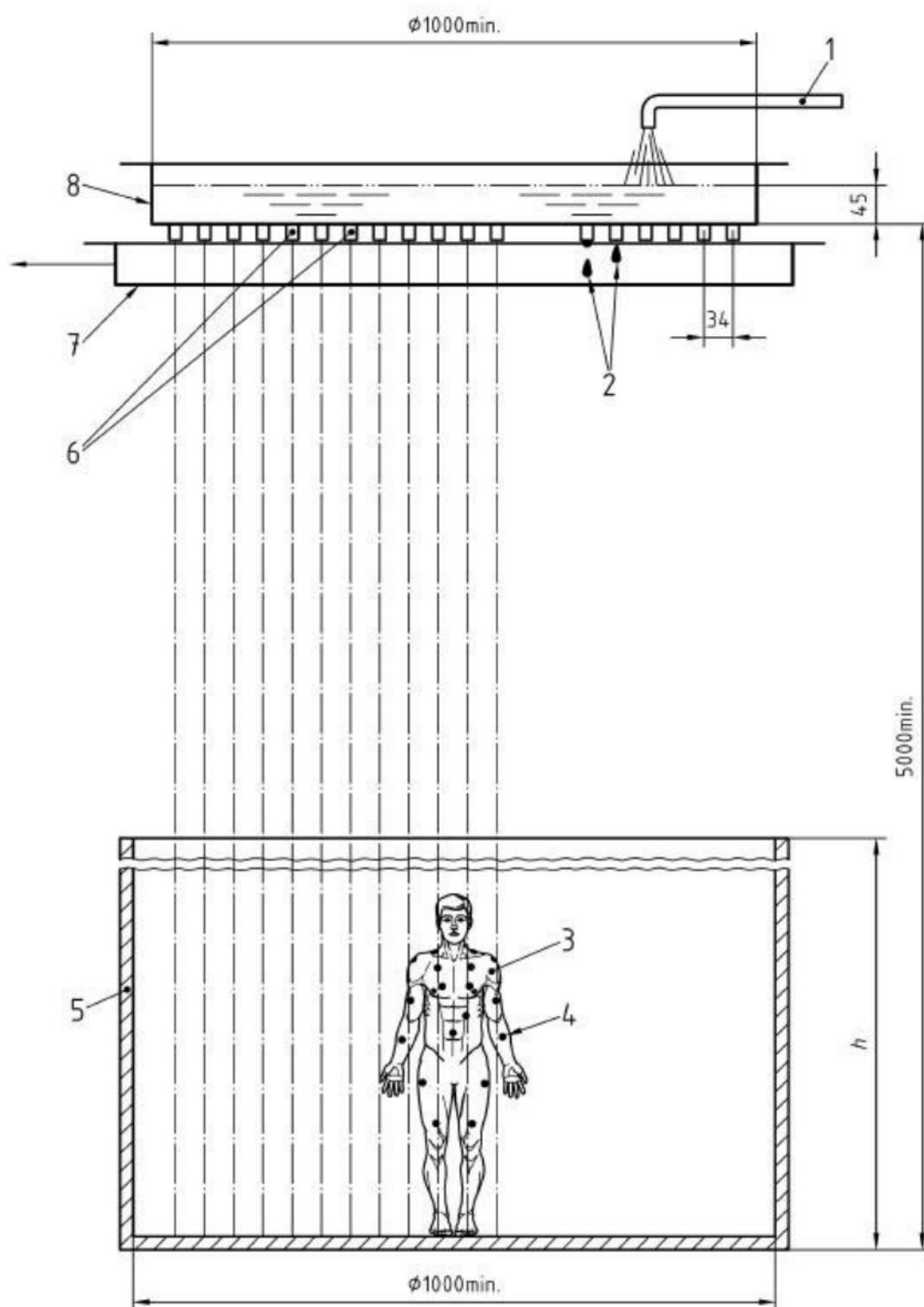
garment

individual component of a clothing ensemble, the wearing of which provides protection to the part of the body that it covers

4 Principle

A manikin with the shape and size of an adult person wearing long underwear made of absorbent fabric is dressed in the garments to be tested and exposed to artificial rain for a specific period. After the exposure the underwear and the inner side of the garment are visually inspected for wet areas. In addition, sensors on the manikin may be used in order to detect the timing of water ingress at individual sites.

Dimensions in millimetres

**Key**

- 1 Water filling pipe
- 2 Droplets
- 3 Manikin
- 4 Sensors

- 5 Protection wall
- 6 Nozzles
- 7 Movable tub
- 8 Rain water tub

Figure 1 — Example of a rain tower device

5 Test device

5.1 *Rain tower*, (as shown in Figure 1) comprising a circular tub at least 1 000 mm in diameter supported at least 5 000 mm above the floor, and supplied with water from an inflow pipe. The base of the tub shall be fitted with approximately 682 nozzles with a hole diameter of 0,6 mm placed at 34 mm centres to deliver water droplets over a circular area with a diameter of 932 mm at a density of approximately 1 000 droplets /m². The tub shall have an overflow pipe placed so as to maintain a water depth of (45 ± 5) mm in the tub.

NOTE 1 The diameter of the water droplets correspond to those described in EN 29865 (app. 5 mm). The amount of water is (450 ± 50) l/(m²h) (see Figure 1).

NOTE 2 To prevent water from the atmosphere condensing inside the garment the water temperature should be the same as the air temperature in the room in which the test is conducted within ± 5 °C.

NOTE 3 To prevent a blockage of the nozzles, water with low calcium content should be used.

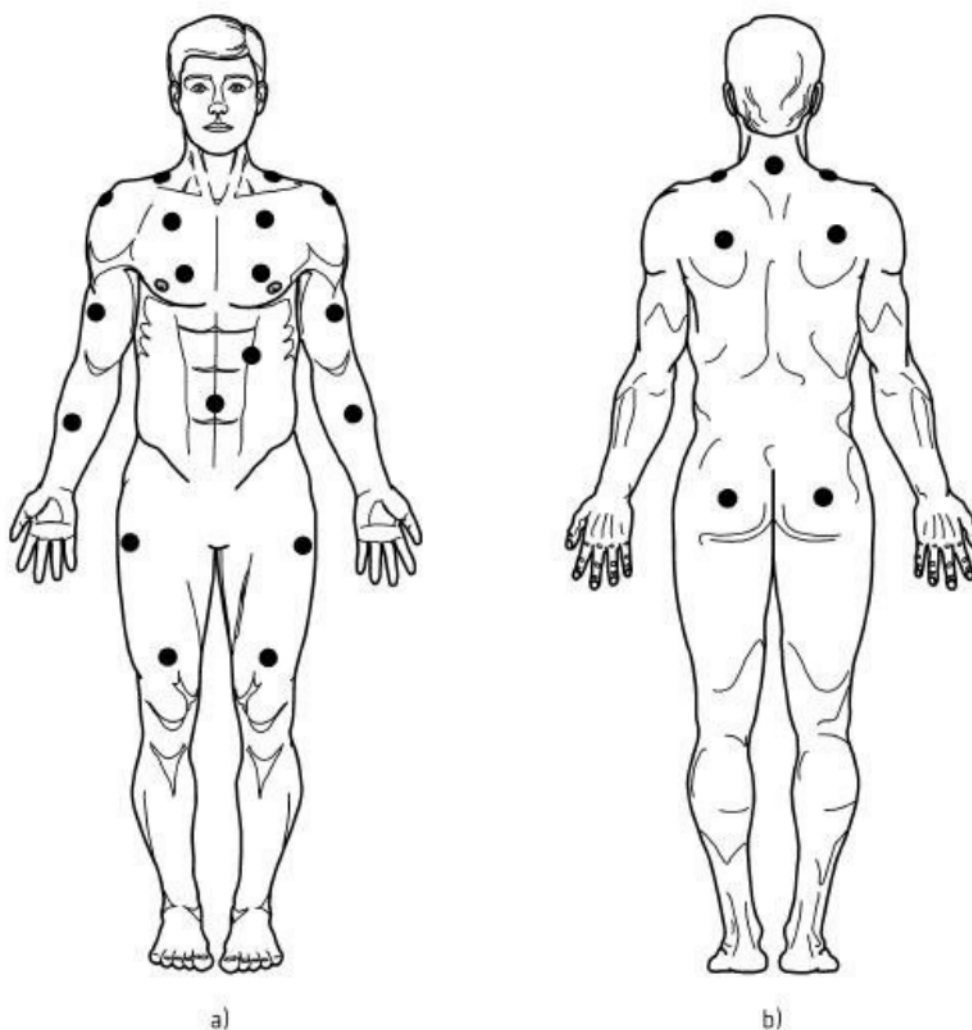
5.2 *Thermometers*, one in the room in which the test is to be carried out to measure the air temperature and one immersed in the tub to measure the temperature of the water.

5.3 *Manikin*, with the shape of an adult person, $(1\,820 \pm 40)$ mm tall and with a chest girth of $(1\,000 \pm 60)$ mm, comprising a head, torso, abdomen, buttocks, arms, hands, straight legs and feet. The arms shall be moveable to make putting on the garment easier.

NOTE It is possible to use alternative manikin sizes (children or female) with the appropriate garment size.

5.4 *Underwear to fit manikin*, comprising a undershirt with long sleeves and underpants with long legs. For testing of jackets with a hood, the undershirt shall have a hood. The underwear shall be made of water absorbent fabric (e.g. washed cotton). When the underwear is tested in accordance with Annex B, the mean time for the drops to be wicked into the fabric shall be not greater than 2 s.

5.5 *Optionally humidity sensors*, connected to a recording system. The humidity sensors shall be placed either on the manikin at convex places or on the underwear. Figure 2 shows a possible position of the sensors. The most critical locations are: shoulders, chest, wrist, back, abdomen (zipper) and shoulder blade.



Key

- a Front view
- b Rear view

Figure 2 — Positions of humidity sensors on the manikin

6 Dressing and positioning the manikin

If only a single piece is to be tested, the manikin has to be fully dressed:

- a) Jacket testing in combination with any appropriate water tight trousers.
- b) Trousers testing in combination with any appropriate water tight jacket.

The manikin shall be dressed with the underwear (5.4) and the garments of a size adequate to the manikin. Any zippers, fastening elements and pockets shall be closed. The draw-cord at the hem of the jacket, if fitted, shall be pulled tight. If the jacket has a hood this shall be put on the manikin's head in the normal wearing position, with any draw-cord pulled tight. If the jacket does not have a hood, the head of the manikin shall be covered with a plastic bag in order to prevent water wicking through the collar inside the jacket. The plastic bag shall not cover the seams in the neckline. If during testing it is found that there is water ingress around the face or through the hood, additional tests shall be carried out with the head and hood covered by plastic bag. If the lower ends of the trouser legs are adjustable they shall be adjusted to the tightest position. The hem area of sleeves and body of the

undershirt and the legs of the underpants shall be adjusted to finish about 45 mm above the ends of the jacket and trouser legs, respectively, to prevent water wicking into the underwear at the wrists or ankles.

The manikin shall be adjusted so that it is leaning backwards at an angle of $(5 \pm 2)^\circ$ to the vertical.

NOTE This is because the critical area of a jacket with regard to water ingress is normally the zipper fastener.

One arm shall be angled backwards and the other arm shall be angled forwards, each at an angle of $(25 \pm 5)^\circ$ to the true vertical.

7 Test procedure

The test sample is positioned on the manikin and the water supply is started. It shall be waited until the tub is filled, i.e. until the overflow pipe is active. Then allow the raindrops to fall down on to the manikin. If not specified, the test duration shall be 1 h. After the test duration time, allow the test garment to drain for 2 min. Remove the test garment carefully avoiding drops contacting the underwear. Examine the inner face of the test garment. Measure the surface of all wetted areas on the underwear and determine the total wetted area in cm^2 . A minimum of two separate specimens per type of garment shall be tested. If one specimen fails, then a third specimen shall be tested. If only one test garment is available, the same test garment shall be tested twice. The test garment shall be dried and conditioned as indicated above before the next test starts.

NOTE The product standard may specify a greater number of tests. A repetition rain test of the same specimen can influence the test results. Normally the second test of the same specimen shows a greater water ingress due to the worse repellency.

8 Test report

The test report shall include the following information:

- a) the number of this European Standard;
- b) identification/description of the test garment;
- c) size of the garment;
- d) test temperature, pre-treatment if relevant;
- e) for each sample tested, the location of wet areas on the inner side of the garment. The total wet area on the underwear and details of the size and location of wet areas. Wet areas should preferably be indicated by shading on diagrams of a human figure (front and back views) or by photographs of the front and back of the manikin;
- f) details of the timing of water ingress obtained from the humidity sensors, if available;
- g) date of testing;
- h) any deviations from the method given in this standard;
- i) any qualifying remarks and observation (e.g. the pocket filled with water, visible changes in water repellency);
- j) any areas covered with plastic bags (hood etc.);
- k) the number of samples tested.

Annex A (informative)

General background to the rain simulation

This European Standard has been prepared to achieve a common basis in Europe for rain shower testing for protective clothing against rain, in particular in the interests of manufacturers, test houses and end-users. The rain-proof properties are tested on the complete garment especially to check design features under non dynamic conditions.

The pre-treatment and the pass-fail criteria have to be specified in the specific type of clothing (e.g. maximum wetted area 50 cm²).

Some meteorological data on amounts of rainfall and size of raindrops are given here to allow a comparison between the artificial rain used in the test and natural rain.

The mean amount of precipitation in many places in Central Europe is 500 mm to 1 000 mm (500 l/m² to 1 000 l/m²) per year. Peak values in the Alps can reach more than 3 000 mm per year. A cloudburst is defined as especially heavy rain during which the water falling is at least 1 l/m² · min⁻¹. During such a cloudburst in Central Europe, a substantial part of the annual precipitation can fall within less than an hour. However, rainfall of more than 1 l/m² · min⁻¹, is rare. In tropical regions, values may exceed 600 l/m² · h⁻¹ in certain cases.

The velocity of rain drops with a diameter of 5 mm is about 9 m/s at a falling height of 10 m.

Although the amount of water for this rain tower test is high, a garment with a good material, design and properly sealed seams can easily remain dry inside after one hour of cloudburst rain. The advantage of a higher rain intensity is that leakages appear quicker and the rain duration time can be reduced.

The results of comparative testing¹⁾ have shown that the same ranking could be established for the water tightness of the jackets under test, when the tests were repeated by the same or by another test house. The wet areas were similar. The repeatability of rain test results with regard to the wet areas is influenced by a number of factors, including the fit and creasing of the test clothing on the manikin as well as positioning and size of the manikin and the treatment of jacket. Additional tests of the same specimen can increase the water ingress due to the wash out of the hydrophobic water repellent treatment.

1) Wetterschutzbekleidung für den Bau (WEBAU) September 1999, ZS Erkrath und EMPA St.Gallen.

Annex B **(normative)**

Absorbency of bleached textiles

AATCC Test Method 79-1992

B.1 Purpose and scope

Absorbency is one of several factors that determine the suitability of a fabric for a particular use, as in the case of gauze or towelling. It is important in fabrics that are to be dyed, since the completeness and uniformity of the dyeing are dependent upon the absorbency. Where fabrics are to be given resin or other specialised finishes, absorbency is a factor to be considered. Wetability or absorbency of textile fabrics or yarns can be determined by this test method.

B.2 Principle

A drop of water is allowed to fall from a fixed height onto the taut surface of a test specimen. The time required for the specular reflection of the water drop to disappear is measured and recorded as wetting time.

B.3 Terminology

Absorbency, - the propensity of a material to take in and retain a liquid, usually water, in the pores and interstices of the material.

B.4 Safety precautions

NOTE 1 These safety precautions are for information purposes only. The precautions are ancillary to the testing procedures and are not intended to be all inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Manufacturers should be consulted for specific details such as material safety data sheets and other manufacturer's recommendations.

NOTE 2 Good laboratory practices should be followed.

Wear safety glasses in all laboratory areas.

B.5 Apparatus

B.5.1 Embroidery hoop [diameter 15 cm or more].

B.5.2 Burette, delivering 15 drops to 25 drops of water per millilitre.

B.5.3 Stop watch.

B.5.4 Burette stand.

B.6 Test specimen

B.6.1 A swatch or skein of bleached material can be used for this test, as long as the specimen can be spread tightly over an embroidery hoop.

B.6.2 Specimens sampled prior to drying should first be air dried. All specimens should be brought to moisture equilibrium in a standard atmosphere having a relative humidity of $(65 \pm 2) \%$ at $(20 \pm 2) ^\circ\text{C}$ (see B.10).

B.7 Procedure

Conduct the test in a standard atmosphere as defined above. The cloth (or smoothed-out, thick portion of yarn) is mounted in the embroidery hoop so that the surface is free of wrinkles, but without distorting the structure of the material. Place the hoop about $(1,0 \pm 0,1)$ cm below the tip of the burette, and allow one drop of distilled or de-ionized water to fall on the cloth. The burette containing distilled or de-ionized water is adjusted so that it delivers one drop of water at $(21 \pm 3) ^\circ\text{C}$ approximately every five seconds. Measure the time required for the surface of the liquid to lose its specular reflectance by means of a stop watch. This point is determined by having the hoop between the observer and a source of light - such as a window or laboratory spot light - at such an angle that the specular reflectance of light from the surface of the flattened drop can be plainly seen. As the drop is gradually absorbed, the area of this tiny mirror diminishes and finally vanishes entirely, leaving only a dull wet spot. At this instant the watch is stopped and the elapsed time is recorded.

B.8 Evaluation

Approximately ten readings should be taken and the times averaged. The shorter the average time, the more absorbent is the textile. Five seconds or less is generally considered to represent adequate absorbency.

B.9 Precision and bias

Precision and bias have not been established for this test method.

B.10 Notes

It has been observed that if specimens collected at drying cans are not brought to moisture equilibrium (see B.6), the wetting times could falsely indicate poor absorbency for that material.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 89/686/EEC Personal Protective Equipment

This European Standard has been prepared under a mandate given to CEN by the European Commission to provide one means of conforming to Essential Requirements of the New Approach Directive 89/686/EEC Personal Protective Equipment.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses 7, 8 of this standard together with the requirements in the appropriate product standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements Annex II, clause 3.7.2 (2) of that Directive and associated EFTA regulations.

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

- [1] EN 29865:1993, *Textiles — Determination of water repellency of fabrics by the Bundesmann rain-shower test (ISO 9865:1991)*.

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