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Indian Standard

IS 4159 : 2021

खनिज भरे ढके तापन एलिमेंट — विशिष्टि

(चौंथा पुनरीक्षण)

Mineral Filled Sheathed Heating Elements — Specification

(Fourth Revision)

ICS 29.100.01; 97.100.01

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली – 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.gov.in www.standardsbis.in

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Electrical Appliances Sectional Committee, ETD 32

FOREWORD

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

Mineral filled sheathed heating elements are used in heating appliances, such as immersion heaters, cooking appliances, kettles and oil heaters. This standard covers the general and safety requirements of mineral filled sheathed heating elements for household and similar purpose intended for installation in a container, designed to operate under specified operating conditions and meant for use in heating appliances, such as water heaters, cooking appliances, kettles, oil heaters and air heaters having water, oil or air as heating medium.

This fourth revision was undertaken primarily to align the existing standard with the IS 302-1 : 2008 and also to take into account the amendments to the standard.

This standard is to be read in conjunction with the latest edition of IS 302-1 : 2008 ‘Safety of household and similar electrical appliances: Part 1 General Requirements’ and its amendments. Clauses/Tables which are additional to those of IS 302-1 are numbered starting from 101. Should however, any deviation exist between IS 302-1 : 2008 and this standard, the provisions of the latter shall apply.

For the purpose of deciding whether a particular requirement of the 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.

Indian Standard

MINERAL FILLED SHEATHED HEATING ELEMENTS — SPECIFICATION

(Fourth Revision)

1 SCOPE

This standard covers the general and safety requirements of mineral filled sheathed heating elements for household and similar purpose intended for installation in a container, designed to operate under specified operating conditions and meant for use in heating appliances, such as water heaters, cooking appliances, kettles, oil heaters and air heaters having water, oil or air as heating medium.

Appliances not intended for normal household use but which nevertheless may be a source of danger to the public, such as appliances intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard.

NOTES — This standard does not apply to:

1 cartridge type heating elements (IS 3724);

2 heating elements with double or reinforced insulation;

3 appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas).

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
302-1 : 2008	Safety of household and similar electrical appliances: Part 1 General requirements
1593 : 2018	Fuel oils — Specification (*third revision*)
3400 (Part 6) : 2012	Methods of test for vulcanized rubbers: Part 6 determination of the effect of liquids (*third revision*)
3725 : 1966	Specification for resistance wires, tapes and strips for heating filaments

3 TERMINOLOGY

For the purpose of this standard the terms given in IS 302-1 and the following shall apply.

3.1 Conditions of Adequate Heat Discharge — Heating elements are installed according to manufacturer's instructions, the tank being thermally insulated. Accessible parts of the heating elements are not thermally insulated.

For the purpose of carrying out relevant test under the condition of adequate heat discharge following conditions shall apply:

a) Heating elements used for water heating shall be installed in an appropriate container filled with water as per manufacturer's instruction with all controls in circuit.

b) Heating elements meant for air heating shall be installed as per manufacturer's instruction sand shall be fitted with all controls in circuit.

c) Heating elements for oil heating shall be installed in an appropriate container and shall be fitted with all controls and filled with oil of following properties.

Oil	*Maximum Temperature of the Heating Medium*
Grade LV fuel oil (*see* IS 1593) and coal tar fuel of viscosity 60 to 100 Redwood No.1 sec at 37.8 °C	176.7
Grade MV fuel oil (*see* IS 1593) and coal tar fuel of viscosity 1 000 to 1 500 Redwood No.1 sec at 37.8 °C	193.7
Grade HV fuel oil (*see* IS 1593) and Coal tar fuel of viscosity 70 to 120 Standard tar viscometer sec at 30 °C	210.0

d) The heating element shall be operated in accordance with the manufacturer's instructions. Maximum surface temperature not exceeding 350 °C for sheathing made out of aluminum material and 500 °C for other materials.

3.2 Mineral Filled Sheathed Elements — Heating elements having one or more heating resistors embedded in mineral insulating material (such as magnesium oxide) and enclosed within a metallic sheath or sheaths.

4 GENERAL REQUIREMENTS

4.1 Clause **4** of IS 302 (Part 1) is applicable.

4.2 Addition

Rating

The preferred rated input power shall be chosen from 250, 500, 750, 1 000, 1 250, 1 500, 2 000, 2 500, 3 000, 3 500, 4 000, 4 500 and 5 000 W.

5 GENERAL CONDITIONS FOR THE TESTS

Clause **5** of IS 302 (Part 1) is applicable.

6 CLASSIFIACTION

Clause **6** of IS 302 (Part 1) is applicable.

7 MARKING AND INSTRUCTIONS

7.1 Heating element shall be marked with the following information:

a) Name of the manufacturer or responsible vendor or trade mark or identification mark;
b) Rated voltage, in volts;
c) Rated power input, in W or kW;
d) Oil pressure rating (in case of oil heating elements):
e) Sheathing material in case of aluminum; and
f) Country of manufacturer.

NOTE — Additional marking are allowed, provided they do not give rise to misunderstanding.

7.2 An instructions sheet giving necessary instructions including precautions to be taken for proper use of heating element shall be provided.

7.3 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

8 PROTECTION AGAINST ACCESS TO LIVE PARTS

Clause **8** of IS 302 (Part 1) is applicable only for heating elements where the terminals are enclosed in a cover.

9 STARTING OF MOTOR-OPEARATED APPLIANCES

This clause of IS 302 (Part 1) is not applicable.

10 POWER INPUT AND CURRENT

Clause **10** of 302 (Part 1) is applicable.

11 HEATING

Clause **11** of IS 302 (Part 1) is applicable except as follows:

11.2 Addition

In case of heating element for water heating, the tank is filled with water to at least 10 mm above the highest point of heating element or the highest level allowed by the construction. The heating element is operated at 1.15 times the rated power input with all controls in the circuit. The water temperature shall not exceed 98 °C.

Heating element for oil heating shall be fitted with all controls and filled with oil of following properties in an appropriate container so designed that the temperature of the heating medium does not go beyond the values specified for the particular grade of oil.

Oil	*Maximum Temperature of the Heating Medium C*
Grade L V fuel oil (*see* IS 1593) and coal tar fuel of viscosity 60 to 100 Redwood No. 1 *see* at 37.8 °C	176.7
Grade M V fuel oil (*see* IS 1593) and coal tar fuel of viscosity 1 000 to 1 500 Redwood No. 1 *see* at 37.8 °C	193.7
Grade HV fuel oil (*see* IS 1593) and coal tar fuel of viscosity 70 to 120 standard tar viscometer *see* at 30 °C	210.0

Heating elements meant for air heating are placed at a distance of 15 cm from the face and wall of the test corner in the most unfavourable position for a period of 30 min.

11.101 Addition:

In case of oil heating element, the temperature at any point on the surface should not be high as to constitute a fire hazard or to damage any material employed in the heater and the temperature rise at specified part shall not exceed the values indicated in Table 3 of IS 302 (Part 1) .

12 VOID

13 LEAKAGE CURRENT AND ELECRICAL STRENGTH AT OPERATING TEMPERATURE

Clause **13** of IS 302 (Part 1) is applicable.

14 TRANSIENT OVER VOLTAGES

Clause **14** of IS 302 (Part 1) is applicable.

15 MOISTURE RESISTANCE

Clause **15** of IS 302 (Part 1) is applicable except as follows:

15.2 Not applicable.

16 LEAKAGE CURRENT AND ELECTRIC STRENGTH

Clause **16** of IS 302-1 is applicable.

17 OVERLOAD PROTECTION OF TRANSFORMERS AND ASSOCIATED CIRCUITS

This clause of IS 302-1 is not applicable.

18 ENDURANCE

18.1 The element shall be subjected to this test in the medium for which it is designed under the conditions of adequate heat discharge. The element shall be operated at 1.15 times the rated input for 96 operating hours. At the end of the test, the element shall withstand for high voltage test of **13.3** of IS 302-1.

NOTE — in case of heating element for water heating, the quantity of water in the tank shall be 2.0 to 2.5 liters per 100 W. The water being initially at the ambient temperature.

19 ABNORMAL OPEARTION

Clause **19** of IS 302-1 is applicable.

20 STABILITY AND MECHANICAL HAZARDS

Clause **20** of IS 302-1 is applicable except as follows:

20.1 Replacement

Heating elements and their accessories shall have no sharp edges, burrs or the like which might cause injury to the user, other than those necessary for the function of the heating element.

Compliance is checked by inspection.

21 MECHANICAL STRENGTH

Clause **21** of IS 302-1 is applicable.

22 CONSTRUCTION

This clause of IS 302-1 is applicable except as follows:

22.101 *Additional Subclause*

The resistance wire used for heating element shall be located centrally within the casing in such a manner as to prevent any relative movement or contact between the element wire and the casing and shall be so arranged as to maintain effective electrical contact with the connecting leads. Connections between the terminals and the element shall be made in a secure and durable manner.

22.102 The watt density for oil heaters shall be as agreed to between the purchaser and the manufacturer.

22.103 Heating elements may be provided with automatic temperature control and non-self resetting cut-out.

NOTE — The automatic temperature control/cut-out may be either supplied along with the heating element or may be procured separately. However, in later case, arrangement for fitting the automatic temperature control device on heating element shall be provided by the manufacturer for heating element for oil.

22.104 A part in contact with liquid shall be resistant to the action of such liquid.

22.105 For any rubber part in contact with liquid when subjected to immersion test according to IS 3400 (Part 6), the change in volume shall not be more than 25 percent swelling or 1 percent shrinkage and the weight loss (extraction) shall not be more than 10 percent. The test should be made in the liquid for which the immersion heating element is meant.

22.106 An automatically actuated part of liquid heating element shall be made of metal resistant to corrosion or of metal protected by a corrosion resistant finish that will not be impaired by exposure, wear etc. during expected service life of the heater.

22.107 Any sheath, capillary, well or other part shall be adequately resistant to attack by the oil it may normally come in contact in service where failure of the part may permit external leakage or cause unsafe operation.

22.108 For oil heaters uncoated non-stainless ferrous materials are considered to satisfy the requirement specified in **22.107** when made of sheet metal not less than 0.4mm in thickness. Brass alloys in sheet form are not considered resistant to the corrosive effects of fuel oils.

22.109 If warping of a casting may affect the tightness of liquid-confining joints or the necessary fit of parts, the casting shall be stress relieved to reduce the possibility of warping to a minimum.

22.110 For flat flanges, a vegetable-fiber gasket shall not be less than 0.8 mm thick, synthetic rubber gaskets shall have thickness of not less than 1.6 mm.

22.111 The mineral filling material such as magnesium oxide shall be of such quality as to withstand the thermal shock. It shall not deteriorate by the heating and cooling.

22.112 The resistance wire used for heating element shall be confirming to IS 3725.

23 INTERNAL WIRING

Clause **23** of IS 302-1 is applicable.

24 COMPONENTS

This clause of IS 302-1 is applicable except as follows:

24.2 Replacement

Heating element shall not be fitted with:

a) Switches in flexible cable or cords;
b) Devices which, in the fault in the appliances cause the interruption of the supply by applying a short circuit;
c) Thermal cut-outs that can be reset by a soldering operation;
d) Self resetting thermal cut-outs.

25 SUPPLY CONNECTIONS AND EXTERNAL FLEXIBLE CABLES AND CORDS

This clause of IS 302-1 is applicable except as follows:

25.1 Replacement

Heating element shall be provided with a means of connection to supply, in the form of a set of terminals for supply leads.

26 TERMINAL FOR EXTERNAL CONDUCTERS

Clause **26** of IS 302 (Part 1) is applicable

27 PROVISION FOR EARTHING

This clause of IS 302 (Part 1) is applicable if earthing terminal is provided.

28 SCREWS AND CONNECTIONS

This clause of IS 302 (Part 1) is applicable in case of screw type terminals.

29 CLEARANCE, CREEPAGE DISTANCE AND SOLID INSULATION

Clause **29** of IS 302 (Part 1) is applicable.

30 RESISTANCE TO HEAT AND FIRE

Clause **30** of IS 302 (Part 1) is applicable.

31 RESISTANCE TO RUSTING

Clause **31** of IS 302 (Part 1) is applicable.

32 RADIATION TOXICITY AND SIMILAR HAZARDS

This clause of IS 302 (Part 1) is not applicable.

101. TESTS

101.0 Categories of Tests

Tests are specified as type, acceptance and routine tests.

101.1 Type Tests

The tests specified in Table 101 shall constitute the type tests and shall be carried out on one sample of heating element selected preferably at random from a regular production lot. Before commencement of the tests, the heating element shall be visually examined and inspected for obvious visual defects in respect of components, parts and their assembly, construction, mechanical hazards, marking and provision of suitable terminals for supply connections.

Table 101 schedule of Type Tests

(*Clause* 101.1 **)**

Sl No.	Test	Reference of Clause No.
(1)	(2)	(3)
i)	Protection against access to live parts	**8**
ii)	Power input and current	**10**
iii)	Heating	**11**
iv)	Leakage current and electric strength at operating temperature	**13**
v)	Transient over voltages	**14**
vi)	Moisture Resistance	**15**
vii)	Leakage current and electric strength	**16**
viii)	Endurance	**18**
ix)	Abnormal Operation	**19**
x)	Stability and Mechanical hazards	**20**
xi)	Mechanical Strength	**21**
xii)	Construction	**22**
xiii)	Internal wiring	**23**
xiv)	Components	**24**
xv)	Supply connection and external flexible cables and cords	**25**
xvi)	Terminal for external conductors	**26**
xvii)	Provision for earthing	**27**
xviii)	Screws and connections	**28**
xix)	Clearance, Creepage Distance and Solid Insulation	**29**
xx)	Resistance to heat and fire	**30**
xxi)	Resistance to rusting	**31**
xxii)	Leakage and hydrostatic strength (for oil heating elements)	**102**

101.1.1 *Criteria of Acceptance*

The sample shall successfully pass all the type tests for proving conformity with the requirements of the standard. If sample fails in any of the type tests, the testing authority, at its discretion, may call for fresh

sample(s) not exceeding twice the original number and subject them again to all tests or to the test(s) in which failure(s) had occurred. No failure should be permitted in repeat test(s).

101.2 Acceptance Test

The tests specified in Table 101.2 shall constitute the Acceptance tests:-

Table 101.2 schedule of Type Tests

(*Clause* 101.2)

Sl No.	Test	Reference of Clause
(1)	(2)	(3)
i)	Protection against access to live parts	8
ii)	Power input and current	10
iii)	Heating	11
iv)	Leakage current and electric strength at operating temperature	13
v)	Moisture resistance	15
vi)	Leakage current and electric strength	16
vii)	Provision for earthing	27
viii)	Leakage and hydrostatic strength (for oil heating elements)	102

NOTE — For the purpose of acceptance test, the humidity treatment shall be of 24 h.

101.3 Routine Tests

The tests specified in Table 101.3 shall constitute the Routine tests:-

Table 101.3 schedule of Type Tests

(*Clause* 101.3)

Sl No.	Test	Reference of Clause
(1)	(2)	(3)
i)	Protection against access to live parts	**8**
ii)	Power input and current	**10**
iii)	Leakage current and electric strength at operating temperature	**13**
iv)	Leakage and hydrostatic strength (for oil heating elements)	**102**

NOTE — Before commencement of the test, the heating element shall be visually examined and inspected for the obvious visual defects in respect of components, parts and their assembly, construction, mechanical hazards, marking and provision of suitable terminals for supply connections.

102. LEAKAGE AND HYDROSTATIC STRENGTH TEST

102.1 All parts of an oil heater which are subjected to liquid pressure during normal usage shall withstand, without leakage, a hydrostatic pressure of one and a half times the rated pressure of the assembly and without rupture or permanent distortion, a hydrostatic pressure of five times the rated pressure of the assembly, but not less than 420 kPa.

102.2 A representative sample of the largest assembly shall be used for this test. If both screwed and flanged type mountings are furnished, a sample of each type is to be tested.

102.3 Hydrostatic pressure is to be applied and uniformly increased upto one and half times rated pressure and maintained for a period of at least one minute. No leakage of test liquid is to occur during this period.

102.4 Hydrostatic pressure is to be applied and uniformly increased up to five times rated pressure, but not less than 420 kPa (4.2 kg/cm²) and maintained for one additional minute.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Electrical Appliances Sectional Committee, ETD 32

Organization	*Representative(s)*
Central Electricity Authority, New Delhi	Shri A. K. Rajput (***Chairman***)
Bajaj Electricals Limited, Mumbai	Shri Chandra Veer Singh
BSH Household Appliances Manufacturing Private Limited, Chennai	Shri Balasubramanian Anand
Bureau of Energy Efficiency, New Delhi	Shri Samir Pandita Shri Kamran Shaikh (*Alternate* I) Ms Neha Kumari (*Alternate* II)
Central Electricity Authority, New Delhi	Shrimati Vandana Singhal
Central Public Works Department, New Delhi	Shri A. K. Goel Shri Mukesh Vij (*Alternate*)
Consumer Education and Research Centre, Ahmedabad	Ms Shweta Mahajan
Consumer Voice, New Delhi	Mr H. S. Wadhwa
Crompton Greaves Power and Industrial Solutions Limited, Mumbai	Shri Mayur Nadkarni
Defence Research and Development Organization, Research Centre Imarat, Hyderabad	Prafulla Chandra
Developement Commissioner Micro – Small and Medium Enterprises	Shri S. K. Saini
Dyson Technology India Pvt Ltd, Gurugram, Haryana	Shekh Tazimul Haque Faridi
Electrical Appliances Manufacturers Association	J. K. Oberoi Parkash Atam (*Alternate*)
Electrical Research and Development Association	Shri Rakesh Patel Dr Vinod Gupta (*Alternate*)
Electronics Regional and Test Laboratory (North), New Delhi	Manjula Bhati
Indian Fan Manufactures Association	Tilak Nijhara Shri Subroto Banerjee (*Alternate*)
Havells India Limited, Noida	Mr Rajeev Kumar Gupta Mr Girishankar Pathak (*Alternate* I) Shri Diwan Singh Kholia (*Alternate* II)
Ministry of Commerce and Industry, Department of Policy and Promotion, New Delhi	S. K. Jain
National Test House, Kolkata	Uma Bhakta
Petroleum Conservation Research Association, New Delhi	Shri P. K. Purkayashta
Philips India Limited, Gurugram	Vivek Sharma
Racold Thermo Limited, Pune	Trishala Chougule Mahesh Bhangale (*Alternate*)

Organization	*Representative(s)*
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Venus Safety and Health Private Limited, Navi Mumbai	Shri I. Ram Kumar
Whirlpool Corporation, Gurugram	Ms Poonam Dake
In Personal Capacity	Shri P. K. Mukherjee
BIS Directorate General	Shri Rajeev Sharma, Scientist 'F' and Head (ETD) [Representing Director General (*Ex-officio*)]

Member Secretary

Shri Sumit Bhardwaj
Scientist 'C' (ETD), BIS

Bureau of Indian Standards

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices: *Telephones*

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002 — 2323 7617, 2323 3841

Eastern : 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi, KOLKATA 700054 — 2337 8499, 2337 8561, 2337 8626, 2337 9120

Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, CHANDIGARH 160019 — 265 0206, 265 0290

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113 — 2254 1216, 2254 1442, 2254 2519, 2254 2315

Western : Manakalaya, E9 MIDC, Marol, Andheri (East), MUMBAI 400093 — 2832 9295, 2832 7858, 2832 7891, 2832 7892

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