

Indian Standard

SPECIFICATION FOR NON-METAL HELMET
FOR FIREMEN AND CIVIL DEFENCE
PERSONNEL

(Second Revision)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

*Indian Standard*SPECIFICATION FOR NON-METAL HELMET
FOR FIREMEN AND CIVIL DEFENCE
PERSONNEL*(Second Revision)*

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(Continued on page 14)

Indian Standard

SPECIFICATION FOR NON-METAL HELMET FOR FIREMEN AND CIVIL DEFENCE PERSONNEL

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 23 May 1983, after the draft finalized by the Fire Fighting Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Helmet is one of the most important items of personal protective equipment used by the industrial workers for protecting against head injuries which may be caused by falling objects, and by other hazards commonly met with in an industrial activity; by fire fighting personnel for protection against fire hazards and by scooter and motorcycle riders for protection against the hazards connected with driving on roads. Besides these, many other operations may require suitably designed helmets to be worn by the persons connected with such operations for their safety. This standard covers requirements of firemen's helmet. This standard was first published in 1964 and revised in 1969. This revision has been prepared so as to align it with other Indian Standards formulated on helmets and also to cover requirements of Civil Defence purposes.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard lays down the requirements regarding materials, construction, workmanship and finish, weight and performance of helmets for the firemen and civil defence personnel.

*Rules for rounding off numerical values (revised).

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Brim — The rim surrounding the shell.

2.2 Clearance — Distance between the vertex of the head and vertical point above the vertex in the interior of the shell.

2.3 Drawlace — The cord used in the cradle to regulate the fitting of the helmet.

2.4 Inner Cushioning — Material to improve wearing comfort.

2.5 Neck Protector — Additional part of the helmet to protect the neck.

2.6 Protective Helmet — Headwear primarily intended to protect against a blow to the wear's head.

2.7 Protective Padding — Material provided to absorb impact energy which in addition provides thermal insulation.

2.8 Retention System — The complete assembly by means of which the helmet is maintained in position on the head which includes, headband, chin strap and cradle.

2.8.1 Headband — Part of retention system in contact with and surrounding head, the plane of lower margin of headband shall correspond to reference line of the headform (see IS : 7692-1975*).

2.8.2 Anti-concussion Tapes — Supporting strap which form the cradle along with the drawlace, and in addition absorb impact energy.

2.8.3 Cradle — The adjustable assembly comprising of anti-concussion tape and draw-lace for affording adequate clearance for ventilation and to ensure proper fitment. This also absorbs impact energy.

2.9 Shell — The hard, smoothly finished material that provides the general outer form of helmet.

2.10 Visor — A transparent screen for the protection of eyes and face which shall allow a clear field of vision to wearer.

2.11 Wearing Height — Vertical distance from the lower edge of the headband to the highest point of the head or headform.

*Specification for wooden headform for testing of helmet.

3. MATERIALS

3.1 Shell — The shell of the helmet shall be made of non-metallic materials so as to meet the test requirements given in this standard.

3.2 Protective Padding — It shall be of expanded polystyrene or materials of similar properties.

3.3 Retention System — The material for the headband, chin strap, and cradle shall be sweat-resistant, non-irritant and shall not cause skin disease. The material for chin strap and cradle shall be of polyethylene or nylon or similar material.

3.4 Neck Protector — It shall be of leather cloth conforming to IS : 6153-1971* or PVC coated fabric conforming to IS : 3322-1965† or leather conforming to IS : 3840-1979‡.

4. SIZES

4.1 Helmets shall be of the size having circumstances of inside headband as 530, 540, 550, 560, 570, 580, 590, 600, 610 and 620 mm. A tolerance of 3 mm for the size of the helmet shall be permitted.

NOTE — The size of the helmet shall be measured either with a fixed plug gauge or an expanding gauge which shall be made of metal.

5. CONSTRUCTION REQUIREMENT

5.1 General — The construction of the helmet shall be essentially in the form of hard outer shell containing the necessary additional means of absorbing impact energy like protective padding and retention system.

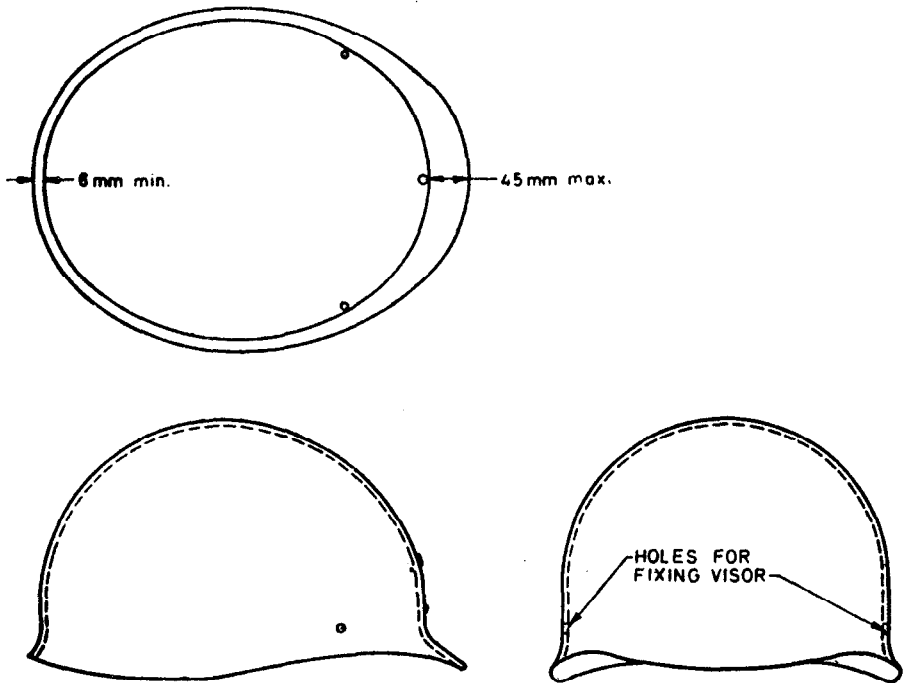
5.2 Shell — The shell of the helmet shall have smoothly finished surface without any sharp edges and shall conform to shape given in Fig. 1. There shall be no metallic components passing through the shell except for fixing visor. Protective padding material of not less than 8 mm thick shall cover the whole inner surface of the shell to within 15 to 25 mm of the plane of anchorage of retention system to the shell. No gaps, if there are any, in the protective padding material shall be of greater width than 5 mm and no part of the protective padding shall be readily detachable.

5.2.1 Brim — The brim shall be an integral part of the shell and shall be continuous, around the dome. The width of the brim shall be as indicated in Fig. 1.

*Specification for protective leather clothing.

†Specification for PVC-coated fabrics for foul weather clothing.

‡Specification for lining leather (*first revision*).



NOTE — Holes for fixing visor shall be made if the visor is provided.

FIG. 1 TYPICAL SHAPE OF SHELL

5.3 Retention stem

5.3.1. Headband — Headband shall not be less than 30 mm in width and shall be fixed along with the corrugated padding to the shell. The headband shall be well-cushioned from the shell by means of not less than 5 mm thick continuous corrugated sponge rubber fixed around the head.

5.3.2 Chinstrap — It shall be anchored to the shell. The chinstrap shall be at least 20 mm wide and shall be permanently fitted with a fastening device to adjust and maintain tension.

5.3.3 Cradle — The cradle shall be formed by anchoring anti-concussion tapes at eight points and shall be adjustable. The anti-concussion tapes shall be attached to the headband at equal spacing. The width of the tapes shall not be less than 20 mm. The cradle shall ensure a clearance of at least 30 mm between the top of the wearer's head and the inside shell when measured as given in 5.3.3.1. No comfort padding shall be provided under the cradle.

5.3.3.1 Mount the helmet on a headform (see IS : 7692-1975*) corresponding to the size of the headband marked on the helmet in a position similar to that which it would occupy on man's head. Apply a load of 120 N to the top of the helmet. Measure the clearance by means of a rod, having diameter more than 10 mm, inserted through the hole drilled in the vertical axis of the headform.

5.3.4 Neck Protector — The neck protector shall be not less than 150 mm in depth from lower edge of the headband and not less than 360 mm wide.

5.3.5 Visor — The requirements in regard to visor if required shall conform to IS : 9995-1981†. The holes for fixing arrangements shall be not less than 5 mm.

6. WORKMANSHIP AND FINISH

6.1 All external surfaces and edges shall be smooth and rounded and there shall be no metallic parts or other rigid projections on the inside of the helmet.

6.2 The colour of the helmet shall be inherent white or lemon yellow.

7. MASS

7.1 Mass of the complete helmet excluding visor may not exceed 800 g and if it exceeds, the mass to the nearest 30 g shall be marked.

8. SAMPLING AND CRITERIA FOR CONFORMITY

8.1 The method of sampling and criteria for conformity shall be as specified in IS : 9695-1980‡.

9. PERFORMANCE REQUIREMENTS

9.1 Shock Absorption Test — Helmets shall be tested for shock absorption by the method described in Appendix A within 1 minute after subjecting them to conditions specified in (a) or (b) or (c) given below:

- a) A temperature of $65 \pm 2^\circ\text{C}$ for 4 hours in an oven,
- b) A temperature of $10 \pm 2^\circ\text{C}$ for 4 hours in a refrigerator, and
- c) Water flowing over the whole outer surface of the shell for 4 hours at the rate of 1 litre per minute at room temperature.

*Specification for wooden headforms for testing helmets.

†Specification for visor for non-metal police and firemen's helmets.

‡Methods of sampling of helmet.

9.1.1 No single helmet shall, however, be subjected to more than one of these conditions and neither of the maximum values of the transmitted force obtained shall exceed 20 kN (2 000 kgf) and shell shall remain intact with no cracks extending as far as the edge and through the thickness of the shell.

9.2 Penetration Resistance — The helmet shall be subjected to the following tests for resistance against penetration within one minute after subjecting to the conditions specified in 9.1 which has given worst result in shock absorption:

- a) *Plate Test* — When tested in accordance with the method described in Appendix B, no integral part of the helmet shall fail or stretch permitting the helmet to be forced down over the headform. The shell shall not be dented or pierced through to touch the wooden headform or the cradle.
- b) *Plumb Bob Test* — When tested by the method described in Appendix B, no integral part of the helmet shall fail or stretch permitting the helmet to be forced down over the headform. The static measurement of the depth of penetration or dent shall not exceed 10 mm.

9.3 Strength of Retention System — Helmet shall be tested for their retention system by the method given in Appendix C and it shall not fail under the maximum loading of 0.5 kN (50 kgf) and the total extension as measured between the pre-load of 0.25 kN (25 kgf) and the maximum load of 0.5 kN (50 kgf), shall not exceed 25 mm.

9.4 Electrical Resistance — Helmet when tested by the method prescribed in Appendix D, the helmets shall not show a leakage of current in excess of 3 mA.

9.5 Water Absorption Test — Helmets shall be tested for water absorption in accordance with the method specified in Appendix E, they shall not absorb water more than 5 percent of their mass.

9.6 Flammability Resistance — When tested by the method described in Appendix F, there shall be no flaming or visible evidence of flame penetration to the inside of the helmet.

10. MARKING

10.1 Each helmet shall be clearly and indelibly marked with the following information:

- a) Manufacturer's name or trade-mark,
- b) Size with colour,

- c) Year of manufacture, and
- d) With or without visor.

10.1.1 The product may also be marked with Standard mark.

10.2 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

APPENDIX A

(Clause 91)

SHOCK ABSORPTION TEST

A-1. APPARATUS

A-1.1 Wooden Headform — conforming to IS : 7692-1975*.

A-1.2 A Gauge and Recording Apparatus for Measuring Force — The gauge and the associated recording apparatus shall have proper time constant to be able to measure the impact loading up to 40 kN (4 000 kgf) independent of the time of application of the force and a slow application of the load required for its calibration. The gauge shall have a minimum stiffness of 500 kN/mm (50 000 kgf/mm). The headform shall be mounted on the gauge so that its vertical axis coincides with the vertical axis of the gauge.

A-1.3 Accuracy — The overall error of the whole set up including the load measuring and recording system shall be not more than 10 percent.

A-1.4 Concrete or similar monolithic block having a minimum height of 1 m, length 1 m and width 0.6 m, and mass 1 tonne, shall be used to support the gauge and headform the block shall be bedded on dry sand on a solid floor.

A-1.5 A striker shall be in the form of a rectangular block of wood weighing $5_{-0}^{+0.1}$ kg and having a horizontal striking face 180 mm square.

The striker shall slide freely and without oscillation down two vertical guide wires so positioned that the centre of gravity of the striker lies on the vertical axis of the gauge and both lie in the plane of the guide wires.

*Wooden headform for testing of helmets.

A-2. METHOD

A-2.1 The helmet shall be placed on the headform. The striker shall be raised to a clear height of $2.5 \text{ m} \pm 5 \text{ mm}$ above the point of contact with the helmet and allowed to fall freely. A photographic or other high speed record of the force transmitted during impact shall be made.

A P P E N D I X B

(Clause 9.2)

METHOD OF TESTING PENETRATION RESISTANCE

B-1. PLATE TEST

B-1.1 Mount the helmet on wooden headform (*see* IS : 7692-1975*) and then drop a steel plate 300 mm square and 6 mm in thickness with its plane vertical from a clear height of 3.0 m so that one side of the square strikes the top of the crown of the helmet. Examine the helmet for denting or piercing, failure of any integral parts, etc.

B-2. PLUMB-BOB TEST

B-2.1 Mount the helmet on the headform and drop freely a steel striker weighing $3 \pm 0.05 \text{ kg}$, of minimum height 40 mm and having at its lower end a conical point with an included angle of $60 \pm 0.5^\circ$ and a maximum tip radius of 0.5 mm, from a clear height of 1 metre to strike the top of the crown of helmet. Examine the helmet for piercing, denting or failure of any integral parts.

A P P E N D I X C

(Clause 9.3)

TEST FOR STRENGTH OF RETENTION SYSTEM

C-1. PROCEDURE

C-1.1 The helmet is placed on the appropriate headform which the chin strap fastened cover a device approximating to the shape of the bony structure of the lower jaw. This shall consist of two metal rollers each $12.5 \pm 0.5 \text{ mm}$ in diameter and at $76 \pm 0.5 \text{ mm}$ centres apart. The helmet

*Specification for wooden headform for testing of helmets,

shall be supported on the headform so that the points of attachment of the chin strap to the shell will be subjected to the same test as the strap itself.

C-1.2 After applying a preload of 0.25 kN (25 kgf) for not less than 30 seconds an additional load of 0.25 kN (25 kgf) shall be applied to the device retained by the chin strap at a uniform rate of 1 kN (100 kgf) per minute. After 2 minutes at the maximum load the elongation of the retention system is determined by measuring the vertical distance between reference point on the device and on top of the helmet shell, and comparing this distance with that obtained under preload at 30 seconds.

A P P E N D I X D (Clause 9.4)

METHOD OF TESTING ELECTRICAL RESISTANCE

D-1. PROCEDURE

D-1.1 The helmet to be tested after removal of neck protector shall be inverted and placed on a wire frame in a suitable container, that is, a tub or similar vessel. The container and the inverted helmet shall be filled with a solution of 6 g of sodium chloride per litre of water to within 12 mm of the junction of the brim and the dome, or, if the helmet is provided with holes in the crown near the brim to a depth of 12 mm below the holes. The helmet shall be allowed to remain in the solution for a period of 18 to 24 hours and the temperature of the solution shall be maintained at $27 \pm 2^\circ\text{C}$ during this period. An alternating voltage of 2 000 volts RMS at 50 Hz, to 60 Hz, and of approximately sine-wave form shall be applied for one minute between electrodes placed in the solution inside and outside the helmet respectively. If no electrical breakdown occurs the high voltage supply shall be disconnected and a milliammeter shall be connected in the circuit on the earth side of the electrode. The test voltage shall be raised slowly observing the ammeter reading until the applied voltage is 2 000 volts. In addition to the milliammeter an automatic tripping device may be used in the circuit.

A P P E N D I X E (Clause 9.5)

METHOD OF DETERMINATION OF WATER ABSORPTION

E-1. SAMPLES

E-1.1 The sample which have been used for shock absorption in condition 9.1(a) shall be used for carrying out this test.

E-2. PROCEDURE

E-2.1 Weigh the sample and immerse for 24 hours in water at a temperature of $27 \pm 2^\circ\text{C}$. Remove from the water, dry the surfaces by wiping and weigh again. Report the average gain in mass as a percentage.

A P P E N D I X F

(*Clause 9.6*)

METHOD FOR TESTING FLAMMABILITY RESISTANCE

F-1. PROCEDURE

F-1.1 The helmet shall be supported, crown uppermost, on a headform (see IS : 7692-1975*). A barthel burner conforming to the requirements given in F-2, is to be brought into contact with outer surface of the helmet with the flame at right angles at a point of 12 cm below the crown, measured externally, whilst it is rotated steadily through one complete revolution at a speed of 2 rev/min.

F-2. BURNER WITH ACCESSORIES

F-2.1 The test shall be carried out with barthel burner conforming to A-1 of IS : 4355-1967†.

F-2.2 The following accessories shall be used with the burner:

- a) Reservoir,
- b) Connecting tube of polyethylene or soft rubber,
- c) Absolute alcohol (ethanol),
- d) Bare copper wire 0.71 mm diameter having a free length of not less than 100 mm, and
- e) Stand to help the reservoir.

F-2.3 The absolute alcohol shall be filled in the reservoir and the tube, air bubbles entrapped in the tube shall be removed by pressing the tube several times. Cotton waste soaked in spirit shall be kept in the cup on

*Specification for wooden headform for testing of helmets.

†Specification for fire-resistant brattice cloth.

the burner and lighted. After a few minutes when the burner is sufficiently heated the regulator of burner shall be turned to allow the spirit to flow in the form of vapour.

F-2.4 Burner shall be operated with the valve so as to get a flame height of 150 mm. Level of the fuel shall be 760 ± 75 mm above the base of the burner. Satisfactory operation of burner shall be checked by inserting in the flame the bare copper wire in position normally occupied by lower edge of the test piece, that is, 50 mm above the burner and reaching farther edge of the flame. The wire should not take more than 6 seconds to melt.

(Continued from page 2)

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TO

IS:2745-1983 SPECIFICATION FOR NON-METAL HELMET
FOR FIREMEN AND CIVIL DEFENCE PERSONNEL

(Second Revision)

(Page 4, clause 2.3) - Delete.

*(Page 4, clause 2.8.2, line 2) - Delete the words
'along with..... energy'.*

*(Page 4, clause 2.8.3, lines 1 and 2) - Substitute
the following for the words 'The adjustable assembly
..... draw-lace':*

*'The fixed or adjustable assembly comprising of anti-
concussion tapes'*

*(Page 5, clause 4.1, first sentence) - Substitute
'circumference' for 'circumstances'.*

*(Page 6, clause 5.3.3, first and second sentences) -
Substitute the following for the existing sentences:*

*'The headband shall be fitted with anti-concussion
tapes secured at atleast four anchoring points and
forming a cradle.'*

*(Page 10, clause C-1.1, first sentence) -
Substitute 'with' for 'which' and 'over' for 'cover'.*

(EDC 22)

TO

IS:2745-1983 SPECIFICATION FOR NON-METAL HELMET FOR
FIREMEN AND CIVIL DEFENCE PERSONNEL

(Second Revision)

[Page 7, clause 9.1(b)] - Substitute '-10 $\pm$ 2°C' for '10 $\pm$ 2°C'.

(Page 8, clause 9.1.1, line 2) - Substitute 'none' for 'neither'.

(Page 8, clause 9.4, line 1, clause 9.5, line 1, clause 9.6, line 3) - Add the word 'shell' after the word 'Helmet'.

(
(Page 12, clause E-2.1, line 1) - Add the words, 'full shell' after the word 'sample'.

(BDC 22)

AMENDMENT NO. 3 DECEMBER 2000
TO
IS 2745 : 1983 SPECIFICATION FOR NON-METAL
HELMET FOR FIREMAN AND CIVIL DEFENCE
PERSONNEL

(Second Revision)

(Page 5, clause 3.4) — Substitute the following for the existing one:

‘Neck Protector — It shall be of PVC coated Fabric or Leather as agreed to between the purchaser and the supplier.’

(Page 7, clause 5.3.4) — Add ‘if provided’ after ‘The neck protector’ in first line.

(Page 12, Appendix F) — Substitute the following Appendix F for the existing:

APPENDIX F

(Clause 9.6)

METHOD OF TESTING FLAMMABILITY RESISTANCE

F-1 SAMPLES

F-1.1 The samples for testing shall be selected as given in 8.1.

F-2 BURNER

F-2.1 Burner shall be operated with the valve so as to get a flame height of 150 mm. Satisfactory operation of burner shall be checked by inserting in the flame. The bare copper wire of 0.71 mm diameter having a free length of not less than 100 mm in position normally occupied by low edge of the test piece, that is, 50 mm above the burner and reaching farther edge of the flame. The wire should not take more than 6 seconds to melt.

F-3 PROCEDURE

F-3.1 The helmet shall be supported, crown upper most, on a head form (*see* IS 7692).

A burner conforming to the requirements given in F-2 is to be brought into contact with outer surface of the helmet with the flame at right angles at a point of 12 cm below the crown, measured externally, whilst it is rotated steadily through one complete revolution at a speed of 2 rev/min.

(CED 22)