UL 1030

ISBN 1-55989-686-8

Sheathed Heating Elements

Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60062-2096

UL Standard for Safety for Sheathed Heating Elements, UL 1030

Sixth Edition, Dated November 2, 1994

Revisions: This Standard contains revisions through and including December 17, 1999.

Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The new and revised requirements are substantially in accordance with UL's Bulletin(s) on this subject dated May 31, 1996. The bulletin(s) is now obsolete and may be discarded.

The revisions dated December 17, 1999 include a reprinted title page (page1) for this Standard.

A portion of the revisions dated December 17, 1999 were issued for editorial corrections. These corrections include the updated Foreword (item D), the updated Scope, and removal of the undated references paragraph. These revisions may also include other miscellaneous editorial corrections.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

As indicated on the title page (page1), this UL Standard for Safety has been adopted by the Department of Defense.

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

UL's Standards for Safety are copyrighted by UL. Neither a printed copy of a Standard, nor the distribution diskette for a Standard-on-Diskette and the file for the Standard on the distribution diskette should be altered in any way. All of UL's Standards and all copyrights, ownerships, and rights regarding those Standards shall remain the sole and exclusive property of UL.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical photocopying, recording, or otherwise without prior permission of UL.

Revisions of UL Standards for Safety are issued from time to time. A UL Standard for Safety is current only if it incorporates the most recently adopted revisions.

UL provides this Standard ″as is″ without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability or fitness for any purpose.

In no event will UL be liable for any special, incidental, consequential, indirect or similar damages, including loss of profits, lost savings, loss of data, or any other damages arising out of the use of or the inability to use this Standard, even if UL or an authorized UL representative has been advised of the possibility of such damage. In no event shall UL's liability for any damage ever exceed the price paid for this Standard, regardless of the form of the claim.

UL will attempt to answer support requests concerning WordPerfect, Envoy, and Standards-on-Diskette. However, this support service is offered on a reasonable efforts basis only, and UL may not be able to resolve every support request. UL supports a Standards-on-Diskette only if it is used under the conditions and operating systems for which it is intended. UL's support policies may change from time-to-time without notification.

UL reserves the right to change the format, presentation, file types and formats, delivery methods and formats, and the like of both its printed and electronic Standards without prior notice.

Standards-on-Diskette purchasers agree to defend, indemnify, and hold UL harmless from and against any loss, expense, liability, damage, claim, or judgement (including reasonable attorney's fees) resulting from any error or deviation introduced while purchaser is storing a Standard-on-Diskette on the purchaser's computer system.

If a single-user version Standards-on-Diskette was purchased, one copy of this Standard may be stored on the hard disk of a single personal computer, or on a single LAN file-server or the permanent storage device of a multiple-user computer in such a manner that this Standard may only be accessed by one user at a time and for which there is no possibility of multiple concurrent access. The original distribution diskette should be stored in a safe place.

If a multiple-user version Standards-on-Diskette was purchased, one copy of the Standard may be stored on a single LAN file-server, or on the permanent storage device of a multiple-user computer. The number of concurrent users shall not exceed the number of users authorized for the Standards-on-Diskette version. The original distribution diskette should be stored in a safe place.

Standards-on-Diskette are intended for on-line use, such as for viewing the requirements of a Standard, conducting a word search, and the like. Only one copy of the Standard may be printed from each single-user version of a Standards-on-Diskette. Only one copy of the Standard may be printed for each authorized user of a multiple-user version of a Standards-on-Diskette. An employee of an organization purchasing a Standard-on-Diskette can make a copy of the page or pages being viewed for their own fair and/or practical internal use. Because of differences in the computer/software/printer setup used by UL and those of Standards-on-Diskette purchasers, the printed copy obtained by a purchaser may not look exactly like the on-line screen view or the printed Standard.

The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Classification and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

Copyright © 1999 Underwriters Laboratories Inc.

This Standard consists of pages dated as shown in the following checklist:

Page	Date
1-3	December 17, 1999
4	November 2, 1994
5-6B	December 17, 1999
7	November 2, 1994
8-10B	December 17, 1999
11-14	November 2, 1994
15	December 17, 1999
16-20	November 2, 1994

No Text on This Page

NOVEMBER 2, 1994 **ANSI/UL 1030-1994**
(Title Page Reprinted: December 17, 1999)

UL 1030

Standard for Sheathed Heating Elements

First Edition – July, 1973
Second Edition – July, 1975
Third Edition – February, 1979
Fourth Edition – September, 1986
Fifth Edition – November, 1991

Sixth Edition

November 2, 1994

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated November 2, 1994 . These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Approved as ANSI/UL 1030-1994, May 12, 1994

The Department of Defense (DoD) has adopted UL 1030 on January 2, 1992 . The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

ISBN 1-55989-686-8

COPYRIGHT © 1975, 1999 UNDERWRITERS LABORATORIES INC.

No Text on This Page

CONTENTS

FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover metal-sheathed heating elements intended for use in appliances and equipment that comply with the requirements for such appliances and equipment.

1.2 These requirements cover sheathed heating elements rated 600 volts or less.

1.3 These requirements do not cover heating elements for use in equipment for use in hazardous locations as defined in the National Electrical Code, NFPA 70.

1.4 Wherever the terms heating element and element are used in these requirements, they are intended to mean a sheathed heating element as defined in 2.4.

1.5 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements to determine that the level of safety as originally anticipated by the intent of this Standard is maintained. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard shall not be judged to comply with this Standard. Where appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

1.5 revised December 17, 1999

2 Glossary

2.1 For the purpose of this standard the following definitions apply.

2.2 DIELECTRIC VOLTAGE WITHSTAND – The ability of a heating element to withstand specified voltages applied between current-carrying parts and dead metal parts for specified times without flashover or puncture.

2.3 LEAKAGE CURRENT – A current, including a capacitively coupled current, that may be conveyed between exposed conductive surfaces of a heating element and ground.

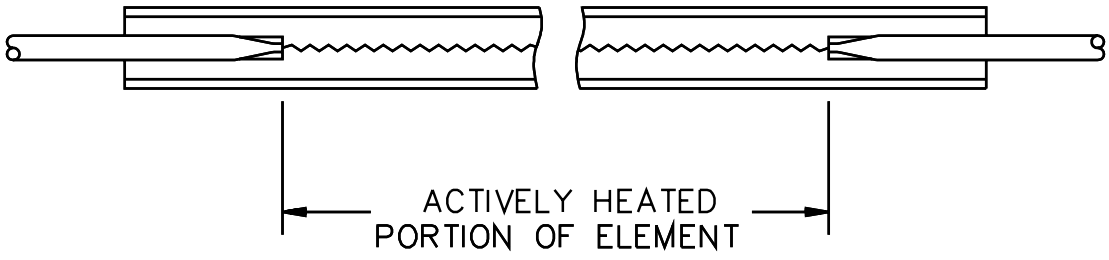
2.4 SHEATHED HEATING ELEMENT – A resistance element that is usually encased in magnesium oxide or encased in a similar insulating material that is, in turn, surrounded by a metal sheath.

2.5 SHEATH WATTAGE DENSITY – The watts per unit area of actively heated sheath surface area. The actively heated sheath surface area is considered to be the area of the exposed surface of that portion of the sheathed heating element between the terminal pins. See Figure 2.1.

2.6 TEST VOLTAGE – The voltage required to obtain rated watt density, but no less than the rated voltage of the heating element.

2.6 added December 17, 1999

Figure 2.1
Sheath wattage density



$$\text{SHEATH WATTAGE DENSITY}^{a} = \frac{\text{RATED WATTAGE}}{\text{ACTIVELY HEATED EXPOSED SHEATH SURFACE AREA}}$$

a – FORMULA BASED ON UNIFORM WATTAGE DENSITY ALONG THE LENGTH OF THE ELEMENT.

S3422

3 General

3.1 Units of measurement

3.1.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

3.2 Undated references

3.2.1 Deleted December 17, 1999

CONSTRUCTION

4 General

4.1 The acceptability of a heating element in any equipment or appliance depends upon its ability to withstand continued use under the conditions that prevail in actual service. In addition to the requirements contained herein, further considerations and investigations may be necessary, depending upon the intended installation and use of the sheathed heating element.

4.2 A sheathed heating element shall employ materials and components throughout that are acceptable for the use, and shall be made and finished with the degree of uniformity and grade of workmanship practicable in a well-equipped factory.

4.3 If a material or alloy not included in Table 13.1, a material provided with a coating, or a composite sheath utilizing dissimilar materials inside and outside is used, it shall be investigated to determine that the material is acceptable for the purpose and that it affords protection equivalent to that of the materials included in Table 13.1.

4.4 After being formed, the sheath of a heating element shall have a thickness not less than specified in Table 4.1.

No Text on This Page

Table 4.1
Sheath thickness

Application	Minimum thickness	
	Inch	(mm)
Surface-unit elements	0.016	(0.41)
Oven elements and space-heater elements:		
Stationary appliances	0.016	(0.41)
Portable appliances	0.013	(0.33)
Elements other than mentioned above, protected against mechanical damage	0.013	(0.33)

4.5 The values in Table 4.1 are intended to specify a minimum thickness for a sheath made of steel copper, copper-clad steel, or steel and nickel alloys. Increased thickness may be required, depending upon the particular end-use application of the heating element. A sheath made of aluminum or aluminum alloy and a sheath having a thickness less than specified in Table 4.1 is to be investigated under conditions of actual service to determine if it has the necessary mechanical properties and will withstand the most severe conditions likely to be met in service.

5 Insulation

5.1 An insulating washer, a bushing, or the like, that is an integral part of a heating element shall be of a material resistant to moisture, such as porcelain, and shall be acceptable for use at the maximum temperature to which it will be subjected under conditions of actual use. Such parts shall have adequate mechanical strength and rigidity to withstand the stress of actual service.

5.2 Insulating material employed in an integral part of a heating element, such as a terminal block, or the like, shall be strong, not easily ignited, and resistant to moisture. A material other than porcelain, phenolic, or one that is known to be acceptable for the support of current-carrying parts shall be investigated under conditions of actual service to determine if it has the necessary electrical and mechanical properties and will withstand the most severe conditions likely to be met in service.

5.3 The thickness of magnesium oxide (MgO) or other similar insulating material between the resistance element and the inside of the sheath, and the material of an end seal between the terminal pin and the inside of the sheath shall not be:

a) Less than 0.016 inch (0.41 mm) for elements rated 300 volts or less, and

b) Less than 0.031 inch (0.79 mm) for elements rated more than 300 volts.

5.4 To determine whether the distances between the resistance element and the sheath complies with the requirements of 5.3, measurements are to be made from two X-ray photographs of actual size taken in planes at right angles to each other at various points on the element.

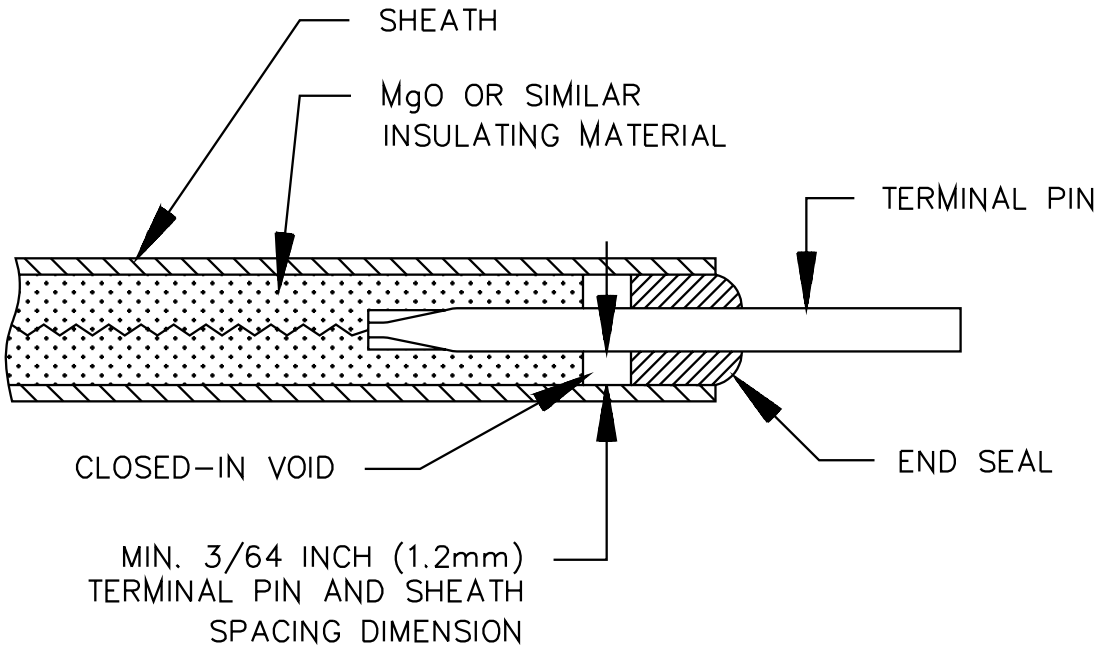
6 Spacings

6.1 A spacing, through air and over surface, of not less than 1/16 inch (1.6 mm) between live parts of opposite polarity and between live parts and dead metal parts shall be maintained at or near the end of the sheath of a heating element rated 300 volts or less. For an element rated more than 300 volts, the spacings at the end of the sheath shall not be less than 1/4 inch (6.4 mm).

Exception No. 1: If exact centering of a terminal pin is required to maintain the 1/16 inch spacing, a spacing of 3/64 inch (1.2 mm) in one location is acceptable.

Exception No. 2: For an element rated 300 volts or less, a spacing not less than 3/64 inch measured between a terminal pin and the sheath is acceptable at a closed-in void, such as between an end seal and the element insulating material. See Figure 6.1.

Figure 6.1
Spacings at closed-in voids



6.2 Spacings at wiring terminals shall be in accordance with the requirements for the end-use product.

PERFORMANCE

7 General

7.1 The performance of a heating element shall be investigated by subjecting representative samples to the tests described in Sections 8 – 13. Three samples in a set are to be subjected to the tests specified in Table 7.1. Insofar as practicable, the tests shall be conducted in the sequence specified in Table 7.1.

7.1 revised December 17, 1999

Table 7.1
Test sequence

Table 7.1 added December 17, 1999

Sample set	Number of samples	Test	Paragraph
A	3	Dielectric	9.1.1
		Resistance to Mostiture (Humidity Conditioning)	10.1
		Insulation Resistance	10.1(a)
		Dielectric	10.1(b)
B	3	Power Input	8.1
		Dielectric	9.1.1
		Leakage Current	11.1
		Endurance	12.1
		Temperature	13.1
		Leakage Current or Insulation Resistance	13.4(a) or 13.4(b)
		Dielectric	13.4(c)

7.2 Deleted December 17, 1999

7.3 For all tests, the heating element is to be mounted or installed in a manner that simulates its intended end-use application.

7.4 A representative test sample as mentioned in 7.1 is one that represents the combination of factors in (a) – (d) that results in the most severe test conditions for each material of sheath used.

a) Diameter of sheath.

b) Sheath wattage density ($W/in.^2$).

c) Number and sharpness of bends.

d) Rated voltage.

7.5 All test are to be performed at test voltage, see 2.6, except for the Thermal Endurance Test, Section 12, which is to be performed at 108 percent of test voltage.

7.5 added December 17, 1999

8 Power Input Test

8.1 At rated voltage, the power input to a heating element shall not be more than 105 percent of its marked wattage or volt-ampere rating.

8.2 To determine whether a heating element complies with the requirement in 8.1, the maximum power input is to be measured with the element connected to a supply circuit adjusted to:

a) Other than as noted in (b), the highest marked voltage rating.

b) If the highest marked voltage falls within a range of 100 – 120, 220 – 240, 257 – 277, or 440– 480 volts, the highest voltage of the range.

8.3 Power input is to be recorded when element temperatures have stabilized. A temperature is considered stabilized when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5-minute intervals, indicate no change.

9 Dielectric Voltage-Withstand Test

9.1 General

9.1.1 A heating element shall withstand without breakdown for 1 minute the application of a 60-hertz essentially sinusoidal potential of the value specified in Table 9.1 between live parts and exposed dead metal parts. The test is to be conducted using the quadrature method described in 9.1.3 and 9.2.1.

Table 9.1
Potentials for dielectric voltage-withstand test

Method	Rating of element, volts	Test potential, volts
Quadrature[a]	0 – 250	1000
	251 – 600	1000 + 2V[b]
Single-phase[c]	0 – 250	1000 + V[b]
	251 – 600	1000 + 3V[b]

[a] The quadrature method is described in 9.2.1.
[b] V is the voltage determined in accordance with 8.2.
[c] The single-phase method is described in 9.3.1.

9.1.2 If a 3-phase source of supply is not available, and if it is agreeable to those concerned, the single-phase test described in 9.3.1 may be conducted instead of the test described in 9.2.1. The dielectric and power supply voltages are to be monitored to ensure that they are 180 degrees out-of-phase. Otherwise, the summation of the in-phase cycles will result in a net test potential in excess of what is required in Table 9.1.

9.1.3 To determine whether a heating element complies with the requirement in 9.1.1, the heating element is to be tested by means of a 500-volt-ampere or larger capacity transformer, the output voltage of which is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test level is reached, and is to be held at that level for 1 minute. The increase in the applied potential is to be at a substantially uniform rate as rapid as is consistent with correct indication of its value by a voltmeter.

9.2 Quadrature method

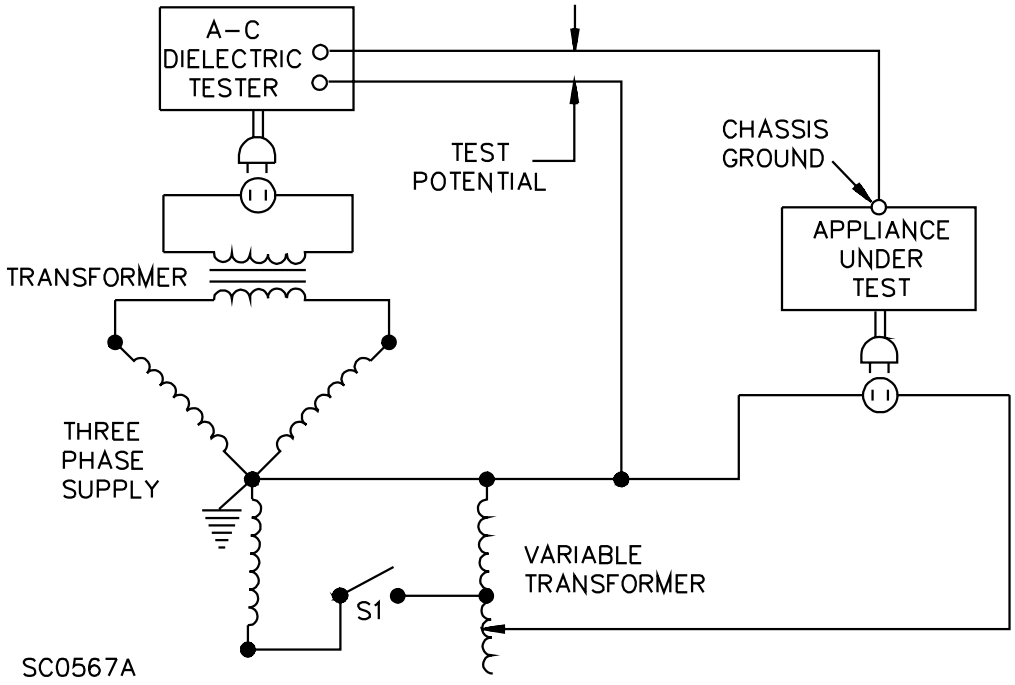
9.2.1 The element is to be connected to a test circuit as illustrated in Figure 9.1 and energized at rated voltage as described in 8.2. At stabilized temperature, the test potential is to be applied in quadrature. After 45 seconds, the element is to be de-energized – switch S1 in Figure 9.1 is to be opened – and the test potential is to be applied for an additional 15 seconds.

9.3 Single-phase method

9.3.1 The element is to be energized at rated voltage as described in 8.2. At stabilized temperature, the test potential specified in Table 9.1 from a single-phase source of supply is to be applied. After 45 seconds, the element is to be de-energized and application of the test potential is to be continued for an additional 15 seconds.

No Text on This Page

Figure 9.1
Circuit diagram for quadrature dielectric test



10 Resistance to Moisture Test

10.1 After a heating element is conditioned for 60 days in moist air having a relative humidity of 85 ±5 percent at a temperature of 32 ±2°C (90 ±4°F):

a) The insulation resistance shall not be less than 50,000 ohms after being operated to thermal stabilization, and

b) The heating element shall comply with the dielectric voltage-withstand test in 9.1.1.

10.2 Ordinarily, insulation resistance is to be measured by means of a voltmeter having an internal resistance of 30,000 ohms and using a 250 volt direct-current, or equivalent circuitry.

11 Leakage Current Test

11.1 The leakage current of a heating element intended for use in a household or similar cord-connected appliance, when tested in accordance with 11.2 and 11.4 (a) and (b), shall not exceed the values specified in Table 11.1. The values recorded during testing in accordance with 11.4(c) shall comply with the requirements for the appliance in which the heating element is to be used.

Exception: A heating element intended exclusively for use in a household electric range, oven, or surface assembly having exposed metal parts connected to the neutral terminal or lead at the factory, or provided with a four-conductor cord at the factory need not be tested for leakage current. See 16.3.

Table 11.1
Maximum acceptable leakage current

Intended use	Maximum leakage current, mA
120 volt two wire appliance	0.50
120/240 volt portable appliance	0.50
120/240 volt stationary or fixed appliance	0.75
NOTE – Additional leakage current requirements may be found in individual product standards.	

11.2 The measurement circuit for leakage current is to be as illustrated in Figure 11.1. The measurement instrument is defined in (a) – (c). The meter that is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the defined instrument. The meter used need not have all the attributes of the defined instrument.

a) The meter is to have an input impedance of 1500 ohms resistive shunted by a capacitance of 0.15 microfarad.

b) The meter is to indicate 1.11 times the average of the full-wave rectified composite waveform of voltage across the resistor or current through the resistor.

c) Over a frequency range of 0 – 100 kilohertz, the measurement circuitry is to have a frequency response – ratio of indicated to actual value of current – that is equal to the ratio of the impedance of a 1500 ohm resistor shunted by a 0.15 microfarad capacitor to 1500 ohms. At an indication of 0.5 milliampere, the measurement is to have an error of not more than 5 percent at 60 hertz.

11.3 The meter is to be connected between the sheath and the grounded supply conductor.

11.4 A sample of the heating element is to be tested for leakage current when connected to a supply voltage of 120 or 240 volts, as applicable. The test sequence, with reference to the measuring circuit – Figure 11.1 – is to be as follows:

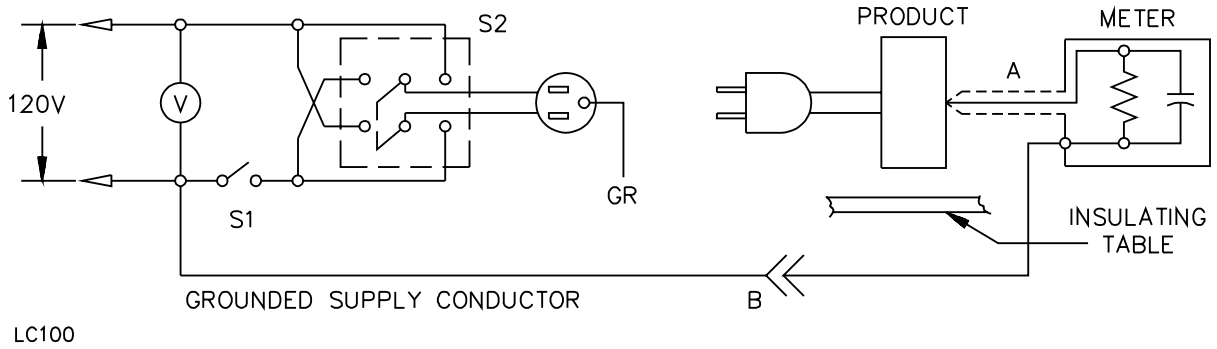
a) With switch S1 open, the element is to be connected to the measuring circuit. Leakage current is to be measured using both positions of switch S2.

b) Switch S1 is then to be closed energizing the element, and within 5 seconds, the leakage current is to be measured using both positions of switch S2.

c) The leakage current is to be monitored using both positions of switch S2 until thermal stabilization as described in 8.3 is reached. At thermal stabilization, switch S1 is to be opened, de-energizing the heating element, and the leakage current is to be monitored using both positions of switch S2. The monitoring is to be continued while the element is cooling, using both positions of switch S2.

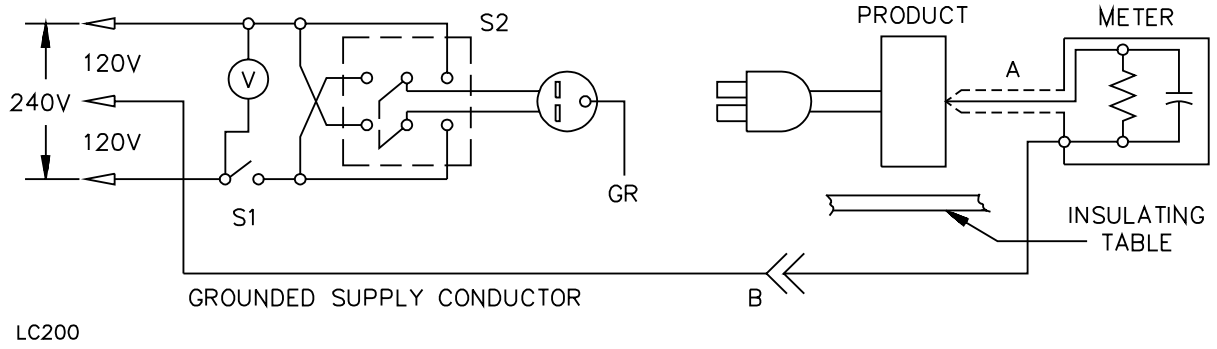
11.5 Normally, the complete leakage-current-test program as described in 11.4 is to be conducted, without interruption for other tests. With the concurrence of those concerned, the leakage-current tests may be interrupted for the purpose of conducting other nondestructive tests.

Figure 11.1
Leakage current measurement circuits



LC100

Heating element intended for use in an appliance intended for connection to a nominal 120-volt power supply.



LC200

Heating electmen intended for use in an appliance intended for connection to a nominal 120/240-volt, 30wire, grounded-neutral power supply.

NOTE:

A: Probe with shielded lead.

B: Separated and used as clip when measuring currents from one part of device to another.

12 Thermal Endurance Test

12.1 When tested as described in 12.2 :

a) A heating element shall not rupture nor otherwise exhibit mechanical damage,

b) There shall be no emission of flame or molten metal, and

c) The fuse connected to the element sheath shall not open.

12.2 The elements are to be subjected to 1000 cycles of heating and cooling, each cycle consisting of 60 minutes on and 20 minutes off. During the thermal endurance test, the sheath of the heating element is to be grounded through a 3-ampere fuse and the heating element samples are to be connected to a supply voltage equal to 108 percent of the test voltage. With the concurrence of those concerned, test time may be reduced by forced cooling of the element.

Exception: A metal-sheathed oven broil heating element is to be subjected to 250 cycles of heating and cooling.

12.2 revised December 17, 1999

13 Temperature Test

13.1 At the completion of the thermal endurance test described in Section 12, Thermal Endurance Test, the supply voltage is to be adjusted to the input test voltage. After temperatures have stabilized, see 8.3, the temperature of the sheath shall not exceed the applicable limit specified in Table 13.1. See 5.1 and 5.2.

Exception: Table 13.1 specifies the maximum acceptable sheath temperatures for heating elements used in air. Higher temperatures may be acceptable, depending upon the particular end-use application of the heating element.

Table 13.1
Temperature limits for sheathed heating element materials

Material	Maximum temperature	
	°F	°C
A. METALLIC MATERIALS		
1. Copper	350	177
2. Aluminum	500	260
3. Brass	750	399
4. Cold rolled steel	750	399
5. Nickel silver	1000	538
6. Stainless steel[a]		
a. Types 302, 303, 304, 316, 321, 347	1400	760
b. Type 309S	1500	816
c. Type 310	1600	871
d. Types 403,405,410,416,501	1200	649
e. Type 430	1300	704
f. Type 442	1400	760
g. Type 446	1500	816
7. Nickel alloys[b]		
a. Alloy 400	900	482
b. Alloy 600	1800	982
c. Alloy 800	1700	927
d. Alloy 825	1100	593
e. Alloy 840	1700	927
8. Cast iron	1200	649
B. NONMETALLIC MATERIALS[c]	Recognized temperature rating	

[a] American Iron and Steel Institute (AISI) type designations.

[b] American Society of Mechanical Engineers (ASME) type designations.

[c] Includes but is not limited to insulated wire, polymeric materials, bushings, washers, end seals, and the like.

13.2 The temperatures specified in Table 13.1 are based on an assumed ambient temperature of 25°C (77°F). A test may be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F). If a test is conducted at an ambient temperature other than 25°C, the difference between the test ambient and 25°C is to be added to or subtracted from the values indicated in Table 13.1.

13.3 Sheath temperatures are to be measured by thermocouples attached to the hottest points on the sheath by welding, brazing, or other equivalent means.

13.4 Immediately after the temperature test and with the element at room temperature:

a) A heating element requiring testing in accordance with Section 11, Leakage Current Test, shall be subjected to a repeat leakage current test. The leakage current shall not be more than the applicable value specified in Table 11.1.

b) A heating element not requiring testing in accordance with Section 11 shall have an insulation resistance not less than 50,000 ohms.

c) A heating element shall comply with the dielectric voltage-withstand test in 9.1.1.

MANUFACTURING AND PRODUCTION TESTS

14 Dielectric Voltage-Withstand Test

14.1 Each heating element shall withstand without electrical breakdown, as a routine production-line test, the application of a potential as specified in Table 14.1 applied between live and exposed dead metal parts.

14.2 The production-line test shall be in accordance with either the 60-second test or the 1-second test in Table 14.1.

14.3 For the 60-second single-phase test, the heating element is to be energized at rated voltage and subjected to the test when temperatures have stabilized.

14.4 For the 60-second quadrature test, the test potential is to be applied by the method illustrated in Figure 9.1. The heating element is to be energized at rated voltage and subjected to the test when temperatures have stabilized.

14.5 For the 1-second single-phase and direct-current tests, the element need not be preheated. The potential is to be applied while the heating element is cold and de-energized.

14.6 For the 1-second quadrature test, the test potential is to be applied by the method illustrated in Figure 9.1. The element need not be preheated. The test potential is to be applied while the element is energized.

Table 14.1
Production-line test conditions

Method[a]	Application time, seconds	Applied potential		
		Volts		Frequency
		Element rating, volts		
		0 – 250	251 – 600	
1	60	1000	1000+2V[b]	60 Hz
2	60	1000+V[b]	1000+3V[b]	60 Hz
3	1	1200+1.2V[b]	1200+3.6V[b]	60 Hz
4	1	1.7(1000+V)[b]	1.7(1000+3V)[b]	DC
5	1	1200	1200+2.4V[b]	60 Hz

[a] Method 1 is described in 14.4; method 2 is described in 14.3; methods 3 and 4 are described in 14.5; and method 5 is described in 14.6.
[b] V is the voltage determined in accordance with 8.2.

14.7 The test equipment is to include a visible indication of application of the test potential and an indication of breakdown that is audible or visible or both. In the event of breakdown, manual resetting of an external switch is to be required, or an automatic reject of the unit under test is to result. Other arrangements may be considered and accepted if found to achieve the results contemplated. A 500-volt-ampere or larger capacity transformer need not be used in tests by the manufacturer if the transformer is provided with a voltmeter to measure directly the applied output potential.

RATING

15 Details

15.1 A heating element shall be rated in volts and volt-amperes or watts. The voltage rating shall be any appropriate single voltage or range of voltage such as 100 – 120, 208, 220 – 240, 257 – 277, 416, 440 – 480, 550, 575, and 600.

MARKING

16 Details

16.1 A heating element shall be legibly and permanently marked with:

a) The manufacturer's name, trade name, or trademark or other descriptive marking by which the organization responsible for the heating element may be identified;

b) A distinctive ″catalog″ or ″model″ number or the equivalent;

c) The electrical rating; and

d) The date or other dating period of manufacture not exceeding any three consecutive months.

Exception No. 1: The manufacturer's identification may be in a traceable code if the heating element is identified by the brand or trademark owned by a private labeler.

Exception No. 2: The date of manufacture may be abbreviated; or may be in a nationally accepted conventional code or in a code affirmed by the manufacturer, provided that the code:

a) Does not repeat in less than 20 years, and

b) Does not require reference to the production records of the manufacturer to determine when the heating element was manufactured.

Exception No. 3: The electrical rating may be omitted if a separate identifying designation is assigned for each rating.

16.2 A heating element intended for use in a household or similar cord-connected appliance, see 11.1, or the container in which the element is shipped shall be marked to indicate such use.

16.3 A heating element intended exclusively for use in a household electric range, oven, or surface assembly – see the Exception to 11.1 – or the container in which such an element is shipped – shall be marked with the word ″CAUTION″ and the following or the equivalent: ″For use only in a household electric range, oven, or surface assembly where the exposed metal parts are connected to the neutral at the factory or provided with a four-conductor cord at the factory. Use in any other cord-connected household appliance may result in a risk of electric shock.″

16.4 If a manufacturer produces or assembles heating elements at more than one factory, each finished heating element shall have a distinctive marking, which may be in code, by which it may be identified as the product of a particular factory.

16.5 If the sheathed portion of the heating element is marked, the marking shall not be located on the outside diameter of a bend, and the element shall comply with the performance requirements in the standard after the marking is applied.

16.6 A heating element not intended for use in free air, or the container in which the element is shipped, shall be marked with the word ″CAUTION″ and the specific use for which it is intended, such as ″For use only submersed in water″ or ″For use only in a metal heat sink.″

16.7 The marking specified in 16.2, 16.3, and 16.6 shall appear on the heating element or shipping container. The marking may also be included in the installation instructions but shall be separated in format from the installation instructions.

No Text on This Page