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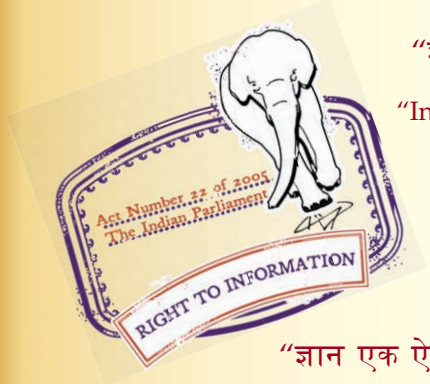
IS 2086 (1993): Carriers and bases used in rewirable type electric fuses for voltages upto 650V [ETD 39: Fuses]



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Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 2086 : 1993
(Reaffirmed 2004)

भारतीय मानक

650 वो. तक की वोल्टता के लिए पुनः तार संस्थापन प्रकार के बिजली के फ्यूजों में वाहक और आधार — विशिष्टि

(तीसरा पुनरीक्षण)

Indian Standard

CARRIERS AND BASES IN REWIRABLE TYPE ELECTRIC FUSES FOR VOLTAGES UP TO 650 V — SPECIFICATION

(*Third Revision*)

Second Reprint JUNE 2007
(Including Amendment No.1)

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May 1993

Price Group 7

FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Fuses Sectional Committee had been approved by the Electrotechnical Division Council.

Rewirable type electric fuses are being used extensively on systems where the voltage does not exceed 650 V. The breaking capacity of this type of fuses is limited and their use is therefore restricted to installations where the short-circuit levels do not exceed 4 000 A. For such installations rewirable type fuses are used alone or in combination with switches in composite units.

This standard was originally brought out in 1963. Prior to that the British Standard BS 3036 : 1958 'Specification for semi-enclosed electric fuses' had been recognized as the Indian Standard. The subsequent versions were aimed at updating the contents and to incorporate the latest thinking in the field.

Most often, the manufacturers of carriers and bases used in rewirable type electric fuses are different from fuse-element manufacturers. This standard is intended to provide guidance for fuse manufacturers as well as the users of rewirable fuses in establishing the optimum performance of such units.

It is widely understood that the behaviour of the fuse-wire is different when used in different carriers. It would, therefore, be essential for the fuse manufacturers, based on their test reports, to provide sufficient guidance on the right size of the fuse-wire to be used in the carrier for achieving the desired performance. For compliance with this standard, the design of the fuse shall be such as to ensure the fusing factor of the recommended fuse-wise.

The second revision of the standard also incorporated dimensions of fuse-carriers and fuse-bases of rewirable fuses, originally covered in a separate standard IS 8724 : 1978, with a view to cover dimensional and performance requirements in same standard. In this respect, the third revision superseded 8724 : 1978.

It was expected that the industry will changeover to the recommended dimensions in due course, to achieve convenience in use and overall economy. The present version takes into account the over 9 years of experience in implementing the earlier version and incorporates modified set of dimensions acceptable to a wider cross-section of industry.

Rewirable fuse-carriers and fuse-bases designed in accordance with the dimensional requirements of this version (Third Revision) standard alone do not automatically satisfy the performance requirements. Subject to the agreement between the manufacturer and the user, special tests may be carried out to determine the adequacy of level of performance when one make or design of fuse-carrier is used in combination with several other makes of designs of fuse-bases and *vice-versa*.

It is however to be noted, that for short-circuit levels greater than 4 kA, use of more dependable protective devices such as the HRC fuses or cartridge type fuses are recommended in place of rewirable fuses.

It may be mentioned that the Technical Committee responsible for this standard had indeed taken note of other designs of rewirable type fuses whose dimensions are different from the data sheets covered in the standard. These types which are distinct designs from the conventional 'porcelain' variety are part of a separate standard under preparation.

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, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 1 JULY 1997
TO
IS 2086 : 1993 CARRIERS AND BASES USED IN REWIRABLE TYPE ELECTRIC FUSES FOR VOLTAGES UP TO 650 V — SPECIFICATION

(Third Revision)

(*First cover page, Title*) — Insert 'Used' between the words 'BASES' and 'IN'.

(*Page* 4, *clause* 7.1) — Substitute the following for the existing clause:

'7.1 The dimensions of carriers and bases used in rewirable type electric fuses shall conform to Type A dimensions given in Annex A.'

(*Page* 4, *clauses* 7.2 *and* 7.3) — Delete.

(*Pages* 12 *and* 14, *Fig.* 5A *and* 6A) — Insert the following Note below both the figures:

'NOTE — Dimension '*a*' is to be measured from the point where the carrier surface touches the base surface in assembled condition.'

(ET 39)

1—88 BIS/ND/07

Indian Standard

CARRIERS AND BASES USED IN REWIRABLE TYPE ELECTRIC FUSES FOR VOLTAGES UP TO 650 V — SPECIFICATION

(Third Revision)

1 SCOPE

1.1 This standard covers performance requirements and tests as well as dimensions of carriers and bases used in rewirable type electric fuses having a rated current up to and including 100 A meant for alternating current systems of voltages not exceeding 650 V between lines.

1.2 The specification does not cover fuse-wire used in rewirable type fuses for which the provisions given in IS 9926 : 1981 shall apply.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard.:

IS No.	*Title*
2 : 1960	Rules for rounding off numerical values (*revised*)
4905 : 1968	Methods for random sampling
8724 : 1978	Dimensions for rewirable fuses up to 650 V
9926 : 1981	Specification for fuse-wire used in rewirable type electric fuses up to 650 volts. .

3 TERMINOLOGY

3.0 For the purpose of this standard the definitions given below shall apply.

3.1 Crazing

Hair-line cracks in the glaze of ceramic material.

3.2 Dunt

A hair-line fracture extending through the body, or the body and the glaze caused by strains set up in the process of manufacture of ceramic material.

3.3 Fuse

A device that, by the fusion of one or more of its specially designed and proportioned components, opens the circuit in which it is inserted when the current through it exceeds a given value for a sufficient time. The fuse comprises all the parts that form a complete device.

3.4 Rewirable Fuse

A fuse in which the fuse-element consists of a wire which may be replaced when necessary (*see* Fig. 1)

NOTE – The drawing is intended to illustrate the basic principle and does not purport to shown actual constructional details.

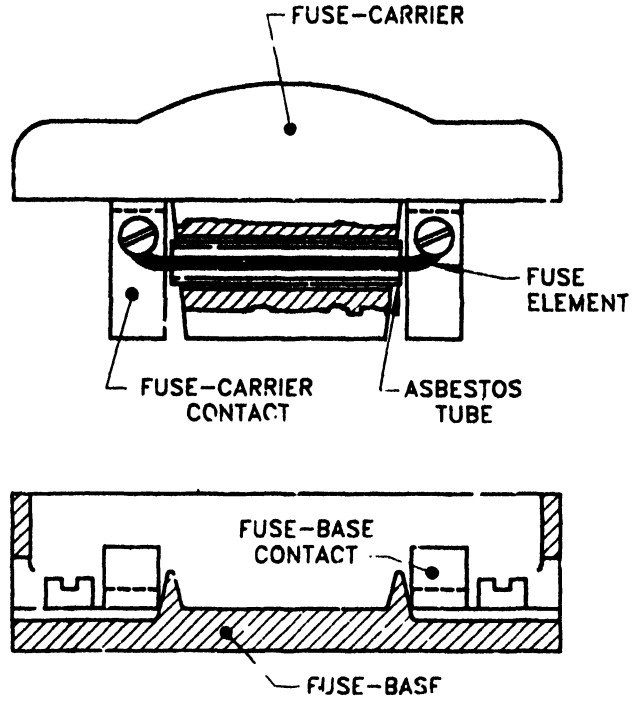


FIG. 1 TYPICAL COMPONENT PARTS OF REWIRABLE FUSES

3.5 Fuse-Carrier

The removable portion of the fuse for carrying the fuse-element, fitted with fuse contacts.

3.6 Fuse-Base

The fixed part of the fuse provided with terminals for connection to the circuit and which is suitable for the reception of the fuse-carrier.

3.7 Fuse-Carrier Contacts

The contacts which are fitted to the fuse-carrier, suitable for engaging with the contacts in the fuse-base and capable of having a fuse-element attached to it.

3.8 Fuse-Base Contact

A conducting part secured to the fuse-base and designed to engage with the fuse-carrier contacts, if

any, or otherwise directly with the fuse-link contacts and connected to or entangled with the fixed terminals.

3.9 Fuse-Element

That part of a fuse which is designed to melt and thus open a circuit.

3.10 Fusing Factor

The ratio, greater than unity, of the minimum fusing current to the rated current, namely:

$$\text{Fusing factor} = \frac{\text{minimum fusing current}}{\text{rated current}}$$

3.11 Projection

A raised imperfection, projecting more than 0.75 mm above the surface of the ceramic material.

3.12 Size

The maximum rated current (expressed in amperes) that a fuse of a given dimension may be allocated.

3.13 Rated Current of a Fuse-Base or of a Fuse-Carrier

A current used in the designation of a fuse-base or fuse-carrier, namely, the current, the fuse, when fitted with a fuse-element of the same rated current, can carry continuously without deterioration and without exceeding the temperature-rise limits.

NOTE – A fuse of one rating (say 100 A) may be fitted with a fuse-element to give it some smaller current rating (say 80 A). This matter is within the control of user. Fuse-carrier contacts, fuse-carriers, fuse-base contacts and fuse- bases are usually described by stating the size of the fuse of which they form a part.

3.14 Rated Voltage

A voltage used in the designation of the fuse, and from which the test conditions and service voltage limits are determined.

3.15 Recovery Voltage (of a Circuit Opened by a Fuse)

The rms value of the normal frequency ac voltage that exists across the terminals of the fuse after the opening of the circuit.

3.16 Routine Test

Test carried out on each item to check requirements which are likely to vary during production.

3.17 Type Test

Tests carried out to prove conformity with the requirements of this specification. These are intended to prove the general qualities of a given type.

3.18 Duty

The satisfactory opening of the fuse at voltages not higher than the voltage rating of the fuse, under conditions that produce for the requisite length of time any prospective current greater than the minimum fusing current of the fuse wire, up to its breaking capacity rating.

4 ELECTRICAL REQUIREMENTS

4.1 Preferred Voltage

Fuses shall be rated for one of the following voltages:

For ac systems – 240 V single-phase and 415 V three phase.

NOTE – A 240 V grade fuse shall not be used in a three-phase 4-wire 415 V systems.

4.2 Rated Currents

The preferred rated currents of fuse-carriers and fuse-bases shall be as follows:

16, 32, 63 and 100 A

4.2.1 The fuse-carrier and base shall be so designed and proportioned, that when they are carrying their rated current continuously in accordance with **9.6** in an ambient temperature not exceeding 40°C, the temperature rise of the carrier and base contacts does not exceed 55°C.

4.3 Rated Breaking Capacity

Fuses shall open circuits satisfactorily, complying with the conditions laid down in **9.9** any prospective current greater than the minimum fusing current of the fuse wire they are intended for up to their rated breaking capacity.

4.3.1 The values of rated breaking/capacity recognized for the purpose of this standard are 2 kA in the case fuses of rating up to and including 16 A, and 4 kA in the case of higher current ratings at a power factor not exceeding 0.4 (lag).

4.4 Fuse-Wire

The fuse-wire, specified by the manufacturer for use with the fuse-carrier, shall conform to the requirements in IS 9926 : 1981. In addition, the fuse-wire shall be capable of blowing-off within 30 minutes when carrying a current of 1.9 times the rated current of the fuse-wire and be capable of carrying 1·6 times the current rating continuously without blowing for at least 30 minutes.

5 PHYSICAL REQUIREMENTS

5.1 Mechanical Robustness

The fuse base and fuse carrier shall be mechanically robust and shall pass satisfactorily the mechanical endurance test and mechanical strength test specified in **9.3** and **9.4** respectively.

5.2 Withdrawal Force

The withdrawal force of fuse-carrier from the fuse-base measured as described in **9.5**, shall be between the values given in Table 1.

Table 1 Withdrawal Force

Rated Current	Withdrawal Force
A	N
16	5 to 35
32	15 " 55
63	30 " 100
100	40 " 160

5.3 Requirements for Ceramic Material

5.3.1 The ceramic material shall be sound, thoroughly vitrified, smoothly glazed except in the case of steatite, and shall be free from defects such as dunts and projections. The mounting surface may be left unglazed.

5.3.1.1 The glaze, which shall show no signs of crazing, shall be leadless and shall cover at least those surfaces which are exposed when the fuse has been mounted in the intended manner.

NOTE – Glazing of non-exposed surfaces of the carrier and base is optional.

5.3.2 *Temperature Cycle*

When fuse-bases and fuse-carrier are subjected to the temperature cycle test specified in **9.11.1**, the ceramic material shall withstand the series of tests without breaking, cracking or crazing. In addition, the fuse-base and fuse-carrier shall comply with the requirements of **9.9.3** when subjected to high voltage test (*see* **9.8**) at the end of the temperature cycle tests.

5.3.3 *Water Absorption*

Ceramic material shall not absorb more than 2 percent of its weight of water, when broken and tested in accordance with **9.11.2**.

5.4 Requirements for Non-ceramic Material

5.4.1 *Water Absorption (For Non-Ceramic Material)*

When tested in accordance with **9.10**, materials other than ceramics, required to be non-hygroscopic shall be incapable of taking up water in sufficient quantity to cause appreciable swelling, laminating, warping or changing of the material in a manner which will impair its compliance with this specification.

5.5 Non-Flammability

Materials required to be non-inflammable shall be incapable of burning or giving off inflammable vapours in sufficient quantity to ignite at a pilot flame when heated for 5 minutes in an oven at 300 °C in the manner specified in **9.12**.

6 DESIGN AND CONSTRUCTION

6.1 Materials

The insulating materials used for construction of fuse-carrier and fuse-base shall be of ceramic or other suitable material. They shall be non-ignitable under specified service conditions.

6.2 Protection

The fuse-carrier and fuse-base when installed in the intended manner shall have all live parts so protected as to prevent inadvertent contact with such live parts.

6.3 Handle or Grip

The fuse-carrier shall be provided with a handle or grip and shall be shaped in an acceptable manner so that it is practicable to withdraw the carrier without the use of tools and without danger to the operator.

6.4 Corrosion

Metal parts shall, unless inherently resistant, be protected against corrosion by suitable methods.

6.5 Fuse-Bases

6.5.1 Every fuse-base shall, as far as possible, be provided in an acceptable manner with one or two holes for fixing, or alternatively with equivalent means of fixing, sufficient to ensure stability

6.5.2 The fuse-base shall have contacts for suitably engaging with the contacts of the fuse-carrier. They shall have suitable means for connecting the contacts to terminals, when the fuse-base is mounted in the intended manner.

6.5.3 Live parts on the underside of the fuse-bases, designed for surface mounting shall either be covered by a shield or barrier of insulating material, or be countersunk not less than 3 mm below the surface of the base and covered with waterproof insulating sealing compound which will not deteriorate or flow at a temperature lower than 100° C or during any of the tests specified in 9, or have a clearance of not less than 6 mm for 16 A and 32 A sizes and 9 mm for 63 A and 100 A sizes from the mounting surface and be riveted, upset or otherwise reliably prevented from loosening.

6.5.4 The mounting surface of the fuse-base shall enable mounting of the fuse on the intended surface.

6.6 Fuse-Carrier

6.6.1 The fuse-carrier shall have contacts suitable for making contact with the contacts of fuse-base. They shall be provided with suitable terminals for the connection of the fuse-elements. The fuse-carrier shall be so constructed that it is capable of being reversible for introduction into the fuse-base unless it is obviously designed to be inserted in one way.

6.6.2 Live parts of fuse-carriers shall be covered either by a shield or barrier of insulating material, or be countersunk not less than 3 mm below the surface of the carrier and covered with a waterproof insulating sealing compound which will not deteriorate or flow at a temperature lower than 100 °C.

6.7 Screws

6.7.1 Screws upon which the general assembly of the fuse-base and fuse-carrier terminals and contacts depend, shall be prevented from loosening or backing out by lock washers, stakings or other reliable means.

6.7.2 If screws, used in the assembly of a fuse, are loosened or removed in order to install the fuse or fuse-element or to connect the fuse into a circuit, they shall thread into metal and shall be provided with washers.

6.7.3 Screws or bolts used for the connection of current-carrying parts of fuses shall engage by at least two full threads or 0.6 of the diameter of the screws, whichever is the greater.

6.8 Current-Carrying Parts

6.8.1 Current-carrying parts, shall be of robust construction and shall be capable of carrying their rated current without exceeding the temperature rise limits specified in **4.2.1**.

6.8.2 Iron and steel shall not be used for current-carrying parts, except as clamping agents or pressure

devices, such as pinching screws, clamps or wire binding screws and nuts.

6.9 Contacts

The contacts of fuse-carrier and those of the fuse-base shall be so constructed, and be of such material, that the required pressure between them is maintained even after repeated engagement and disengagement.

6.10 Terminals

6.10.1 Fues carriers and fuse-bases shall be provided with terminals of adequate current carrying capacity.

6.10.2 Terminals, unless of a form which will prevent the conductor wires from excessive spreading, shall be fitted with special washers or other suitable means to prevent such spreading.

6.10.3 Wiring terminal screws shall thread into metal. Terminal screws shall have smooth clean threads free from burrs, and the ends of the screw shall be of such a shape as to prevent undue damage to the conductor.

7 DIMENSIONS OF CARRIERS AND BASES

7.1 The dimensions of carriers and bases used in rewirable type electric fuses shall conform to those given in Annex A.

7.2 Annex A covers Type A and Type B dimensions of rewirable fuses. This standard recommends preference to Type A dimensions. Conformity to Type B dimensions is permissible and would be deemed as compliance to this standard for an interim period which will expire 2 years from the date of enforcement of this standard.

7.3 For claiming conformity to the provisions of this standard conformity to dimensions given in Annex A is essential (*see* **7.2**).

8 MARKING

8.1 Every fuse-carrier shall be clearly and indelibly marked with the following information:

a) Rated current,

b) Rated voltage,

c) Size of the fuse-wire, and

d) Manufacturer's name and trade-mark.

8.1.1 The marking given in **8.1** shall be indelibly cast, etched or otherwise permanently marked on the fuse-carrier and the voltage and current rating shall be visible to the operator when the fuse is installed in the intended manner.

8.2 In addition carriers and bases of designs conforming to Type B dimension in Annex A shall be marked with the words "TYPE B".

9 TESTS

9.0 General

9.0.0 The test shall be done in the sequence they are listed in **9.0.3.1**.

9.0.1 Unless otherwise specified, each test shall be commenced with the fuse-base, fuse-carrier and all associated apparatus approximately at the prevailing ambient temperature.

9.0.2 Wherever required for the tests, the carrier shall be fitted with the appropriate size of fuse wire recommended by the manufacturer of the carriers and bases with which satisfactory performance will be ensured.

9.0.3 Categories of Tests

9.0.3.1 Type tests

The following shall constitute type tests:

a) Mechanical test sequence:
   1) Visual examination (*see* **9.1**),
   2) Test for dimensions (*see* **9.2**),
   3) Test for mechanical endurance (*see* **9.3**),
   4) Test for mechanical strength (*see* **9.4**), and
   5) Test for withdrawal force (*see* **9.5**).

b) Electrical test sequence:
   1) Test for temperature-rise (*see* **9.6**),
   2) Insulation resistance test (*see* **9.7**),
   3) High voltage test (*see* **9.8**), and
   4) Test for breaking capacity (*see* **9.9**).

c) Test for proving material properties:
   1) Test for water absorption (non-ceramic) (*see* **9.10**),
   2) Test on ceramic material (*see* **11**), and
   3) Ignition test (*see* **9.12**).

Number of Samples – Six samples of fuse-carrier and fuse-base shall be drawn at random and tests specified in **9.0.3.1** shall be carried out on each of these samples in the order mentioned.

Criteria of Compliance – All these samples shall successfully pass all the tests specified in **9.0.3.1** to prove conformity with this specification.

9.0.3.2 Acceptance test

The following shall constitute acceptance tests:

a) Visual examination (*see* **9.1**),

b) Test for dimensions (*see* **9.2**),

c) Test for mechanical endurance (*see* **9.3**),

d) Test for withdrawal force (*see* **9.5**),

e) Test for temperature-rise (*see* **9.6**),

f) Insulation resistance (*see* **9.7**),

g) High voltage test (*see* **9.8**),

h) Test for water absorption (*see* **9.10**), and

j) Temperature cycle test (for ceramic material) (*see* **9.11.1**).

A recommended sampling plan for acceptance is given in Annex B.

However for the purposes of temperature cycle test (*see* **9.9**), it shall be sufficient to draw one sample from every batch of 1 000 (or less) for each current rating.

9.0.3.3 *Routine test*

High voltage test (*see* **9.8**) shall be the routine test.

9.1 Visual Examination

The fuse-carrier and bases shall be visually examined for compliance with the general requirements of this standard.

9.2 Test for Dimensions

The dimensions of fuse-carrier and bases shall be checked for compliance with the values specified in Annex A.

9.3 Tests for Mechanical Endurance

9.3.1 The fuse-base shall be fixed on a suitable support as for normal use, with all fixing means being used. The fuse-carrier shall have the fusing element connected to the terminals as in normal use.

9.3.2 The fuse-carrier shall be introduced into the fuse-base and drawn out, the fuse-carrier shall then be turned by 180°C around an axis perpendicular to the fuse-base in the case of reversible type and its introduction and drawing out shall be repeated. This shall comprise one cycle.

9.3.3 The test cycle specified in **9.3.2** shall be carried out 100 times for the reversible type and 200 times for the non-reversible type.

9.3.4 At the end of the test, the fuse (fuse-base and fuse-carrier), shall be examined for the following:

a) The contacts shall not work loose.

b) No damage shall be caused to any part of the fuse-carrier or fuse-base,

c) There shall be no displacement of any of the component parts, and

d) The serviceability of the fuse shall not have been impaired.

9.4 Test for the Mechanical Strength

The assembled fuse-carrier and fuse base shall be firmly mounted horizontally on a hardwood block. A mild steel guiding rod of 6 mm in diameter and 60 cm long, fitted with a hard fibre base-plate 25 mm in diameter and 12.5 mm thick, shall be rested vertically on the sample. A cylindrical metal piece having an outer diameter of 25 mm weight as given below for the different sizes of fuse-carrier and fuse-bases, and a bore permitting a loose fit over the rod, shall be dropped freely from a height of 25 cm on the fibre base-plate. The test shall be repeated three times with each of the three different vertical axes.

Nominal Current of the Fuse	*Weight of Metal Piece*
A	g
16	75
32	100
63	150
100	200

9.4.1 At the end of the test, the fuse-base and fuse-carrier shall show neither cracks nor permanent deformation such as will impair its compliance with this standard.

9.5 Test for Withdrawal Force

9.5.1 The fuse-base shall be fixed on a suitable support as for normal use, with all fixing means being used. The fuse-carrier shall be introduced into the fuse-base correctly and to the end.

The fuse-carrier shall then be pulled with a force applied gradually perpendicular to the axes of fuse until the fuse-carrier is drawn out. In the case of vertical sliding type of fuse, the force shall be applied in the direction of sliding.

9.5.2 The fuse-carrier shall be introduced anew into the fuse- base, after being turned through 180° around an axis perpendicular to the fuse-base and withdrawn from the fuse-base as specified in **9.5.1** unless the fuse-carrier is so constructed that it can be inserted only in one way.

9.5.3 The force needed for drawing out the fuse-carrier from the fuse base shall be between the limits specified in **5.2.**

9.6 Test for Temperature-Rise

9.6.1 It shall be first ensured that the fuse-wire specified for use with the rewirable fuse (if of tinned-copper) complies with the requirements of IS 9926 : 1981, and those given in **4.4.** Fuse-wire of the maximum current rating assured by the manufacturer shall be used for the test.

9.6.2 The temperature-rise test shall be carried out in an ambient temperature not exceeding 40 °C.

9.6.3 Fuse-base and fuse-carrier shall be tested for temperature-rise at rated current, in surroundings free from external droughts and in a containing case representative of that which may be used in service.

9.6.4 The fuse-base and fuse-carrier shall be mounted in the intended manner on a vertical surface of insulating material. If alternative positions are possible they shall be mounted with the fuse-elements vertical.

9.6.5 The cables connected to the fuse for the purposes of this test, shall be of PVC insulation of the sizes corresponding to the rated current of the fuse.

9.6.6 The temperature shall be measured by means of thermocouple attached to :

a) the upper fuse-carrier contact as close as possible to the fuse-element and

b) the upper fuse-base contact as close as possible to the connecting conductor.

9.6.7 A current equal to the current rating of the fuse-carrier or fuse-base shall be passed through the fuse. A low voltage source of either ac or dc may be used for this test. The test shall be made over a period of time sufficient for the temperature-rise to reach a constant value, but not exceeding 8 hours. In practice this condition is reached when the variation does not exceed 1°C per hour.

9.6.8 The temperature-rise, thus measured, shall not exceed the value specified in **4.2.1.**

9.7 Insulation Resistance Test

The insulation resistance of the carrier and base shall be measured at a voltage of 300 V dc between the following parts:

a) Between live terminals and any metal parts which should be exposed when the fuse is mounted in the intended manner. This test shall be made with all exposed metal parts electrically connected together and with all live terminals electrically connected together, and

b) Between incoming live terminals and outgoing live terminals.

9.7.1 The voltage shall be applied for sufficient time for the reading of the test indicator to become practically steady.

9.7.2 The insulation resistance shall be not less than 10 M Ω.

9.8 High Voltage Test

9.8.1 An ac voltage of approximately sine-wave form, at 50 Hz shall be applied between the parts specified in **9.7** and maintained for one minute. The magnitude of the voltage shall be as given below:

Rated Voltage of Fuse (V)	*Test Voltage* (rms) (V)
240 single-phase	2 000
415 three-phase	2 500

9.8.2 There shall be no puncture or flash-over during the high voltage test. Immediately following the test, the insulation resistance shall be measured in accordance with **9.7** and shall be not less than the value specified in **9.7.2.**

9.9 Test for Breaking Capacity

9.9.0 *General Conditions for Test*

9.9.0.1 *Source of supply*

The source of energy for the test shall be capable of giving the required prospective currents at the *pf* given in **4.3** and shall produce a recovery voltage equal to the voltage rating of the fuse with a tolerance of ±15 percent. If necessary the voltage of the test circuit may be increased initially above the maximum value in order to ensure that the recovery voltage will have the required value.

9.9.0.2 The recovery voltage corresponding to the rated voltage shall be maintained within the limits stated in **9.9.0.1** for not less than 30 seconds after the breaking of the prospective current.

9.9.0.3 It shall be first ensured, that the fuse-wire specified for use with the rewirable fuse (if of tinned-copper), complies with the requirements of IS 9926 : 1981 and these given in **4.4.** Fuse-wire of the maximum current rating assured by the manufacturer shall be used for the test for breaking capacity.

9.9.0.4. Throughout the test, the fuse base and fuse-carrier shall be mounted in the intended manner, on a metal plate and surrounded by a screen of woven wirecloth. The clearance between the screen and the external surfaces of the fuse shall be not greater than 25 ± 2 mm. In case a lesser distance is claimed by the manufacturer, the distance shall be reduced accordingly.

9.9.0.5 If the fuse is designed to hold three fuse-carrier in the same fuse-base, the two centre screens should be centrally placed between the fuse-carriers.

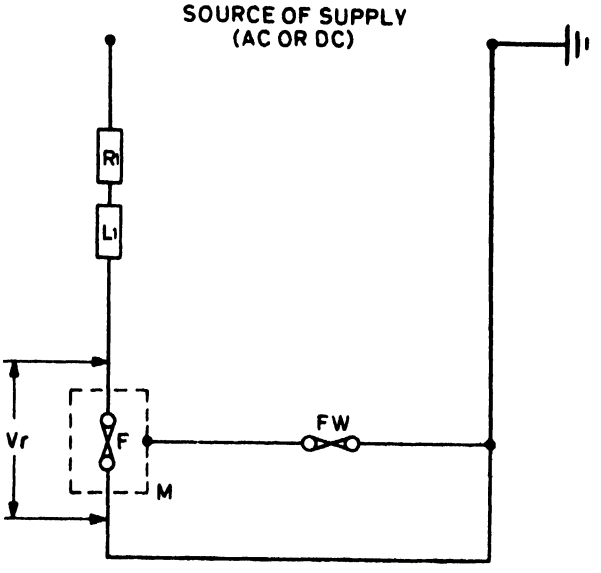
9.9.0.6 The woven wire cloth shall be formed from 0.4 mm diameter wire with approximately 6 meshes per centimetre. The wire screens shall be connected electrically to the metal mounting plate which shall be insulated from earth potential but connected there to through a fine-wire fuse, the fuse-element of which shall be formed from copper wire with a diameter not greater than 0.12 mm and not less than 75 mm in length. The fine wire fuse-element shall not melt during the test for performance.

9.9.1 *Arrangement of the Circuit*

The arrangement of the circuit for the test shall be that given in one of Fig. 2 or 3 according to the details as follows:

a) Testing of individual fuse of 240 V grade shall be in accordance with Fig. 2 (*see* **9.9.0.4**),

b) Testing of three individual fuse and multi-carrier fuses of 415 V grade shall be in accordance with Fig. 3. Unless specified otherwise by the manufacturer, the individual fuses shall be mounted such that they touch earth other (*see* **9.9.0.4**).



F = Fuse on test
M = Metal case
FW = Fine-wire fuse
V_r = Points at which recovery voltage is measured
$R_1 L_1$ = Resistor and inductor as required for tests at full prospective current

FIG. 2 TEST CIRCUIT FOR FUSES OF 240 V GRADE

9.9.2 *Procedure*

With the fuse-element to be tested inserted in the circuit, the circuit shall be closed. The fuse-wire shall open the circuit at this test but the fine-wire fuse connecting the mounting plate to earth shall not melt.

9.9.2.1 The fuse wire shall now be replaced and the test shall be repeated twice more, on each sample.

9.9.2.2 During three phase test it may be found that one of the fuses may remain unblown at the end of the test. Provided that at least two adjacent fuses have blown, the test can be considered satisfactory, and sufficient tests must be made to achieve this.

9.9.2.3 The current applied shall be not less than 100 percent and not more than 115 percent of the breaking capacity rating of the fuse. The power-factor shall be in accordance with the value given in **4.3** with a tolerance of ± 8.05. For three phase tests (*see* Fig. 3), the current in all phases shall be equal.

9.9.3 *Criteria for Failure*

The fuse carrier and the fuse-base shall be deemed to have failed the test for breaking capacity if one or more of the following occur:

a) Any part of the carrier or the base ignites,

b) The fuse-carrier is ejected,

c) Any part of the fuse except the fuse-element and its covering is damaged to such an extent as to render it unserviceable,

d) Melting of the fine-wire fuse, indicating arcing to metal case, and

e) Arcing between fuses on tests involving 2 or more fuses.

9.9.3.1 If the insulation resistance reduces to below 100 k Ω when measured in accordance with **9.7**, within 3 minutes after the conclusion of the test, the sample shall be considered to have failed the test.

9.10 Test for Water Absorption (for Non-ceramic Material)

The non-metallic portions of the fuse-carrier and fuse-base shall be immersed in distilled water at 27 ± 2°C for 18 hours. At the end of this test the material shall conform to the requirements specified in **5.4.1.**

9.10.1 This test does not apply to ceramic or asbestos material.

9.11 Test on Ceramic Material

9.11.1 *Temperature Cycle Test*

The fuse-bases and fuse-carriers from which any renewable covering has been removed, shall be passed through the following cycle three times in succession:

a) Immersion in water maintained at a temperature of 70 to 75°C for 20 minutes, and

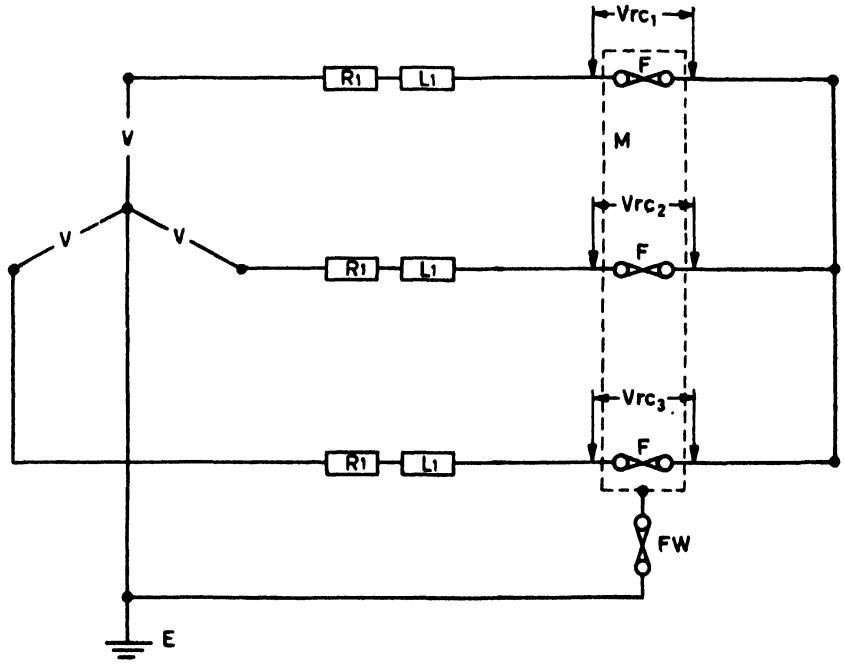
b) Immediately thereafter immersion in ice and water at a temperature not exceeding 7 °C for 20 minutes.

9.11.1.1 The weight of water in each bath shall be not less than four times that of the specimens immersed at one time and the water should cover the specimens completely.

9.11.1.2 At the conclusion of the series of immersions specified in **9.11.1**, the fuse-base and fuse-carrier shall be dried and subjected to the high voltage test (*see* **9.8**). There shall be no arcing or puncture.

9.11.2 *Water Absorption Test (for Ceramic Material)*

9.11.2.1 The clean, dry fuse-bases and fuse-carriers from which any renewable covering and other metallic



V = Three-phase source of supply
F = Fuses on test
M = Metal case
FW = Fine-wire fuse
V_r = Points at which recovery is measured
E = Earth connection
R_1L_1 = Resistor and inductor as required for tests at full prospective current

FIG. 3 TEST CIRCUIT FOR FUSES OF 415 V GRADE

portion have been removed, shall be broken into pieces having a size within the range of 12.5 mm to 6 mm. A number of these pieces, weighing between 40 g and 50 g, shall be taken for testing. The test pieces shall be heated to 110 ± 1 °C in a dry atmosphere for at least 2 hours and cooled in a desiccator.

9.11.2.2 The conditioned test pieces shall be weighed and then immersed in distilled water. The water shall be brought to the boiling point and kept boiling for not less than 30 minutes.

9.11.2.3 The test pieces still immersed in the water shall be allowed to cool to ambient temperature for a period of not less than 6 hours.

9.11.2.4 The test piece shall be taken from the water after cooling and the residual drops of water shall be removed by rolling them over a piece of filter paper. The test piece shall then be transferred to a piece of wire gauge supported in still air at ambient temperature.

9.11.2.5 The test pieces shall be reweighed to the nearest milligram, not less than 5 and not more than 10 minutes after removal from the water.

9.11.2.6 The mass of water absorbed shall be calculated from these readings by the following formula:

$$\text{Mass of water absorbed, percent} = \frac{A}{B} \times 100$$

where

A = mass of moisture absorbed, and

B = initial mass of test piece.

9.12 *Ignition Test (for Non-Ceramic Materials Only)*

9.12.1 *Preparation of Specimens*

9.12.1.1 *Selection*

Three test specimens shall be prepared from the insulating materials of the fuse-carrier and fuse-base. The width of each specimen should be 12.5 mm, length being approximately 50 mm. The thickness shall be the same as that of the fuse, if it is less than 6.5 mm; should the thickness exceed 6.5 mm it shall be reduced to this value by the removal of material.

If such specimens cannot be obtained, samples shall consist of broken pieces of materials to be tested which weigh not more than 10 g and are not more than 10.0 mm in thickness measured from an externally cured face.

9.12.1.2 *Conditioning*

The specimens shall be conditioned for a period of not less than 24 hours in a controlled atmosphere of temperature of 27 ± 2°C at a relative humidity of 65 percent ± 4 percent before the test is carried out (*see* Annex C). Each specimen shall be tested within three minutes after their removal from the controlled atmosphere.

9.12.2 The specimen shall be tested in the heating chamber of an apparatus of the general type, shown in Fig. 4, a pilot flame being located 22 mm above the upper end of the specimen. A conical cover at the top shall limit the opening to approximately 650 mm^2 while the air intake at the bottom shall be approximately 65 mm^2.

9.12.2.2 The support for this specimen shall be provided in the heating chamber. This may suitably consist of a light stirrup of nichrome wire supported by a length of nichrome wire passing over the pilot flame. Support shall be such that the specimen is fixed centrally in the heating chamber, with its largest dimension vertical.

9.12.2.3 Apparatus shall be heated by passing a suitably regulated electric current through a nichrome resistance wire surrounding the heating chamber.

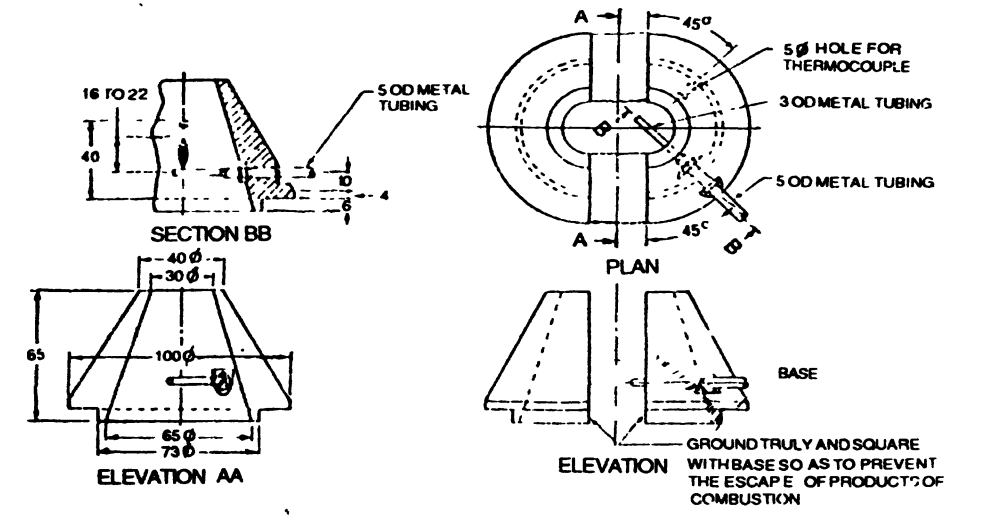
9.12.3 *Measurement of Temperature of Heating Chamber*

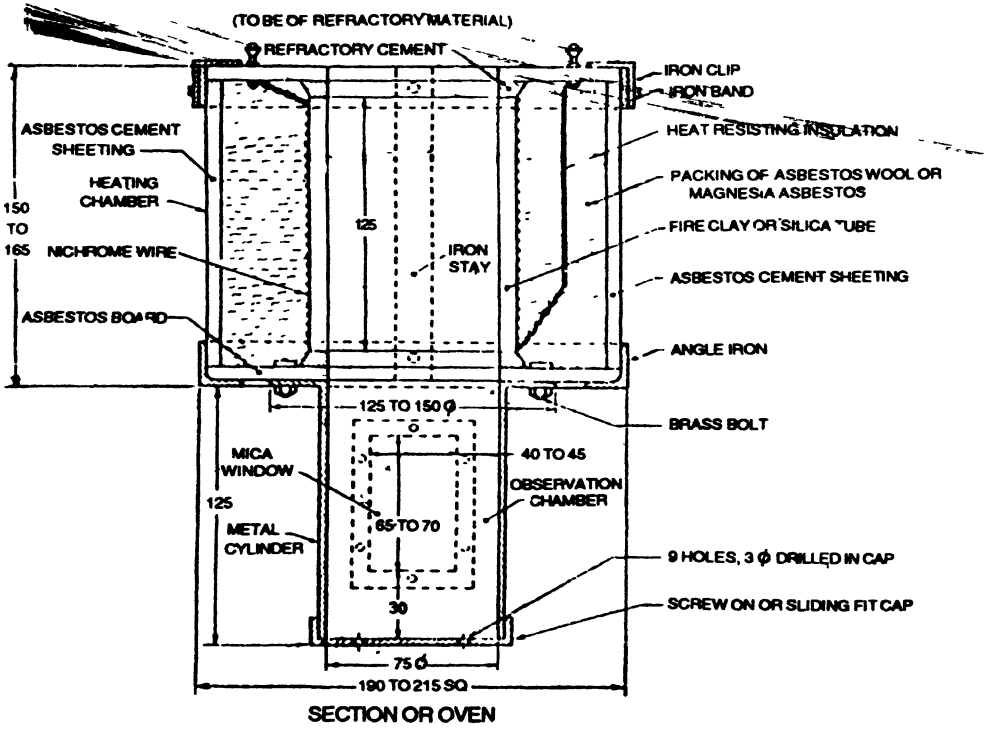
The temperature of the heating chamber shall be taken as shown by a thermocouple situated at the level of the centre of the specimen and equidistant from the inner surface of the heating chamber and the specimen. The wire of which the thermocouple is made shall be not larger than 1.25 mm and not smaller than 0.462 mm in diameter and shall be bare for a length of 25 mm from the junction.

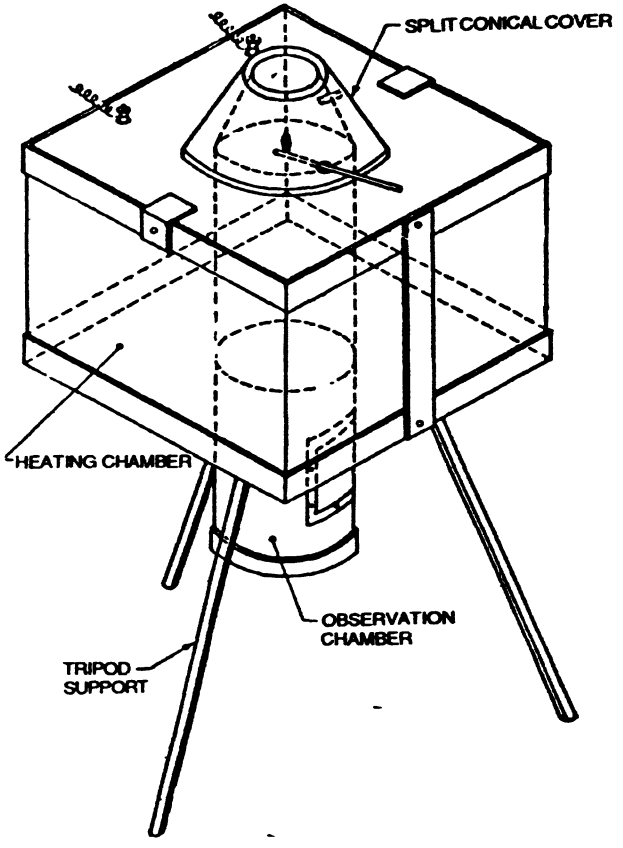
9.12.4 *Procedure*

The temperature of the heating chamber shall be raised to 300°C and a specimen shall be inserted vertically in the chamber. The temperature shall then be readjusted to 300 ± 3° C within 3 minutes and maintained for a period of 5 minutes. At the end of this period the specimen shall be removed from the chamber.

9.12.4.1 At any time during the test the specimen shall not inflame or give off any inflammable vapours in sufficient quantities to ignite at the pilot flame.







All dimensions in millimetres.

FIG. 4 APPARATUS FOR IGNITION TEST

ANNEX A

(*Clauses* 7.1 *and* 9.2.1)

DIMENSIONS OF CARRIERS AND BASES OF REWIRABLE TYPE ELECTRIC FUSES

A-0 GENERAL

A-0.1 The figures given in this annex are for representing the dimensions and are not indicative of the shape of the fuse.

A-1 DIMENSIONS OF 240 V GRADE FUSE

A-1.1 The dimensions of carrier of the fuses of rated voltage 240 V of current rating 16 A are given in Fig. 5. Dimensions of the bases of the fuses of rated voltage 240 V shall be such as to ensure dimensional interchangeability with any fuse carrier complying with Fig. 5. However, the mounting dimensions and maximum width of bases shall be as given in Fig. 5.

A-2 DIMENSIONS OF 415 V GRADE FUSE

A-2.1 The dimensions of the carrier of the fuse of rated voltage 415 V are given in Fig. 6. The dimensions of the bases of fuses of rated voltage 415 V shall be such as to ensure dimensional interchangeability with any fuse-carrier complying with Fig. 6. However, the mounting dimensions and maximum width of bases shall be as given in Fig. 6 (*see* **7.2**).

ANNEX B

(*Clause* 9.0.3.2)

SAMPLING PLAN FOR ACCEPTANCE OF LOTS

B-1 LOT

B-1.1 In any consignment, all the fuse-carriers and fuse-bases of the same ratings and size manufactured under similar conditions of production, and submitted for inspection and test at one time shall constitute a lot.

B-1.2 From each lot a certain number of fuse-carriers and fuse-bases shall be selected independently at random and matched before subjecting them to acceptance tests. Any fuse-carrier and fuse-base which fails to satisfy the requirements of any one or more acceptance tests shall be considered as defective.

B-1.3 The number of fuse-carriers and fuse-bases to be selected at random from the lot shall be in accordance with col 1 and 2 of Table 2.

B-1.3.1 In order to ensure the randomness for selection, random number tables shall be used (*see* IS 4905 : 1968).

B-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

B-2.1 The fuse-carrier and fuse-bases selected in **B-1.3** shall be subjected to the acceptance tests in the order specified in **9.0.3.2.**

B-2.2 Each of the fuse-carrier and fuse-bases selected in the first stage in accordance with col 1 and 2 of Table 2 shall be subjected to acceptance tests. If the number of defectives is less than or equal to the acceptance number (*see* col 5), the lot shall be considered as conforming to the requirements of the standard. If the number of defectives is equal to or greater than the first rejection number (*see* col 6), the lot shall be considered as not conforming to the requirements of the standard. If the number of defectives is between the acceptance number and the first rejection number, a second sample of the same size as taken at the first stage shall be taken and tested. If the number of defectives in the two samples combined is less than the second rejection number (*see* col 7), the lot shall be considered as conforming to the requirements of the standard, otherwise the lot shall be rejected.

Table 2 Scale of Sampling, Acceptance Number and Rejection Number

(*Clasues* B-1.3 and B-2.2)

Lot Size	Sample Size		Cumulative Sample Size	Acceptance Number	First Rejection Number	Second Rejection Number
	First Stage	Second Stage				
N	*n*	*n*	*2n*	C_1	C_2	C_3
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Up to 150	5	5	10	0	2	2
151 " 500	8	8	16	0	2	2
501 " 1 000	13	13	26	0	2	2
1 001 " 3 000	20	20	40	0	3	4
3 001 and above	32	32	64	1	4	5

ANNEX C

(*Clause* 9.12.1.2)

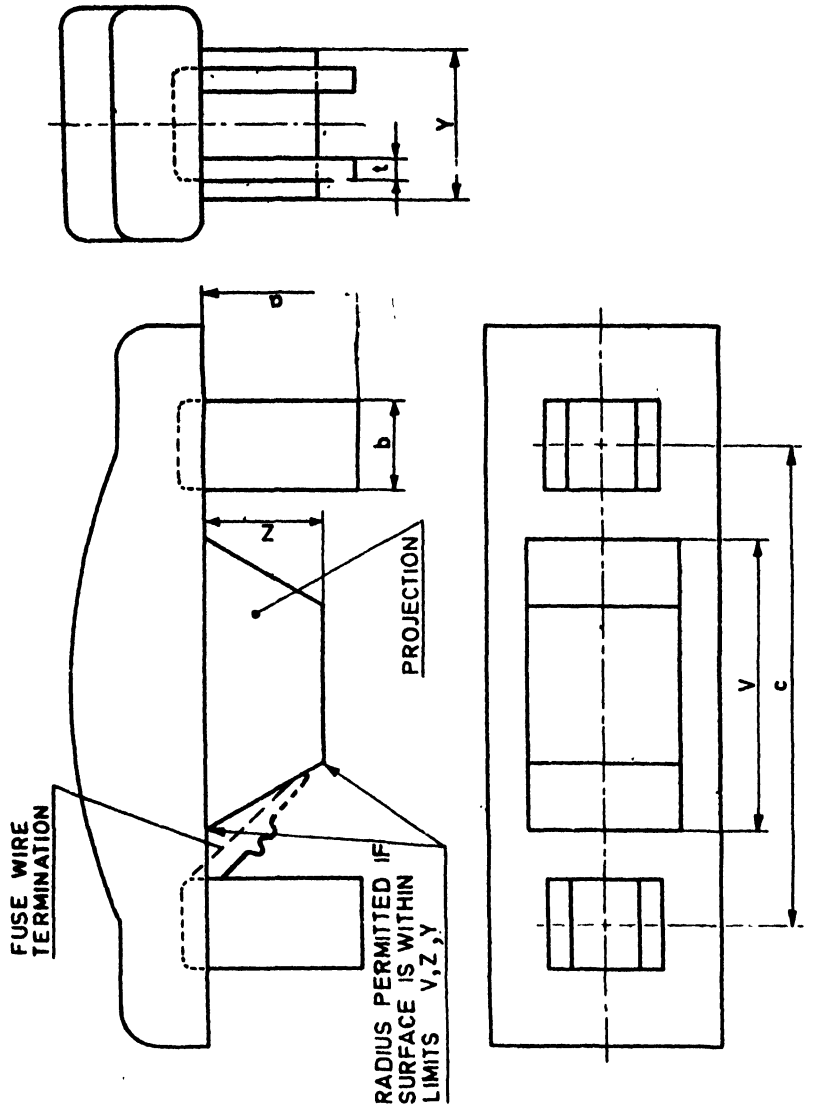
METHOD FOR ACHIEVING STANDARD RELATIVE HUMIDITY

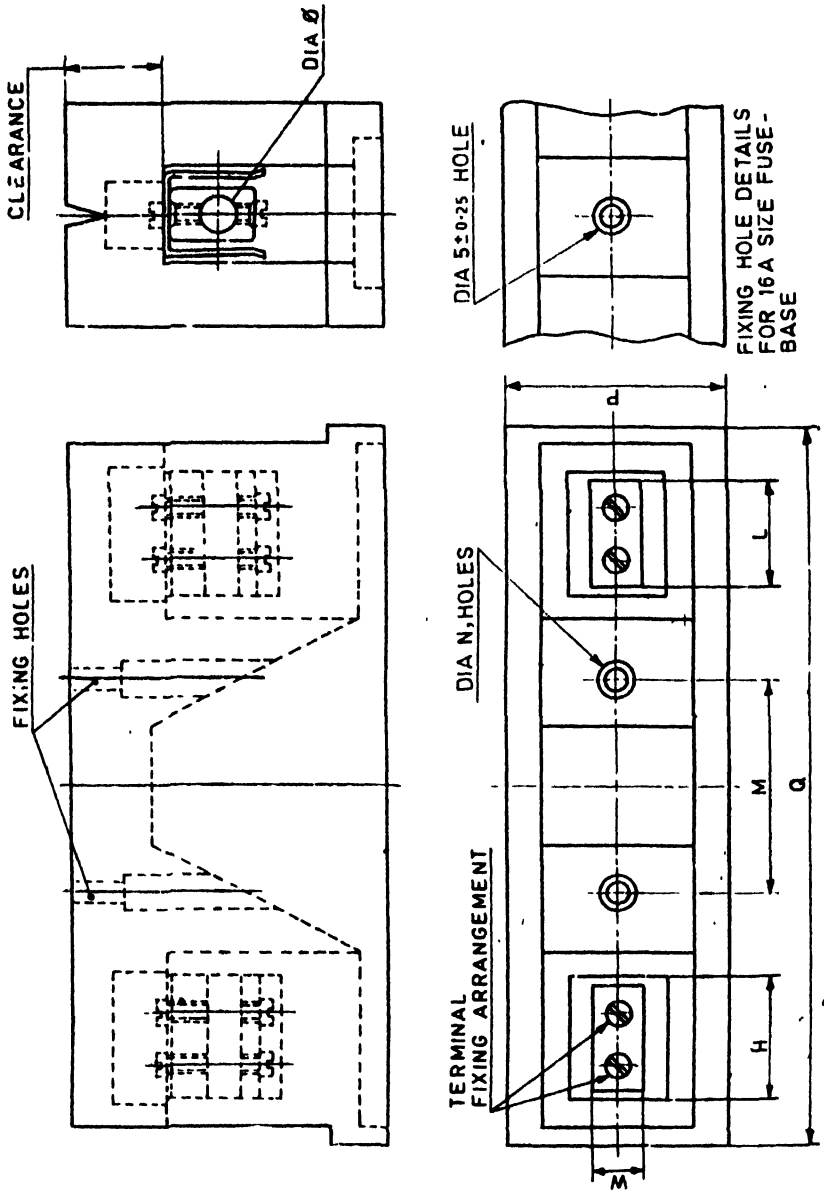
C-1 A convenient method of achieving an atmosphere of relative humidity of 65 percent at a temperature of 27 ± 2°C is by the use of saturated solution of sodium chloride and sodium nitrate exposed to the atmosphere in an enclosed chamber where it is desired to have the required humidity.

C-2 The saturated solution is prepared by boiling in water a mixture of one part by weight of sodium chloride and $2\frac{1}{4}$ parts by weight of sodium nitrate. The solution is then cooled and more of the solid mixture is added than what can be taken into solution.

C-3 The saturated solution shall be exposed so that maximum surface is in contact with the air in the chamber, for example, by covering the floor of the chamber with a tray containing the saturated solution. To ensure that the solution remains saturated an excess of the solid salt shall be contained in the liquid. It is important that the solid remains covered by the solution and that the surface of the liquid is free from any crust of film of grease, dirt, etc.

C-4 To ensure uniform conditions throughout the chamber, a fan should circulate air over the surface of the saturated solution and around the specimens. Care should be taken to allow free access of the conditioning atmosphere to all specimens.

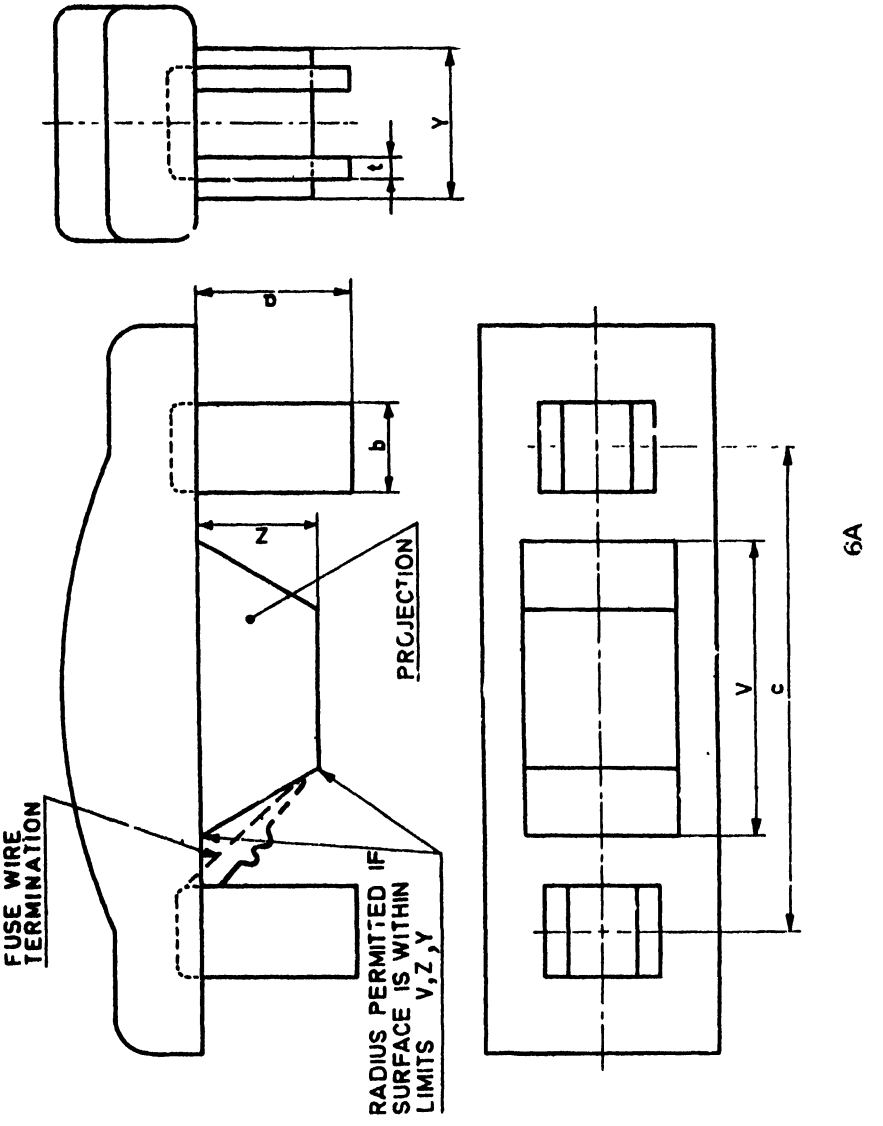

Y
t
a
b
Z
PROJECTION
FUSE WIRE TERMINATION
RADIUS PERMITTED IF SURFACE IS WITHIN LIMITS V, Z, Y
V
c



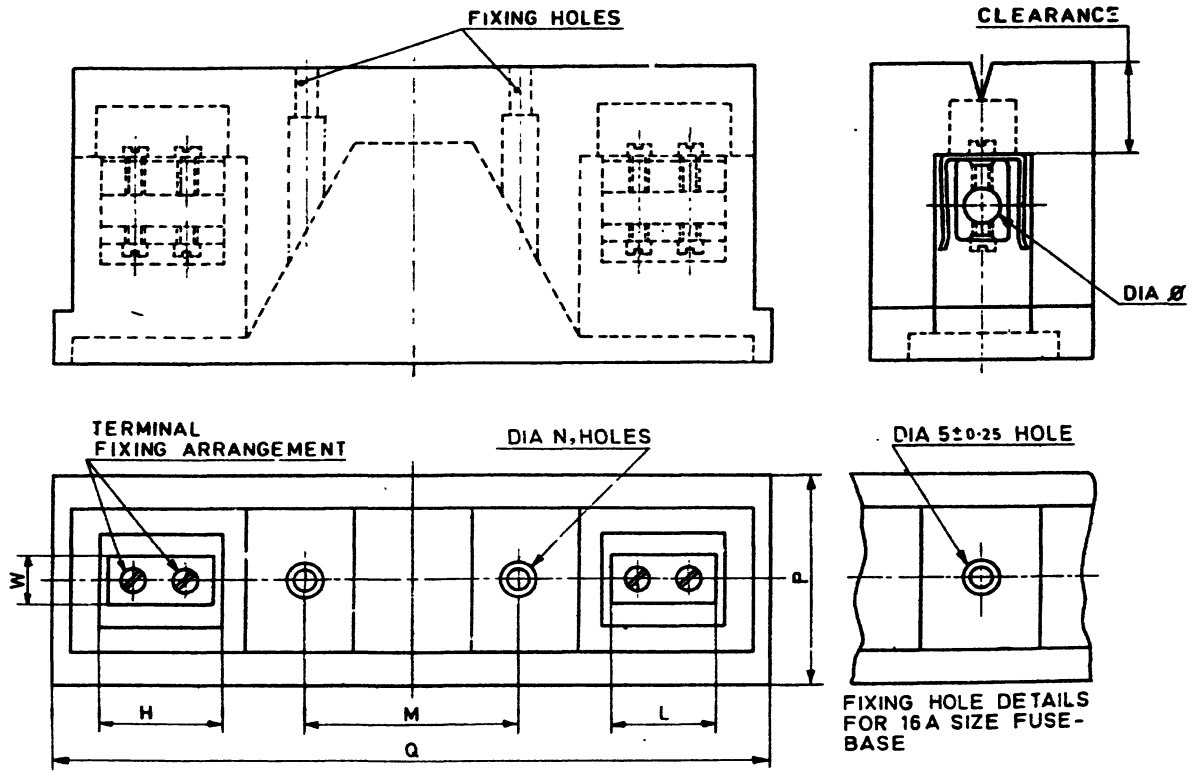
Type	Current Rating	$a^{(Min)}$	$b^{\pm 0.5}$	$c^{\pm 0.1}$	$t^{\pm 0.1}$	$V^{(Max)}$	$Z^{(Max)}$	$Y^{(Max)}$	$M^{\pm 1.0}$	$N^{\pm 0.5}$	$P^{(Max)}$	$L^{\pm 0.5}$	$W^{\pm 0.2}$	$\phi^{\pm 0.2}$	$H^{(Max)}$	$Q^{(Max)}$
A	16A	17.5	7.0	38	1.2	26	14	15	—	4.5	29	8	6.3	4.25	11.5	62

All dimensions in millimetres.

FIG. 5 FUSE UNITS FOR 16A/240 V


Y
t
a
b
Z
PROJECTION
FUSE WIRE TERMINATION
RADIUS PERMITTED IF SURFACE IS WITHIN LIMITS V,Z,Y
V
c

6A



Type	Current Rating	$a^{(Min)}$	$b^{\pm 0.5}$	$c^{\pm 1.0}$	$t^{\pm 0.1}$	$V^{(Max)}$	$Z^{(Max)}$	$Y^{(Max)}$	$M^{\pm 1.0}$	$N^{\pm 0.5}$	$P^{(Max)}$	$L^{\pm 0.5}$	$W^{\pm 0.2}$	$\phi^{\pm 0.2}$	$H^{(Max)}$	$Q^{(Max)}$
A	16	22	9	46	1.2	28	23	18.5	—	5	32	11	6.3	4.5	20	78
B	16	25	9	54	1.5	35	14	15.2	19.3	4.7	29.6	11.1	7.9	5.8	14.8	78.2
A	32	24.5	11	73	1.4	54	32	23	42	5.5	38	12.5	8.0	5.5	25	109
B	32	27	10.8	67	1.5	48.3	14.9	18.7	25.6	4.8	34.5	14.3	9.5	7.1	18.6	95.5
A	63	37	16	87	1.8	58	45	32	43	6	50	20.5	12.7	9.5	33.5	133
B	63	40	14.35	77.2	1.8	52	23.5	24.4	33.4	5	47.6	17.5	12.7	9.5	22.52	115.8
A	100	34	19	114	2.5	78	45	43	58	6	64	23.5	17	12.6	46	166
B	100	47	19	99	1.8	73.7	28.5	35.6	43.1	5.8	57.2	22.9	19	12.7	28.4	142.4

All dimensions in millimetres.

FIG. 6 DIMENSIONS OF 415 V GRADE FUSES

GMGIPN—88 BIS/ND/07—100

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Amendments Issued Since Publication

Amendment No.	Date of Issue	Text Affected

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