International Standard ISO 4855

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Personal eye-protectors — Non-optical test methods

Protecteurs individuels de l'œil — Méthodes d'essai autres qu'optiques

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4855 was developed by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, and was circulated to the member bodies in July 1978.

It has been approved by the member bodies of the following countries :

Australia	Ireland	Romania
Austria	Israel	South Africa, Rep. of
Belgium	Italy	Spain
Czechoslovakia	Mexico	Switzerland
France	Netherlands	USA
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The member bodies of the following countries expressed disapproval of the document on technical grounds :

Denmark
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Personal eye-protectors — Non-optical test methods

1 Scope and field of application

This International Standard specifies the non-optical test methods for eye-protectors the requirements for which are given in ISO 4849 to 4853.[1]

The optical test methods are given in ISO 4854.

PRELIMINARY REMARK — Of the tests described, the test for stability at elevated temperature should be carried out first on eye-protectors, generally followed by the test for robustness.

2 References

ISO 565, *Test sieves — Woven metal wire cloth and perforated plate — Nominal sizes of apertures.*

ISO 4849, *Personal eye-protectors — Specifications.*

ISO 4850, *Personal eye-protectors for welding and related techniques — Filters — Utilisation and transmittance requirements.*

ISO 4851, *Personal eye-protectors — Ultraviolet filters — Utilisation and transmittance requirements.*

ISO 4852, *Personal eye-protectors — Infrared filters — Utilisation and transmittance requirements.*

ISO 4854, *Personal eye-protectors — Optical test methods.*

1) In preparation : ISO 4853, *Personal eye-protectors — Daylight filters — Utilization and transmittance requirements.*

3 Test for robustness of the eye-protectors

This test applies to eye-protectors whose primary function is to protect against high-mass, low-velocity flying objects.

3.1 Unmounted oculars

3.1.1 Apparatus

The apparatus is shown in figure 1.

The immediate support for the ocular shall be a steel or rigid plastics cylinder with an internal diameter of $25\ ^{+0,4}_{0}$ mm and an outside diameter of 32 mm. The cylinder shall be inserted into, or be an integral part of, a steel base. The ocular shall be cushioned by a seating ring firmly attached to the top of the tube. This seating shall have a thickness of 3 mm and the same inside and outside diameters as the tube. The seating material shall have a hardness of 40 ± 5 IRHD. The combined mass of the support assembly shall be at least 12 kg.

A load ring of mass 250 g shall be placed upon the ocular. This ring shall have an inside diameter the same as that of the support tube, and any convenient outside diameter. A setting ring having the same dimensions and hardness as the support tube seating ring (gasket) shall be placed between the load ring and the ocular.

For cylindrically curved oculars, the test support tube and load ring shall be curved to conform to the convex and concave surfaces of the ocular respectively.

3.1.2 Procedure

Centre the ocular approximately on the support tube. Adjust the apparatus so that a 22 mm diameter steel ball of 44 g mass falling from $1,3\ ^{0}_{-0,03}$ m, strikes the ocular within an 8 mm radius from the centre of the support tube.

For plastics or laminated oculars, the temperature in the test area shall be 23 ± 3 °C. For oculars made solely from glass, normal room temperature shall apply.

Alternative tests may be used, provided that it can be demonstrated that they give equivalent results.

3.2 Mounted oculars

3.2.1 Head-form

The head-form shall be made of a suitable material having a hardness of 50 to 60 IRHD. The dimensions shall conform to those of the appropriate national head-form of which figure 2 shows an example.

Dimensions in millimetres

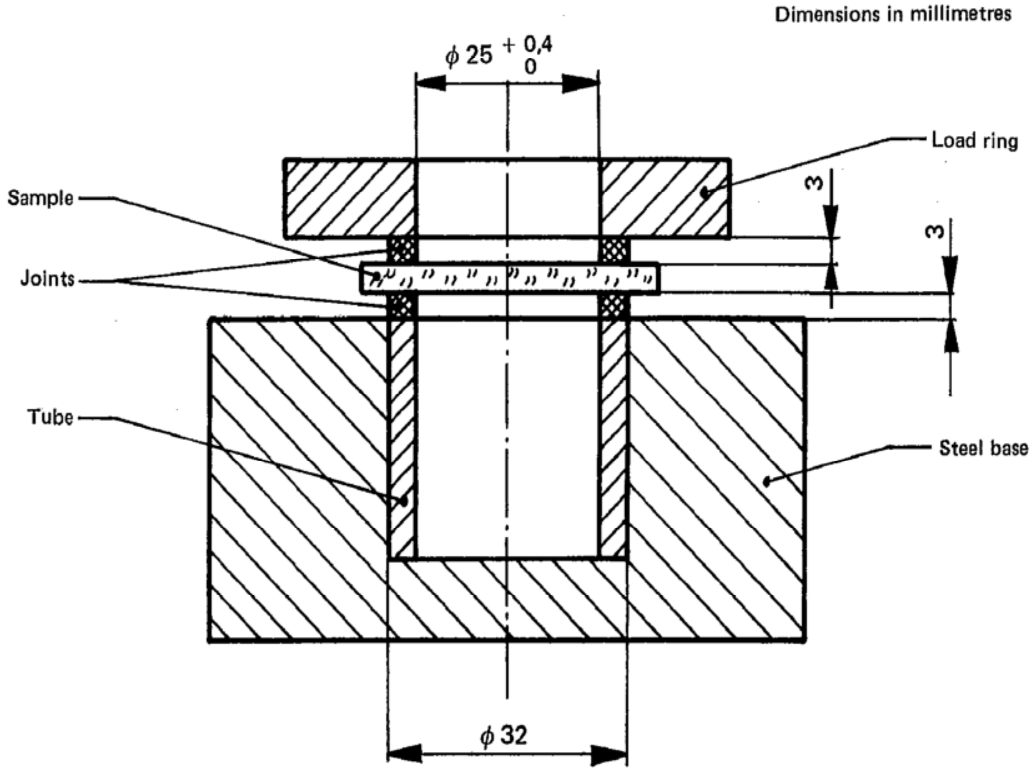
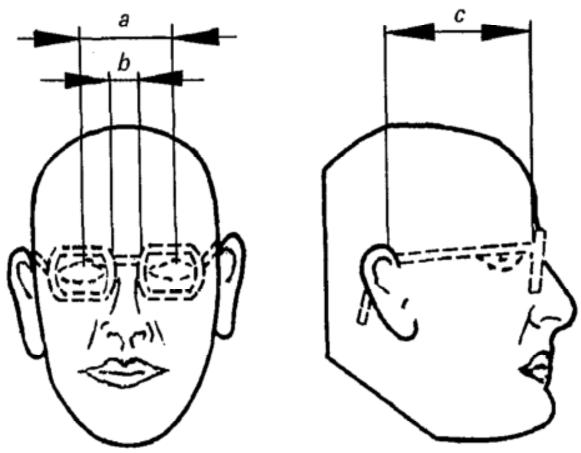


Figure 1 — Apparatus for test for robustness of unmounted oculars



$a =$ 66 to 68 mm

$b =$ 22 mm

$c =$ 100 to 115 mm

Figure 2 — Example of head-form for test for robustness of mounted oculars
(and the tests specified in clauses 12, 13 and 14)

3.2.2 Apparatus

A device allowing a 22 mm diameter steel ball of nominal mass 44 g to drop, from rest, from a height of $1,3 \ _{-0,03}^{\ 0}$ m, on to the specified area of the eye-protector.

3.2.3 Procedure

The eye-protector to be tested shall be placed on the head-form in the position corresponding to normal use.

A sheet of carbon paper on top of a sheet of white paper, each sheet being of the appropriate dimensions, shall be inserted between the eye-protector and the head-form. The head-form and eye-protector assembly shall be positioned underneath the test apparatus. The points of impact shall be :

- within 5 mm of the geometric centre of both right and left mounted oculars,
- on the nose bridge, and
- on the two hinges.

This test is considered as the reference test.

For routine production monitoring, an alternative test and support may be used, provided that they give equivalent results.

3.2.4 Temperature requirements for the test

The above test shall be carried out in the following conditions :

- heat the eye-protector to 55 ± 2 °C and maintain it at that temperature for 1 h before testing;
- cool the eye-protector to − 5 ± 2 °C, and maintain it at that temperature for 1 h before testing a second time.

For eye-protectors intended for use in lower temperatures, additional treatment shall be carried out by cooling the eye-protector to − 20 ± 2 °C, and maintaining it there for 4 h before testing.

The tests shall be conducted within 30 s after completing the temperature treatment.

4 Test for stability at elevated temperature

4.1 Apparatus

Oven, capable of maintaining a temperature of 55 ± 2 °C.

4.2 Procedure

Place the eye-protector, in the position corresponding to normal use, in the oven for 30 min at a temperature of 55 ± 2 °C. Then remove it and allow to stabilize at 23 ± 3 °C for a minimum of 30 min. Then submit the eye-protector to the optical test in accordance with the method given in clause 3 of ISO 4854.

5 Test for resistance to ultraviolet radiation

Expose the ocular to be tested for 100 h to radiation from a fused-silica envelope high-pressure xenon lamp of 450 W at a distance of 300 mm. Incident radiation shall be substantially normal to the surface of the ocular.

NOTE — It is possible, if necessary, to reduce the time exposure and the distance to the ocular; for example, 50 h at 200 mm.

6 Test for ignition

6.1 Industrial protectors

6.1.1 Purpose of test

This test is intended to establish whether the test samples ignite or continue to glow.

6.1.2 Number and nature of test samples

Five complete eye-protectors shall be tested.

6.1.3 Apparatus

6.1.3.1 Gas welding rod, made of steel; 300 mm long and 6 mm in diameter, with flat end faces.

6.1.3.2 Heat source.

6.1.3.3 Thermocouple and temperature-indicating device.

6.1.4 Procedure

Heat the gas welding rod over a length of at least 50 mm to a temperature of 650 ± 10 °C. Measure the temperature of the rod by means of the thermocouple attached at a distance of 20 mm from the heated end of the rod. Press the heated face of the rod (positioned vertically) against the surface of the test sample (the contact force being equal to the weight of the rod) for a period of 5 s, and then remove it.

Carry out the test on all parts of the eye-protector.

Carry out a visual inspection during the test in order to establish whether the test samples ignite or continue to glow.

6.2 Eye-protectors used by workers solely for the attenuation of daylight

6.2.1 Purpose of test

This test is intended to assess eye-protectors for ignition properties.

6.2.2 Procedure

Place the complete eye-protector, or its components, into a preheated oven set to 200 ± 5 °C, for 15 ± 1 min. When the sample is removed, note whether it has burned during the test period.

The volume of the sample should not exceed 10 % of the oven volume.

The oven should be purged with air between tests.

7 Test for resistance to corrosion

Determine the resistance to corrosion of frames, side-shields or metal components by first removing all adhering matter, particularly oil and grease, then immersing the metal parts in a boiling aqueous 10 % (*m*/*m*) solution of sodium chloride for 15 min. On removal from this solution, immerse the metal parts immediately in a 10 % (*m*/*m*) aqueous solution of sodium chloride at room temperature for 15 min. After removal from this solution and without wiping off the adhering liquid, leave to dry for 24 h at room temperature. Then rinse in lukewarm water and leave to dry before inspecting.

8 Test for suitability for disinfection

Disinfect each eye-protector by immersion in a disinfectant solution, for example a 0,1 % solution of dodecyl-*di*(aminoethyl) glycine hydrochloride in tap water, for 10 min. Unless it is required to remove substantial deposits, no preliminary washing is necessary, nor is any rinsing needed.

9 Test for resistance to high-speed particles

In the light of present knowledge, it is believed that the tests using steel balls described in this clause provide the most satisfactory control of impact resistance of eye-protectors. Should specific hazards be identified at some future time against which eye-protectors to present standards are found to be unsuitable, the establishment of other test requirements may be necessary.

9.1 Apparatus

9.1.1 Head-form

The head-form shall be made of cast aluminium. The dimensions shall conform to those of the appropriate national head-form of which figure 3 shows an example.

9.1.2 Propulsion equipment

The apparatus shall be capable of imparting to a 6 mm steel ball known velocities up to 190 m/s.

NOTES

1 The apparatus consists fundamentally of a barrel or tube of sufficient length to ensure a constant exit velocity of the steel ball, with a breech or loading mechanism ensuring that the ball is in a given position in relation to the tube or barrel end, and of a spring or compressed gas to provide propulsion. The apparatus also includes a means of calibrating or measurement of the exit velocities; because of the velocities and distances involved, a timing indicator, recording in multiples of 10 μs, is required.

The measurement of velocities should be made as near as possible to the point of impact and in any case not further than 250 mm from it. The end of the barrel or tube should be protected against ricochets. The area surrounding the test specimen, the head-form and the barrel or tube should be enclosed.

2 The tube length is determined by its ability to produce an almost constant velocity of the steel ball in the final stages of its travel, i.e. when it passes through the timing device and is in flight to the item under test. Achievement of this requirement depends not only upon the air pressure or force of the spring but also upon the length of the tube and the fit of the ball inside the tube. Accordingly, each apparatus may have different characteristics and it is impossible to give precise requirements as to the length of the barrel and fit of the ball in the bore.

3 The timing device shall have a degree of accuracy not less than that specified; the following two methods are recommended :

- an electronic timer operated by photoelectric cells through amplifiers;
- a cathode ray oscilloscope actuated by detector coils located on the tube.

The accuracy of the timing device depends upon the spacing between sensing elements and the required accuracy for measurements of the ball velocity. Present indications are that the spacing between the sensing elements ought not to exceed 150 mm; with this spacing and the highest velocity contemplated, the accuracy of the timing device should be fixed so as to allow for variations of other factors while still keeping the velocity within the limits stipulated.

Dimensions in millimetres

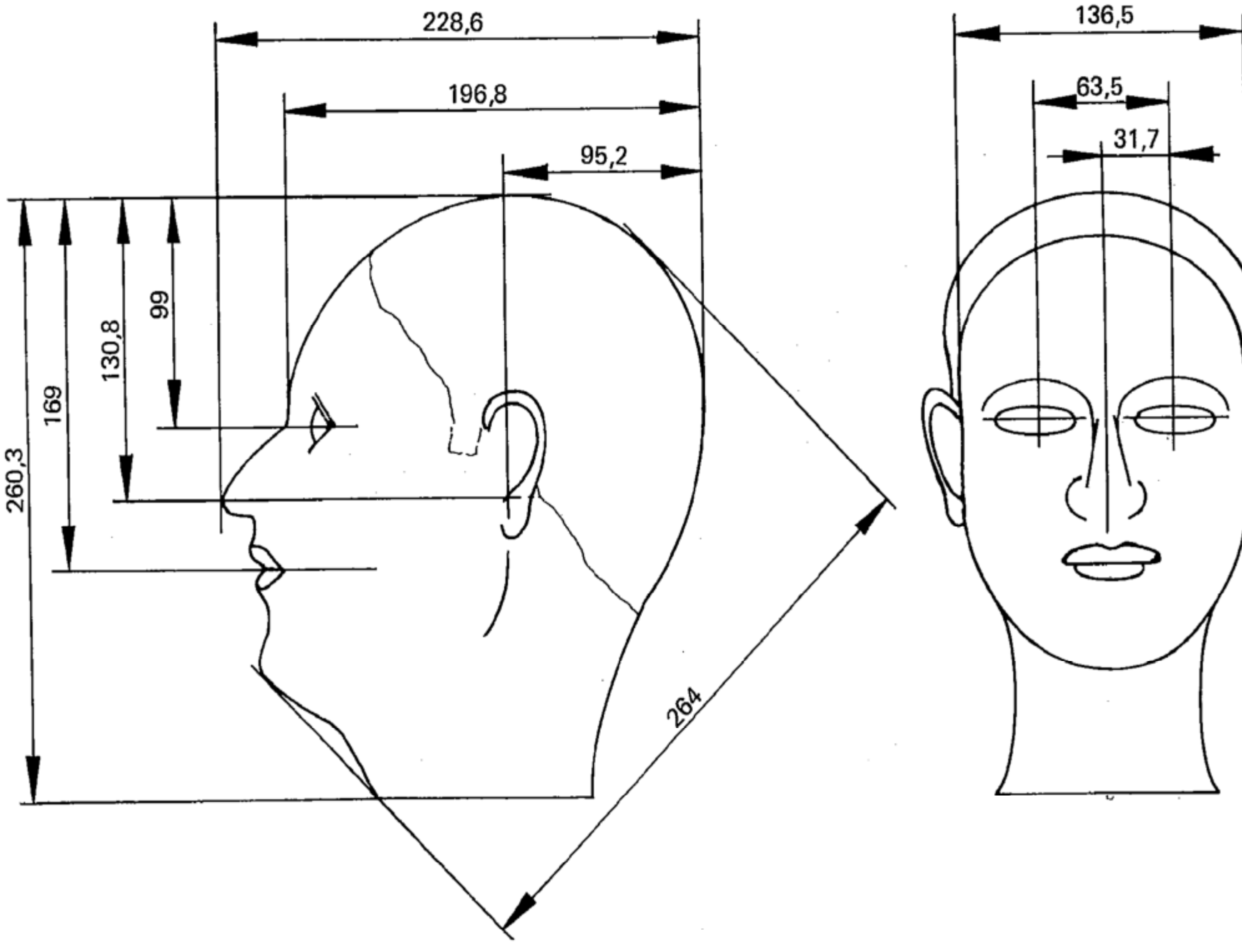


Figure 3 — Example of head-form for test for resistance to high-speed particles

9.2 Procedure

Place the eye-protector to be tested on the head-form in the position corresponding to normal use and with the tension of the headband adjusted according to the manufacturer's instructions.

Insert a sheet of carbon paper on top of a sheet of white paper, each sheet being of the appropriate dimensions, between the eye-protector and the head-form. Then position the eye-protector/head-form assembly in front of the propulsion equipment, the point of impact being not more than 100 mm from, and in line with, the muzzle of the tube.

Project the steel ball at the selected speed on to the centre of each ocular in the case of a two-ocular eye-protector, or, in the case of a one-ocular eye-protector, onto two tests points 33 mm from the vertical midline of the eye-protector on the horizontal line passing through the centre between the top and bottom of the ocular. The direction of the impact shall be substantially normal to the surface of the eye-protector.

10 Test for non-adherence of molten metal

10.1 Apparatus

The test apparatus, shown in figure 4, consists of a spring-loaded piston fitted with an ejector head dished in the centre to take the molten metal. A fixed platform is mounted above the ejector head and has a central opening large enough to permit the charge of molten metal to go through it.

The energy of the ejection spring and the position of the fixed platform shall be such that, on ejection, the metal charge is projected upwards to a nominal distance of 250 mm above the level of the ocular.

10.2 Procedure

Place the eye-protector above the opening in such a way that its ocular is immediately above the centre of the ejector head.

Load the ejector head, which shall have been pre-heated to reduce cooling of the molten metal, with a silica crucible containing 100 g of grey iron at a temperature of 1 450 ± 20 °C. Release the pedal : the spring drives the head vertically upwards until it strikes the stop platform and the molten metal is projected against the ocular.

Dimensions in millimetres

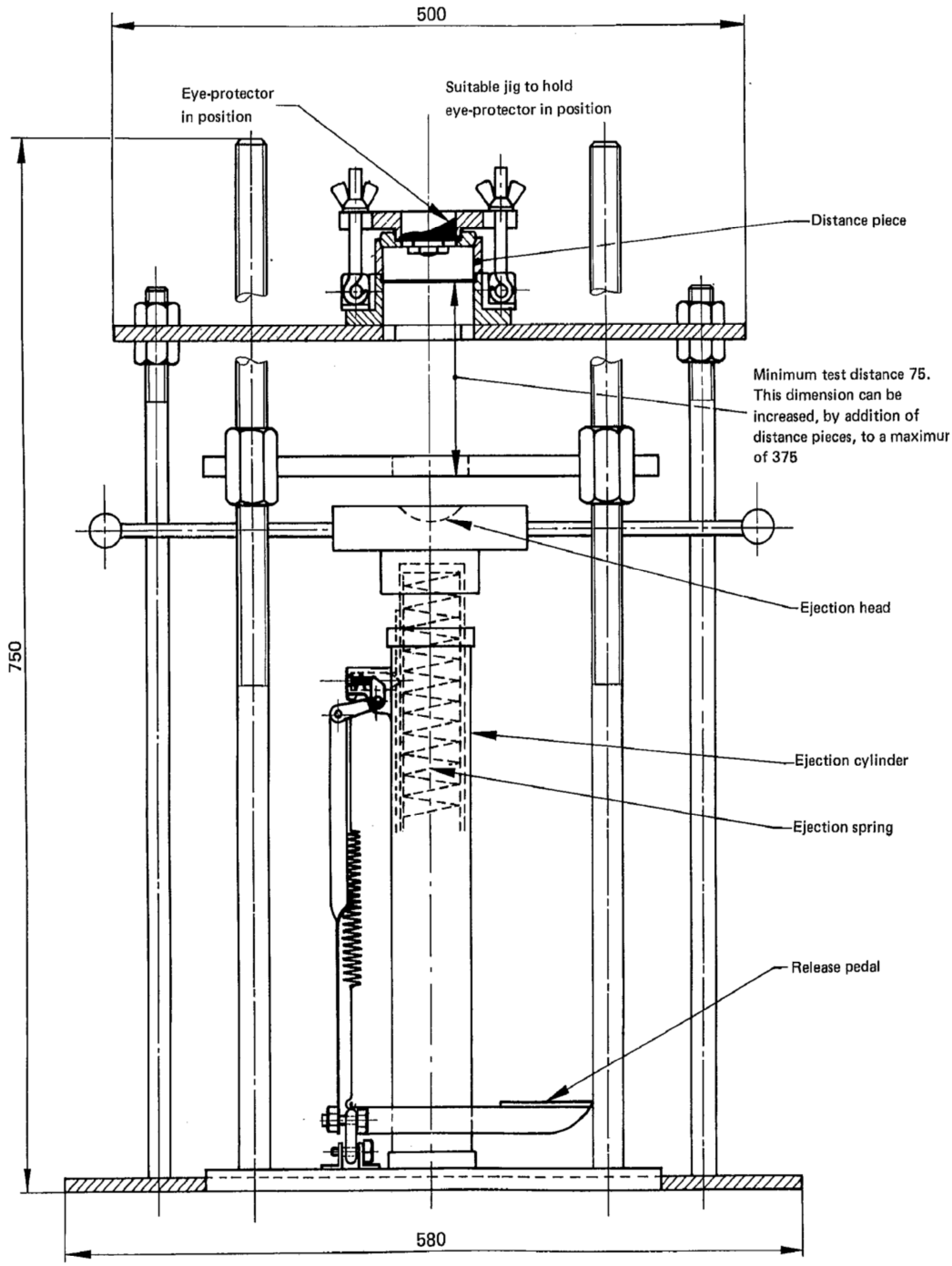


Figure 4 — Apparatus for testing for non-adherence of molten metal

11 Test for resistance to penetration of hot solids

11.1 Apparatus

The test apparatus, shown in figure 5, consists of a metal cylinder shaped to hold the test material and to take a funnel of heat-insulating material shaped to centre a steel ball on the test specimen.

11.2 Procedure

Place the test specimen in the cylinder. Preheat a 6,5 mm diameter steel ball to about 1 030 °C in a furnace, withdraw the ball from the furnace, and drop it as quickly as possible into the funnel, where it comes into contact with the test specimen at a temperature of about 900 °C.

Observe the underside of the cylinder and, if the ball drops, indicating complete penetration, record the time it has taken to penetrate.

12 Test for proof against chemical droplets

12.1 Apparatus

12.1.1 Head-form, as described in 3.2.1 (figure 2). The ocular area shall be covered with a double thickness of absorbent lint the mass per unit area of which is approximately 185 g/m².

12.1.2 Hand atomizer, capable of producing fine droplets (not mist).

12.1.3 Test paper : white blotting paper 180 mm × 100 mm approximately, dipped in a 0,1 mol/l solution of sodium carbonate. This paper shall be placed over the lint.

12.1.4 Detecting solution, prepared by dissolving 5 g of phenolphthalein in 500 ml of methanol and adding 500 ml of water, stirring constantly (filter if a precipitate forms), to obtain 1 litre.

Dimensions in millimetres

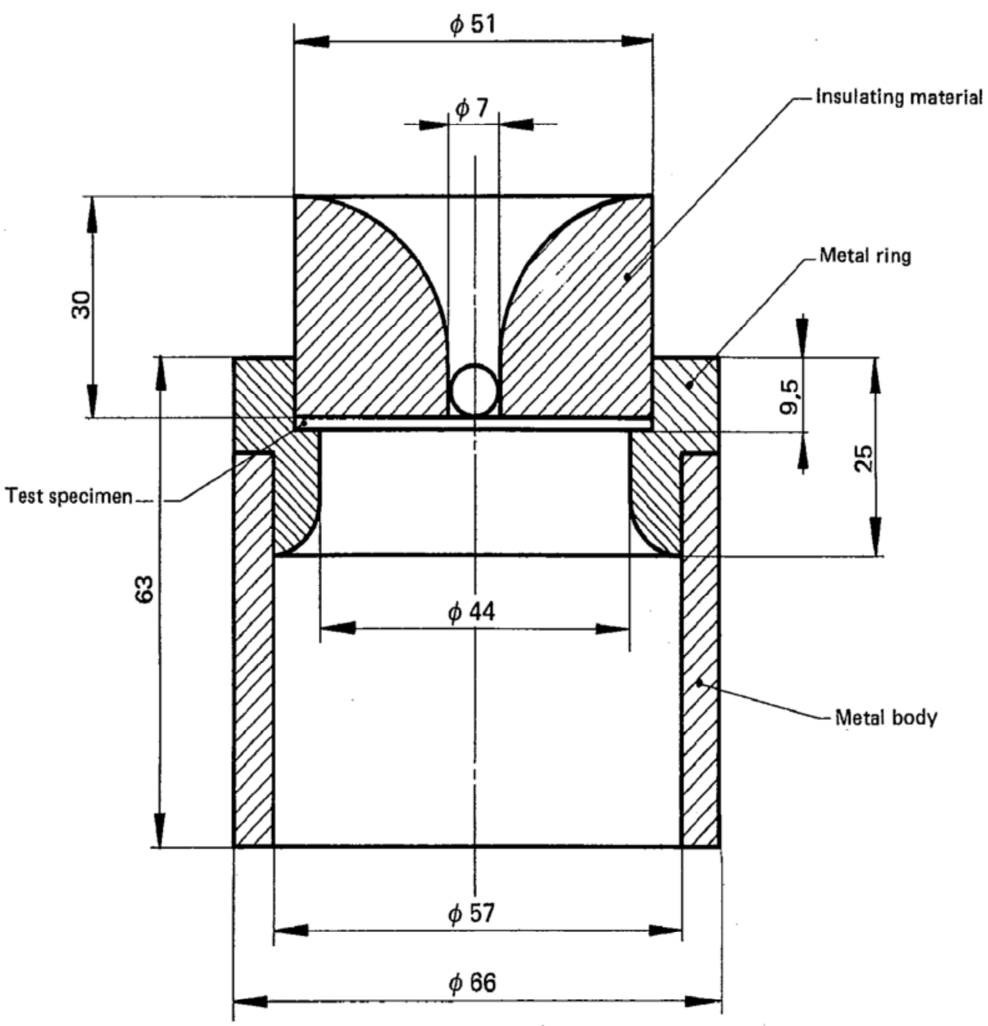


Figure 5 — Apparatus for testing resistance to penetration of hot solids

12.2 Procedure

Mount the eye-protector normally and place in a vertical plane on the head-form, covering the test paper; adjust the headband to the tension recommended by the manufacturer, and spray the assembly with the detector solution. Carry out the spraying at an approximate rate of 20 to 30 ml/min, holding the atomizer about 600 mm from the head-form. The period of spraying shall be about 10 s; during this time, spray the head-form from all directions.

For safety reasons, it is recommended that the test be carried out under a hood.

12.3 Assessment of results

If the detecting solution penetrates the eye-protectors, a crimson coloration will instantly develop on the test paper. No account need be taken of crimson coloration in the immediate proximity of the edges, provided that it does not develop more than 6 mm inside the eye-protector.

13 Test for protection against dust

13.1 Apparatus

The test apparatus is shown in figure 6.

13.1.1 Dust-chamber, glass-fronted, with internal dimensions 560 mm × 560 mm × 560 mm, with a hopper-shaped bottom and a tightly sealed, hinged lid. To the bottom of the inverted hopper is connected an air-blower capable of delivering approximately 2,8 m^3/min at a pressure of 2 255,5 Pa. A suitable agitator, capable of inducing swirling in the air stream from the blower, should be arranged immediately above the air inlet. The dust-chamber outlet is connected to the air blower inlet.

13.1.2 Test dust : 1 000 g of pulverized coal shall be placed inside the dust-chamber; the coal dust shall have the following grain size :

Nominal mesh dimension of sieve (ISO 565)	Percentage pass (mass/mass)
250 µm	95
125 µm	85
90 µm	40

13.1.3 Head-form, as described in 3.2.1 (see figure 2). It shall be covered with a double thickness of absorbent lint the approximate mass per unit area of which is 185 g/m^2. This lint shall be covered by a sheet of moist white paper on which have been marked in pencil two circles about 57 mm in diameter, the horizontal distance between centres being 66 mm (representing the ocular areas).

13.1.4 Photoelectric reflectometer, for the measurement of quantities pertaining to reflection. The apparatus consists of an interference filter for the wavelength λ = 546 nm, a lens at the focus of which the mercury lamp is placed, and a radiation receiver (for example, photovoltaic cell, photodiode). The experimental mounting is shown in figure 7.

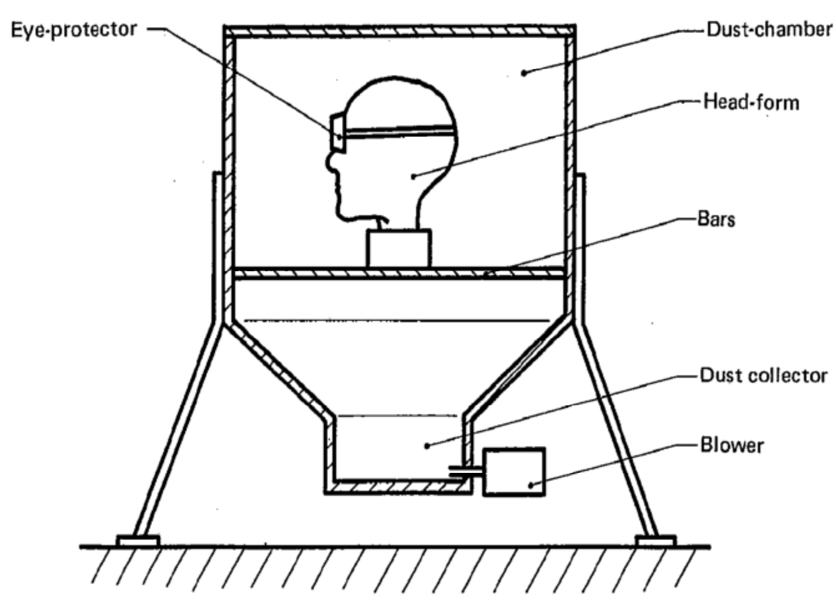


Figure 6 — Apparatus for test for protection against dust

Dimensions in millimetres

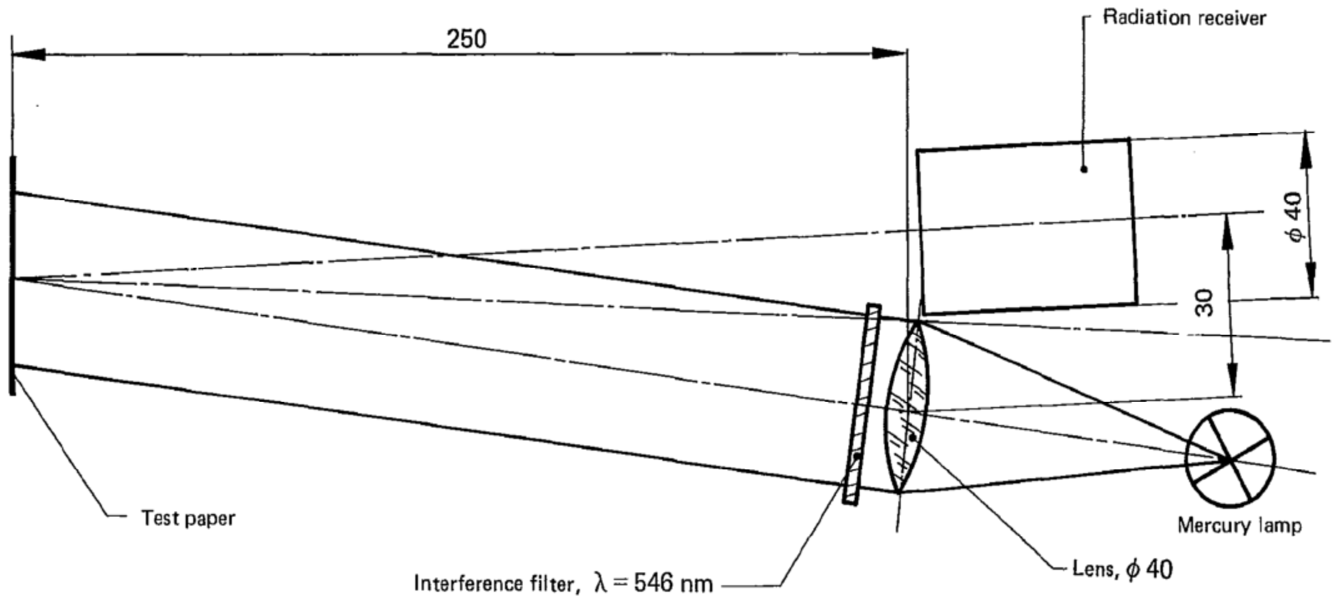


Figure 7 — Photoelectric reflectometer

13.2 Procedure

Before placing the eye-protector on the head-form, determine the reflectance of the unexposed moist test paper within the two circular areas. For this purpose, place the experimental mounting as shown in figure 7 at a distance of 250 mm from the test paper.

Place the assembled eye-protector and head-form in the dust-chamber and fasten the lid. Operate the blower for 1 min, switch off and keep the chamber closed until the dust has settled. Carefully remove the exposed moist test paper and remeasure the reflectance of the two circular areas. Finally, calculate the ratio of the mean reflectance after exposure to the mean reflectance before exposure.

14 Test for protection against gas

14.1 Apparatus

14.1.1 Head-form, as described in 3.2.1 (see figure 2).

14.1.2 Gas-chamber : a gas-tight, glass-fronted enclosure, with internal dimensions 560 mm × 560 mm × 560 mm and a tightly sealing, hinged lid. The gas chamber shall be ventilated by means of a small blower with a capacity of about 1,4 cm^3/s and a vent pipe leading to a fume chamber or to the outside atmosphere.

Gas supply : any convenient means of generating ammonia gas, for example by blowing air through a washing bottle containing a concentrated solution of ammonia (ϱ 0,88 g/ml approximately) or by using a gas cylinder of ammonia. The outlet from the generator or cylinder is connected to the gas chamber.

14.1.3 Test paper : white blotting paper, free from sulphur compounds, 180 mm × 100 mm, dipped in 1 % mercury(I) nitrate solution at the time of test.

14.1.4 Mercury(I) nitrate solution, prepared by dissolving 10 g of finely ground mercury(I) nitrate in 100 ml of distilled water to which 1 ml of concentrated nitric acid (ϱ 1,42 g/ml) has been added.

14.2 Procedure

Mount the eye-protector on the head-form symmetrically over the test paper, which itself rests on absorbent lint of mass per unit area about 185 g/m^2 arranged in a double thickness so as to cover the ocular area. Place the assembly in the gas-chamber with a control strip of test paper placed on the floor of the chamber. Then open the gas generator slightly, the vent being slightly open, and fill the gas-chamber with ammonia gas at room temperature. Close the vent and leave the test specimen in the gas for 5 min. After the chamber has been cleared of the gas, remove the eye-protector and examine the test paper.

14.3 Assessment of results

If any trace of gas has penetrated the eye-protector, the treated test paper will turn brown.

No account need be taken of any darkening in the immediate vicinity of the edges, provided that it does not develop further in than a distance of 6 mm inside the eye-protector.