

UL 1026

ISBN 1-55989-889-5

Electric Household Cooking  
and Food Serving Appliances



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

UL Standard for Safety for Electric Household Cooking and Food Serving Appliances, UL 1026

Fourth Edition, Dated July 27, 1995

Revisions: This Standard contains revisions through and including May 28, 2002.

UL Standards for Safety are developed and maintained in the Standard Generalized Markup Language (SGML). SGML -- an international standard (ISO 8879-1986) -- is a descriptive markup language that describes a document's structure and purpose, rather than its physical appearance on a page. Due to formatting differences resulting from the use of UL's new electronic publishing system, please note that additional pages (on which no requirements have been changed) may be included in revision pages due to relocation of existing text and reformatting of the Standard.

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 December 26, 2001. The bulletin(s) is now obsolete and may be discarded.

The following table lists the future effective dates with the corresponding item.

Future Effective Dates	References
November 28, 2003	13.2, 41.1.2, 41.1.3, 41.1.4

The revisions dated May 28, 2002 include a reprinted title page (page1) for this Standard.

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.

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 electronic versions of its Standards. 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 the electronic versions of its Standards only if they are 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.

Purchasers of the electronic versions of UL's Standards for Safety 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 an electronic Standard on the purchaser's computer system.

If a single-user version electronic Standard 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.

If a multiple-user version electronic Standard 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, or on an Intranet server. The number of concurrent users shall not exceed the number of users authorized.

Electronic Standards 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 an electronic Standard. Only one copy of the Standard may be printed for each authorized user of a multiple-user version of an electronic Standard. Because of differences in the computer/software/printer setup used by UL and those of electronic Standards purchasers, the printed copy obtained by a purchaser may not look exactly like the on-line screen view or the printed Standard.

An employee of an organization purchasing a UL Standard can make a copy of the page or pages being viewed for their own fair and/or practical internal use.

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 Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

Copyright © 2002 Underwriters Laboratories Inc.

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

Page	Date
1-2B .....	May 28, 2002
3 .....	January 22, 2001
4-5 .....	May 28, 2002
6 .....	May 1, 2000
7-8 .....	February 2, 1999
9-10 .....	July 27, 1995
11 .....	March 26, 1996
12-17 .....	July 27, 1995
18 .....	November 15, 1996
19 .....	July 27, 1995
20 .....	May 1, 2000
21 .....	February 2, 1999
22 .....	November 17, 1998
23 .....	February 2, 1999
24 .....	July 27, 1995
25-27 .....	February 2, 1999
28 .....	July 27, 1995
29-30B .....	May 28, 2002
31-45 .....	July 27, 1995
46-50 .....	January 22, 2001
51-53 .....	November 17, 1998
54 .....	July 27, 1995
55-56B .....	November 17, 1998
57 .....	July 27, 1995
58 .....	January 22, 2001
59-62 .....	July 27, 1995
63 .....	November 17, 1998
64-64B .....	May 28, 2002
65-66F .....	November 17, 1998
67-70 .....	February 2, 1999
71-72B .....	January 22, 2001
73-76 .....	February 2, 1999
77-84 .....	July 27, 1995
85-86 .....	February 2, 1999
87-90 .....	July 27, 1995
91 .....	February 2, 1999
92 .....	July 27, 1995
A1-A2 .....	January 22, 2001
B1-B2 .....	January 22, 2001
SR1-SR2 .....	May 28, 2002

No Text on This Page

**JULY 27, 1995**  
(Title Page Reprinted: May 28, 2002)

1

## **UL 1026**

### **Standard for Electric Household Cooking and Food Serving Appliances**

Prior to the first edition, the requirements for the products covered by this standard were included in the Standard for Electric Heating Appliances, UL 499.

First Edition – November, 1975  
Second Edition – March, 1981  
Third Edition – September, 1988

#### **Fourth Edition**

**July 27, 1995**

The most recent approval of UL 1026 as an American National Standard (ANSI) occurred on April 16, 2002 and covers the Fourth Edition, including revisions through May 28, 2002. Approval of UL 1026 as an American National Standard is maintained using the continuous maintenance process. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Written comments are to be sent to the UL-MEL Standards Department, 1285 Walt Whitman Road, Melville, New York 11747-3081.

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

Approved as ANSI/UL 1026-1980, July 3, 1980  
Approved as ANSI/UL 1026-1980, June 3, 1988  
Approved as ANSI/UL 1026-1995, February 6, 1995  
Approved as ANSI/UL 1026-2002, April 16, 2002

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 1-55989-889-5**

**COPYRIGHT © 1975, 2002 UNDERWRITERS LABORATORIES INC.**

No Text on This Page



## CONTENTS

FOREWORD .....	4
----------------	---

## INTRODUCTION

1 Scope .....	5
2 Components .....	5
3 Units of Measurement .....	6
4 References .....	6

## CONSTRUCTION

5 General .....	6
6 Frame and Enclosure .....	6
7 Assembly .....	14
8 Stability .....	15
9 Corrosion Protection .....	15
10 Supply Connections .....	15
10.1 Permanently connected appliances .....	15
10.2 Cord-connected appliances .....	17
11 Current-Carrying Parts .....	25
12 Internal Wiring .....	26
12.1 General .....	26
12.2 Protection of wiring .....	26
12.3 Splices .....	27
12.4 Separation of circuits .....	27
13 Heating Elements .....	29
14 Electrical Insulation .....	30
15 Thermal Insulation .....	30
16 Motors .....	30A
17 Motor-Running Overcurrent (Overload) Protection .....	31
18 General (Short-Circuit and Ground-Fault) Overcurrent Protection .....	31
19 Overcurrent and/or Over-Temperature Protection .....	31
20 Lampholders .....	32
21 Power-On Indicator – Toaster Ovens, Toaster Oven/Broilers .....	32
22 Switches .....	33
23 Dual Voltage Appliance .....	33
24 Automatic Controls and Control Circuits .....	34
25 Overheating Protection .....	34
26 Spacings .....	35
26.1 Line-voltage circuits .....	35
27 Grounding .....	37
28 Pressure Vessels and Parts Subject to Pressure .....	38
29 Protection Against Personal Injury .....	40

## PERFORMANCE

30 General .....	40
31 Power Input Test .....	41
32 Leakage Current Tests .....	41
33 Operational Tests .....	44

34	Calibration of Probe-Type Temperature Controls Tests	44
34.1	Ovens	44
34.2	Other appliances	45
34.3	All appliances	45
35	Normal Temperature Test	45
35.1	General	45
35.2	Specific test condition	53
36	Top-Front Edge Temperatures– Convection Ovens Tests	56A
37	Tests for Insulation Resistance and Leakage Current as a Result of Moisture	59
38	Dielectric Voltage-Withstand Test	61
39	Mechanical Endurance Test	62
40	Broken Element Test	63
40A	Push-Back Relief Test	63
41	Overflow Test	63
41.1	General	63
41.2	Fill	64
42	Metal Enclosure Impact Tests	64A
42A	Non-Metallic Enclosure-Fasteners Test	66A
43	Thermal Degradation Test	66E
44	Abnormal Operation Test	67
44.1	General	67
44.2	Specific test conditions	69
45	Under-Cabinet and Wall Mounted Appliances-Impact Test	72B
46	Loading Test	73
47	Temperature Probe Insertion Test	73
48	Component Switches and Control Devices	74
48.1	Overload	74
48.2	Endurance	75
48.3	Limited short circuit	77
49	Permanence of Marking	78
50	Test for Permanence of Cord Tag for Outdoor-Use Appliances	78
50.1	General	78

## MANUFACTURING AND PRODUCTION-LINE TESTS

51	Dielectric Voltage-Withstand Test	79
52	Polarization and Grounding Continuity Tests	81
52.1	Polarization test	81
52.2	Continuity of grounding connection	81
52.3	Electrical indicating device	81

## RATINGS

53	Details	82
----	---------	----

## MARKINGS

54	Details	82
55	Carton Marking	86

**INSTRUCTION MANUAL**

56 General .....87  
57 All Appliances .....88  
58 Specific Appliances .....89  
59 User Maintenance .....91

**APPENDIX A**

Standards for Components..... A1

**APPENDIX B**

Food Color Charts .....B1

## 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 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 or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this 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 electric household cooking and food serving appliances, rated at 250 V or less, other than those mentioned in 1.2, for use in ordinary locations, including appliances intended for casual and permanent outdoor use, in accordance with the National Electrical Code.

1.2 These requirements do not cover household electric ranges, electrode type appliances, skillets and frying type appliances, fondues, woks, tempuras, corn poppers, coffee makers and brewing type appliances, commercial cooking appliances, microwave cooking appliances, or appliances that are covered in individual requirements that are separate from this standard.

1.3 In the following text, a requirement that applies to one type of equipment coming within its scope (toaster, and the like) will be so identified by a specific reference in that requirement to the type of equipment involved. In the absence of such specific reference or if the term "appliance" is employed, it is to be understood that the requirement applies to all of the types of equipment covered by the standard.

1.4 *Deleted May 28, 2002*

### 2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components used in the products covered by this standard.

2.1 revised May 1, 2000

2.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

2.2 revised May 1, 2000

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.3 revised May 1, 2000

2.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

2.4 revised May 1, 2000

### 3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

3.1 revised May 1, 2000

### 4 References

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

## CONSTRUCTION

### 5 General

5.1 If the operation of an appliance involves the generation and confining under pressure of steam or other gas, consideration shall be given to the possibility of an explosion risk incident to such operation. The appliance shall not be acceptable unless its strength is adequate with respect to any explosion risk that may be involved.

### 6 Frame and Enclosure

6.1 The frame and enclosure of an appliance shall be sufficiently strong and rigid to resist the abuses likely to be encountered during intended service. The degree of resistance inherent in the appliance shall preclude total or partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and other serious defects that alone or in combination constitute an increase in the risk of fire, electric shock, or injury.

6.2 An appliance shall be provided with an enclosure of material acceptable for the particular application, which shall house all electrical parts, except for a supply cord, and except for an open-wire-element unit as mentioned in 14.3 and 14.4 that may present a risk of fire, shock, or injury under any condition of use. If an appliance is intended for permanent connection to the power supply, the enclosure shall be provided with means for mounting in the intended manner and shall be furnished with any necessary fittings, such as brackets, hangers, or the like.

6.3 In the case of an appliance employing oil or grease in its normal cooking operation, special consideration shall be given to the need for an enclosure over the cooking compartment, and to the acceptability for the purpose of the material employed for such an enclosure.

6.4 If openings for ventilation are provided in the enclosure of an appliance or in an externally mounted component intended for permanent connection to the power supply, they shall be so located that they will not vent into concealed spaces of a building structure such as into false-ceiling space, into hollow spaces in the wall, or the like, when the appliance is installed as intended.

6.5 Among the factors that shall be considered when an enclosure is being judged for acceptability are its:

- a) Physical strength,
- b) Resistance to impact,
- c) Moisture-absorptive properties,
- d) Combustibility,
- e) Resistance to corrosion, and
- f) Resistance to distortion at temperatures to which the enclosure may be subjected under conditions of normal or abnormal use.

For a nonmetallic enclosure, see the enclosure requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. A metal enclosure or enclosure part shall be tested in accordance with Metal Enclosure Impact Test, Section 42, for resistance to impact.

*Exception No. 1: When considering the abnormal and severe conditions tests of UL 746C, the appliance enclosure is to be judged under the abnormal operations tests of Abnormal Operation Test, Section 44, of this standard.*

*Exception No. 2: Thermoset materials need not be subjected to the relative thermal capability requirements of UL 746C. For a thermoset material operating at a temperature above its temperature rating, the 1000 hour aging test as outlined in 43.1 shall be conducted.*

6.6 A thermoplastic enclosure of an appliance provided with overheating protection (Overheating Protection, Section 25) need not comply with the flammability requirements of UL 746C if a material rated HB, and possessing 60 arcs minimum resistance to high current arc ignition, and 7 second minimum resistance to hot wire ignition is employed and all enclosure parts including ribs, grills, and the like are spaced a minimum 1/2 inch (12.7 mm) from uninsulated live parts.

6.6 revised November 17, 1998

6.7 Cast- and sheet-metal portions of enclosure shall be no thinner than indicated in Table 6.1 unless the enclosure is found to be acceptable when judged under considerations such as are mentioned in 6.5 and 6.8.

6.8 In addition to being considered with reference to the factors mentioned in 6.5, an enclosure of sheet metal is to be judged with respect to its size and shape, the thickness of metal and its acceptability for the particular application, considering the intended use of the appliance.

6.9 Electrical parts of an appliance, except the radiating portion of an open-wire element of an automatic toaster, shall be so located or enclosed that protection against unintentional contact with uninsulated live parts will be provided (see also 22.7). Insulated motor brush caps do not require additional enclosure.

**Table 6.1**  
**Minimum acceptable thicknesses of enclosure metal**

Metal	At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing, and the like (or are otherwise of a shape and/or size) to provide equivalent physical strength		At surfaces to which a wiring system is to be connected in the field		At relatively large unreinforced flat surfaces	
	Inches	mm	Inches	mm	Inches	mm
Die-cast	3/64	1.2	–	–	5/64	2.0
Cast malleable iron	1/16	1.6	–	–	3/32	2.4
Other cast metal	3/32	2.4	–	–	1/8	3.2
Uncoated sheet steel	0.026 <sup>a</sup>	0.66 <sup>a</sup>	0.032	0.81	0.026	0.66
Galvanized sheet steel	0.029 <sup>a</sup>	0.74 <sup>a</sup>	0.034	0.086	0.029	0.74
Nonferrous sheet metal	0.036 <sup>a</sup>	0.91 <sup>a</sup>	0.045	1.14	0.036	0.91

<sup>a</sup> Thinner sheet metal may be employed if found to be acceptable when the enclosure is judged under considerations such those mentioned in 6.5.



6.10 The enclosure shall be constructed so that molten metal, burning insulation, flaming particles, or the like will not fall on the supporting surface.

6.11 The requirement in 6.10 necessitates that an enclosure bottom with an opening be provided with a barrier above or below the opening if the opening is:

a) Under a motor unless:

1) The structural parts of the motor or of the appliance provide the equivalent of such a barrier.

2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the appliance when the motor is energized under each of the following fault conditions:

i) Open main winding,

ii) Open starting winding,

iii) Starting switch short-circuited; and

iv) For a permanent-split-capacitor motor the capacitor is short circuited. The short circuit is to be applied before the motor is energized and the rotor is to be blocked,

3) The motor is provided with a thermal motor protector (a protective device that is sensitive to both temperature and current) that prevents the temperature of the motor windings from becoming more than 125°C (257°F) under the maximum load under which the motor runs without causing the protector to cycle, and from becoming more than 150°C (302°F) with the rotor of the motor locked, or

4) The motor complies with the requirements for impedance-protected motors.

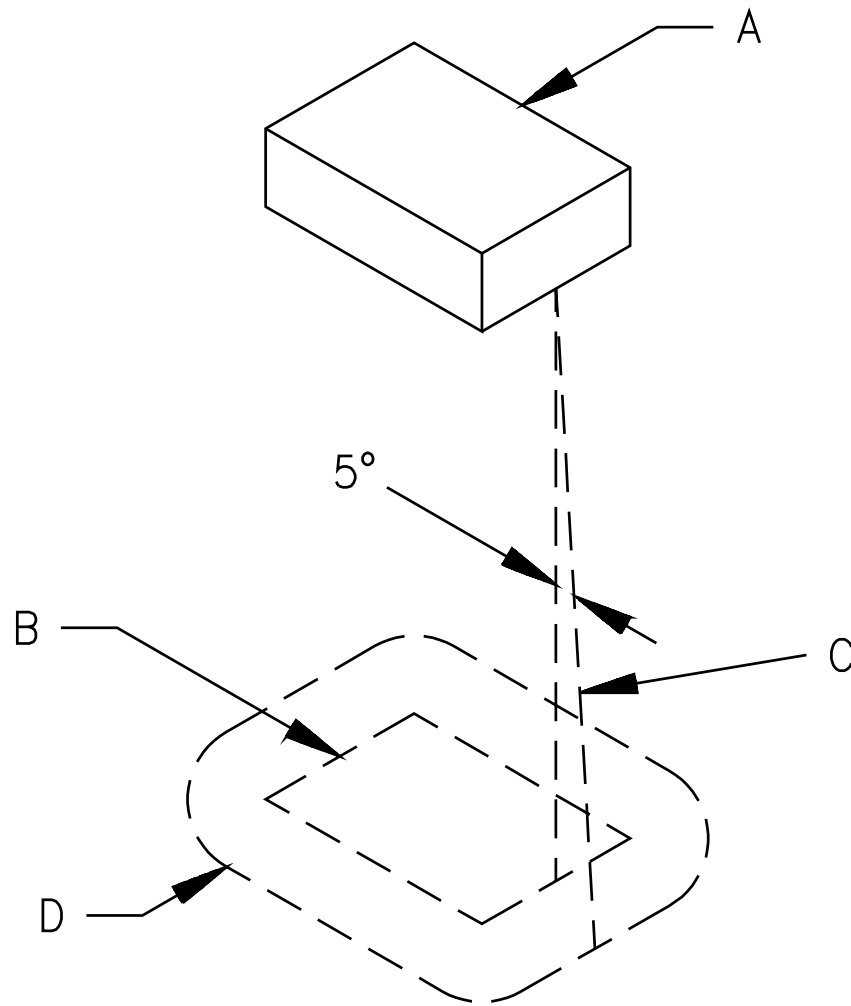
b) Under wiring, unless the wiring complies with the VW-1 flame test or the Vertical Flame Test described in the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.

c) Under an unenclosed switch, transformer, relay, solenoid, and the like, unless it can be shown that malfunction of the component is not likely to result in a fire.

d) Under field- and factory-made splices and overload and overcurrent protective devices.

*Exception: A barrier need not be provided if the opening is not within the area under the component requiring a barrier as illustrated by Line D in Figure 6.1.*

**Figure 6.1**  
**Location and extent of barrier**



EB120A

A – Region to be shielded by barrier. This will consist of the entire component if it is not otherwise shielded and will consist of the unshielded portion of a component that is partially shielded by the component enclosure or equivalent.

B – Projection of outline of component on horizontal plane.

C – Inclined line that traces out minimum area of barrier. The line is always

- 1) tangent to the component,
- 2) 5 degrees from the vertical, and
- 3) so oriented that the area traced out on a horizontal plane is maximum.

D – Location (horizontal) and minimum area for barrier. The area is that included inside the line of intersection traced out by the inclined line C and the horizontal plane of the barrier.

6.12 The barrier mentioned in 6.11 shall be:

- a) Of metal, ceramic, or a material that would be acceptable as an enclosure in accordance with 6.5,
- b) Horizontal, and
- c) Located as indicated in Figure 6.1, and shall not have an area less than that described in Figure 6.1.

6.13 An opening in the enclosure that has a minor dimension of less than 1 inch (25.4 mm) is acceptable if a probe as illustrated in Figure 6.2, inserted through the opening, cannot be made to touch any uninsulated live part or film-coated wire that involves the risk of electric shock. The probe shall be applied in all possible articulated positions before, during, and after insertion.

6.14 An opening that has a minor dimension of 1 inch (25.4 mm) or more, in an enclosure, as illustrated in Figure 6.3, is acceptable if, within the enclosure, there is no uninsulated live part or film-coated wire less than, R distance from the inside edge of the perimeter of the opening and X distance from the plane of the opening. T equals the enclosure thickness, R equals X minus T, and X equals five times the diameter of the largest round rod that can be inserted through the opening but not less than 6-1/16 inches (154 mm). In evaluating an opening, any barrier located within the volume is to be ignored unless it intersects the boundaries of the volume in a continuous closed line.

6.15 If a marking draws attention of the user to a hole of any size in the enclosure for the adjustment of a thermostat or for a similar activity, it shall not be possible to damage insulation or contact uninsulated live parts through the hole with a 1/16-inch-diameter rod (1.6 mm).

6.16 During the examination of an appliance in connection with the requirements in 6.9 and 6.13 – 6.15, any part of the enclosure is to be disregarded (opened or removed) – that is, it will not be assumed that the part in question affords protection against electric shock or injury to persons – if it either:

- a) Must be opened or removed, with or without the use of tools, to perform manufacturer's recommended user servicing, maintenance, operating adjustments, attachment of accessories, or other instructions, or
- b) Can be opened or removed without the use of tools. See 6.16.1.

*Exception: A part that requires a tool for opening or removal to perform manufacturer's recommended user servicing, maintenance, operating adjustments, attachment of accessories, or other instructions is to remain in place if the appliance is marked in accordance with 54.9.*

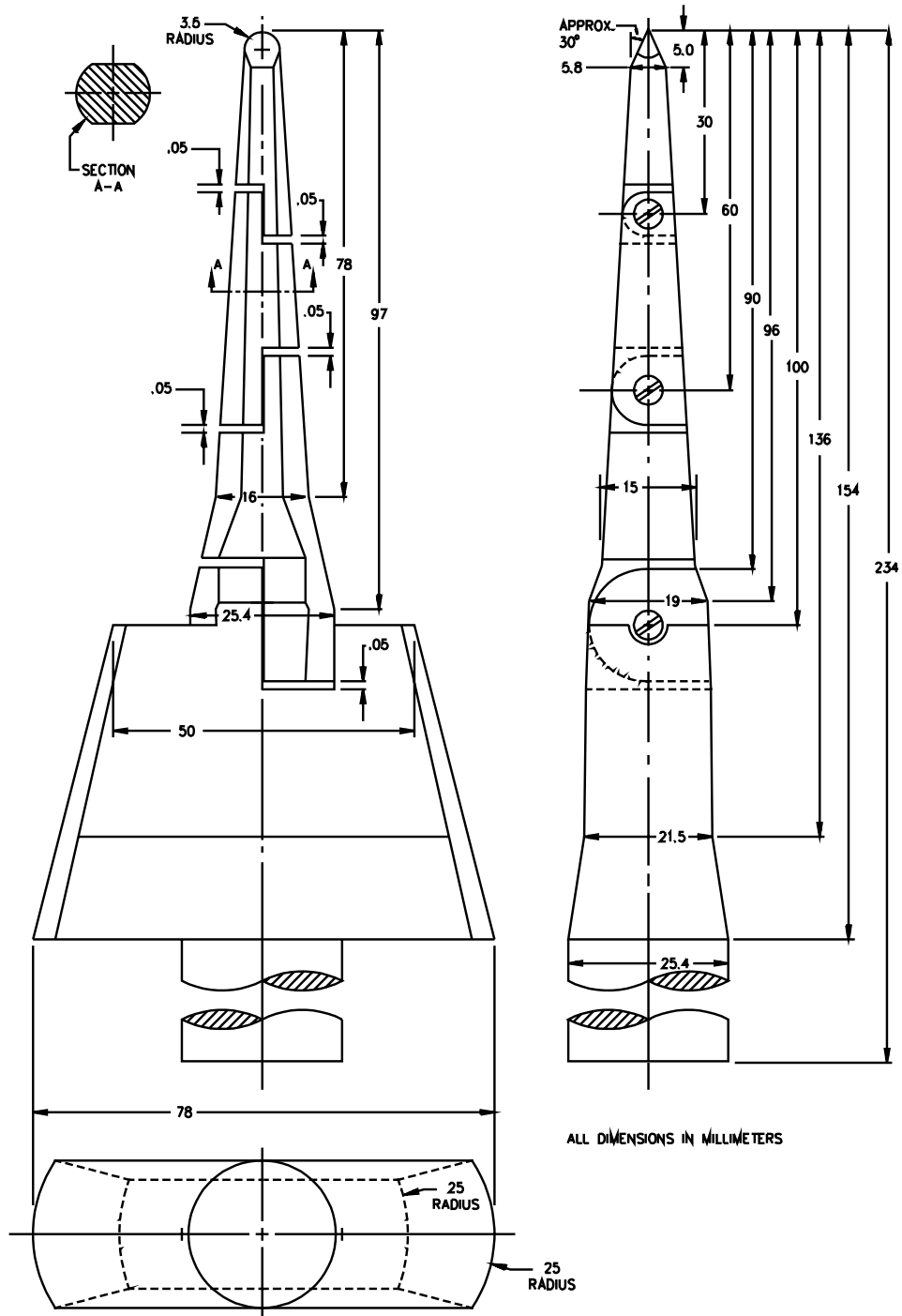
6.16 effective March 26, 1997

6.16.1 With reference to 6.16(b), to determine that a part of an enclosure requires the use of tools for opening or removal, the enclosure or any part of the enclosure that relies for mechanical securement on non-metallic parts, such as plastic tabs or snap-action inserts and posts, shall comply with Non-Metallic Enclosure-Fasteners Test, Section 42A.

*Exception: An enclosure or enclosure part secured entirely by metallic fasteners (such as screws or rivets) to other enclosure parts need not be subjected to this test.*

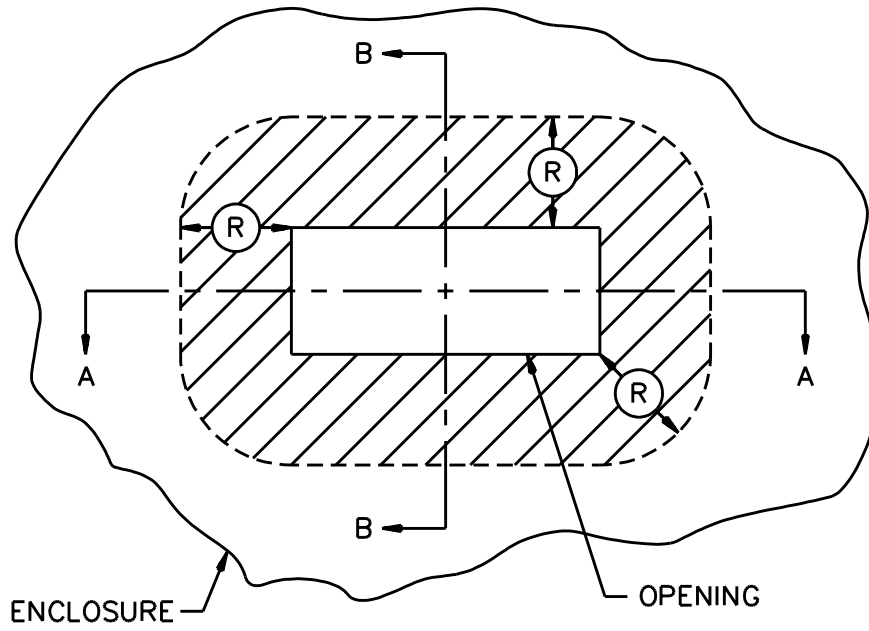
6.16.1 effective March 26, 1997

Figure 6.2  
Accessibility probe

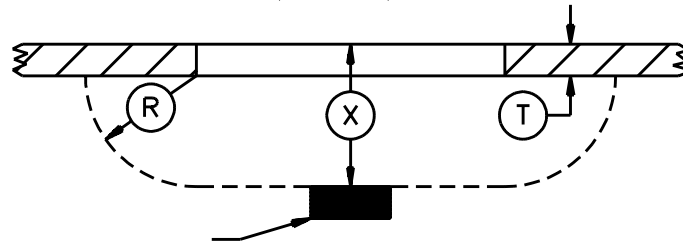


PA100A

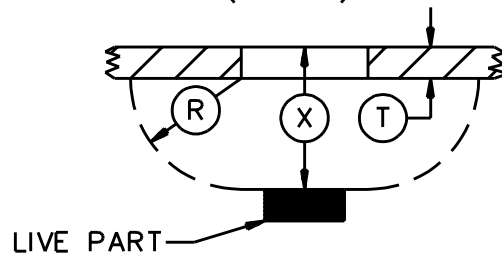
Figure 6.3  
Opening in enclosure



SECTION A-A  
( $X=R+T$ )



SECTION B-B  
( $X=R+T$ )



SB0610-1

Proportions exaggerated for clarity

6.17 Any moving parts, such as rotors of motors, chains, pulleys, belts, and gears, shall be enclosed or guarded to reduce the likelihood of injury to persons.

6.18 With reference to the requirements in 6.17, the degree of protection required of the enclosure depends upon the general construction and intended use of the appliance. The factors to be taken into consideration in judging the acceptability of exposed moving parts are:

- a) The degree of enclosure,
- b) The sharpness of the moving parts,
- c) The likelihood of unintentional contact with the moving parts,
- d) The speed of movement of those parts, and
- e) The likelihood of fingers, arms, or clothing being drawn into the moving parts (such as at points where gears mesh, where belts travel onto a pulley or where moving parts close in a pinching or shearing action).

6.19 The door or cover of an enclosure shall be provided with means for holding it securely in place in the closed position.

6.20 The door or cover of an enclosure shall be hinged or otherwise attached in an equivalent manner if it gives access to any overload protective device whose functioning requires renewal, or if it is necessary to open the cover in connection with the operation of the protective device. Such a door or cover shall be provided with a latch or the equivalent, and shall be tight-fitting or shall overlap the surface of the enclosure around the opening.

6.21 A component of an appliance shall be readily accessible without the use of special tools (tools not available to other than service personnel) if it is intended to be manually operated or adjusted or periodically serviced.

6.22 The bulb and capillary tube of a thermostat shall be protected from mechanical damage if damage of the tube or bulb would increase the risk of fire.

## **7 Assembly**

7.1 A switch, lampholder, attachment-plug receptacle, or plug-type receptacle, or plug-type connector provided as a part of an appliance shall be mounted securely and prevented from turning by means other than friction between surfaces.

7.2 A lock washer properly applied is acceptable as a means to prevent turning of a stem-mounted switch.

7.3 Uninsulated live parts shall be so secured to the base or surface that they will be prevented from turning or shifting in position as the result of stresses if such motion may result in a reduction of spacings below the minimum required in 26.1.1.1 – 26.1.1.4.

7.4 Friction between surfaces is not acceptable as a means to prevent shifting or turning of live parts, but a lock washer properly applied is acceptable.

## 8 Stability

8.1 The stability of an appliance shall be such that it will not be overturned readily in intended use.

8.2 A household cooking or warming appliance that is easily carried or conveyed by hand (such as a slow cooker, or a food warmer and the like) in which liquids are heated to a temperature greater than 115°F (46°C) shall be placed on a plane inclined at an angle of 15 degrees to the horizontal. The appliance shall be positioned and loaded with whatever combination of separable components, liquid, or other media (material) that results in the maximum tendency to overturn under conditions of intended use. The appliance shall contain a minimum of 5 ounces (148 mL) of liquid. The appliance shall be prevented from sliding on the inclined surface. The appliance shall not overturn as a result of this test.

## 9 Corrosion Protection

9.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means, if the malfunction of such unprotected parts would increase the risk of fire or electric shock.

*Exception: In certain equipment where the oxidation of steel is not likely to be accelerated due to the exposure of metal to air and moisture or other oxidizing influence – thickness of metal and temperature also being factors – surfaces of sheet steel within an enclosure may not be required to be protected against corrosion. Cast-iron parts are not required to be protected against corrosion. A sheath employed on a heating element operating in air and terminal parts attached directly to the heating element need not be protected against corrosion.*

9.2 The aging characteristics of plating or other finish used in an appliance shall be such that deterioration of the finish will not result eventually in unacceptable performance of the appliance.

## 10 Supply Connections

### 10.1 Permanently connected appliances

#### 10.1.1 General

10.1.1.1 Except as noted in 10.1.1.2, an appliance intended for permanent connection to the power supply shall have provision for connection of one of the wiring systems that, in accordance with the National Electrical Code, ANSI/NFPA No. 70–1993, would be acceptable for the appliance.

10.1.1.2 An appliance that is intended to be fastened in place or located in a dedicated space may be acceptable if provided with a short length of appropriate flexible cord and an attachment plug for supply connection. The investigation of such a feature shall include consideration of the utility of the appliance and the necessity of having it readily detachable from its source of supply by means of the attachment plug.

10.1.1.3 The location of a terminal box or compartment in which power-supply connections to a permanently connected appliance are to be made shall be such that these connections may be readily inspected after the appliance is installed as intended.

10.1.1.4 A terminal compartment intended for the connection of a supply raceway shall be so attached to the appliance as to be prevented from turning.

### 10.1.2 Field wiring terminals

10.1.2.1 An appliance intended for permanent connection to the power supply shall be provided with wiring terminals or leads for the connection of conductors having an ampacity of not less than 125 percent of the current rating of the appliance when the load is continuous (3 hours or more) and not less than the current rating of the appliance when the load will be intermittent.

10.1.2.2 For the purpose of these requirements, wiring terminals are considered to be terminals to which power-supply or control connections will be made in the field when the appliance is installed.

10.1.2.3 A wiring terminal shall be provided with a soldering lug or with a pressure wire connector securely fastened in place (for example, firmly bolted or held by a screw), except that a wire-binding screw may be employed at a wiring terminal intended to accommodate a No. 10 AWG (5.3 mm<sup>2</sup>) or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in position.

10.1.2.4 A wiring terminal shall be prevented from turning or shifting in position by means other than friction between surfaces. This may be accomplished by two screws, or rivets, by square shoulders or mortises, by a dowel pin, lug or offset, by a connecting strap or clip fitted into an adjacent part, or by some other equivalent method.

10.1.2.5 A wire-binding screw at a wiring terminal shall not be smaller than No. 10, except that a No. 8 screw may be used at a terminal intended for the connection of a No. 14 AWG (2.1 mm<sup>2</sup>) or smaller conductor, and a No. 6 screw may be used for the connection of a No. 16 AWG (1.3 mm<sup>2</sup>) or smaller control-circuit conductor.

10.1.2.6 A terminal plate tapped for a wire-binding screw shall be of metal not less than 0.050 inch (1.3 mm) thick, except that a plate not less than 0.030 inch (0.8 mm) thick is acceptable if the tapped threads provide equivalent mechanical strength. There shall be two or more full threads in the metal, which may be extruded if necessary to provide the threads.

10.1.2.7 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size mentioned in 10.1.2.1, but not smaller than No. 14 AWG (2.1 mm<sup>2</sup>), under the head of the screw or the washer.

10.1.2.8 A wire-binding screw shall thread into metal.

10.1.2.9 An appliance intended for connection to a grounded power-supply conductor and employing:

- a) A lampholder or element holder of the Edison-screw-shell type,
- b) A single-pole switch, or
- c) A single-pole automatic control shall have one terminal or lead identified for connection of the grounded conductor of the supply circuit.

The terminal or lead so identified shall be the one that is connected to screw shells of lampholders or element holders, and with no connections to single-pole switches or single-pole automatic controls, except as noted in 24.2.



10.1.2.10 A terminal intended for the connection of a grounded circuit conductor shall be made of or plated with a metal substantially white in color and shall be readily distinguishable from the other terminals, or proper identification of that terminal shall be clearly shown in some other manner, such as on an attached wiring diagram. A lead intended for the connection of a grounded circuit conductor shall be finished to show a white or natural grey color and shall be readily distinguishable from the other leads.

10.1.2.11 Except as noted in 10.1.2.12, the free length of a lead inside an outlet box or wiring compartment shall be 6 inches (152 mm) or more if the lead is intended for field connection to an external circuit.

10.1.2.12 A lead may be less than 6 inches (152 mm) in length if it is evident that the use of a longer lead might result in an increased risk of fire or electric shock.

10.1.2.13 The surface of an insulated lead intended solely for the connection of an equipment-grounding conductor shall be green with or without one or more yellow stripes, and no other lead shall be identified.

10.1.2.14 A wire-binding screw intended for the connection of an equipment-grounding conductor shall have a green-colored head that is hexagonal-shaped, slotted, or both. A pressure wire connector intended for connection of such a conductor shall be plainly identified as such by being marked "G", "GR", "GND", "GROUNDING" or the like or by a marking on the wiring diagram provided on the heating appliance. The wire-binding screw or pressure wire connector shall be so located that it is unlikely to be removed during servicing of the appliance.

10.1.2.15 A terminal solely for connection of an equipment-grounding conductor shall be capable of securing a conductor of the proper size for the particular appliance.

## **10.2 Cord-connected appliances**

### **10.2.1 General**

10.2.1.1 A cord-connected appliance (an appliance intended to be connected to the power-supply circuit by means of a flexible cord) shall be provided with a power-supply cord for connection to the supply circuit, or shall have male pin terminals that accommodate a detachable power-supply cord. The length of attached cord or separable cord shall be within the limit indicated in Table 10.1.

10.2.1.2 For a cord-connected appliance, the rating (both current and voltage) of the cord and the fittings, shall not be less than that of the appliance. The current rating of the attachment plug shall not be less than 125 percent of the current rating of the appliance when the load will constitute a continuous load (3 hours or more).

10.2.1.3 An attached flexible cord and the cord in a detachable power-supply cord that is provided with an appliance shall be of a type indicated in Table 10.2, or shall have such properties that it will be at least equally as serviceable for the particular application.

10.2.1.4 In the case of a broiler attachment intended for use on a roaster, a detachable power-supply cord acceptable for the purpose shall be supplied with the roaster, and no additional detachable power-supply cord shall be provided with either the roaster or the broiler.

**Table 10.1**  
**Lengths of cord connection**

Table 10.1 revised November 15, 1996

Type of appliance	Kind of cord connection	Minimum acceptable length <sup>a</sup>		Maximum acceptable length <sup>a</sup>	
		Feet	Meters	Feet	Meters
All counter top or table-top appliances	Attached cord or detachable power supply cord	2.0	0.6	7.0	2.1
All appliances intended for outdoor use	Attached cord or detachable power supply cord	1.0	0.3	12.0	3.6
All appliances not covered above	Attached cord or detachable power supply cord	6.0	1.8	7.0	2.1

<sup>a</sup> Measured external to the appliance and including the fittings but excluding the blades on the attachment plug.

**Table 10.2**  
**Acceptable types of cord and applicable limitations on their use**

Table 10.2 revised November 15, 1996

Appliance on which the cord is to be used	Cords acceptable where temperatures are more than 121°C (250°F) on any surface that the cord is likely to touch when the appliance is used as intended	Cords acceptable where temperatures are 121°C (250°F) or less on any surface that the cord is likely to touch when the appliance is used as intended
Except as noted below, table stoves, toasters and other appliances that are not intended for use outdoors	HPD, HPN, HSJ, or HSJO	HPD, HPN, HSJ, HSJO, SP-2, SPE-2, SPT-2, SV, SVE, SVO, SVT, SVTO, SJ, SJE, SJO, SJT or SJTO
Barbecue-spit motor	SJE, SJO, SJT, or SJTO	SJE, SJO, SJT, or SJTO
Appliances intended for outdoor use	HSJW-A or HSJOW-A	HSJW-A, HSJOW-A, SJW-A, SJEW-A, SJOW-A, SJTW-A or SJTOW-A

10.2.1.5 Supplementary insulation, if employed in a flexible cord, shall not extend more than 1/2 inch (13 mm) outside the appliance, unless provided with additional mechanical protection, and shall be prevented from fraying or unraveling, and shall not affect adversely the means for providing strain relief.

10.2.1.6 A 3- to 2-wire, grounding-type adapter shall not be provided with an appliance.

10.2.1.7 The attachment plug of the power supply cord of an appliance provided with a 15- or 20- ampere general use receptacle shall be of the 3-wire grounding type. The attachment plug of the power supply cord of an appliance provided with a manually operated, line-connected, single pole switch for appliance on-off operation or an Edison-base lampholder shall be of the polarized or grounding type.

10.2.1.8 If a 3-wire grounding-type attachment plug or a 2-wire polarized attachment plug is provided, the attachment plug connection shall comply with Figure 10.1 and the polarity identification of the flexible cord shall comply with Table 10.3.

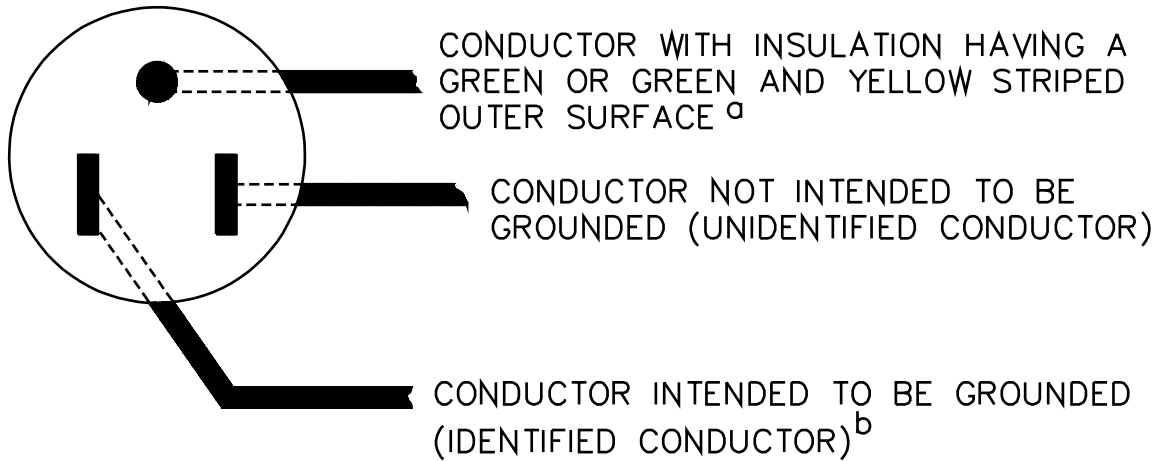
10.2.1.9 The conductor of the power supply cord that is intended to be grounded shall have the following items connected to it:

- a) The screw shell of an Edison-base lampholder and
- b) The terminal or lead of a receptacle intended to be grounded.

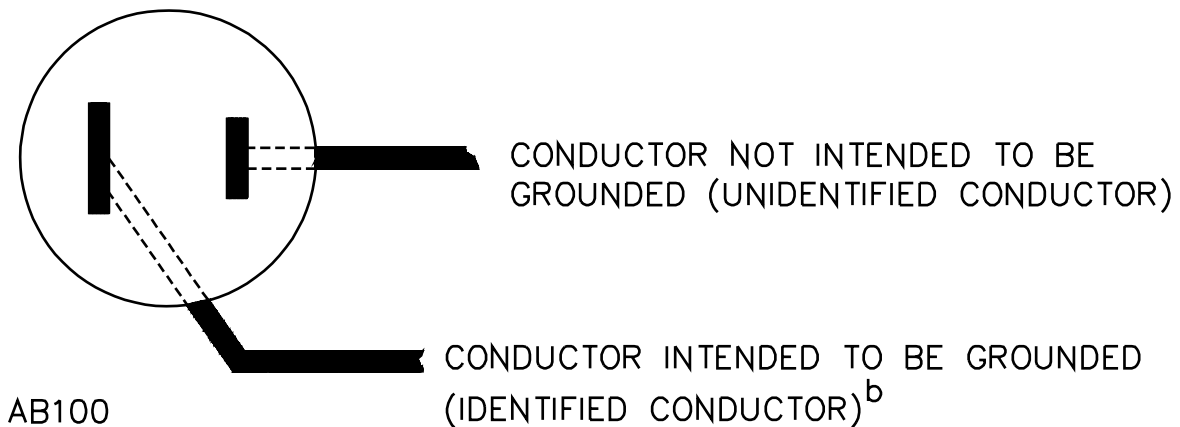
Table 10.3 identifies the supply cord conductor intended to be grounded.

**Figure 10.1**  
**Connection to attachment plug**

CONNECTIONS OF CORD CONDUCTORS TO GROUNDING – TYPE  
 ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



CONNECTIONS OF CORD CONDUCTORS TO POLARIZED  
 ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



<sup>a</sup> In the above illustration, the blade to which the green conductor is connected may have a U-shaped or circular cross section.

<sup>b</sup> Signifies a conductor identified in accordance with Table 10.3

**Table 10.3**  
**Polarity of identification of flexible cords**

Method of identification	Acceptable combinations		
	Wire intended to be grounded <sup>d</sup>		All other wires <sup>d</sup>
Color of braids on individual conductors	A	Solid white or natural grey – without tracer	Solid color other than white or natural grey – without tracer
	B	Color other than white or natural grey with tracer in braid	Solid color other than white or natural grey – without tracer
Color of insulation on individual conductors	C <sup>a</sup>	Solid white or natural grey	Solid color other than white or natural grey
	C1 <sup>e</sup>	Light blue	Solid color other than light blue, white or natural grey
Color of separators	D <sup>b</sup>	White or natural grey	Color other than white or natural grey
Other means	E <sup>c</sup>	Tin or other white metal on all strands of the conductor	No tin or other white metal on the strands of the conductor
	F <sup>b</sup>	A stripe, ridge or groove on the exterior surface of the cord	

<sup>a</sup> Only for cords – other than Type SP-1, and SPT-1 – having no braid on any individual conductor.

<sup>b</sup> Only for Types SP-1, SP-2, SPT-1, and SPT-2 cords.

<sup>c</sup> Only for Type SPT-1 and SPT-2 cords.

<sup>d</sup> A wire finished to show a green cord with or without one or more yellow stripes or tracers is to be used only as an equipment grounding conductor. See 27.3 and Figure 10.1.

<sup>e</sup> For jacketed cords.

## 10.2.2 Strain relief

10.2.2.1 Strain relief shall be provided to prevent a mechanical stress on an attached flexible supply cord from being transmitted to terminals, splices or interior wiring.

10.2.2.2 If wood, pressed board, or other fibrous material is used to secure the strain-relief assembly, the fibrous material shall be secured to the appliance by a pin, setscrew, or other positive means.

10.2.2.3 Means shall be provided to reduce the likelihood of an attached supply cord or lead from being pushed into the enclosure of an appliance through the cord-entry hole. To determine compliance with this requirement, the supply cord or lead shall be tested in accordance with Push-Back Relief Test, Section 40A.

10.2.2.3 revised November 17, 1998

10.2.2.4 If a knot serves as strain relief in an attached flexible cord, any surface with which the knot may come in contact shall be free from projections, sharp edges, burrs, fins, and the like that may cause abrasion of the insulation on the conductors.

10.2.2.5 The strain-relief means provided on an attached flexible cord, when tested in accordance with 10.2.2.6, shall be capable of withstanding for 1 minute, without displacement, a pull of 35 lbf (156 N) applied to the cord, with the connection within the appliance disconnected.

10.2.2.6 The specified force is to be applied to the cord and so supported by the appliance that the strain-relief means will be stressed from any angle that the construction of the appliance permits. The strain relief is not acceptable if, at the point of disconnection of the conductors, there is sufficient movement of the cord to indicate that stress on the connections would have resulted.

## 10.2.3 Pin terminals

10.2.3.1 If an appliance is provided with pin terminals, the construction of the appliance shall be such that no live parts will be exposed to unintentional contact both during and after the placement of the plug on the pins, in the intended manner.

10.2.3.2 A pin guard is required, such that:

- a) A straight edge placed in any position, across and in contact with edges of the plug opening without the plug in place, cannot be made to contact any current-carrying pin.
- b) With the plug aligned with the pins and the face of the plug in a plane located perpendicular to the end or ends of the farthest projecting current-carrying pin, the probe illustrated in Figure 6.2 should not touch any current-carrying pin while the probe is inserted through any opening with the appliance in any position.

10.2.3.3 The plug used in accordance with 10.2.3.2(b) is to be the plug supplied with the appliance.

10.2.3.4 If an appliance employs three or more pin terminals intended for use with a plug that covers all the pins, the terminals shall be so spaced that they will not accommodate a flatiron or appliance plug or cord-connector body. The plug that these pins will accommodate shall be appropriate for the particular application.

10.2.3.5 If an appliance is provided with a user removable heating element, the heating element shall have a guard that shall:

- a) Be securely and rigidly mounted by means other than friction alone and
- b) Prevent the heating element pins from being damaged, shorting to the appliance enclosure during insertion or removal, and shifting in position relative to each other.

10.2.3.6 A pin terminal shall be securely and rigidly mounted and shall be prevented from shifting in position by means other than friction between surfaces.

10.2.3.7 The requirement in 10.2.3.6 is intended primarily to provide for maintenance of spacings as given in 26.1.1.1 and Tables 26.1 and 26.2 and to provide for the maintenance of proper spacings between pin terminals. Under this requirement, consideration is also to be given to the means for locking terminals in position to maintain tightness.

10.2.3.8 The dimensions of pins and their center-to-center spacings, including the corresponding spacings of the female contacts of general-use plugs that these arrangements of pins will accommodate, are as indicated in Table 10.4.

10.2.3.9 An appliance provided with three pin terminals, one of which is for grounding, shall not be provided with or capable of being used with a two-conductor detachable power-supply cord.

10.2.3.10 An appliance provided with two pin terminals shall not be provided with or capable of being used with a three-conductor detachable power-supply cord employing a grounding conductor.

**Table 10.4**  
**Pins of appliance and flatiron plugs**

Type and rating of plug that accommodates the pins	Configuration of pins			Dimensions of pins	
	Number	Arrangement	Spacing between centers, inch (mm)	Diameter, inch(mm)	Length, inch(mm)
Appliance plug rated 5 A at 250 V and 10 A at 125 V	2	In line	1/2 (12.7)	0.156 ±0.005 (3.97 ±0.13)	9/16 – 5/8 (14.3 – 15.9)
Flatiron plug rated 5 A at 250 V and 10 A at 125 V	2	In line	11/16 (17.5)	0.188 ±0.005 (4.76 ±0.13)	3/4 – 7/8 (19.0 – 22.2)
Jumbo appliance plug rated 10 A at 250 V and 15 A at 125 V	2	In line	1-1/16 (27.0)	0.188 ±0.005 (4.76 ±0.13)	3/4 – 7/8 (19.0 – 22.2)
Reversible plug (for two-heat control) rated 10 A at 250 V and 15 A at 125 V <sup>a</sup>	3	In line	7/8 (22.2)	0.188 ±0.005 (4.76 ±0.13)	3/4 – 7/8 (19.0 – 22.2)
Reversible plug (for two- or three- heat control) rated 10 A at 250 V and 15 A at 125 V <sup>a</sup>	3	One pin at apex of an equilateral triangle	7/8 (22.2)	0.188 ±0.005 (4.76 ±0.13)	3/4 – 7/8 (19.0 – 22.2)

<sup>a</sup> Usually this plug is made without a contact in one of the holes.

#### 10.2.4 Bushings

10.2.4.1 At a point where a flexible cord passes through an opening in a wall barrier or enclosing case, there shall be a bushing or the equivalent that shall be secured in place, and shall have a smooth, well-rounded surface against which the cord may bear. If Type SP-2, SPT-2, or other cord lighter than Type HSJ is employed, and if the wall or barrier is of metal, and if the construction is such that the cord may be subjected to strain or motion, an insulating bushing shall be provided. The heat- and moisture-resistant properties of the bushing material shall be such that the bushing is acceptable for the particular application.

10.2.4.2 If the cord hole is in wood, porcelain, phenolic composition, or other nonconducting material, a smooth, well-rounded surface is considered to be equivalent to a bushing.



10.2.4.3 Ceramic materials and some molded compositions are usually acceptable for insulating bushings, but a separate bushing of wood, hot-molded shellac and tar composition, or rubber material (other than in a motor) is not acceptable. Vulcanized fiber may be employed if the bushing is not less than 3/64 inch (1.2 mm) thick, and if it is so formed and secured in place that it will not be affected adversely by conditions of ordinary moisture.

10.2.4.4 A separate soft-rubber, neoprene, or polyvinyl chloride bushing may be employed in the frame of a motor or in the enclosure of a capacitor physically attached to a motor (but not elsewhere in an appliance, except as indicated in 10.2.4.5) provided that:

- a) The bushing is not less than 3/64 inch (1.2 mm) thick, and
- b) The bushing is so located that it will not be exposed to oil, grease, oily vapor, or other substance having a deleterious effect on the compound employed.

10.2.4.5 A bushing of any of the materials mentioned in 10.2.4.4 may be employed at any point in an appliance if used in conjunction with a type of cord for which an insulating bushing is not required, and if the edges of the hole in which the bushing is mounted are smooth and free from burrs, fins, and the like.

10.2.4.6 An insulated metal grommet may be accepted in place of an insulating bushing if the insulating material used is not less than 1/32 inch (0.8 mm) thick, and completely fills the space between the grommet and the metal in which it is mounted.

## 11 Current-Carrying Parts

11.1 Each current-carrying part shall be made of metal that is appropriate for the particular application.

11.2 Current-carrying parts made of corrosion-resistant alloys (for example, stainless steel) are acceptable regardless of temperature. Current-carrying parts made of ordinary iron and steel are not acceptable unless they are rendered corrosion-resistant by an appropriate coating and, even then, they are acceptable only as follows:

- a) Pin terminals.
- b) Terminal parts and other parts of a motor and its governor (if any).
- c) Parts whose normal operating temperature is higher than 100°C (212°F).
- d) Parts of a component that the requirements referred to in paragraph 2.1 indicate as being acceptable with coated iron and steel parts.

11.3 If a reservoir is part of an appliance, all live parts shall be so located or protected that they will not be subjected to dripping if the reservoir fails, unless:

- a) The reservoir is resistant to corrosion from the liquid intended for use in it, and
- b) The reservoir does not develop cracks as a result of aging.

## 12 Internal Wiring

### 12.1 General

12.1.1 The internal wiring of an appliance shall consist of wires of size and of a type or types that are acceptable for the particular application, when considered with respect to:

- a) The temperature and voltage to which the wiring is likely to be subjected,
- b) Its exposure to oil or grease, and
- c) Other conditions of service to which it is likely to be subjected.

12.1.2 There is no temperature limit applicable to unimpregnated glass fiber, beads of inorganic material, or the equivalent employed as conductor insulation.

12.1.2 revised November 17, 1998

12.1.3 Thermoplastic-insulated wire employed for the internal wiring of an appliance shall be standard building wire, fixture wire, or appliance wiring material acceptable for the particular application.

12.1.3 revised November 17, 1998

### 12.2 Protection of wiring

12.2.1 The wiring and connections between parts of an appliance shall be protected or enclosed, except that a length of flexible cord may be employed for external connections, or for internal connections that may be exposed during servicing, if flexibility of the wiring is essential. A bare conductor or a conductor with beads for insulation shall not be used outside an enclosure.

12.2.2 Internal wiring that is exposed through an opening in the enclosure of an appliance is considered to be protected as required in 12.2.1 if, when judged as if it were film-coated wire, the wiring would be acceptable according to 6.9 – 6.13. Internal wiring not so protected may be accepted if it is so secured within the enclosure that it is unlikely to be subjected to stress or mechanical damage.

12.2.3 If the wiring of an appliance is so located that it may be in proximity to combustible material or may be subjected to mechanical injury, it shall be armored cable or in rigid metal conduit, electrical metallic tubing, metal raceway, or shall otherwise be protected.

12.2.4 Wires within an enclosure, compartment, raceway, or the like shall be so located or protected that damage to conductor insulation cannot result from contact with any rough, sharp, or moving part.

12.2.5 A hole by means of which insulated wires pass through a sheet-metal wall within the overall enclosure of an appliance shall be provided with a smooth, well-rounded bushing or shall have smooth, well-rounded surfaces upon which the wires may bear, to prevent abrasion of the insulation. A flexible cord used for external inter-connection as mentioned in 12.2.1 shall be provided with strain relief and bushings in accordance with 10.2.2.1 – 10.2.2.6 and 10.2.4.1 – 10.2.4.6 unless the construction is such that the cord will be protected from stress or motion.

12.2.6 Insulated wires may be bunched and passed through a single opening in a metal wall within the enclosure of an appliance.

### 12.3 Splices

12.3.1 All splices and connections shall be mechanically secure and shall provide acceptable electrical contact. A soldered connection shall be made mechanically secure before being soldered if breaking or loosening of the connection may result in risk of fire or electric shock.

12.3.2 A splice shall be provided with insulation equivalent to that of the wires involved if permanence of spacing between the splice and other metal parts of the appliance is not maintained.

12.3.3 Insulation consisting of two layers of friction tape, two layers of thermoplastic tape, or of one layer of friction tape on top of one layer of rubber tape, is acceptable on a splice. In determining whether splice insulation consisting of coated fabric, thermoplastic, or other type of tubing is acceptable, consideration is to be given to such factors as its dielectric properties, heat-resistant and moisture-resistant characteristics. Thermoplastic tape wrapped over a sharp edge is not acceptable.

12.3.4 Where stranded internal wiring is connected to a wire-binding screw, loose strands of wire shall be positively prevented from contacting any other uninsulated live part that is not always of the same polarity as the wire, and from contacting any dead metal part. This may be accomplished by the use of pressure terminal connectors, soldering lugs, crimped eyelets, soldering all strands of the wire together, or other equivalent means.

### 12.4 Separation of circuits

#### 12.4.1 General

12.4.1.1 Unless provided with insulation rated for the highest voltage involved, insulated conductors of circuits connected to separate sources of supply shall be separated by barriers or segregated. Except as described in 12.4.1.3, an insulated conductor of one circuit shall be separated or segregated from any uninsulated live part of a different circuit.

12.4.1.2 Segregation of insulated conductors may be accomplished by clamping, routing, or an equivalent means which provides permanent separation from insulated or uninsulated live parts of a different circuit.

12.4.1.3 Field-installed conductors of any circuit shall be segregated by barriers from:

a) Field-installation and factory-installed conductors connected to any other circuit, unless the conductors of both circuits are or will be insulated for the maximum voltage of either circuit and,

b) Uninsulated live parts of any other circuit of the appliance, and from any uninsulated live parts whose short-circuiting would result in risk of fire or electric shock, except that:

1) A construction in which field-installed conductors may make contact with wiring terminals is acceptable provided that Type T, TF, or equivalent conductors are or will be installed be, and

2) A construction in which field-installed conductors that do or may have insulation less than the types of wire mentioned in item 1 may make contact with low-voltage wiring terminals (see 12.4.1.6) is acceptable, provided that the short-circuiting of such terminals would not result in risk of fire or electric shock.

12.4.1.4 With respect to 12.4.1.3(a), if the intended uses of an appliance are such that in some applications a barrier is required, a removable barrier or one having openings for the passage of conductors may be employed, provided instructions for the use of the barrier are a permanent part of the appliance, and complete instructions in conjunction with a wiring diagram may be acceptable instead of a barrier if, upon investigation, the combination is found to provide the required separation.

12.4.1.5 Segregation of field-installation conductors from other field-installation conductors and from uninsulated live parts of an appliance connected to different circuits may be accomplished by arranging the location of the openings in the enclosure for the various conductors (with respect to the terminals or other uninsulated live parts) so that there is no likelihood of the intermingling of the conductors or parts of different circuits. If the number of openings in the enclosure does not exceed the minimum required for the proper wiring of the appliance, and if each opening is located opposite a set of terminals, it is to be assumed (for the purpose of determining whether the appliance complies with the requirement in 12.4.1.3) that the conductors entering each opening will be connected to the terminals opposite the opening. If more than the minimum number of openings are provided, the possibility of conductors entering at points other than opposite the terminals to which they are intended to be connected and contacting insulated conductors or uninsulated current-carrying parts connected to a different circuit is to be investigated. To determine whether the appliance complies with the requirement in 12.4.1.3, it is to be wired as it would be in service, and in doing so, a reasonable amount of slack is to be left in each conductor, within the enclosure, and no more than average care is to be exercised in stowing this slack in the wiring compartment.

12.4.1.6 **LOW-VOLTAGE CIRCUIT** – A low-voltage circuit is one involving a potential of not more the 30 V and supplied by a primary battery, by a standard Class 2 transformer, or by an impedance that, as a unit, complies with all of the performance requirements for Class 2 transformer.

12.4.1.7 A circuit derived from a source of supply classified in 12.4.1.8 as a line-voltage circuit, by connecting resistance in series with the supply circuits as a means of limiting the voltage and current, is not considered to be a low-voltage circuit as described in 12.4.1.6.

12.4.1.8 **LINE-VOLTAGE CIRCUIT** – A line-voltage circuit is one involving a potential of not more than 250 V and having circuit characteristics in excess of those of a low-voltage circuit.

## 12.4.2 Barriers

12.4.2.1 If a barrier is used to provide separation between the wiring of different circuits, it shall:

- a) Be of metal or of insulating material,
- b) Be reliably held in place and
- c) Be of a mechanical strength to withstand any anticipated mechanical exposure.

Unclosed openings in a barrier for the passage of conductors shall not be larger in diameter than 1/4 inch (6.4 mm) and shall not exceed in number, on the basis of one opening per conductor, the number of wires which will need to pass through the barrier. The closure for any other opening shall present a smooth surface wherever an insulated wire may be in contact with it, and the area of any such opening, with the closure removed, shall not be larger than required for the passage of the necessary wires.

12.4.2.2 A metal barrier shall have a thickness at least as great as the minimum acceptable thickness of the enclosure metal. A barrier of insulating material shall not be less than 0.028 inch (0.71 mm) thick, and shall be of greater thickness if its deformation may be readily accomplished so as to defeat its purpose.

### 13 Heating Elements

13.1 A heating element shall be adequately supported. It shall be protected against mechanical damage and contact with outside objects.

13.2 In determining that a heating element is adequately supported, consideration is to be given to sagging, loosening, and other adverse conditions of the element resulting from continuous heating. For an open-wire (uninsulated resistance wire) heating element consideration is also to be given to breakage at any point. When a fiberglass rope heating element is provided it shall be secured within the unit by a positive means such as screws, lock washers/nuts, rivets or the equivalent so that with minor loosening, disengagement of the heating element will not result in the risk of fire or shock as determined by the Abnormal Operation Test (Section 44).

Revised 13.2 effective November 28, 2003

13.3 Except for an automatic toaster, a heating element in an appliance that may be contacted by the user during intended use or cleaning shall not be of the open wire construction. An automatic toaster employing open wire heating elements and provided with a mode of operation that does not require the operation of both heating elements within a toaster slot meets the intent of the requirement provided at least one of the heating elements within the slot is in a mode of operation generating heat.

13.3 revised May 28, 2002

13.4 An open-wire element, that is, uninsulated resistance wire, may be used in an appliance provided it is enclosed or protected by barriers or covers that require tools for removal, and it complies with the accessibility of live parts requirements outlined in 6.9, 6.13 and 6.14 and the broken element test of Broken Element Test, Section 40.

13.5 A sheathed element, rope heater, or the like shall be judged under the applicable requirements of this standard.

13.6 An appliance in which the heating element is intended for operation only in an air blast shall be so wired or controlled that the element can be operated only while under the cooling effect of the blast. An appliance in which the cooling effect of the motion of a part is necessary for acceptable temperatures shall be so wired or controlled that the element cannot be operated without such motion.

13.7 The heating elements of an automatic toaster shall de-energize independent of the movement of a simulated toast load, as determined by 44.2.5.3.1

Added 13.7 effective November 30, 2001

## 14 Electrical Insulation

14.1 Insulating washers, bushings, and the like that are integral parts of an appliance, and bases or supports for the mounting of current-carrying parts, shall be of a moisture-resistant material that will not be damaged by the temperatures to which they will be subjected under conditions of actual use. Molded parts shall be so constructed that they will have the mechanical strength and rigidity necessary to withstand the stresses of actual service.

14.2 Insulating material employed in an appliance shall be judged with respect to its acceptability for the particular application. Materials such as mica, some molded compounds, and certain refractory materials are usually acceptable for use as the direct support of live parts. Other materials which are not acceptable for general use, such as magnesium oxide, may be acceptable if used in conjunction with other more appropriate insulating materials or if located and protected against mechanical damage and the absorption of moisture is minimized. When it is necessary to investigate a material to determine whether it is acceptable, consideration is to be given to its mechanical strength, dielectric properties, insulation resistance, heat-resistant qualities, the degree to which it is enclosed or protected, and any other features having a bearing on the risk of fire, electric shock, or injury to persons involved, in conjunction with conditions of actual service. All of these factors are considered with respect to thermal aging. The appropriate tests in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, see Electrical Insulation Section.

*Exception: Thermoset materials need not be subject to the relative thermal capability requirements of UL 746C. For a thermoset material operating at a temperature above its temperature rating, the 1000 hour Aging Test as outlined in 43.1 shall be conducted.*

14.3 In the mounting or supporting of small, fragile insulating parts, screws or other fastenings should not be tight enough to cause cracking or breaking of these parts with expansion and contraction. Generally, such parts should be slightly loose.

14.4 Sleeving or tubing used as an insulator for uninsulated live parts (such as glass fiber in rope heaters) shall be so disposed or protected that no damage to the sleeving or tubing can result from contact with any rough, sharp, or moving part. The sleeving or tubing shall not be installed under a compression that renders it incapable of complying with the dielectric voltage-withstand requirements in 38.1.

## 15 Thermal Insulation

15.1 Thermal insulation, if employed, shall be of such a nature and so located and mounted or supported that it will not be adversely affected by any intended operation of the appliance. See 35.1.27.

15.2 Combustible or electrically conductive thermal insulation shall not make contact with uninsulated live parts of an appliance.

15.3 Some types of mineral-wool thermal insulation contain conductive impurities in the form of slag, which makes its use unacceptable if in contact with uninsulated live parts. See 37.1.

## 16 Motors

16.1 A motor shall be appropriate for the particular application, and shall be capable of handling its maximum intended load without risk of fire, electric shock, or personal injury.

16.2 A motor winding shall resist the absorption of moisture and shall be formed and assembled in a workmanlike manner.

16.3 With reference to the requirement in 16.2, film-coated wire is not required to be additionally treated to resist absorption of moisture, but fiber slot liners, cloth coil wrap, and similar moisture-absorptive materials should be provided with impregnation or otherwise treated to resist moisture absorption.

16.4 An automatic bread maker that performs both a heating and motor-operated food preparation function, shall have the motor-operated food preparing function evaluated in accordance with the requirements for a dough maker, in the following Sections in the Standard for Motor-Operated Household Food Preparing Machines, UL 982; Capacitors, Section 17; Starting Current Test, Section 25; Normal Temperature Test, Section 27; Abnormal Operation Test, Section 33; Enclosures of Polymeric Material for Portable Appliances, Section 40 and Thermoplastic Coil Forms and Thermoplastic Insulating Material, Section 42.

16.4 added November 17, 1998

No Text on This Page



## 17 Motor-Running Overcurrent (Overload) Protection

17.1 The following appliances in which a 1 hp or smaller motor is used shall incorporate thermal or overload protection that prevents the motor from attaining excessive temperatures under any operating conditions:

- a) A remotely or automatically controlled appliance.
- b) A permanently connected, continuous-duty, manually started appliance.

An impedance-protected motor is not required to have additional thermal or overload protection.

17.2 An appliance intended to be automatically or remotely controlled and employing a motor rated at more than 1 hp shall incorporate thermal or overcurrent protection.

17.3 Fuses shall not be used as motor-overload-protective devices unless the motor is protected by the largest size of fuse that can be inserted in the fuseholder.

## 18 General (Short-Circuit and Ground-Fault) Overcurrent Protection

18.1 Overcurrent protection at not more than 20 A shall be provided by means of a circuit breaker or fuse, as a part of a heating appliance, for each general-use receptacle circuit and each lampholder circuit independent of a heating element, included in the appliance, unless the appliance would be properly connected to a branch circuit rated at 20 A or less.

18.2 The overcurrent protection mentioned in 18.1 shall be of a type indicated as being acceptable for branch-circuit protection.

18.3 A fuseholder or circuit breaker provided as a part of an appliance shall be acceptable for the particular application and shall not be accessible from the outside of the appliance without opening a door or cover, except that the operating handle of a circuit breaker may project outside of the enclosure. A fuseholder shall be so installed that no uninsulated live parts other than the screw shell or clips of the fuseholder are exposed to contact by a person removing or replacing a fuse. If the fuseholder is intended to be accessible only to a serviceman, uninsulated live parts other than the screw shell or clips may be exposed if they are guarded, or the fuseholder is so located to prevent unintentional contact with these live parts.

## 19 Overcurrent and/or Over-Temperature Protection

19.1 If an appliance is provided with a replaceable overcurrent and/or over-temperature protective device, the device shall be secured in place and shall be so located that it will be accessible for replacement without damaging other connections or internal wiring. See 54.9.

19.2 If an appliance is provided with a fusible device, the device shall be capable of opening the circuit in the intended manner without causing the short-circuiting of live parts and without causing live parts to become grounded to the enclosure when the appliance is connected to a circuit of voltage in accordance with 35.1.14, and operated in a normal position to cause abnormal heating.

19.3 To determine whether a fusible device complies with the requirement in 19.2, the appliance is to be operated with separate devices five times as described in 19.2 while any other thermally operated control devices in the appliance are short-circuited. Each device is required to perform acceptably. During the test, the enclosure is to be connected through a 3-A fuse to a supply conductor not containing the device.

## **20 Lampholders**

20.1 If an appliance intended for permanent connection to the power supply or an appliance equipped with a polarized or grounding type attachment plug is intended to be connected to the grounded conductor of a power-supply circuit, a lampholder supplied as a part of the appliance shall be so wired that the screw shell is connected to the grounded conductor.

20.2 Except as noted in 20.3, a lampholder shall be so constructed and installed that uninsulated live parts other than the screw shell will not be exposed to contact by persons removing or replacing lamps in user service.

20.3 The requirement in 20.2 does not apply if, in order to remove or replace a lamp, it is necessary to dismantle the appliance by means of tools.

20.4 A medium-base lampholder or screw-shell receptacle shall not be used as a holder for a heating element rated at more than 6 A or 660 W, except that a screw with a left-handed thread may be used with a heating element rated at not more than 10 A.

20.5 Except as noted in 20.6, a screw-shell lampholder for an infrared lamp shall be of the unswitched, medium-base type, and used with a 300-W or smaller lamp.

20.6 A lamp-and-lampholder combination need not comply with the requirement in 20.5 if no unacceptable temperature is produced on any of the components in the normal-temperature test, and if the switching mechanism of a switched lampholder is capable of performing acceptably without undue burning, pitting, or the like.

20.7 A female screw shell used as a holder for a heating element shall be of copper or of a copper-base alloy and shall be plated with nickel or equivalent oxidation-resistant metal.

## **21 Power-On Indicator – Toaster Ovens, Toaster Oven/Broilers**

21.1 A toaster-oven and toaster-oven/broiler shall be provided with power-on and power-off indicators. The power-on indicator shall be readily visible and distinguishable from any off position indicator. The power-on indicator shall clearly indicate that the appliance is on.

21.2 The power-on indicator shall be an illuminated switch or pilot light. An ordinary on/off switch position marking alone is unacceptable. The power-on indicator shall remain on during any operating condition (including cycling of the thermostat) of the appliance.

21.3 At least one means shall be provided, other than unplugging the cord, to turn the appliance off.

## 22 Switches

22.1 A switch or other control device provided as a part of an appliance shall be of a type intended for the particular application and shall have a current and voltage rating not less than that of the circuit (load) which it controls.

22.2 A switch employed on an appliance shall be so located or protected that will not be subjected to mechanical damage during use.

22.3 It is recommended that all switches be of an indicating type.

22.4 A switch on a cord-connected toaster shall be of such a type and so connected that it will disconnect any open-wire element or elements that it controls from all conductors of the supply circuit.

22.5 The requirement in 22.4 applies to a switch in the "off" position or any other setting in which the element is not heated, and also to a through-cord switch or a plug in which a switch is incorporated.

22.6 A manually operated, line-connected, single pole switch for appliance on-off operation shall not be connected to the conductor of the power supply cord intended to be grounded. Table 10.3 specifies the identification of the power supply cord conductor intended to be grounded.

22.7 A switch or other device controlling one or more elements of an appliance intended for permanent connection to the power supply shall be of such construction that opening the switch will disconnect all of the ungrounded conductors of the supply circuit, unless there will be no live parts exposed to unintentional contact when the switch is open or unless the fact that such parts are live parts is apparent.

22.8 A switch or other means of control intended to provide for the use of a limited number of elements at one time shall be so located or of such a type that the user cannot readily change the connections to energize more elements than intended.

22.9 A switch controlling a lampholder shall be acceptable for use with tungsten-filament lamps.

22.10 A switch shall not be incorporated in a wooden handle or in other combustible material unless enclosed in metal or insulating material.

## 23 Dual Voltage Appliance

23.1 The construction of the circuit voltage selector shall be such that the circuit voltage setting cannot be changed inadvertently.

23.2 If the appliance is so constructed that the supply circuit voltage selector can be changed, the action of changing the voltage selector setting shall also change the supply circuit voltage indication.

23.3 An appliance that can be set to different rated supply circuit voltages shall be provided with the statement required by 58.10.

## 24 Automatic Controls and Control Circuits

24.1 A control circuit shall comply with the requirements in 12.4.1.1 – 12.4.2.2.

24.2 The operation of an auxiliary control device in an appliance shall disconnect the element or elements that it controls from all ungrounded conductors of the supply circuit, unless there will be no live parts exposed to unintentional contact when the auxiliary control device is open or unless the fact that such parts are live parts is apparent.

24.3 The operation of an auxiliary control device in an automatic toaster shall disconnect the element or elements that it controls from all conductors of the supply circuit in a cord-connected toaster and from all ungrounded conductors of the supply circuit for a permanently connected toaster if live parts are accessible to the extent that they are subject to unintentional contact when the appliance appears to be in a de-energized condition.

24.4 An auxiliary control is considered to be one that is intended primarily for time, temperature, or pressure regulation, and the like, under conditions of intended operation, and not for protection against overload or excessive temperature conditions resulting from abnormal operation.

24.5 A temperature-limiting control intended to reduce the risk of fire or electric shock shall be operative whenever the appliance is connected to its power supply. Except for the inherent thermal protector of a motor, the control of a permanently connected appliance that has exposed live parts shall disconnect the element or elements it controls from all ungrounded conductors of the supply circuit. The operation of such a control shall comply with the requirements in 24.2. A controlled contactor shall comply with the endurance requirement for a limiting control if it is part of the limiting-control circuit.

24.6 A control device shall not deliberately overload the branch-circuit protective device as a means of disconnecting the appliance from the supply.

## 25 Overheating Protection

25.1 The requirements in 25.2 – 25.5 are applicable to an air-type corn popper, bacon-broiler, broiler, toaster-oven, toaster oven/broiler and table stove, or an appliance provided with an enclosure complying with 6.6. These requirements are in addition to or modify the applicable requirements in Overcurrent and/or Over-Temperature Protection, Section 19, Automatic Controls and Control Circuits, Section 24, and Component Switches and Control Devices, Section 48.

25.2 An appliance shall be provided with a separate and distinct temperature-limiting device to limit temperatures within the appliance. A single combination regulating-limiting control is unacceptable for this purpose.

*Exception: A temperature-limiting device is not required if, with all thermally responsive devices short-circuited, the results of all appropriate abnormal tests in Abnormal Operation Test, Section 44, are acceptable.*

25.3 A limiting device shall be any one-time device or manual-reset thermostat, inaccessible to the user, (see 6.13 – 6.16) that performs its intended function when tested according to these requirements.

25.4 A single-operation thermostat or a manual-reset thermostat that is provided as the temperature-limiting device shall comply with the applicable requirements for Single-Operation Devices in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873.

*Exception: See 25.6*

25.5 A thermal cutoff that is provided as a temperature-limiting device shall comply with the applicable requirements in the Standard for Thermal Cutoffs for Use in Electrical Appliances and Components, UL 1020.

*Exception: See 25.6*

25.6 A thermostat or thermal cutoff need not comply with a specific requirement in the standard indicated in 25.4 and 25.5, respectfully, if the requirement:

- a) Involves a feature or characteristic not needed in the application of the component in the product, or
- b) Is superseded by a requirement in this standard.

## 26 Spacings

### 26.1 Line-voltage circuits

#### 26.1.1 General

26.1.1.1 Except as noted in 26.1.1.2 and 26.1.1.3, the spacings in an appliance shall be in accordance with Tables 26.1 and 26.2.

26.1.1.2 The spacings specified in Tables 26.1 and 26.2, do not apply to the inherent spacings of a component part of an appliance, such spacings are judged under the requirements for the component in question.

**Table 26.1**  
**Minimum acceptable spacings at field-wiring terminals<sup>a,b</sup>**

Parts involved	Through air		Over the surface	
	inch	mm	inch	mm
Between live parts of opposite polarity; and between a live part and a dead metal part, other than the enclosure, which may be grounded	1/4	6.4	3/8	9.5
Between a live part and the enclosure	1/2	12.7	1/2	12.7
<sup>a</sup> These spacings do not apply to connecting straps or busses extending away from wiring terminals. Such spacings are to be judged under Table 26.2. <sup>b</sup> Applies to the sum of the spacings involved where an isolated dead part is interposed.				

**Table 26.2**  
**Minimum acceptable spacings through air or over the surface at points other than field-wiring terminals or inside motors<sup>a,b</sup>**

Parts involved	Inches	mm
Between uninsulated live parts of opposite polarity; and between a rigidly mounted uninsulated live part and a dead metal part that either is exposed for persons to contact or may be grounded	1/16	1.6
<sup>a</sup> If an uninsulated live part is not rigidly supported, or if a movable dead metal part is in proximity to an uninsulated live part, the construction shall be such that at least the minimum acceptable spacing of 1/16 inch (1.6 mm) is maintained under all operating conditions and under all conditions of handling. <sup>b</sup> If exact centering of the cold pin of a sheathed-type heating element is required to maintain the 1/16-inch (1.6-mm) spacing, a spacing of 3/64 inch (1.2mm) in one location is acceptable.		

26.1.1.3 The spacings within a motor shall comply with the requirements in the Standard for Electric Motors, UL 1004.

26.1.1.4 At closed-in points only, such as the screw-and-washer construction of an insulated terminal mounted in metal, a spacing of 3/64 inch (1.2 mm) is acceptable in an appliance. Within a thermostat, except at contacts, the spacings between uninsulated live parts on opposite sides of the contacts are to be not less than 1/32 inch (0.8 mm) through air and 3/64 inch (1.2 mm) over the surface of insulating material, and the construction is to be such that the spacings will be maintained permanently.

#### 26.1.2 Barriers

26.1.2.1 Except as noted in 26.1.2.2, an insulating liner or barrier of fiber or similar material employed where spacings would otherwise be unacceptable shall not be less than 0.032 inch (0.8 mm) thick and shall be so located or of such material that it cannot be adversely affected by arcing, except that the fiber not less than 0.016 inch (0.4 mm) thick may be used in conjunction with an air spacing of not less than 50 percent of the spacing required for air alone.

26.1.2.2 Insulating material having a thickness less than specified in 26.1.2.1 may be used if it is equivalent in appropriate properties.

26.1.2.3 Unless protected from mechanical abuse during assembly and functioning of an appliance, a barrier of mica shall be 0.010 inch (0.25 mm) or thicker.

## 27 Grounding

27.1 In an appliance intended for permanent connection to the power supply by a metal-enclosed wiring system (such as rigid metal conduit or armored cable), all exposed dead metal parts and all dead metal parts inside the enclosure that are exposed to contact during any servicing operation (including maintenance and repair) and that are likely to become energized shall be conductively connected to the point at which the cable armor, conduit, and the like, is attached to the appliance.

27.2 In an appliance intended for permanent connection to the power supply by means other than a metal-enclosed wiring system (such as non-metallic-sheathed cable):

- a) An equipment-grounding terminal or lead shall be provided (see 10.1.2.13 and 10.1.2.14), and
- b) All exposed dead metal parts and all dead metal parts inside the enclosure that are exposed to contact during any servicing operation (including maintenance and repair) that are likely to become energized shall be conductively connected to such terminal or lead.

27.3 On a cord-connected appliance where grounding is required or provided, the flexible cord shall include a grounding conductor that shall be:

- a) Green with or without one or more yellow stripes,
- b) Connected to the grounding blade of an attachment plug of a grounding type, and
- c) Connected to the enclosure of the appliance by means of a screw not likely to be removed during ordinary servicing, or by other equivalent means. Solder alone is not acceptable for making this connection.

27.4 All exposed dead metal parts of a cord-connected appliance that is equipped with a grounding conductor, and all dead metal parts within the enclosure that are exposed to contact during any user servicing and are likely to become energized, shall be conductively connected to the grounding conductor of the power-supply cord.

27.5 A separable connecting device provided with a grounding connection shall be such that the appliance grounding connection is made before connection to, and broken after disconnection from the supply circuit.

*Exception: An interlocked plug, receptacle, and connector that is not energized when the appliance grounding connection is made.*

27.6 A cord-connected appliance that is intended for more than occasional outdoor use and can be so used, and a motor-driven spit, outdoor electric grill, food smoker, or similar device intended for outdoor use:

- a) Shall be double insulated, or
- b) Shall have provision for grounding dead metal parts in the form of a grounding conductor in the cord and a grounding type of attachment plug, in accordance with 27.3 (see also 54.14).

Grounding shall not be used if the product is marked as being provided with double insulation.

27.7 A cord-connected two-wire appliance intended to operate at a nominal potential of 240 V (and similarly any other potential within the 220 – 250-V range) shall have provision for grounding in accordance with 27.3 unless the marked rating on the appliance is 120/240 V or unless the appliance is otherwise marked to indicate that it is to be connected only to a 120/240-V circuit with a grounded neutral.

## 28 Pressure Vessels and Parts Subject to Pressure

28.1 Except as noted in 28.2, a pressure vessel having an inside diameter of more than 6 inches (152 mm) and subject to a gauge pressure of more than 15 lbf/in<sup>2</sup> (103 kN/cm<sup>2</sup>) shall be certified by the National Board of Boiler and Pressure-Vessel Inspectors and marked in accordance with the appropriate boiler and pressure vessel code symbol of the American Society of Mechanical Engineers (ASME) ("H", "M", "S", or "U") for a working pressure not less than the pressure determined by applying 28.3.

28.2 If a pressure vessel, because of its application, is not covered under the inspection procedures of the ASME code, it shall be so designed and constructed that it will comply with the requirements in 28.3.

28.3 Except as noted in 28.4 and 28.5, a part that is subject to air or vapor pressure (including the vapor pressure in a vessel containing only a superheated fluid) during normal or abnormal operation shall withstand without bursting or leaking a pressure equal to the highest of the following that is applicable:

- a) Five times the pressure corresponding to the maximum setting of a pressure-reducing valve provided as part of the assembly, but no more than five times the marked maximum supply pressure from an external source and no more than five times the pressure setting of a pressure-relief device provided as part of the assembly.
- b) Five times the marked maximum supply pressure from an external source, except as provided in (a).
- c) Five times the pressure setting of a pressure-relief device provided as part of the assembly.
- d) Five times the maximum pressure that can be developed by an air compressor that is part of the assembly, unless the pressure is limited by a pressure-relief device in accordance with (a).
- e) Five times the working pressure marked on the part.



28.4 A test need not be performed to determine whether a part complies with the requirement in 28.3 if study and analysis indicate that the strength of the part is adequate for the purpose as a result of its material and dimensions – for example, copper or steel pipe of standard size and provided with standard fittings might be considered to have adequate strength.

28.5 A pressure vessel bearing the ASME code inspection symbol ("H", "M", "S", or "U") is considered to comply with the requirement in 28.3 if the vessel is marked with a value of working pressure not less than that to which it is subject during normal or abnormal operation.

28.6 If a test is necessary to determine whether a part complies with the requirement in 28.3, two samples of the part are to be subjected to a hydrostatic-pressure test. Each sample is to be so filled with water as to exclude air and is to be connected to a hydraulic pump. The pressure is to be raised gradually to the specified test value and is to be held at that value for 1 minute. The results are not acceptable if either sample bursts or leaks, except as indicated in 28.7.

28.7 Leakage at a gasket during the hydrostatic-pressure test is not unacceptable unless it occurs at a pressure 40 percent or less of the required test value.

28.8 A means for relieving pressure shall be provided for all parts in which pressure might be generated in the event of fire.

28.9 Pressure-relief devices (see 28.15), fusible plugs, soldered joints, nonmetallic tubing, or other pressure-relief means or the equivalent may be employed to comply with the requirements in 28.8.

28.10 There shall be no shut-off valve between the pressure-relief means and the parts that it is intended to protect.

28.11 A vessel having an inside diameter of more than 3.0 inches (76.2 mm) and subject to air or steam pressure generated or stored within the appliance shall be protected by a pressure-relief device.

28.12 The start-to-discharge pressure setting of the pressure-relief device shall not be higher than the working pressure marked on the vessel. The discharge rate of the device shall acceptably relieve the pressure.

28.13 A pressure-relief device shall comply with all four of the following:

- a) Shall be connected as close as possible to the pressure vessel or parts of the system that it is intended to protect.
- b) Shall be so installed that it is readily accessible for inspection and repair and cannot be readily rendered inoperative.
- c) Shall have its discharge opening so located and directed that the risk of scalding is reduced to a minimum.
- d) Shall have its discharge opening so located and directed that operation of the device will not deposit moisture on bare live parts or on insulation or components affected detrimentally by moisture.

28.14 A pressure-relief device having an adjustable setting is judged on the basis of its maximum setting unless the adjusting means is sealed at a lower setting.

28.15 A pressure-relief device is considered to be a pressure-actuated valve or rupture member intended to relieve excessive pressures automatically.

28.16 Where a pressure relief device is required, the control responsible for limiting the pressure in the vessel shall be capable of performing under rated load for 100,000 cycles of operation and shall prevent the pressure from exceeding 90 percent of the relief device setting under any condition of normal operation.

## **29 Protection Against Personal Injury**

29.1 Materials employed in the construction of an appliance to protect against personal injury shall be acceptable for the particular use. See 6.1 and 6.5.

29.2 An enclosure, a frame, a guard, a handle, or the like shall not be sufficiently sharp to constitute a risk of injury to persons during normal maintenance and use.

*Exception No. 1: A part or portion of a part needed to perform a working function need not comply with this requirement.*

*Exception No. 2: A part or portion of a part inaccessible to the probe illustrated in Figure 6.2 need not comply with this requirement.*

29.3 Compliance with the requirement of 29.2 is determined by applying the test procedures, equipment, and acceptance criteria described in the requirements for test for sharpness of edges on equipment – UL 1439.

29.4 The release mechanism for detachable handles shall be:

- a) So located and/or so guarded that inadvertent detachment of the handle does not occur during normal use of the appliance, and
- b) So constructed that complete and proper engagement of the handle is made evident to the user during the operation of attaching the handle.

## **PERFORMANCE**

### **30 General**

30.1 The performance of an appliance shall be investigated by subjecting the requisite number of samples to all the applicable tests as described in Sections 31 – 48, inclusive. Insofar as practicable, the tests shall be conducted in the order in which they are presented here. Samples employed for leakage-current tests shall be first tested for leakage prior to employing the samples for other tests.

### 31 Power Input Test

31.1 The power input to an appliance shall not be more than 105 percent of its marked rating.

31.2 To determine whether an appliance complies with the requirement in 31.1, the power input is to be measured with the appliance at normal operating temperature under full-load conditions (if required for normal operation), and while connected to a supply circuit adjusted to be the highest of the following:

- a) The marked voltage rating, or
- b) The highest voltage of the applicable range of voltages specified in 53.1 if the marked voltage is within one of the voltage ranges indicated in 53.1.

If an appliance employs a nonmetallic element (such as carbon), the power input is to be determined for an unused element.

### 32 Leakage Current Tests

32.1 The leakage current of a cord-connected appliance rated for a nominal 120-V or 240-V supply when tested in accordance with 32.3 – 32.8 shall not be more than:

- a) 0.5 mA for an ungrounded (2-wire) appliance,
- b) 0.5 mA for a grounded (3-wire) appliance that is easily carried or conveyed by hand, and
- c) 0.75 mA for a grounded (3-wire) permanently connected appliance, or a cord connected appliance that is intended to be fastened in place or located in a dedicated space and employing a standard attachment plug rated 20 A or less.

*Exception: The leakage current of an appliance incorporating a sheath type heating element, when measured in accordance with 32.3 – 32.8, shall not exceed 2.5 mA during the first 5 minutes after reaching the leakage current limit of 0.5 mA or 0.75 mA, as applicable, and at the end of this time, the leakage current shall be not more than the 0.5 mA or 0.75 mA limit as applicable – the leakage current is to be monitored during heat-up and cool-down.*

32.2 Leakage current refers to all currents, including capacity coupled currents, which may be conveyed between exposed conductive surfaces of an appliance and ground or other exposed conductive surfaces of an appliance.

32.3 All exposed conductive surfaces are to be tested for leakage currents. The leakage currents from these surfaces are to be measured to the grounded supply conductor individually as well as collectively where simultaneously accessible and from one surface to another where simultaneously accessible. Parts are considered to be exposed surfaces unless guarded by an enclosure considered acceptable for protection against electric shock as defined in 6.1 – 6.16. Surfaces are considered to be simultaneously accessible when they can be readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at voltages which do not present a risk of electric shock.

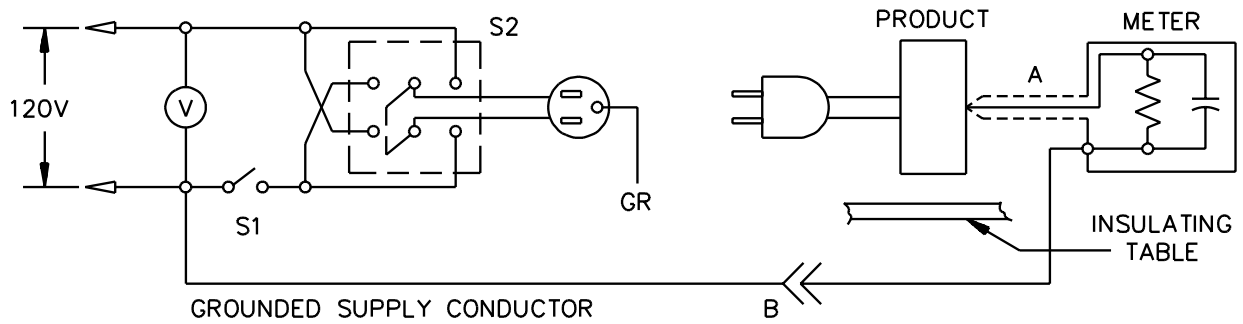
32.4 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using a metal foil with an area of 10 by 20 cm in contact with the surface. Where the surface is less than 10 by 20 cm, the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to affect the temperature of the appliance.

32.5 A heated surface of insulating material is to be investigated concerning the leakage current available from the use of metal utensils.

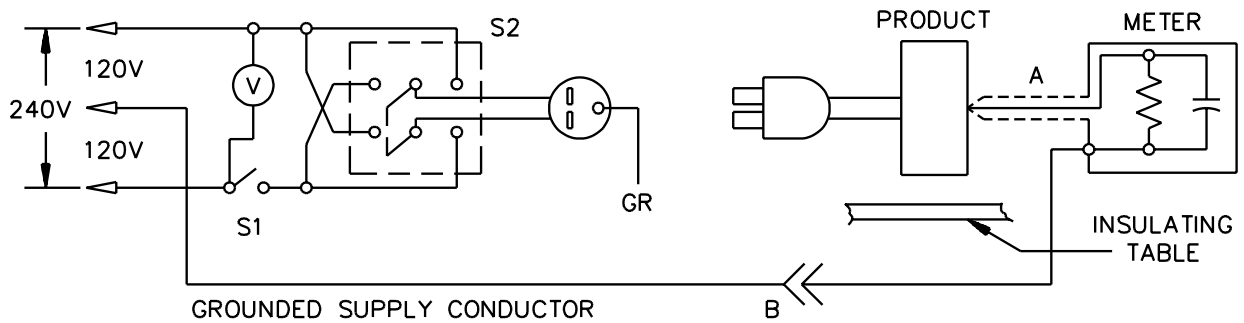
32.6 The measurement circuit for leakage current is to be shown in Figure 32.1. The ideal measurement instrument is defined in items (a) – (d). The meter which is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the ideal instrument. The meter used need not have all the attributes of the ideal instrument.

- a) The meter is to have an input impedance of 1500 ohms resistive shunted by a capacitance of 0.15  $\mu$ F.
- b) The meter is to indicate 1.11 times the average of the full-wave rectified composite wave-form of voltage across the resistor or current through the resistor.
- c) Over a frequency range of 0 – 100 kHz, 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 1500 ohm resistor shunted by a 0.15  $\mu$ F capacitor to 1500 ohms. At an indication of 0.5 or 0.75 mA, the measurement is to have an error of not more than 5 percent at 60 Hz.
- d) Unless the meter is being used to measure leakage from one part of an appliance to another, the meter is to be connected between the accessible parts and the grounded supply conductor.

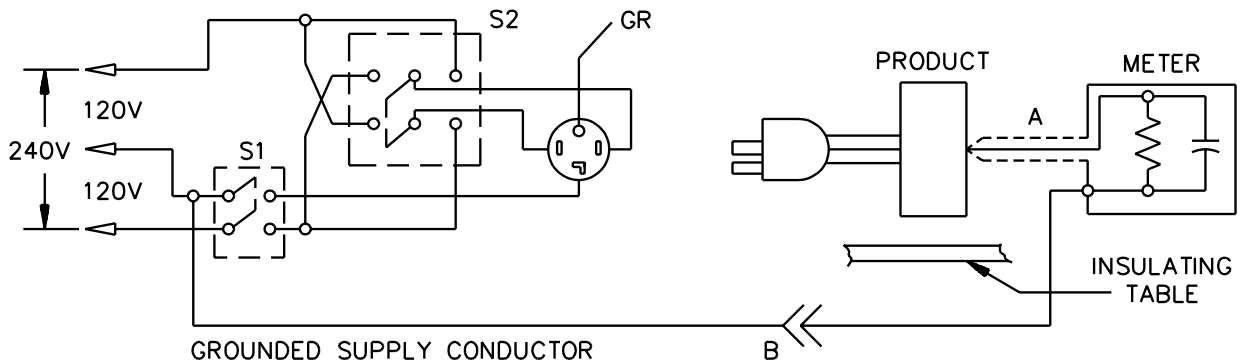
**Figure 32.1**  
**Leakage-current measurement circuit**



Appliance intended for connection to a 120-V power supply, as illustrated above.



2-wire appliance intended for connection to a 3-wire, grounded neutral power supply, as illustrated above.



3-wire appliance intended for connection to a 3-wire, grounded neutral power supply, as illustrated above.

NOTES -

A - Probe with shielded lead.

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

LC300N

32.7 A sample of the appliance is to be tested for leakage current starting with the "as received" condition with all its switches and thermostats closed, but its grounding conductor, if any, open at the attachment plug. The "as received" condition being without prior energization, except as may occur as part of the production line testing. The supply voltages is to be 120- to 240V. The test sequence, with reference to the measuring circuit (Figure 32.1), is to be as follows:

- a) With switch S1 open, the appliance 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 appliance, and within a period of 5 seconds, the leakage current is to be measured using both positions of switch S2, and with the appliance operated at the maximum heat setting of controls.
- c) Leakage current is to be monitored until thermal stabilization under the maximum heat condition. Both positions of switch S2 are to be used. The equivalent of thermal stabilization is considered to be obtained as in the normal temperature test. If any thermostat does not cycle at the maximum heat setting, it is to be adjusted until it does cycle before the final measurements at thermal stabilization are taken. Measurements are to be made with the thermostat, if any, open and closed. Upon evidence of stabilizing readings, monitoring periods may be increased.
- d) If the appliance employs a single pole switch, monitoring of leakage current is to continue until the leakage current stabilizes or decreases after the appliance is turned off.

32.8 Normally a sample will be carried through the complete leakage current test program as covered by 32.7, 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.

### **33 Operational Tests**

33.1 Operation of an appliance while simulating anticipated conditions of use shall not increase the risk of fire, electric shock, or injury to persons.

33.2 In conducting the test, the conditions mentioned in the manufacturer's instructions, including cleaning, maintenance, and the use of accessories may be included or omitted so as to simulate reasonably foreseeable actions of the user.

### **34 Calibration of Probe-Type Temperature Controls Tests**

#### **34.1 Ovens**

34.1.1 The maximum temperature in the center of an oven shall not be higher than 300°C (572°F) either before or after a probe-type control is dropped five times from a height of 3 ft (0.91 m) onto a hardwood surface.

## 34.2 Other appliances

34.2.1 The maximum temperature at the center of the underside of the appliance cooking surface shall not be higher than 300°C (572°F) either before or after a probe-type control is dropped in accordance with 34.2.2. The average of the maximum and minimum temperatures shall not be higher than 260°C (500°F) either before or after the dropping.

34.2.2 Six samples of each control are to be calibrated, and the maximum or minimum temperature in any case is to be the average of at least five temperature readings taken during the cycling of the control after a stabilized cycling pattern has been established. After the initial calibration, each control, while still heated, is to be dropped five times from a height of 3 ft (0.91 m) onto a hardwood surface, following which the control is to be recalibrated.

## 34.3 All appliances

34.3.1 The normal temperature test is to be conducted:

- a) Employing the sample probe-type control that results in the highest center temperature before the drop test, and also, employing the sample probe-type control that results in the highest center temperature after the drop test, if that temperature is higher than the highest temperature obtained before the drop test, or
- b) Employing the sample probe-type control that results in the highest center temperature after the drop test, if that temperature is higher than the highest temperature obtained before the drop test. However, if the highest center temperature is obtained before the drop test, a sample probe-type control that is calibrated to provide the highest center temperature is to be employed.

## 35 Normal Temperature Test

### 35.1 General

35.1.1 An appliance, when tested under the conditions described in 35.1.3 – 35.2.7, shall comply with all three of the following conditions:

- a) The appliance shall not attain at any point a temperature that would constitute a risk of fire or damage any materials employed in the appliance.
- b) At any time during the test – other than as indicated in 35.1.2 and 35.1.3 – temperature rises at specific points shall not be greater than indicated in Table 35.1.
- c) The appliance shall comply with the requirement in 6.1

**Table 35.1**  
**Maximum acceptable temperature rises**

	Materials and component parts	Degrees	
		C	F
1.	Any point within a terminal box or wiring compartment of a permanently connected appliance in which field-installed conductors are to be connected (including such conductors themselves) unless the appliance is marked in accordance with 54.12	35	63
2.	Any point on a surface adjacent to a permanently connected appliance or wall-mounted or under-cabinet mounted cord-connected appliance, including the surface on which the appliance is mounted, and specified points on test surfaces and enclosures at designated clearances from the appliance	65	117
3.	Any point on a surface of a wall-mounted or under-cabinet cord connected appliance exposed to casual contact except for surfaces that are intended for contact during normal operation of the appliance		f
4.	Fuses	65	117
5.	Fiber used as electrical insulation or as cord bushing	65	117
6.	Wood or other combustible material which is part of a heating appliance	65	117
7.	Cotton or rayon braiding of flexible cord	65 <sup>a</sup>	117 <sup>a</sup>
8.	Class 105 insulation systems on winding of relays or solenoids and the like:		
	Thermocouple method	65	117
	Resistance method	85	153
9.	Class A insulation systems on coil windings of d-c and universal motors <sup>b</sup> :		
	a) In open motors:		
	Thermocouple method	65	117
	Resistance method	75	135
	b) In totally enclosed motors:		
	Thermocouple method	70	126
	Resistance method	80	144

Table 35.1 Continued on Next Page



Table 35.1 Continued

	Materials and component parts	Degrees	
		C	F
10.	Class A insulation systems on coil windings of a-c motors (not including universal motors) and on vibrator coils – thermocouple or resistance method <sup>b</sup>		
	a) In open motors and on vibrator coils	75	135
	b) In totally enclosed motors	80	144
11.	Class 130 insulation systems on windings of relays, solenoids, or the like:		
	Thermocouple method <sup>b</sup>	85	153
	Resistance method	105	189
12.	Class B insulation systems on coil windings of d-c and universal motors <sup>b</sup>		
	a) In open motors:		
	Thermocouple method	85	153
	Resistance method	95	171
	b) In totally enclosed motors:		
	Thermocouple method	90	162
	Resistance method	100	180
13.	Class B insulation systems on coil winding of a-c motors (not including universal motors) and on vibrator coils – thermocouple or resistance method <sup>b</sup>		
	a) In open motors and on vibrator coils	95	171
	b) In totally enclosed motors	100	180
14.	Phenolic composition used as electrical insulation or where deterioration would result in a risk of fire, electric shock, or injury to persons <sup>c</sup>	125	225
15.	Points on surface supporting a cord-connected appliance other than wall-mounted or under-cabinet	100	180

Table 35.1 Continued on Next Page

Table 35.1 Continued

	Materials and component parts	Degrees	
		C	F
16.	Points on adjacent surfaces of test corner for counter-top appliances	100	180
17.	Flatiron or appliance plug face	175	315
18.	Insulated wire or cord	25°C (77°F) less than its temperature rating <sup>d</sup>	
19.	Sealing compound	e	
20.	a) Copper tinned or bare strands:		
	1. Less than 0.015 inch (0.38 mm) in diameter	125	225
	2. 0.015 inch diameter and larger	175	315
	b) Nickel, gold or silver platings, or combinations of those platings over copper conductors	225	405
21.	Termination of copper conductor and pressure terminal connector without being nickel-coated or otherwise acceptably protected	125	225
<sup>a</sup> Inside an appliance, the braid of a heater cord may be subjected to a greater rise if the impregnated asbestos insulation is held in place by other appropriate means. <sup>b</sup> See 35.1.12 and 35.1.13 <sup>c</sup> The limitation on phenolic composition does not apply to a compound which has been investigated and found to have special heat-resistant properties. <sup>d</sup> Inside an appliance, the temperature rise on a wire or cord may be greater than the specified maximum rise, provided that the insulation on each individual conductor is protected by supplementary insulation (such as braid, wrap, tape, or close-fitting tubing) which is appropriate for the temperature and the type of insulation involved. <sup>e</sup> Unless a thermosetting material, the maximum sealing compound temperature, when corrected to a 25°C (77°F) ambient temperature, is 15°C (27°F) less than the softening point of the compound as determined by the Test Method for Softening Point by Ring-and-Ball Apparatus, ASTM E28-92. <sup>f</sup> Maximum temperature shall not exceed the temperature specified in Table 36.1, unless appliance is marked "CAUTION – Hot Surface" and temperature rise does not exceed 100°C (180°F). Such marking shall be in letters not less than 3/32 inch (2.4mm) high, see 54.22.			

35.1.2 Initial temperature transients may be in excess of the temperature limits specified in Table 35.1 and 35.1.3 if the duration and extent of the excursion do not result in risk of fire or electric shock.

35.1.3 Temperatures are to be measured during preheat modes. Temperature rises not exceeding those specified in Table 35.1 by more than 20 percent are acceptable.

35.1.4 All values in Table 35.1 are based on an assumed ambient (room) temperature of 25°C (77°F), but a test may be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F). However, if the operation of an automatic thermal control during the test limits the temperatures under observation, no temperature higher than 25°C (77°F) plus the specified maximum rise is acceptable.

35.1.5 During intended operation, the temperature of the fat, oil, or grease in the drip pan or equivalent part of a grill-type broiler shall be less than the flash point of the fat.

35.1.6 A gasket that is depended upon to prevent the entrance of water into an appliance during cleaning shall not become hard or brittle, shall not crack, and shall show no other signs of deterioration as a result of an accelerated-aging test in which the gasket is subjected to elevated temperatures.

35.1.7 The temperature to which the gasket is subjected during the test, as well as the duration of the test, is to be determined in accordance with the material of the gasket, the temperature to which it is subjected during operation, and other conditions of the particular application. Usually the appliance is to be operated dry and for a period of 240 hours.

35.1.8 Following the accelerated aging, the sample is to be immersed, tested, and examined for the entrance of water.

35.1.9 Temperatures are to be measured by thermocouples consisting of wires no larger than No. 24 AWG (0.21 mm<sup>2</sup>) and no smaller than No. 30 AWG (0.05 mm<sup>2</sup>), except that a coil temperature may be determined by the change-of-resistance method if the coil is inaccessible for mounting thermocouples. When thermocouples are used in determining temperatures in electrical equipment, it is standard practice to employ thermocouples consisting of No. 30 AWG iron and constant wire and a potentiometer-type instrument, and such equipment is to be used whenever referee temperature measurements by thermocouples are necessary. The thermocouple wire is to conform with the requirements specified in the Initial Calibration Tolerances for Thermocouples table in Temperature-Measurement Thermocouples, ANSI/ISA MC96.1-1982. The thermocouples and related instruments are to be accurate and calibrated in accordance with good laboratory practice.

35.1.9 revised January 22, 2001

35.1.10 For tests that are to be continued until constant temperatures are attained, thermal equilibrium is to be considered to exist only if three successive readings indicate no change when taken at the conclusion of each of three consecutive equal intervals of time, the duration of each interval being whichever of the following is longer:

- a) 5 minutes, or
- b) 10 percent of the total test time elapsed previous to the start of the first interval.

35.1.11 A thermocouple junction and adjacent thermocouple lead wire are to be securely held in good thermal contact with the surface of the material whose temperature is being measured. In most cases, good thermal contact will result from securely taping or cementing the thermocouple in place but, if a metal surface is involved, brazing or soldering the thermocouple to the metal may be necessary.

35.1.12 Usually, the temperature of a coil or winding is to be measured by means of thermocouples mounted on the outside of the coil wrap. If the coil is inaccessible for mounting thermocouples (for example, a coil immersed in sealing compound) or if the coil wrap includes thermal insulation, or more than 1/32 inch (0.8 mm) of cotton, paper, rayon, or similar insulation, the change-of-resistance method is to be used. For the thermocouple-measured temperature of a coil of an alternating-current motor (other than a universal motor) the thermocouple is to be mounted on the integrally applied insulation of the conductor.

35.1.13 At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature rise measured by means of a thermocouple may be higher by the following amount than the maximum indicated in Table 35.1 provided that the temperature rise measured by the change-of-resistance method does not exceed the values indicated in Table 35.1.

Item in Table 35.1	Additional thermocouple rise	
Item 8	15°C	27°F
Part A of Item 10	5	9
Part A of Item 12	20	36
Part A of Item 13	10	18

If the coil wrap is not caused to exceed its temperature limitation by radiation from an external source, the temperature of the coil may be measured by means of a thermocouple on the integral insulation of the coil conductors.

35.1.14 To determine whether an appliance complies with the requirements in 35.1.1, the appliance is to be operated continuously until constant temperatures have been reached. The test voltage is to be the highest of the following:

- a) The marked voltage rating, or
- b) The highest voltage of the applicable range of voltages specified in 53.1 if the marked voltage is within one of the voltage ranges indicated in 53.1.

35.1.15 Unless a particular voltage or other test condition is specified in 35.2.1.1 – 35.2.7.1, the test voltage specified in 35.1.14 is to be increased, if necessary, to cause the wattage input to the appliance to be equal to the wattage rating marked on the appliance.

35.1.16 If an appliance employs a motor in addition to a heating element, the voltage applied to an integrally connected motor is to be the test voltage as specified in 35.1.14. A motor supplied from a separate circuit is to be connected to a test voltage derived from its marked rated voltage in accordance with 35.1.14.

35.1.17 In conducting a test to determine whether an appliance complies with the temperature requirements, it is to be mounted or supported as in service and tested under conditions approximating those of intended operation, except as otherwise noted. Temperatures are to be observed on nearby surfaces, on the supporting surface, at points of support, on attachment plugs, and at other points as may be necessary, including building wiring which may be located adjacent to or behind a permanently installed appliance.

35.1.18 A counter-type appliance is to be tested in a test corner with the appliance located 4 inches (100 mm) away from the side and rear walls of the test corner. The 4 inch (100 mm) spacing is to be measured from the outer-most extremity of the appliance. The test corner is to consist of dull black-painted fir plywood not less than 3/8 inch (9.5 mm) thick, having such width and height that the walls extend no less than 2 ft (0.61 m) beyond the physical limits of the appliance. The vertical walls are to meet at a right angle.

*Exception No. 1: Front- or side-loaded appliances (such as a toaster-oven, broiler and convection oven) and other appliances (such as a table stove, food warmer and food tray), which by virtue of their size, usual loading and unloading procedures, or intended usage are not likely to be moved from a counter resting location prior or during use, are to be located with the back of the appliance placed directly against one wall of the corner, and with 4 inches (100 mm) maintained from the side of the appliance to the other corner wall.*

*Exception No. 2: An appliance intended for outdoor use only need not be tested in a test corner.*

35.1.19 A cord-connected wall or under-cabinet mounted appliance is to be mounted on one wall or cabinet bottom of a test corner consisting of dull black-painted fir plywood not less than 3/8 inch (9.5 mm) thick, having such a width and height that the walls extend not less than 2 ft (0.61 m) beyond the physical limits of the appliance. The vertical walls are to meet at a right angle. Unless marked as described in 54.13, the appliance is to be placed as close to the corner wall as the construction will permit, and an under-cabinet appliance is to be in contact with the rear wall while a wall-mounted appliance is to be in contact with either the cabinet bottom or the counter, whichever results in the highest temperature. The cabinet bottom is to be 12 inches (300 mm) deep, located 16 inches (400 mm) above the counter top. The surface beneath the unit is to be softwood covered with a double layer of white tissue paper.

No Text on This Page

35.1.20 Thermocouples are to be mounted on wood surfaces using the method illustrated in Figure 35.1 or the equivalent. Starting in the corner, thermocouples are to be placed every 3 inches (76 mm) on each surface (Figure 35.2) so that a minimum area of 18 inches by 18 inches (460 mm by 460 mm) is covered by the thermocouples on each surface.

**Figure 35.1**  
**Method of mounting thermocouple**

Figure 35.1 revised November 17, 1998

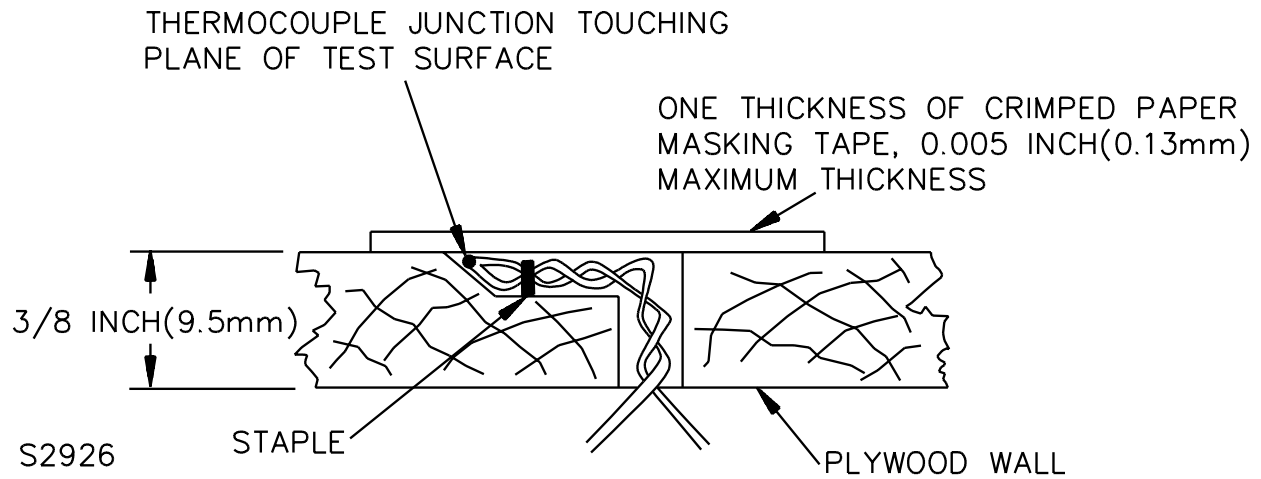
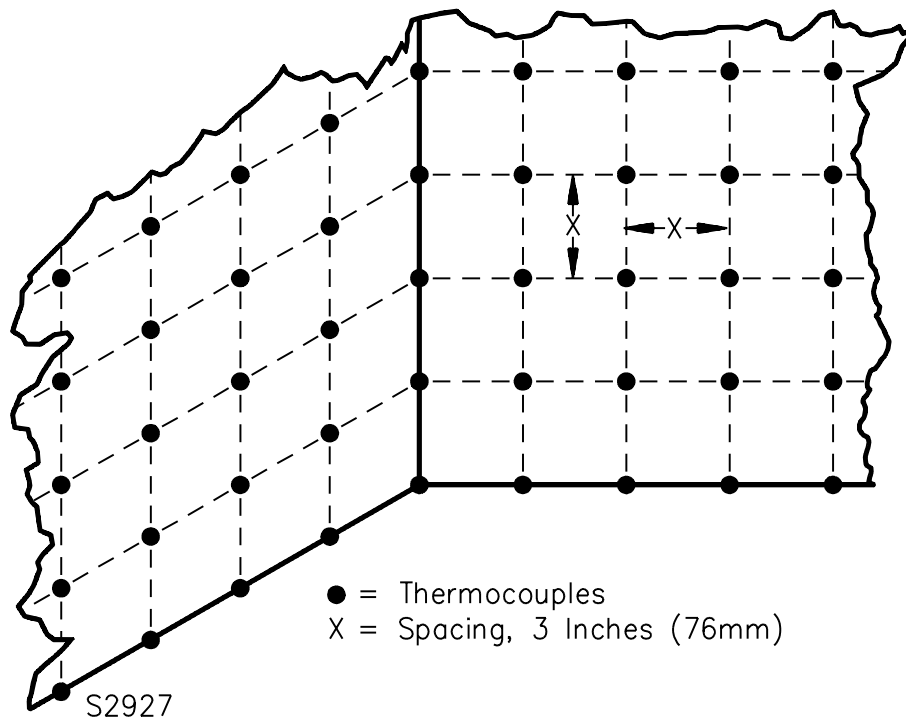


Figure 35.2  
Thermocouple spacings



35.1.21 An appliance intended to be permanently connected to the power supply is to be supported in the intended manner on black-painted wood not less than 3/8 inch (9.5 mm) thick and is to be located in a corner (vertical walls meeting at a right angle) formed by two black-painted, vertical sheets of 3/8 inch (9.5 mm) plywood having such width and height that they extend not less than 2 ft (0.61 m) beyond the physical limits of the appliance. The appliance is to be located as close to both walls of the corner as its construction will permit, and it is to be so placed relative to the walls that maximum heating of the walls will occur, except that it may be spaced away from the walls to preclude the wall temperatures from rising more than 65°C (117°F) if the appliance is marked as described in 54.13. For wall-mounted or under-cabinet mounted appliances intended to be permanently connected to the power supply, mounting is to be as outlined in 35.1.19 above.

35.1.22 Unless otherwise indicated in the description of the test for a specific appliance, a cord-connected appliance is to be supported on two layers of white tissue paper on a softwood surface.

35.1.23 An automatic temperature-regulating or -limiting control or other protective device is to be shunted out of the circuit, unless the control has been shown, in accordance with Table 48.1 to be rugged, reliable, and unlikely to be defeated by the user. The control is considered to be unlikely to be defeated if tools are required to gain access to the control, or a positive stop is incorporated in the control.

35.1.24 During the normal temperature test, a temperature-limiting device provided for overheating protection shall not operate.



35.1.25 If the construction of an appliance is such that cooking or heating of a liquid is a determining factor in the temperature attained (such as in a slow cooker or food warmer), the intended duty of an appliance is to be taken into consideration. Normal operating conditions cannot be obtained however, if certain types of appliances are operated continuously and in a dry condition. Accordingly, in determining whether or not an appliance complies with the requirements in 35.1.1, actual service conditions or an approximation thereof are to be employed. Unless otherwise specifically indicated below:

- a) If the appliance is controlled by an adjustable thermostat, the thermostat is to be set to give maximum temperatures, and
- b) If the appliance is controlled by a nonadjustable thermostat, it is to be allowed to operate at whatever temperature the thermostat permits.

In each case, operation is to be continued until temperatures stabilized.

35.1.26 An appliance that may be either open or closed in actual service is to be tested both open and closed in actual service to determine which condition produces the higher operating temperature. In the case of an open-front tabletop broiler or the like where some cooking operation may be performed without a tray in the broiler compartment, temperatures are to be measured on the horizontal supporting surface in front of the open face of the appliance.

35.1.27 External thermal insulation, such as woven glass fiber or mineral wool, is to be removed before a heating appliance is installed in the test enclosure unless the material is bonded or permanently attached to the appliance. Rubber or other material similarly subjected to deterioration is to be removed from feet or other supports if the removal of the material is likely to result in higher temperatures being attained on the appliance.

No Text on This Page

35.1.28 Wherever cheesecloth is mentioned in connection with either a temperature test or an abnormal test, the cloth is to be bleached cheese-cloth, running 14 – 15 yd<sup>2</sup>/lb (approximately 28 – 30 m<sup>2</sup>/kg), and having what is known to the trade as a "count of 32 × 28" – that is, for any inch square, 32 threads in one direction and 28 threads in the other direction (for any centimeter square 13 threads in one direction and 11 threads in the other direction).

35.1.29 An appliance that is required to be preheated as part of the temperature or abnormal tests is to be preheated as follows:

- a) In accordance with the manufacturer's instructions marked in a readily visible location on the appliance, or
- b) If not marked, the appliance is to be operated for 15 minutes at the temperature setting specified for the cooking portion of the test.

*Exception: An appliance is not to be preheated if the manufacturer's instructions specifically state that preheating of the appliance is not necessary. See 56.8.*

35.1.30 Whenever hamburger is mentioned in connection with either a temperature or an abnormal test, each hamburger is to consist of a mixture of 75 percent lean beef and 25 percent suet by weight ground together twice in succession. A hamburger is to be 3/4 inch (19 mm) thick and have a 4 inch (102 mm) diameter before cooking. The initial hamburger temperature is to be 4.4°C (40°F). A hamburger is considered well done when a central internal temperature of 74°C (165°F) is attained on a centrally located hamburger.

## 35.2 Specific test condition

### 35.2.1 General

35.2.1.1 For most of the common types of appliances, standardized conditions for the temperature tests are given in 35.2.2.1 – 35.2.8.1.

35.2.1.1 revised November 17, 1998

35.2.1.2 In the case of a multi-functional appliance, such as a toaster oven/broiler, the appropriate tests for each function are to be conducted as outlined in 35.2.2.1 – 35.2.7.1.

### 35.2.2 Electrically-equipped barbecue units and grill-type broilers

35.2.2.1 In the case of grill-type broiler, barbecue unit, or the like that is intended to burn solid fuel, (see 44.2.4.2 and 54.8), the heat source is to be a fire of charcoal briquettes as follows:

- a) In a circular fire box, a conical pile of fuel having a diameter 3/4 of that of the box, and a height 3/4 of that of the sides of the box, but not less than three briquettes high, or
- b) In a rectangular fire box, a pyramidal pile of fuel having respective width and length 3/4 of those of the box, and a height 3/4 that of the sides of the box, but not less than three briquettes high.

### 35.2.3 Broilers/ovens/grills

35.2.3.1 A convection oven, broiler, grill or a broiler/oven is to be preheated in accordance with 35.1.29. The cooking tray or rack is to be loaded to 75 – 80 percent of its capacity with hamburgers. A total of 3 loads of hamburgers are to be cooked until well done. A 10-second interval per hamburger is to be allowed for changing loads. On an appliance that broils only on one side, a 5-second interval per hamburger is to be allowed for turning the hamburgers at the middle of each cycle. If the appliance is marked with a temperature setting for hamburgers, the specified temperature is to be used for the test. Otherwise, the maximum temperature setting is to be used. Temperatures are to be measured continuously during each cooking cycle. A maximum of 30 seconds is to be allowed between hamburger loads for emptying a grease tray.

35.2.3.2 An oven, convection oven or a broiler/oven is to be preheated in accordance with 35.1.29 and then operated while baking potatoes. The potatoes are to occupy 75 – 80 percent of the bake tray. The temperature control setting is to be adjusted to maintain an oven chamber temperature of 204°C (400°F) or the temperature setting marked in a readily visible location on the appliance, but not less than 177°C (350°F) in any case. The potatoes are to be standard baking potatoes each weighing between 3/8 – 5/8 lb (0.85 – 1.38 kg). Temperatures are to be measured continuously during the test. The test is to be terminated when the internal center temperature of a centrally located potato is 99°C (210°F).

### 35.2.4 Table stoves

35.2.4.1 The appliance is to be operated continuously with each heating unit covered with a shallow pan of water. The diameter of the bottom plane surface of a pan is to be equal to the outside diameter of the active part of the heating element with a plus tolerance on 1 inch (25 mm).

### 35.2.5 Toaster

35.2.5.1 A toaster, toaster oven, or toaster oven/broiler is to be operated first toasting a total of six slices of bread with one slice of bread per cycle and then toasting a total of 24 slices of bread while loaded to its maximum capacity. Between the two sets, a sufficient cool-down period is to be allowed for the appliance to return to its ambient temperature. For each of the two tests, the bread is to be toasted to a good brown color as rapidly as the toaster will operate. The bread is to be commercially available white bread weighing approximately 25 grams. A good brown color is to be determined by use of the toast color chart in Appendix B.

### 35.2.6 Warming trays and food warmers

35.2.6.1 Warming trays (receive only vessels on the heated surface) and food warmers (receive food directly on the heated surface) are to be operated continuously with the thermostat set at the maximum-heat position and with the surface empty. If the thermostat cycles, the test is to be repeated with a vessel containing water (minimum depth: 1 inch or 25 mm) placed on the heating surface over the thermostat. The vessel will normally consist of a 6-inch-diameter (152-mm) shallow pan.

### 35.2.7 Rotisseries

35.2.7.1 A rotisserie is to be operated continuously until thermal equilibrium is obtained. During the test, the manufacturer's maximum recommended load, or if not specified, a 10 lb (4.5 kg) steel weight as shown in Figure 35.3 is to be employed. In the case of multiple spits, each spit is to be loaded with the manufacturer's maximum recommended load or a total of 10 lb (4.5 kg) distributed equally among the spits.

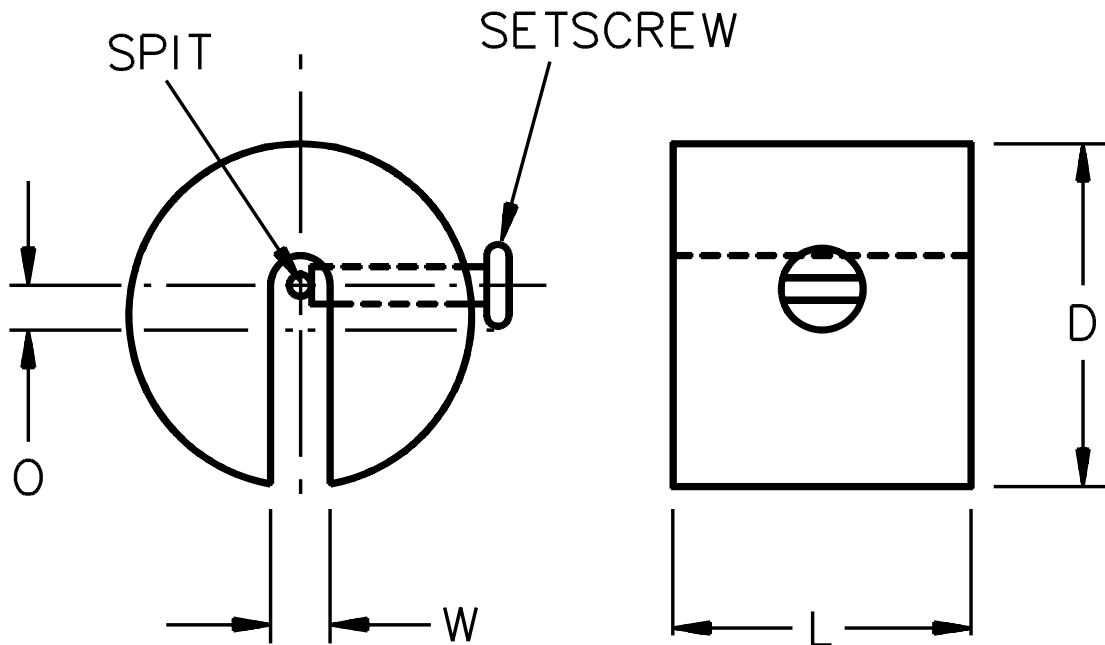
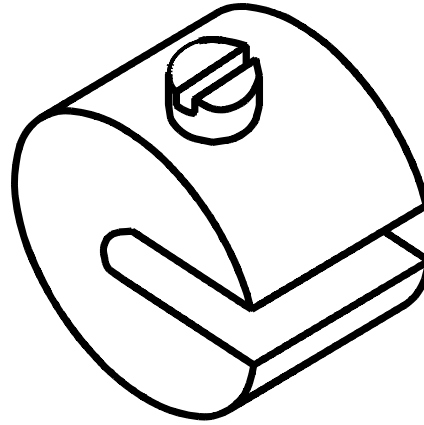
### 35.2.8 Automatic bread makers

35.2.8.1 An automatic bread maker is to be operated for two complete cycles making the maximum size loaf of white bread in accordance with the manufacturers instructions. The second cycle is to begin immediately after completion of the first cycle.

35.2.8.1 added November 17, 1998

**Figure 35.3**  
**Load for rotisseries**

Figure 35.3 revised November 17, 1998



S0912A

Dimension	Inches	mm
O	7/32	5.6
W	3/4	19.0
L	3-3/8 <sup>a</sup>	85.7 <sup>a</sup>
D	4	102.0

<sup>a</sup> Length approximate, length varied to obtain weight specified.

### 36 Top-Front Edge Temperatures – Convection Ovens Tests

36.1 When tested under the conditions described in 36.5 – 36.10, the temperatures of an external top-front edge of a convection oven with a top-mounted manual control panel shall not exceed the maximum acceptable temperatures specified in Table 36.1

*Exception: An oven that is marked in accordance with 54.21 need not comply with this requirement.*

36.2 With reference to 36.1, a top-front edge is considered to be a locus of points on the top-front horizontal plane, located 7/64-inch (2.8 mm) to the rear of and parallel to the front vertical enclosure panel. A top-mounted manual control panel is considered to be one that is mounted 6-inches (152 mm) or more horizontally behind the top-front edge of the appliance.

36.3 All values for temperatures specified in Table 36.1 are based on a 25°C (77°F) ambient (air) temperature within the range of 20 – 30°C (68 – 86°F).

**Table 36.1**  
**Maximum temperature limits**

	°C	°F
(1) Bare or painted metal	67	152
(2) Porcelain enamel	71	160
(3) Glass	78	172
(4) Plastic <sup>a</sup>	83	182
<sup>a</sup> Includes plastic with a metal plating not more than 0.005 inch (0.127 mm) thick; and metal with a plastic or vinyl covering not less than 0.005 inch (0.127 mm) thick.		

36.4 For the test described in 36.5 – 36.10, if the ambient temperature is other than 25°C (77°F), the temperatures measured are to be corrected to this ambient – that is, the temperatures are to be decreased or increased, as appropriate, 1 degree for each degree the ambient is greater than or less than 25°C (77°F).

36.5 A convection oven is to be completely assembled for the test – all handles, knobs, guards, and the like are to be mounted in place. A shelf, a rack, or the like may be removed if it interferes with the placement of the thermocouple used to measure oven temperature.

36.6 With reference to the requirement in 36.1, corrugated, dimpled, and similarly finished edges are to be tested. Edges are to be clean when temperatures are measured.

36.7 Temperatures are to be measured immediately prior to or following oven thermostat cycling – opening of thermostat – after convection oven has been operating for 1 hour with the temperature control maintaining an average oven temperature of 204 ±3°C (400 ±5°F) and constant surface temperatures have been attained.

No Text on This Page



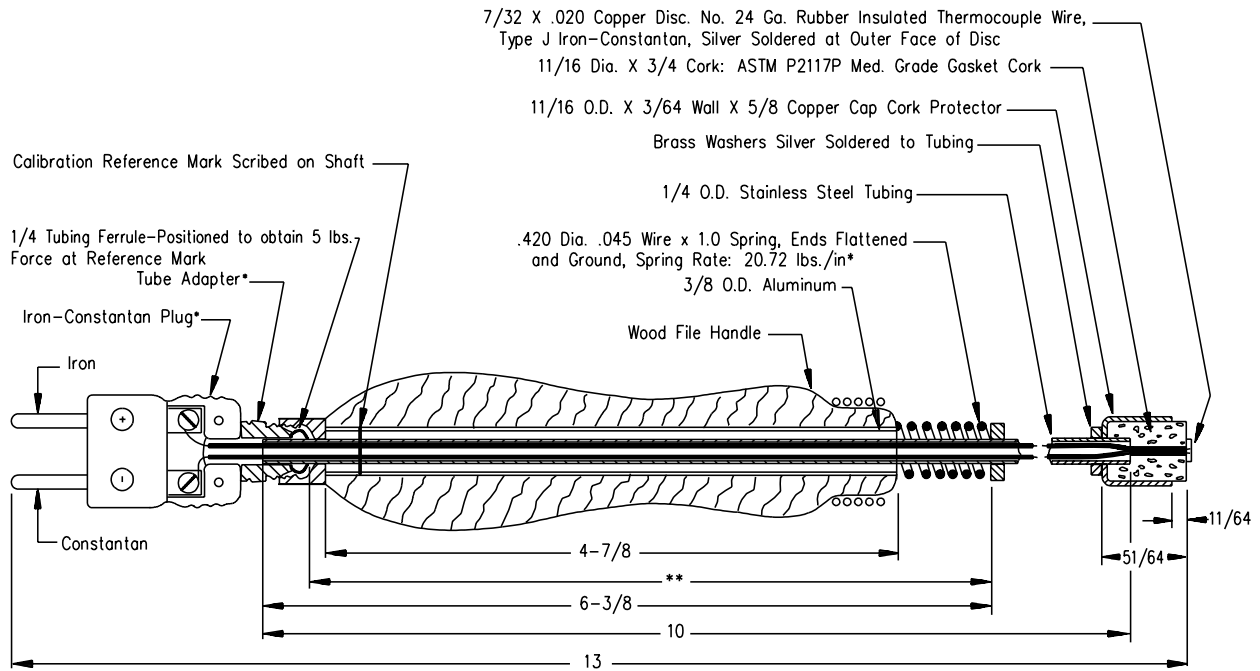
36.8 Convection-oven temperatures are to be measured with a single unshielded thermocouple located in the geometric center of the oven cavity.

36.9 Top-front temperatures are to be measured using the probe illustrated in Figure 36.1. For each measurement, the probe is to be at the ambient temperature, and then is to be preheated for 15 seconds to approximately the temperature of the edge under consideration. Preheating consists of applying the probe with a 5 lbf (22 N) force for 15 seconds to a similarly heated edge located approximately 1 inch (25 mm) from the edge to be tested. The probe is then to be vertically applied to the edge under consideration with a 5 lbf for 10 seconds. The probe is to be moved from the preheat position to the edge as quickly as possible, and is to be applied so that the probe disc is tangent to the front edge with the axis of the probe perpendicular to the horizontal enclosure panel of the convection oven.

36.10 A top-front edge temperature is considered to be constant when three successful readings taken at not less than 5-minute intervals indicate no change.

**Figure 36.1**  
**Temperature measuring and accessibility probe**

Figure 36.1 revised August 8, 1996

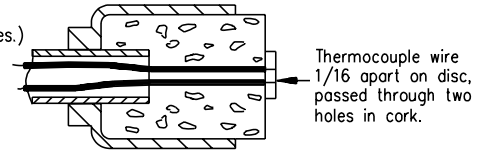


\*Dimensions shown above are based on use of the following purchased parts: Marlin No.1060 Iron-Constantan plug Marlin No. 1070 Tube Adapter No. C420-045-1000 Spring (Associated Spring Corp.)

(All dimensions shown are in inches.)  
(1/8 inch = 3.2mm)  
(1 inch = 25.4mm)  
(1 pound-force = 4.45N)

\*\*This dimension will vary so that 5 pound calibration will align with reference mark on probe shaft.

PA150B



### 37 Tests for Insulation Resistance and Leakage Current as a Result of Moisture

37.1 An appliance employing insulation material likely to be affected adversely by moisture under condition of intended use shall be conditioned for 48 hours in moist air having a relative humidity of  $88 \pm 2$  percent at a temperature of  $32.0 \pm 2.0^\circ\text{C}$  ( $89.6 \pm 3.6^\circ\text{F}$ ). After the conditioning:

- a) A cord-connected appliance rated for a nominal 120- or 240-V supply shall comply with the requirement in 32.1 in a repeat leakage current test, except that the test shall be discontinued when leakage current stabilizes.
- b) An appliance other than mentioned in (a) shall have an insulation resistance of not less than 50,000 ohms between live parts and interconnected dead metal parts.

37.2 The insulation resistance is to be measured:

- a) By a magneto megohmmeter that has an open circuit output of 500 V,
- b) By a voltmeter having an internal resistance of at least 30,000 ohms and using a 250-V d-c circuit, or
- c) By equivalent equipment.

37.3 If glass-fiber sleeving is used as electrical insulation in a rope heater assembly, a previously untested appliance shall be operated for 96 continuous hours under the condition resulting in the maximum temperature on the sleeving, as determined from the normal temperature test, following that it shall be conditioned for 48 hours in moist air having a relative humidity of  $88 \pm 2$  percent at a temperature of  $32 \pm 2.0^\circ\text{C}$  ( $89.6 \pm 3.6^\circ\text{F}$ ). After the conditioning, the appliance shall comply with the requirement in 32.1 in a repeat leakage test, except that the test shall be discontinued when the leakage current stabilizes. Following the leakage current test, the appliance shall also comply with the dielectric voltage-withstand test requirement in 38.1.

37.4 An appliance that by construction and intended use can be expected to be used outdoors (for example, an outdoor electric grill, motor-operated spit, and the like) when tested after being conditioned as indicated in 37.5.

- a) If a cord connected appliance rated for a nominal 120- or 240-V supply, shall comply with the requirement in 32.1 in a repeat leakage current test, except that the test shall be discontinued when leakage current stabilizes.
- b) If an appliance other than those mentioned in (a), shall have an insulation resistance of not less than 50,000 ohms.
- c) Shall also be capable of withstanding without breakdown for a period of 1 minute the application of a 60 Hz essentially sinusoidal potential between live parts and interconnected dead metal parts. The dielectric test potential shall be 1000 V.

37.5 One sample of an appliance that can be expected to be used outdoors is to be mounted as in actual service (the appliance is to be mounted in any shield or other shelter that the manufacturer provides for use with the appliance). While so mounted and without being energized, the appliance is to be subjected for 4 hours to a water spray applied at an angle 45 degrees from the vertical and adjusted to be equivalent to a beating rain. After this conditioning and while still mounted, the appliance is to be tested first for leakage current or for insulation resistance and then dielectric withstand as indicated in 37.4.

37.6 In the case of a warming tray, a solution of 1/2 g of calcium sulphate ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) per liter of distilled water, in sufficient quantity to cover the appliance surface to a depth of 5 mm, is to be sponged over the serving surface. The sponging operation consists of using the volume of water described above in a simulated cleaning operation with the water being allowed to drain from the edges. At the conclusion of this test, the leakage current or insulation-resistance and the dielectric-withstand tests described in 37.4 are to be conducted. The leakage current is not to exceed 0.5 mA.

37.7 In the case of food warmers, the volume of hard water solution described in 37.6 is to be poured on the surface of the appliance and allowed to remain for a period of 1 hour. Without removing the solution, the tests described in 37.4 are to be conducted.

37.8 Except as noted in 37.9, an appliance (such as a food warmer) that is likely to be immersed in water for cleaning shall show a leakage current of not more than 0.5 mA and shall be capable of withstanding a potential of 1000 V when tested in accordance with 37.9 – 37.12. The test shall not result in the entrance of water into the interior of the appliance such that the water might come into contact with uninsulated live parts.

37.9 An appliance marked to indicate that it is not intended for immersion need not comply with the requirements in 37.8. See 54.18.

37.10 Three samples of the appliance are to be heated as described in 37.12 and after disconnection from the supply circuit, are then to be immersed immediately in water at a temperature of 10 – 25°C (50 – 77°F). The immersion is to be complete unless the appliance is marked to indicate that it is intended for partial immersion only (see 54.18), in which case each appliance is to be immersed only to the extent indicated. After 1 hour of immersion, the samples are to be removed from the water, dried with a soft cloth to remove all surface moisture, including surface moisture from terminal pins, and the samples are to be tested for leakage current as indicated in 37.4.

37.11 The entire procedure of immersion and leakage current measurement is to be repeated four times, immediately following which each sample is to be subjected to a 1000-V dielectric voltage-withstand test as described in 38.1. The three samples are to be used for aging tests, and are required to comply with the requirements in 35.1.7 – 35.1.9. If there is an air cavity having electrical components, the three samples are to be disassembled and the internal parts visually examined for the presence of water (37.8). See Table 37.1.

**Table 37.1**  
**Immersion tests<sup>a</sup>**

All appliances likely to be immersed			
	Sample No. 1	Sample No. 2	Sample No. 3
First 5 cycles	Conditioning for Tests Dry initially and throughout conditioning Immerse 1 hour Dry with cloth Leakage-current test		
After 5th cycle	High-potential test Operate 240 hours Cool to room temperature Reheat as for normal-temperature test Immerse for 1 hour Leakage-current test High-potential test		
<sup>a</sup> If there is an air cavity housing electrical components in the appliance, disassemble and examine for water.			

37.12 The appliance is to be heated for the immersion test by operating it dry, with the thermostat at the highest setting, until the thermostat automatically switches to the low or off position.

37.13 A food-warming tray or food warmer provided with a seal is to be energized and maintained at its maximum temperature for 2-1/2 hours, after that it is to be cooled to ambient temperature and re-energized. Operation in this manner is to continue until 1000 hours of on time has accrued. The test described in 37.6 or 37.7 is then to be repeated.

### 38 Dielectric Voltage-Withstand Test

38.1 An appliance shall be capable of withstanding for 1 minute without an indication of unacceptable performance, the application of a potential applied between live parts and accessible metal parts. The appliance is to be at its maximum normal operating temperature. The test potential (rms) shall be 1000 V.

38.2 With respect to 38.1, an appliance having an enclosure constructed partly or totally of insulating material is to have accessible surfaces of the material closely wrapped in metal foil. The test potential is to be applied between live parts and the foil.

38.3 With respect to 38.1 and 38.2, a part is considered to be accessible if it can be contacted by the probe illustrated in Figure 6.2 when applied in all possible articulated positions, with and without the parts referenced in 6.16 in place.

38.4 To determine whether an appliance complies with the requirements in 38.1, the test potential is to be applied as described in 38.6, by means of test equipment having the characteristics outlined in 38.5.

38.5 The test equipment for conducting the dielectric voltage-withstand test is to have the following features and characteristics:

- a) A means for indicating the test voltage that is being applied to the appliance under test. This may be accomplished by sensing the voltage at the test leads or by an equivalent means.
- b) An output voltage that:
  - 1) Has a sinusoidal waveform,
  - 2) Has a frequency that is within the range of 40 – 70 Hz, and
  - 3) Has a peak value of the waveform that is not less than 1.3 and not more than 1.5 times the root-mean-square value.
- c) A sensitivity of the test requirement that is such that when a resistor of 120,000 ohms is connected across the output, the test equipment does not indicate unacceptable performance for any output voltage less than the specified test voltage, and the test equipment does indicate unacceptable performance for any output voltage equal to or greater than the specified test value. The resistance of the calibrating resistor is to be adjusted as close to 120,000 ohms as instrument accuracy can provide, but never more than 120,000 ohms.

*Exception No. 1: The sensitivity of the test equipment may be reduced, a lower value of calibrating resistance may be used, when testing an appliance intended to be permanently wired.*

*Exception No. 2: The sensitivity of the test equipment may be increased, a higher value of calibrating resistance may be used, if agreeable to those concerned.*

38.6 The method of applying the test voltage to the appliance is to be such that there are not any transient voltages that result in the instantaneous voltage applied to the appliance exceeding 105 percent of the peak value of the specified test voltage. The applied potential is to be increased from zero at a substantially uniform rate so as to arrive at the specified test potential in approximately 5 seconds, and then is to be maintained at the test potential for one minute. Manual control of the rate of rise may be used.

38.7 In the case of an appliance in which the electric wiring passes through a hinged member or spring, the cover is to be raised and lowered three or more times while the test potential is being applied in order to determine whether an indication of unacceptable performance may result from damaged insulation on the conductors while the cover is in other than the closed position.

### **39 Mechanical Endurance Test**

39.1 If the intended operation of an appliance causes movement of the internal wiring, the appliance shall be capable of operating for 6000 cycles in the intended manner while connected to a supply circuit of the voltage indicated in 39.2. If the cleaning of an appliance, such as a range element on a table stove, causes movement of the internal wiring, the movable part shall be capable of operating successfully for 1000 cycles unenergized in the intended manner indicated in 39.2. There shall be no electrical or mechanical malfunction and, after the test, the appliance shall comply with the requirements for dielectric voltage-withstand in 38.1 – 38.7.

39.2 In a test to determine whether an appliance complies with the requirements in 39.1, any mechanical arrangement may be employed to operate the movable member at a rate of approximately 12 cycles per minute, but, in any case, the cover or movable member is to be so operated that it will reach the actual limits of travel in both directions, each cycle.

#### **40 Broken Element Test**

40.1 An open-wire heating element in an appliance shall be so constructed and supported so that if the wiring is cut at any point there shall be no reduction of electrical spacings below the limits specified in this standard. Except for an automatic toaster, after being cut, no portion of the heating element wire shall be accessible to contact by the articulate probe through any opening in the enclosure.

40.2 To determine compliance with 40.1:

- a) The appliance is first to have been operated until fully heated as in the Power Input or Temperature Tests, and
- b) After cutting the heating element, the appliance is to be rotated 360 degrees in the direction most likely to cause contact between the heating element and accessible parts.

#### **40A Push-Back Relief Test**

40A added November 17, 1998

40A.1 To determine compliance with 10.2.2.3, a product shall be tested in accordance with 40A.2 without occurrence of any of the following conditions:

- a) Subjecting the supply cord or lead to mechanical damage;
- b) Exposing the supply cord or lead to a temperature higher than that for which it is rated;
- c) Reducing spacings (such as to a metal strain-relief clamp) below the minimum required values;  
or
- d) Damaging internal connections or components.

40A.2 The supply cord or lead is to be held 1 inch (25.4 mm) from the point where the cord or lead emerges from the product and is then to be pushed back into the product. The cord or lead is to be pushed back into the product in 1 inch (25.4 mm) increments until the cord buckles or the force to push the cord into the product exceeds 6 pounds-force (26.7 N). The supply cord or lead within the product is to be manipulated to determine compliance with 10.2.2.3.

#### **41 Overflow Test**

##### **41.1 General**

41.1.1 If an appliance incorporates a reservoir or liquid-storage chamber that is likely to be over-filled in intended service, liquid overflowing from the reservoir or chamber shall not wet uninsulated live parts or film-coated wires, and shall not wet electrical insulation that is likely to be adversely affected by the liquid used in the reservoir or chamber.

41.1.2 To determine whether an appliance complies with the requirement in 41.1.1, it is to be tested as follows: water is to be used for the test, and is to be poured into the reservoir through an orifice 3/8 inch (9.5 mm) in diameter. The reservoir is to be filled to the level recommended by the manufacturer if such level is plainly marked; otherwise, the reservoir is to be filled to maximum capacity. Additional water, equal to 50 percent of the volume just mentioned (but not more than 1 pint), is then to be poured into the reservoir. The appliance is considered to involve a risk of electric shock if the current measured through a 500 ohm resistor between an accessible part and ground is more than 5 mA.

Revised 41.1.2 effective November 28, 2003

41.1.3 A cup or carafe warmer that incorporates ventilation or other openings through which liquid may enter, liquid entering the openings shall not wet uninsulated live parts or film-coated wires, and shall not wet electrical insulation that is likely to be adversely affected by the liquid entering the openings.

Added 41.1.3 effective November 28, 2003

41.1.4 To determine whether a cup or carafe warmer complies with the requirement in 41.1.3, standard hard water solution consisting of 0.07oz/gal (0.5g/L) of calcium sulfate ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) in distilled water, is to be poured uniformly through an orifice 3/8 inch (9.5 mm) in diameter directly onto the center of the warming plate. For a warmer intended for vessels that hold up to 17.5 oz (0.51 L), then 8 oz (0.24 L) of standard hard water solution is to be used for this test. For a warmer intended for vessels that hold more than 17.5 oz (0.51 L), then 16 oz (0.47 L) of standard hard water solution is to be used for this test. The appliance is considered to involve a risk of electric shock if the current measured through a 500 ohm resistor between an accessible part and ground is more than 5 mA.

Added 41.1.4 effective November 28, 2003

## 41.2 Fill

41.2.1 After testing as described in 41.2.2, an appliance that incorporates a removable container shall not permit uninsulated live parts, film-coated wire, or electrical insulation that may be adversely affected by liquid to become wet when used with the container removed.

*Exception: An appliance that is marked in accordance with 54.26 need not be tested.*

41.2.2 With the cooking container removed, 1 pint (0.47 l) of standard hard water solution (see 37.6) is to be poured into the appliance through a 3/8-inch (9.5-mm) diameter orifice in the locations likely to cause wetting of live parts and wiring. Determination of whether uninsulated live parts have become wet as a result of the test is to be made by means of a leakage current test or dielectric voltage-withstand test, or both, with the appliance de-energized. The appliance is then to be disassembled and examined for the presence of water on metal parts in the electrical component spaces that directly support electrical parts, the failure of which could result in a risk of fire or electric shock.



## 42 Metal Enclosure Impact Tests

42.1 A metal enclosure part shall comply with the tests outlined in 42.2 – 42.5. For polymeric enclosure parts, see the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

42.2 A metal enclosure part shall withstand the ball impact, with the appliance restrained, as described in 42.3 without occurrence of any one of the following conditions:

- a) Making live parts accessible to contact with the articulate probe, see 6.13 and 6.14.
- b) Producing any other condition that results in damage of the enclosure so as to adversely affect the function of any safety or constructional feature, such as thermostats, overload protective devices or strain relief.
- c) Producing other conditions so that the appliance does not comply with the dielectric voltage-withstand requirements in Dielectric Voltage-Withstand Test, Section 38 after being subjected to the impact.

42.3 Each of three samples of the appliance is to be subjected to one impact. This impact is to be imparted by dropping or swinging a 2-inch (50.8-mm) diameter steel sphere, weighing 1.18 lb (0.535 kg) from a height that will produce an impact of 1.5 ft-lbf (203 N·m). The sample is to be rigidly supported and the impact is to be made perpendicular to the most vulnerable spots on the appliance enclosure that are exposed to a blow during intended use. A different spot on the enclosure is to be selected for each impact. Refer to Figure 42.2 with respect to the ball drop impact test and to Figure 42.3 for the ball pendulum impact test.

*Exception: If the manufacturer elects, fewer than three samples may be used for the test in accordance with Figure 42.1 wherein each series consists of one impact. The overall performance is acceptable upon completion of any one of the procedures represented in Figure 42.1.*

No Text on This Page

42.4 With reference to Figures 42.2 and 42.3, the "H" designation represents the vertical distance the sphere must travel to produce the desired impact. For the pendulum impact, the sphere is to contact the test sample when the string is in the vertical position. The supporting surface is to be as described in 42.5. The backing surface for the pendulum impact is to consist of 3/4-inch (18-mm) plywood over a rigid surface of concrete or an equivalent nonresilient backing surface may be used.

**Figure 42.1**  
**Procedure for impact test**

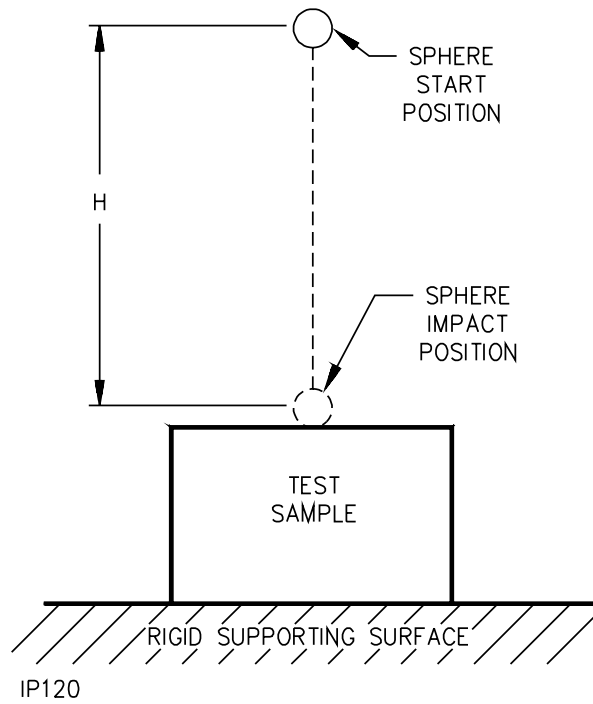
Figure 42.1 revised November 17, 1998

Series Number	Sample Number											
	1	2	3	1	2	3	1	2	3	1	2	3
1	↓ A	N	N	↓ A	N	N	↓ A	N	N	↓ A	N	N
2	↓ A	N	N	↓ A	N	N	↓ U	↓ A	N	↓ U	↓ A	N
3	↓ A	N	N	↓ U	↓ A	N	↓ A	N		↓ U	↓ A	

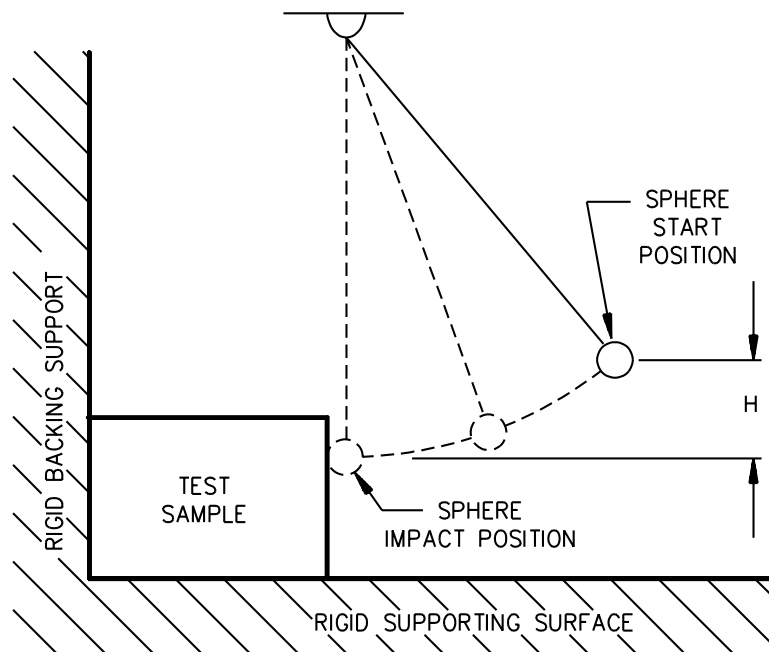
Arrows indicate sequence of test procedure  
 A – Acceptable results from drop  
 U – Unacceptable results from drop  
 N – No test necessary

SA1162

**Figure 42.2**  
**Ball drop impact test**



**Figure 42.3**  
**Ball pendulum impact test**



IP 160

42.5 The supporting surface mentioned in 42.4 is to consist of a layer of tongue-and-groove oak flooring mounted on two layers of 3/4-inch (18-mm) thick plywood. The oak flooring is to be nominally 3/4 inch by 2-1/4 inch (actual size 3/4 by 2-1/4 inch – 18 by 57 mm). The assembly is to rest on a concrete floor or an equivalent nonresilient surface.

#### 42A Non-Metallic Enclosure-Fasteners Test

42A effective March 26, 1997

42A.1 An enclosure or enclosure part secured by non-metallic fasteners shall not become detached and shall remain in the secured position when tested in accordance with 42A.2 – 42A.7. An enclosure or part that requires removal to perform manufacturer's recommended user servicing, maintenance, operating adjustments, attachment of accessories, and the like, is to be disassembled and assembled 10 times before the test is conducted. The tests are to be performed on a total of six samples; three samples as-received, and three samples that have been conditioned by operating until constant temperatures are obtained in accordance with Normal Temperature Test, Section 35. The test is to be commenced within one minute after completion of the conditioning of the three samples.

*Exception: For polymeric enclosure not fabricated with thermoplastic materials, only the as-received samples are to be tested.*

42A.1 effective March 26, 1997

42A.2 Each sample is to be subjected to push and pull forces as specified below. The forces are to be applied in any direction likely to result in non-compliance:

- a) A push force of 11.2 lbf (50 N); and
- b) A pull force:
  - 1) Of 11.2 lbf (50 N), if the shape of the part is such that the fingertips cannot easily slip off, or
  - 2) 6.7 lbf (30 N), if the projection of the part which is gripped is less than 0.4 inch (10 mm) in the direction of removal.

The force is to be applied gradually at a uniform rate until the specified value is obtained. The force is then to be maintained for 10 seconds. For each of the samples tested, the point of application and direction of the force is to be different.

42A.2 effective March 26, 1997

42A.3 The push force is to be applied by means of a rigid probe of the dimensions shown in Figure 42A.1. The pull force is to be applied by an acceptable means such as a wire through an opening in the enclosure that does not affect the securement means of the enclosure or enclosure part being evaluated, so that the test results are not affected.

42A.3 effective March 26, 1997

42A.4 While the pull force specified in 42A.2(b) is being applied, the test fingernail shown in Figure 42A.2 is to be inserted in any aperture or joint with a force of 2.24 lbf (10 N). The fingernail is then to be slid sideways with a force of 2.24 lbf. The fingernail is not to be twisted or used as a lever.

42A.4 effective March 26, 1997

42A.5 If the shape of the part is such that an axial pull is unlikely, no pull force is to be applied but the test fingernail shown in Figure 42A.2 is to be inserted in any aperture or joint with a force of 2.24 lbf (10 N) and then is to be pulled for 10 seconds by means of the loop with a force of 6.7 lbf (30 N) in the direction of removal.

42A.5 effective March 26, 1997

42A.6 If the enclosure or enclosure part is likely to be subjected to a twisting force, a torque as specified below is to be applied at the same time as the pull or push force:

- a) For major dimensions up to and including 2 inches (50.8 mm) – 17.7 in.-lbf (2 N·m).
- b) For major dimensions over 2 inches – 35.4 in.-lbf (4·m).

The torque is also to be applied when the test fingernail is pulled by means of the loop.

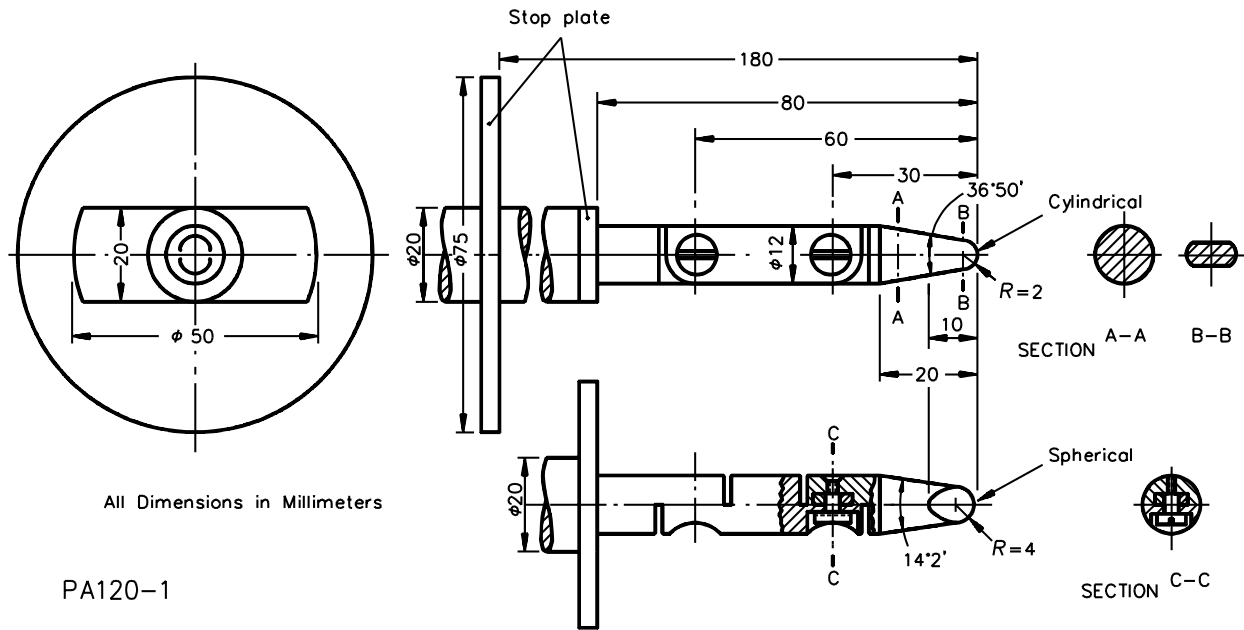
42A.6 effective March 26, 1997

42A.7 If the projection of the enclosure or enclosure part that is gripped is less than 0.4 inch (10 mm), the torque as specified in 42A.6 is to be reduced to 50 percent of the value.

42A.7 effective March 26, 1997

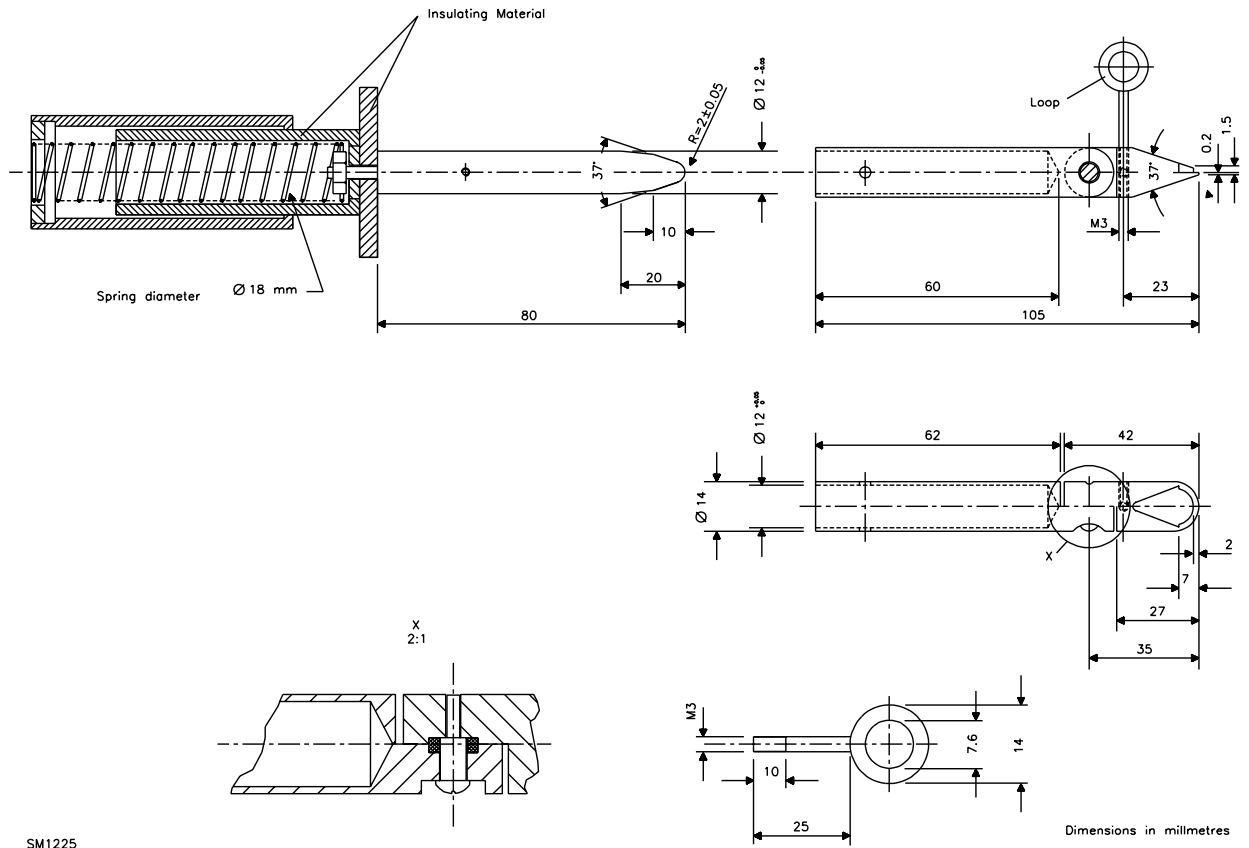
**Figure 42A.1**  
**IEC accessibility probe with stop plate**

Figure 42A.1 effective March 26, 1997



**Figure 42A.2**  
**Test fingernail**

Figure 42A.2 effective March 26, 1997



Dimensions in millimetres

SM1225



### 43 Thermal Degradation Test

43.1 A thermoset material used for a part of an appliance where risk of fire, electric shock or injury to persons is involved shall be resistant to thermal degradation at the maximum temperature to which it is exposed during normal use of the appliance. The thermal-aging characteristics of the material may be investigated by any one of the following procedures:

- a) The material shall have a temperature index, based on historical data or a long-term thermal aging program, described in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, which indicates acceptability for use at the temperature involved or
- b) The product shall be operated with the input voltage adjusted so that the part in question operates at the maximum temperature obtained during the normal temperature test. The test is to be conducted with all temperature controls by-passed for a period of 1000 hours. There shall be no visible degradation of parts at the conclusion of the 1000 hours.

No Text on This Page

## 44 Abnormal Operation Test

### 44.1 General

44.1.1 If the conditions of normal operation are not representative also of abnormal conditions likely to be obtained in actual service, an appliance shall not involve a risk of fire or electric shock when operated continuously under such abnormal conditions.

44.1.2 The appliance shall have its voltage selector switch set in any supply circuit voltage position being connected to any one of the rated supply circuits. The combination of selector settings and supply circuit to which the equipment is connected is to be that which develops the most severe operating conditions.

44.1.3 If provided, an externally operable input voltage selector is to be operated for 25 cycles with the appliance operating at the minimum rated voltage and for 25 cycles with the appliance at the maximum rated voltage. Each cycle consisting of moving the voltage selector to its alternate position and back at the rate of six cycles per minute with the voltage selector in each position for 5 seconds. The operating and temperature controls are to be set as to result in the most adverse operating conditions.

*Exception: If an externally operable voltage selector switch interlocks with the power switch and cannot be operated with the power switch in the on position, the test procedure will be as described in 44.1.4.*

44.1.4 For an externally operable voltage selector switch that interlocks with the power switch and cannot be operated with the power switch in the on position, the voltage selector is to be operated for 25 cycles each at the maximum and minimum voltages. Each cycle is to consist of the following steps:

- a) With the power switch in the off position, move the voltage selector to the alternate position;
- b) Turn the power switch on and operate the appliance for 5 seconds;
- c) Turn the power switch off;
- d) Move the voltage selector to the original position; and
- e) Turn the power switch on and operate the appliance for 5 seconds.

44.1.5 To determine whether a risk of fire or electric shock actually exists, a separate burnout or abnormal test is to be conducted with the appliance operating continuously until the ultimate result has been observed. Unless otherwise indicated below, the test is to be conducted with the applied voltage, method of mounting, and thermostat connection in accordance with 35.1.14 – 35.1.23. Accessible metal parts, those that can be contacted by the probe in Figure 6.2, and metal parts accessible during user-servicing are to be connected to ground through a 3-A fuse. In most cases, continuous operation for 7 to 8 hours will be necessary to determine the ultimate result.

44.1.6 A counter-top appliance, including a table stove and a front- or side-loaded appliance, is to be located as close to the walls of the test corner as the construction will permit. The test corner is also to be provided with a 12-inch (300-mm) deep, simulated cabinet bottom, located 16 inches (400 mm) above the counter top. The cabinet bottom is to consist of dull black-painted fir plywood 3/8 inch (9.5 mm) thick.

*Exception No. 1: An appliance such as a yogurt maker, slow cooker, and the like with relatively low surface temperatures are typical appliances that need not be tested in an alcove corner.*

*Exception No. 2: An appliance intended for outdoor use only need not be tested in a test corner.*

*Exception No. 3: When an appliance is more than 16 inches (406 mm) high and not more than 22 inches (559 mm) high, the cabinet bottom is to be just over the appliance. When the appliance is more than 22 inches high, the cabinet bottom is to be omitted.*

*Exception No. 4: When the test specifies the use of an indicator test panel over the appliance, the cabinet bottom is to be omitted.*

44.1.7 When operated under such abnormal conditions, an appliance is considered to involve a risk of fire if there is any emission of flame or molten metal (other than drops of melted solder), or if the operation of the appliance results in the glowing or flaming of combustible material upon which the appliance may be placed or, in the case of a permanently installed appliance, that may be in proximity to the appliance as installed.

44.1.8 An appliance is considered to involve a risk of electric shock if the 3-A fuse connected from accessible metal parts of the appliance to ground opens during the test.

44.1.9 After having been subjected to an abnormal test, a cord-connected appliance is considered to involve a risk of electric shock if the current measured through a 500 ohm resistor between an accessible part and ground is more than 5 mA. The current need not be measured at terminals operating at voltage levels less than 42.4 V peak. In the case of an appliance utilizing a liquid in its normal operation, the liquid container is to be filled with the hard water solution described in 37.6 in the intended manner, prior to the current measurement. Liquid need not be added if it is obviously apparent that the appliance will not hold liquid. Otherwise, water in an amount equal to the capacity of the container is to be poured into the container and the current is to be measured as quickly as possible thereafter.

44.1.10 After having been subjected to an abnormal test, a permanently-connected appliance shall be subjected to a repeated Dielectric Voltage-Withstand Test as described in Section 38.

44.1.11 If a motor is connected across a portion of a resistance element, the appliance shall not present risk of fire or electric shock as the result of an open circuit in the portion of the element that is in parallel with the motor.

## 44.2 Specific test conditions

### 44.2.1 General

44.2.1.1 For most of the common types of appliances, standardized abnormal test conditions are given in 44.2.2.1 – 44.2.8.1.

### 44.2.2 Appliances with breakable exterior surfaces

44.2.2.1 If an appliance (such as a warming tray or food warmer) has an exterior surface of glass, ceramic, or comparably brittle material in or on which the heating element is mounted or which is an essential part of the enclosure of live parts, the material shall be capable of withstanding the stresses likely to be encountered in actual service.

44.2.2.2 Certain specific tests are described in 44.2.3.1 – 44.2.3.6, but other tests may be necessitated by the design or intended operation of the appliance.

### 44.2.3 Appliances with breakable surfaces

44.2.3.1 The glass or ceramic surface shall withstand without cracking or breaking the application of a cloth fully saturated with water (the hard water solution described in 37.6) at room temperature, with the appliance in the fully heated condition. The quantity of water involved shall wet the surface completely.

a) A cord-connected appliance rated for a nominal 120-V or 240-V supply shall comply with the requirement in 32.1 in a repeat leakage current test, except that the test shall be discontinued when leakage current stabilizes.

b) An appliance other than those specified in (a) shall have an insulation resistance of not less than 50,000 ohms.

44.2.3.2 The horizontal glass or ceramic food warming surface of an appliance shall withstand without cracking or breaking the impact of a steel sphere, 2 inches (50.88 mm) in diameter and weighing 1.18 pounds (535 g), dropped from a height of 20.25 inches (514 mm). Four drops shall be made at different places on separate samples.

*Exception: Breakage or cracking of the surfaces as a result of the test is acceptable if the leakage current, when measured as described in 44.2.3.3 and 44.2.3.4, does not exceed the limits described in 44.1.9 and acceptable results are obtained following a repeated Dielectric Voltage-Withstand Test as described in Section 38.*

Revised 44.2.3.2 effective November 17, 1999

44.2.3.3 With reference to the Exception to 44.2.3.2, to determine whether a broken or cracked surface is acceptable, a solution of 500 cubic centimeters of water containing 1/4 gram of ordinary table salt is to be spilled over the broken or cracked area of the surface. A layer of metallic foil is then to be placed over the surface. The foil is to be covered with a 1-inch (25-mm) thick layer of 1 lb/ft<sup>3</sup> (16 kg/m<sup>3</sup>) glass fiber insulation. A 10-inch (254-mm) diameter pan filled with enough water to make it weigh 10 lb (4.54 kg) is then to be placed on the insulation directly over the broken or cracked area. The leakage current is then to be measured in accordance with 44.1.9.

44.2.3.4 The leakage current between the metallic foil and live parts of the appliance is to be measured as soon after the water-salt solution has been poured on the surface as is possible. For the test, the appliance frame is to be connected to the metallic foil. The Dielectric Voltage-Withstand Test shall be conducted immediately after the leakage current measurement.

44.2.3.5 *Deleted effective November 17, 1999*

44.2.3.6 In the case of an appliance other than a warming tray, the glass or ceramic surface shall withstand without cracking or breaking the impact of a utensil loaded with shot to a mass of 4 lbf (1.81 kgf) and dropped from a height of 6 inches (152 mm). The size and shape of the utensil shall be as appropriate as possible for the particular appliance, and ten drops of the utensil shall be made.

44.2.4 Barbecue units and grill-type broilers

44.2.4.1 An electrically heated grill-type broiler, barbecue unit, or the like shall comply with the flare-up-test requirements in 44.2.4.3 – 44.2.4.7 if:

- a) The heat source is below the cooking surface, and
- b) The temperature of the heat source has an average value higher than 260°C (500°F) or a maximum value higher than 300°C (572°F), and
- c) The use of the appliance, if cord connected is not restricted to outdoor or fireplace use by a marking in accordance with 54.8.

44.2.4.2 A solid-fuel-fired grill-type electric broiler, barbecue unit, or the like is not acceptable for indoor use unless connected to a chimney in accordance with the Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, NFPA 211–1992.

44.2.4.3 There shall be no ignition of an indicator test panel as the result of flame from burning fat or grease when the appliance is performing its intended function when tested in accordance with 44.2.4.4 – 44.2.4.7. The regulating thermostat is not to be defeated during this test.

44.2.4.4 The test panel is to consist of two layers of cheesecloth (see 35.1.28) secured to a wire frame in such a manner that no loose thread ends are visible on the underside. The area of the panel is not to be less than the active area of the heating element and is not to be larger than 4 inches (102 mm) beyond the sides of the appliance enclosure.

44.2.4.5 After the appliance has been subjected to maximum normal heating for 10 minutes, the cooking surface above the active element area is to be covered uniformly with 3-inch diameter (76-mm), 1-inch-thick (25 mm) pats of hamburger beef (adjacent edges touching before cooking begins) consisting of a mixture of 50 percent each by weight of lean beef and suet that have been ground together twice in succession.

44.2.4.6 During the broiling of the beef pats on both sides, the indicator test panel is to be supported 8 inches (203 mm) above and parallel to the cooking surface. The panel is to remain in place throughout the test except when necessary manipulations of the meat occur, such as placing the meat on the cooking surface, turning the meat over, or removing it. Flare-ups which occur as a direct result of such manipulation are to be allowed to subside or are to be deliberately extinguished, as by lifting the meat away from the cooking surface, before the test panel is replaced. A second loading of hamburgers is to be cooked immediately following completion of the first cycle.

44.2.4.7 During both test cycles, melted fat is to be allowed to accumulate in the intended manner except that any instructions for adding water or other similar material to the fat receptacle are to be disregarded.

#### 44.2.5 Toasters, Toaster Ovens and Toaster Oven/Broilers

44.2.5.1 A toaster is to be operated as described in 44.1.5 without toast and with doors, or the equivalent, closed. In the case of an automatic toaster, any means employed for de-energizing the heating elements is to be defeated.

Revised 44.2.5.1 effective November 30, 2001

44.2.5.2 There shall be no ignition of an indicator test panel as the result of flame from burning bread when an automatic toaster is operated toasting bread for one cycle with the color setting of the toaster set to maximum darkness. Two tests are to be performed. The toaster is to be loaded initially for the first test with one slice of bread and then to maximum capacity for the second test. The bread is to be slices of commercially available white bread, each weighing approximately 25 g.

44.2.5.3 The test panel is to be that described in 44.2.4.4 and is to be supported 8 inches (203 mm) above and parallel to the top of the toaster.

*Exception: For under-cabinet mounted toaster, the test panel shall be located on the surface directly above the toaster, with the closest spacing the mounting means will allow.*

44.2.5.3.1 An automatic toaster is to be operated with a simulated toast load as described in Figure 48.1, with the color setting of the toaster set to minimum, to determine the length of time for a toast cycle at this setting. This operation is to be repeated with the simulated toast load artificially jammed at its normal toasting position in the toaster slot so as to prevent its movement. As a result of this test, the heating elements of an automatic toaster shall de-energize upon completion of the toast cycle.

Added 44.2.5.3.1 effective November 30, 2001

44.2.5.3.2 The two operations described in 44.2.5.3.1 shall be repeated with the color setting of the automatic toaster set to maximum. As a result of this test, the heating elements of an automatic toaster shall de-energize upon completion of the toast cycle.

Added 44.2.5.3.2 effective November 30, 2001

44.2.5.4 There shall be no ignition of the bread load when a toaster oven or toaster oven/broiler is operated in the toasting mode for one cycle with the color setting set to maximum darkness. The appliance is to be loaded with any load up to maximum recommended capacity. Slices of commercially available white bread, each weighing approximately 25 g are to be used. If the toasting cycle does not terminate automatically, operation is to continue until ultimate results are obtained. The regulating thermostat is not to be defeated during this test.

44.2.5.5 A toaster oven or toaster oven/broiler is to be operated without any food load in the toasting mode with all temperature controls, other than the temperature limiting device, defeated.

44.2.5.6 A toaster oven or toaster oven/broiler is to be operated at its maximum temperature setting in the oven mode, in its intended operating position, with the crumb tray in such a position as to cause maximum heating of the supporting surface. If the crumb tray is removable, it is to be removed. The temperature regulating control is not to be defeated for this test. Temperatures of the supporting surfaces shall comply with Table 35.1.

44.2.5.7 With the oven door shut, the broiler pan removed, and crumb tray in place, a toaster oven or toaster oven/broiler is to be operated as described in 44.1.5 except that it is to be surrounded on five sides (top, front, back, left side, and right side) with two layers of cheesecloth (see 35.1.28). The cheesecloth is to be held in place by a steel wire frame extending out horizontally roughly one inch (2.5 cm) from the five exposed sides of the toaster oven. The toaster oven is to be placed on a supporting surface covered with two layers of tissue paper. For under-the-cabinet installation, a toaster oven or toaster oven/broiler is to be surrounded on five sides (bottom, front, back, left side, and right side) with two layers of cheesecloth held in place by a steel wire frame extending out horizontally roughly one inch (2.5 cm) from the five exposed sides of the toaster oven. For under-the-cabinet installation, the cheesecloth shall extend three inches (7.5 cm) vertically above the top of the front of the appliance. A toaster oven or toaster oven/broiler provided with an automatic door opening feature is to have its door opened after the bread-load has ignited.

Added 44.2.5.7 effective May 17, 2000

44.2.5.8 There shall not be any emission of flame as determined by ignition of the cheesecloth when a toaster oven or toaster oven/broiler is operated with a bread load conditioned as described in 44.2.5.10. Charring of the cheesecloth does not constitute a failure. Two tests are to be performed. The toaster oven or toaster oven/broiler is to be loaded initially for the first test with one slice of bread centered on the toasting surface and then to the manufacturer's specified maximum capacity with the bread equally spaced on the toasting surface for the second test. The slices of bread are to be ignited by

- a) repeatedly applying the toast cycle, or
- b) operating the oven cycle (if any), or
- c) having all temperature regulating devices defeated (non-resettable temperature limiting devices need not be defeated)

The toast is to be allowed to burn until it is completely consumed, or until the flaming ceases.

Added 44.2.5.8 effective May 17, 2000

44.2.5.9 If the bread-load does not ignite within 15 minutes of the start of the test described in 44.2.5.8, the test is to be repeated with a new bread-load and with the voltage increased by 5 Volts. If need be, this test procedure is to be repeated, each time with a new bread-load and voltage increased by an additional 5 Volts, until ignition of the bread-load occurs.

Added 44.2.5.9 effective May 17, 2000



44.2.5.10 The bread is to be commercially available white bread weighing approximately 25 g. The bread is to be dried for one hour in open air at approximately 25°C with 50 percent relative humidity before the toaster oven or toaster oven/broiler is operated, as described in 44.2.5.8.

Added 44.2.5.10 effective May 17, 2000

#### 44.2.6 Warming trays and food warmers

44.2.6.1 The appliance is to be operated with the entire serving surface covered with a double layer of cheesecloth and with a 1-inch-thick (25-mm) hair-felt pad. If the thermostat cycles, the test is to be repeated with only two thirds of the serving surface covered and again with one-third of the serving surface covered. In the partial coverage test, the area of the tray farthest from the thermostat is to be covered. Operation under each of the above conditions is to be continuous for a period of 7 hours.

#### 44.2.7 Broiler/ovens

44.2.7.1 A broiler, an oven, or a broiler/oven is to be operated at the maximum temperature setting until constant temperatures are obtained without any food load.

#### 44.2.8 Table stoves

44.2.8.1 A sample of the appliance is to be operated continuously with each heating until covered with a cast-iron circular stove plate. An additional sample is to be operated in the same manner but with an aluminum plate. The cast iron plate to be used with a 6 inch (152 mm) or smaller surface unit is 7 – 8 inches (178 – 203 mm) in diameter and weighs approximately 3 lb (1.36 kg). The cast iron plate to be used with a larger surface unit is 10 – 11 inches (254 – 279 mm) in diameter and weighs approximately 7 lb (3.18 kg). The aluminum plates are to be of the same dimensions indicated above, except 1/4 inch (6.4 mm) thick and no weight is specified.

44.2.8.2 When the size of the table stove is such that when the stove plate is centered on a surface unit the plate touches the wall, the test is to be conducted with the table stove positioned as follows:

- a) With the plate centered on a surface so that the plate touches the wall, and
- b) With the plate off center and the stove as close to the wall as possible with the plate stable and touching wall.

44.2.8.3 In addition to the applicable test described in 44.2.1.1 – 44.2.8.2, a dual voltage appliance shall be subjected to the tests described in 44.1.2 – 44.1.4. These tests are subject to the test conditions described in 44.1.5 and 44.1.6 and to the acceptance criteria described in 44.1.7 – 44.1.11. There shall be no electrical or mechanical breakdown of the voltage selector switch.

#### **45 Under-Cabinet and Wall Mounted Appliances-Impact Test**

45.1 The impact test of 45.2 shall be conducted on all under-cabinet and wall mounted appliances without occurrence of any of the following conditions:

- a) Making live parts accessible to contact with the articulate probe, see 6.13 and 6.14
- b) Producing any other condition that results in damage of the enclosure so as to adversely affect the function of any safety or constructional feature, such as thermostats, overload-protective devices or strain relief.

- c) Producing other conditions so that the appliance does not comply with the dielectric voltage-withstand requirements in Dielectric Voltage-Withstand Test, Section 38, after being subjected to the impact.
- d) Dislodging of the appliance or separable parts of the appliance.

45.2 A 1-1/2 ft-lbf (2.0 N-m) impact is to be performed on all exposed sections of the enclosure, while the unit is installed under a cabinet or on a wall. Each of three samples is to be subjected to one impact on each surface. The impact is to be imparted by swinging a 2-inch (50.8-mm) diameter steel sphere, weighing 1.18 lb (0.535 kg) from a height that will produce an impact of 1-1/2 ft-lbf (2.0 N-m).

*Exception No. 1: All glass surfaces need not comply with this requirement.*

*Exception No. 2: If the manufacturer elects, fewer than three samples may be used for the test in accordance with Figure 42.1 wherein each series consists of one impact. The overall performance is acceptable upon completion of any one of the procedures represented in Figure 42.1.*

#### **46 Loading Test**

46.1 A loading test is to be performed on the mounting brackets of an under-cabinet or wall mounted appliance with the appliance mounted in accordance with the manufacturer's installation instructions, using the hardware and construction as described. A bracket shall not break, loosen, or pull out of the wall nor shall any portion of the unit attached to the mounting means be adversely affected as a result of this test.

46.2 The test load is to consist of the weight of the appliance plus three times the maximum normal load (food load, water, grounds, basket, and the like, based on cavity size and maximum recipe book weight recommendations). A gradually increasing force is to be applied to act vertically through the center of the gravity of the unit. The force is to be increased in a 5 to 10 second interval until the test load is applied to the mounting system and is to be sustained for a period of 1 minute. For this test an under-cabinet unit is to be mounted on a wood board with a minimum thickness as specified by the manufacturer and a wall unit is to be mounted on 3/8 inch (4.8 mm) thick wall board.

46.3 If the mounting brackets are constructed of a thermoplastic material, they are to be conditioned for 7 hours in an air circulating oven maintained at 70°C (158°F) or 10°C (18°F) higher than that measured during the normal temperature test, whichever is higher, prior to performing the loading test.

#### **47 Temperature Probe Insertion Test**

47.1 Each of six samples is to be subjected to 50 cycles of insertion and withdrawal of the temperature-probe plug. The cycles are to be performed manually at a rate of speed no greater than 6 cycles per minute, under rated load. At the completion of the 50 cycles, the voltage drop at rated current shall not exceed 50 mV between the male and female contacts of the temperature probe plug. There shall be no mechanical failure of the temperature probe plug, nor shall there be any undue deterioration, pitting, or burning of the probe contacts.

## 48 Component Switches and Control Devices

### 48.1 Overload

#### 48.1.1 Motor switches

48.1.1.1 A switch or other device that controls a motor employed in an appliance, unless acceptable for the application or unless so interlocked that it will never have to break the locked-rotor motor current, shall be capable of performing acceptably when subjected to an overload test consisting of 50 cycles of operation, making and breaking the locked-rotor current of the motor. There shall be neither electrical nor mechanical malfunction of the device, nor undue burning, pitting, or welding of the contacts.

48.1.1.2 To determine whether a switch or other control device is capable of performing acceptably in the overload test, the appliance is to be connected to a grounded supply circuit of rated frequency and of voltage in accordance with 35.1.14, with the rotor of the motor locked in position. During the test, exposed dead metal parts of the appliance are to be connected to ground through a 3-A fuse, and the current-interrupting device, if single-pole, is to be located in an ungrounded conductor of the supply circuit. If the appliance is intended for use on direct current, or on direct current as well as alternating current, the test is to be conducted with direct current and exposed dead metal parts are to be so connected as to be positive with respect to a single-pole, current-interrupting device. The device is to be operated at the rate of 10 cycles per minute, except that a faster rate of operation may be employed if agreeable to all concerned. The performance is unacceptable if the fuse in the grounding connection opens during the test.

#### 48.1.2 Automatic controls

48.1.2.1 An automatic control for temperature regulating or temperature limiting shall be capable of performing successfully for 50 cycles of operation, when the heater is connected to a supply circuit having a potential of 120 percent of the voltage specified in 35.1.14. There shall be neither electrical nor mechanical malfunction of the control, nor undue burning, pitting, or welding of the contacts.

48.1.2.2 In tests to determine whether an automatic control complies with the requirements in 48.1.2.1 and 48.1.2.3, the appliance is to be connected to a grounded supply circuit; the enclosure of the appliance, if of metal, is to be connected to ground through a 3-A fuse; and the control, if single-pole, is to be connected in an ungrounded conductor of the circuit. If the heater is intended for use on direct current, or on direct current as well as on alternating current, the test is to be conducted with direct current, and the enclosure is to be so connected as to be positive with respect to a single-pole automatic control. The device is to be operated at the rate of 10 cycles per minute, except that a faster rate of operation may be employed if agreeable to all concerned. The performance is unacceptable if the fuse in the grounding connections opens during the test.

48.1.2.3 An automatic control intended for use on direct current, which is so constructed that the starting handle does not stay latched with the timing knob in all of its position settings, thereby resulting in a slow break of the switch contacts upon release of the handle, shall be capable of performing successfully when tested as follows. The switch shall be subjected to 50 cycles of operation at normal load by releasing the handle slowly and, during the test, the metal frame of the appliance shall be connected to ground through a 3-A fuse to give indication of a flashover, should this occur. The test shall be made following the overload test and preceding the endurance test on the control. See 48.1.2.1 and 48.2.1.1.

**Table 48.1**  
**Number of cycles of operation for endurance test**

Type of thermostat	Automatically reset thermostat	Manually reset thermostat
Temperature regulating	A number of cycles equivalent to 1000 hours of intended operation of the appliance, but not less than 6000 cycles. However, the test may be omitted if, with the thermostat short-circuited, no temperature higher than the limits given in Table 35.1 are attained during the normal-temperature test of the appliance.	To be made the subject of special consideration <sup>a</sup>
Temperature-limiting <sup>b</sup>	A number of cycles equivalent to 100 hours of operation of the appliance under any condition which causes the thermostat to function, or 100,000 cycles, whichever is greater. However, the test may be omitted if, with the thermostat short-circuited, there is no evidence of risk of fire as described in 44.1.1 – 44.1.11 during the continuous abnormal operation of the appliance.	1000 cycles underload and 5000 cycles without load. However, the test may be omitted if, with the thermostat short-circuited, there is no evidence of risk of fire as described in 44.1.1 – 44.1.11 during continuous abnormal operations of the appliance.
Combination temperature-regulating and -limiting	100,000 cycles if, with the thermostat short-circuited, there is evidence of fire as described in 44.1.1 – 44.1.11. If there is no evidence of risk of fire under this condition, the thermostat is to be tested as a temperature-regulating thermostat (see above).	To be made the subject of special consideration.
<sup>a</sup> If the operation of the thermostat controls the physical movement of a part of the appliance (such as in a pop-up type of automatic toaster), the test is to be so arranged that each cycle will involve the complete intended operation of the appliance. <sup>b</sup> See 25.1 and 25.2.		

## 48.2 Endurance

### 48.2.1 Thermostats

48.2.1.1 A thermostat shall be capable of withstanding an endurance test which shall consist of the number of cycles indicated in Table 48.1. Unless it is specified that the test be made without load, the thermostat shall make and break the rated current of the appliance while connected to a circuit of rated voltage. There shall be neither electrical nor mechanical malfunction of the thermostat, nor undue burning, pitting, or welding of the contacts.

48.2.1.2 With reference to 48.2.1.1 and Table 48.1, thermostats are classified as follows:

- a) A temperature-regulating thermostat is one which functions only to regulate the temperature of the appliance under normal conditions of use, and whose malfunction would not result in a risk of fire.
- b) A temperature-limiting thermostat is one which functions only under conditions which produce abnormal temperatures. The malfunction of such a thermostat might or might not result in a risk of fire.
- c) A combination temperature-regulating and -limiting thermostat is one that functions to regulate the temperature of the heating appliance under normal conditions of use, and also serves to reduce the risk of a fire that might result from conditions of abnormal operation of the appliance.

#### 48.2.2 Automatic toasters

48.2.2.1 An automatic toaster shall be capable of withstanding an endurance test consisting of 6000 cycles of operation while loaded as outlined in 48.2.2.2. A complete cycle shall consist of the switch contacts making and breaking the rated current of the toaster and, except as indicated in 48.2.2.2, movement of the elevator mechanism completely throughout its normal travel. There shall be no electrical or mechanical malfunction with regard to opening the contacts and no welding or undue pitting of the switch contacts. In addition, the toaster shall comply with the test described in 44.2.5.2 and 44.2.5.3 following the endurance test.

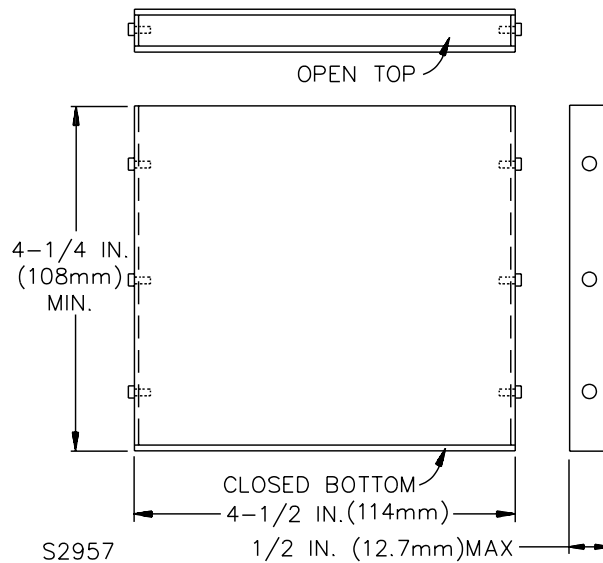
48.2.2.2 With reference to 48.2.2.1, each bread slot or space is to be loaded with a 50 g weight for the first 25 cycles and last 25 cycles, and a 25 g weight for the intervening 5950 cycles. The weights are to consist of the simulated toast load described in Figure 48.1. Lead shot (No. 7) is to be added to the simulated toast load as necessary to obtain the exact weights of the total loads. During the cycles using the 50 g weights, the elevator mechanism need not move through its complete travel but shall open the switch contacts providing power to the heating elements.

48.2.2.3 During the endurance test described in 48.2.2.1 and 48.2.2.2, external fan cooling may be provided to shorten the cycle time, however, the temperatures obtained adjacent to temperature sensing components or other appropriate reference points shall not exceed those measured during the normal temperature test described in 35.2.5.1. Operation is to consist of simulating the toasting of bread with each cycle terminated by the toaster automatically.

48.2.2.4 The automatic toast feature of a toaster oven shall be capable of withstanding an endurance test consisting of 6000 cycles simulating the process of making toast. A complete cycle shall consist of the initiation of the toast cycle through use of the toast feature actuator, heating the oven to normal operating temperature and termination of the toast cycle by the toaster automatically. There shall be no electrical or mechanical malfunction with regard to opening the contacts, and there shall be no welding or undue pitting of the switch contacts. In addition, the toaster oven shall comply with the tests described in 44.2.5.4 following the endurance test.

48.2.2.5 During the endurance test described above, forced air cooling may be provided to shorten the cool down time, however temperatures obtained adjacent to temperature sensing components or other appropriate reference points shall not exceed those measured during the normal temperature test. During the test a simulated bread load need not be utilized.

**Figure 48.1**  
**Simulated toast load**



To be constructed to aluminum flashing approximately 0.010 inch (0.254 mm) thick. Outside surface to be painted with minimum 500°F (260°C) flat black engine paint. Total weight to be equal to or less than 25 g without lead shot.

48.2.2.6 A toaster oven and toaster oven/broiler shall be capable of withstanding an endurance test consisting of 6000 cycles of operation of opening and closing the door. During and at the conclusion of the test, the appliance shall meet the following criteria.

- a) There shall be no electrical or mechanical malfunction that could result in the likelihood of fire, electric shock or injury to persons.
- b) There shall be no loosening or shifting of adjustments or parts that could result in the likelihood of fire, electric shock or injury to persons.
- c) There shall be no failure of applicable switches and contacts.

### 48.3 Limited short circuit

#### 48.3.1 Motor-control devices

48.3.1.1 There shall not be any ignition of cotton surrounding the outer enclosure of the protective device (that in some cases, will be the enclosure of the motor that it protects) when three samples of a device controlling a motor are subjected to short circuits on a circuit limited to 200 A.

48.3.1.2 Usually, a motor is to be considered to comply with the requirement in 48.3.1.1 if it is equipped with an inherent overheating protector that complies with the requirements for such protectors.

48.3.1.3 For the tests mentioned in 48.3.1.1, the power factor of the test circuit is to be 0.9 – 1.0, and the circuit capacity is to be measured without the device in the circuit.

48.3.1.4 In each case, a nonrenewable cartridge fuse is to be connected in series with the device under test; the fuse is to be of the maximum current rating that will be accommodated by a fuse-holder of the branch circuit to which the appliance would be connected. The test on one sample is to be made by closing the device on the short circuit.

## **49 Permanence of Marking**

49.1 A required marking shall be molded, die-stamped, paint-stenciled, stamped or etched metal that is permanently secured, or indelibly stamped lettering on a pressure-sensitive label secured by adhesive that upon investigation is found to be acceptable for the application. Ordinary usage (including the likely exposure to weather and other ambient conditions), handling, storage, and the like of the equipment is to be considered in the determination of the acceptability of the application.

49.2 Unless it has been investigated and found to be acceptable for the application, a pressure-sensitive label or label that is secured by cement or adhesive shall comply with the adhesion requirements in Table 7.1 for indoor equipment, and Table 7.2 for outdoor equipment in the Standard for Marking and Labeling Systems, UL 969.

49.3 Unless otherwise indicated, a required cautionary marking shall be located on a part that would require tools for removal or that cannot be removed without impairing the operation of the product.

## **50 Test for Permanence of Cord Tag for Outdoor-Use Appliances**

### **50.1 General**

50.1.1 To determine compliance with 54.25, representative samples that have been subjected to the tests described in 50.1.3 – 50.1.6 shall meet the following requirements:

- a) The tag shall resist tearing for longer than 1/16 inch (1.6 mm) at any point;
- b) The tag shall not separate from the power supply cord;
- c) There shall be no permanent shrinkage, deformation, cracking, or any other condition that will render the marking on the tag illegible; and
- d) Overlamination shall remain in place and not be torn or otherwise damaged. The printing shall remain legible.

50.1.2 For each type of conditioning mentioned in 50.1.3 – 50.1.5, three samples of the tag applied to the power supply cord in the intended manner are to be used. If tags are applied by an adhesive, tests are to be conducted no sooner than 25 hours after application of the tag.

50.1.3 Three samples are to be tested as received.



50.1.4 Following conditioning in an air-circulating oven at  $60 \pm 1^\circ\text{C}$  ( $140 \pm 1.8^\circ\text{F}$ ) for 240 hours, three samples are to be tested after 30 minutes of conditioning at a room temperature of  $23 \pm 2^\circ\text{C}$  ( $73.4 \pm 3.6^\circ\text{F}$ ) and  $50 \pm 5$  percent relative humidity.

50.1.5 Three samples are to be tested within 1 minute after exposure for 72 hours to a humidity of  $85 \pm 5$  percent at  $32 \pm 2^\circ\text{C}$  ( $89.6 \pm 6^\circ\text{F}$ ).

50.1.6 Each sample is to consist of a length of power supply cord to which the tag has been applied. The power supply cord, with the attachment plug pointing up, is to be held tautly in a vertical plane. A force of 5 lbf (22.2 N) is to be applied to the upper-most corner of the tag farthest from the power supply cord, within 1/4 inch (6.4 mm) of the vertical edge of the tag. The force is to be applied vertically downward in a direction parallel to the major axis of the cord. In determining compliance with 50.1.1(d), manipulation is permissible, such as straightening of the tag by hand. To determine compliance with 50.1.1(d), each sample is to be scraped 10 times across printed areas and edges, with a force of approximately 2 lbf (8.9 N), using the edge of a 5/64 inch (2.0 mm) thick steel blade held at a right angle to the test surface.

## MANUFACTURING AND PRODUCTION-LINE TESTS

### 51 Dielectric Voltage-Withstand Test

51.1 Each appliance shall withstand without an indication of unacceptable performance as a routine production-line test, the application of a potential between the primary wiring, including connected components, and accessible metal parts that are likely to become energized, and between primary wiring and accessible low voltage (42.4 V peak or less) metal parts, including terminals. The test potential shall be 1200 V applied for 1 second or 1000 V applied for 1 minute.

51.2 The appliance may be in a heated or unheated condition for the test.

51.3 The test shall be conducted with the appliance complete – fully assembled. It is not intended that the appliance be unwired, modified, or disassembled for the test.

*Exception No. 1: A part, such as a snap cover or a friction-fit knob, that would interfere with performance of the test need not be in place.*

*Exception No. 2: The test may be performed before final assembly if such a test represents testing the complete appliance.*

51.4 If the appliance employs a solid-state component that can be damaged by the test potential, the test on each appliance may be conducted before the component is electrically connected. In such a case, additional testing is to be made of a random sampling of each day's production with the circuitry rearranged to reduce the likelihood of damage to any solid-state component but retaining representative dielectric stress of the circuit.

51.5 The test equipment is to produce an output voltage that is not less than the factory test value specified, nor is the magnitude of the test voltage to be greater than 120 percent of the specified test potential when the tester is used in each of the following conditions:

- a) If the test duration is one second, the output voltage is to be maintained within the specified range,
  - 1) When only a voltmeter having an input impedance of at least 2 megohms and a specimen of the product being tested are connected to the output terminals, and
  - 2) When a relatively high resistance is connected in parallel with the voltmeter and the product being tested, and the value of the resistance is gradually reduced to the point where an indication of unacceptable performance just occurs.
- b) If the test duration is one minute, the output voltage is to be maintained within the specified range, by manual or automatic means, throughout the one minute duration of the test or until there is an indication of unacceptable performance.

51.6 The specified control of the applied voltage, manual or automatic, shall be maintained under conditions of varying line voltage. Higher test potentials may be used if the higher dielectric stress is not likely to adversely affect the insulating systems of the product.

51.7 In addition to the characteristics indicated in 51.5, the test equipment is to have the following features and characteristics:

- a) A means of indicating the test voltage that is applied to the product under test. This may be accomplished by sensing the voltage at the leads or by equipment means.
- b) An output voltage that:
  - 1) Has a sinusoidal waveform,
  - 2) Has a frequency that is within the range of 40 – 70 Hz, and
  - 3) Has a peak value of the waveform that is not to be less than 1.3 and not more than 1.5 times the root-mean-square value.
- c) A means of effectively indicating unacceptable performance. The indication is to be:
  - 1) Auditory if it can be readily heard above the background noise level,
  - 2) Visual if it commands the attention of the operator,
  - 3) A device that automatically rejects an unacceptable appliance.

If the indication of acceptable performance is auditory or visual, the indication is to remain active and conspicuous until the test equipment is reset manually.

d) When the test equipment is adjusted to produce the test voltage and a resistance of 120,000 ohms is connected across the output, the test equipment is to indicate an unacceptable performance within 0.5 second. A resistance of more than 120,000 ohms may be used to produce an indication of unacceptable performance, if the manufacturer elects to use a tester having higher sensitivity.

*Exception: The sensitivity of the test equipment may be reduced, a lower value of resistance may be used, when testing an appliance intended to be permanently wired.*

51.8 There is not to be any transient voltage applied to the appliance under test that results in the instantaneous voltage applied to the product exceeding 120 percent of the peak value of the test voltage that the manufacturer elects to use for this test. This requirement applies for the entire duration of the test, including the time that the voltage is first applied to the product and the time that the voltage is removed from the product.

51.9 During the test, a sufficient number of primary switching components shall be in the on position so that all primary circuitry will be stressed. Both sides of the primary circuit of the appliance are to be connected together to one terminal of the test equipment. The second equipment terminal is to be connected to accessible dead metal.

*Exception: Resistive-type appliances and appliance utilizing motors, relays, coils or transformers, having circuitry not subject to excessive secondary build-up in case of indication of unacceptable performance during the test, may be tested with only one side of the primary circuit connected to the dielectric test equipment.*

## **52 Polarization and Grounding Continuity Tests**

### **52.1 Polarization test**

52.1.1 Each appliance provided with a polarized attachment plug (2-wire plug with one blade wider than the other) shall be tested for electrical-continuity between the grounded supply-circuit conductor of the attachment plug (wide blade of a 2-wire plug) and the part of the appliance that is intended to be connected to the grounded supply-circuit conductor. If the continuity cannot be readily determined by visual inspection and component checking, an electrical-continuity test is to be made.

### **52.2 Continuity of grounding connection**

52.2.1 Each cord-connected appliance having provision for grounding shall be tested, as a routine production-line test, to determine that grounding continuity exists between the ground blade of the attachment plug and the accessible dead metal parts of the appliance that are likely to become energized.

52.2.2 Only a single test need be conducted if the accessible metal selected is conductively connected by design to all other accessible metal.

### **52.3 Electrical indicating device**

52.3.1 Any indicating device, such as an ohmmeter, a battery and buzzer combination, or the like, may be used to determine compliance with the tests described in 52.1.1 – 52.2.2.

## RATINGS

### 53 Details

53.1 An appliance shall be rated in amperes, volt-amperes, or watts, and also in volts, and may be rated for alternating current only. The rating shall include the frequency if necessary because of motors, relay coils, or other control devices. The voltage rating shall be in accordance with any appropriate single voltage or range of voltages such as 100 – 120 and 220 – 240.

53.2 If an appliance includes an attachment plug receptacle which is not intended as a disconnecting means for any part of the appliance or necessary accessory, and which may serve as a general-use outlet, the added load which the receptacle may impose on the appliance and its supply connections (not less than 660 W or 6 A) shall be taken into consideration in determining the electrical rating of the appliance.

## MARKINGS

### 54 Details

54.1 A warning or caution marking shall comply with all of the following requirements:

- a) The marking shall be permanently attached.
- b) The marking shall not be attached to parts removable by hand.
- c) The marking shall be attached to parts that cannot be removed without impairing the operation of the appliance or left off the appliance without being readily apparent.
- d) The marking shall have lettering that complies with the following requirements:
  - 1) The precautionary signal word (such as "DANGER", "WARNING", OR "CAUTION") shall be in letters not less than 3/32 inch (2.4 mm) high.
  - 2) If contrasting color is used, lettering other than signal words can be a minimum of 1/16 inch (1.6 mm) high.

54.2 All other markings required in this section shall be such that the marking is clear and legible under conditions of intended use of the appliance.

54.3 An appliance shall be legible and permanently marked, where it will be plainly visible (after installation in the case of a permanently connected appliance), with:

- a) The manufacturer's name, trade name, trademark, or other descriptive marking by which the organization responsible for the product may be identified,
- b) The date or other dating period of manufacture not exceeding any three consecutive months, that may be abbreviated or in a nationally acceptable code, or in a code affirmed by the manufacturer,

- c) A distinctive (catalog) (model) number or the equivalent, and
- d) The electrical rating.

A date code repetition time cycle shall not be less than 10 years. An appliance intended for use on alternating current only or on direct current only shall be so marked.

54.4 An appliance shall be marked, where readily visible, to indicate that the appliance is intended for household type usage, such as "Household Use Only", "Household Type", and the like. Lettering shall not be less than 3/32 inch (2.4 mm) high.

54.5 If a manufacturer produces or assembles appliances at more than one factory, each finished appliance shall have a distinctive marking – that may be in code – to identify it as the product of a particular factory.

54.6 Each individual heating element or unit that is a part of an appliance and that is replaceable in the field shall be plainly marked with its electrical ratings in amperes or watts, and also in volts, or with the manufacturer's part number.

54.7 An appliance whose acceptable performance depends upon its proper location or position shall be marked (such as "top" or "bottom") to indicate the way that it is to be installed or used, unless such position is obvious.

54.8 A cord-connected electrically heated grill-type broiler, barbecue unit, motor-operated spit for use with a charcoal brazier, or the like which does not comply with the requirements in 44.2.4.1 – 44.2.4.7, and a solid-fuel-fired unit shall be plainly marked "Use only outdoors, do not expose to rain."

54.9 If the construction of an appliance contemplates disassembly by means of a tool for the purpose of cleaning or similar servicing by the user (including replacement of a replaceable overcurrent and/or over-temperature protective device) and, if such disassembly involves the exposure of persons to unintentional contact with any normally enclosed or protected live part, the appliance shall be plainly marked with a warning that such servicing should be done only while the appliance is disconnected from the supply circuit. See also 6.16.

54.10 The crumb tray of a toaster shall be marked "WARNING – To prevent electric shock, unplug before cleaning" or with an equivalent statement following the WARNING.

54.11 The crumb door of an under-cabinet or wall mounted toaster shall be marked "WARNING – To Reduce the Risk of Fire or Electric Shock, Operate with Crumb Door Closed", or with an equivalent statement following the word WARNING.

54.12 If any point within a terminal box or wiring compartment of a permanently connected appliance in which field-installed conductors are intended to be connected (including such conductors themselves) attains a temperature higher than 60°C (140°F) during the normal-temperature test, the appliance shall be legibly marked "For supply connections, use \_\_\_ AWG or larger wires suitable for at least \_\_\_ °C (\_\_\_ °F)" or with an equivalent statement, and the temperature value shall be in accordance with Table 54.1. The wire size need not be included if No. 14 AWG wire was used during the test. This wording shall be located at or near the point where the supply connections are to be made and shall be clearly visible during installation and examination of the supply-wiring connections.

**Table 54.1**  
**Temperature for marking**

Temperature attained in terminal box or compartment during test	Temperature marking
61 – 75°C (142 – 167°F)	75°C (167°F)
76 – 90°C (169 – 194°F)	90°C (194°F)

54.13 If a specific spacing between a permanently connected appliance, or a cord-connected wall or under-cabinet mounted appliance, and an adjacent surface is necessary to prevent the attainment of a temperature higher than 90°C (194°F) on the latter when the appliance is operated normally, the appliance shall be marked "Do not install closer than \_\_\_ inches (or \_\_\_ millimeters) to a (vertical, horizontal, and the like) surface" or the equivalent. A diagram indicating the spacings is also acceptable. The value of the spacing to be used in the statement or diagram shall not be less than that necessary to prevent the attainment of temperatures higher than 90°C (194°F) on the walls when the appliance is tested in the corner described in 35.1.19 and 35.1.21. The statement or diagram shall be legible and so located that it will be clearly visible during installation and it shall also be visible during examination of the supply-wiring connections for a permanently connected appliance.

54.14 A cord-connected appliance that is required to have provision for grounding through the cord and plug in accordance with 27.6 shall be plainly marked "CAUTION – To ensure continued protection against risk of electric shock, connect to properly grounded outlets only" or with equivalent wording following the word CAUTION.

54.15 An appliance provided with a flexible cord less than 4-1/2 ft (1.4 m) in length (see 10.2.1.1) shall be provided with instructions in accordance with 54.16.

54.16 The instructions required in 54.15 are to include the following information:

- a) A short power-supply cord (or detachable power-supply cord) is to be provided to reduce the risk resulting from becoming entangled in or tripping over a longer cord.
- b) Longer detachable power-supply cords or extension cords are available and may be used if care is exercised in their use.
- c) If a longer detachable power-supply cord or extension cord is used,
  - 1) The marked electrical rating of the cord set or extension cord should be at least as great as the electrical rating of the appliance, and
  - 2) The cord should be arranged so that it will not drape over the countertop or tabletop where it can be pulled on by children or tripped over unintentionally.

If the appliance is of the grounded type, the extension cord should be a grounding-type 3-wire cord.

54.17 For appliances intended for outdoor use, the instructions shall include 54.16 (b) and (c) and the following information:

- a) Outdoor extension cords should be used with outdoor use products and are surface marked with suffix letters "W-A" and with a tag stating "Suitable for Use with Outdoor Appliances".
- b) A statement indicating that the connection to an extension cord should be kept dry and off the ground.
- c) Store products indoors when not in use – out of the reach of children.
- d) Do not clean this product with a water spray or the like. (This statement may be omitted if the results of a special water hose spray test are acceptable.)

54.18 An appliance that is likely to be lifted and handled for cleaning purposes and has not been subjected to the Immersion Tests, in accordance with 35.1.6 and 37.8 shall be marked "Do not immerse in water" or with an equivalent wording. If the appliance is intended for partial immersion but not for complete immersion, it shall be marked "Do not immerse beyond this point" or with an equivalent wording to show the point beyond that it should not be immersed.

54.18 revised November 17, 1998

54.19 An appliance that is intended for installation by a nonmetal enclosed wiring system only, shall be marked to indicate that it must be installed with such a wiring system. The marking shall be so located that it will be visible while power-supply connections to the appliance are being made.

54.20 An appliance that is intended for use with a thermostatically controlled appliance plug shall be permanently marked "Use only (manufacturer) (designation) temperature-controlling plug" or with an equivalent wording.

54.21 A convection oven with a top-mounted control panel shall be marked "CAUTION – Hot Surface" if the temperatures on an external top front edge exceed the maximum acceptable temperatures specified in Table 36.1. Such marking shall be in letters not less than 3/32 inch (2.4 mm) high, shall be in contrasting colors and readily visible to the user, and shall clearly identify the surface that is hot.

54.22 An under-cabinet or wall mounted appliance shall be marked "CAUTION – Hot Surface" if the temperatures on any exposed surface exceed the maximum acceptable temperatures specified in Table 36.1. Such marking shall be in letters not less than 3/32 inch (2.4 mm) high, shall be in contrasting colors and readily visible to the user, and shall clearly identify the surface that is hot.

54.23 An under-cabinet or wall mounted appliance shall be permanently marked with the following or equivalent "CAUTION – To reduce the risk of fire do not place any heating or cooking appliance beneath this unit". The marking is to be in lettering minimum 3/32 inch (2.4 mm) high, on the front of the appliance, or the front leading edge of the mounting bracket and shall be visible after the appliance is mounted. The lettering is to be on a contrasting background, or the letters are to be raised, or the equivalent so that the marking is readily readable.

54.24 A cord connected outdoor-use product shall be marked: "CAUTION – To reduce the risk of electric shock, keep extension cord connection dry and off the ground", or with an equivalent wording following the word "CAUTION".

54.25 The marking described in 54.24 may be provided on a tag that is permanently attached to the power supply cord. The tag material and means of attachment to the power supply cord shall comply with the requirements in Test for Permanence of Cord Tag for Outdoor-Use Appliances, Section 50. The tag and the printing there-on shall be resistant to water.

54.26 An appliance with a removable cooking container shall be marked with the word "CAUTION" and the following or the equivalent on the internal surface of the basic appliance: "TO REDUCE THE RISK OR ELECTRIC SHOCK, COOK ONLY IN REMOVABLE CONTAINER." Such marking shall be in letters not less than 3/32 inch (2.4 mm) high. The lettering shall be on a contrasting background or the letters are to be raised or the equivalent so that the marking is readily readable.

## 55 Carton Marking

55.1 A carton (individual marketing container) for an appliance shall be marked to indicate that the appliance is intended for household type usage, such as, "Household Use Only", "Household Type", and the like. The marking shall:

- a) Be located on at least one outside surface and
- b) Appear in lettering not less than the height specified in Table 55.1.

**Table 55.1**  
**Lettering height**

Smallest dimension of the carton panel to be marked in inches (mm)		Minimum height of lettering in inches (mm)
More than	Less than or equal to	
0	6 (152)	1/8 (3.2)
6 (152)	10 (254)	3/16 (4.8)
10 (254)	—	1/4 (6.4)



## INSTRUCTION MANUAL

### 56 General

56.1 An instruction manual or the equivalent shall be provided with the appliance. The manual shall specifically warn the user against each potential risk and state the precautions that should be taken to guard against each risk. The safety instructions shall be a permanent part of the manual but separated in format from the other instructions, and shall appear before the operating instructions in the manual.

56.2 The instruction manual shall include instructions or illustrations to identify important safety features.

56.3 The instruction manual of a toaster-oven or toaster oven/broiler shall clearly include a description, in a pictorial presentation, of the location and operation of each control.

56.4 The pictorial presentation mentioned in 56.3 shall highlight the means by which the unit is turned on or off.

56.5 The height of lettering in the text and illustrations of the safety instructions shall be as follows:

- a) Upper case letters shall not be less than 1/12 inch (2.11 mm) in height,
- b) Lower case letters shall not be less than 1/16 inch (1.6 mm) in height,
- c) The phrases "IMPORTANT SAFEGUARDS" and "SAVE THESE INSTRUCTIONS" shall be in letters no less than 3/16 inch (4.8 mm) in height.

56.6 The instruction manual shall include the important safeguards in All Appliances, Section 57 and the appropriate text from Specific Appliances, Section 58.

56.7 Unless otherwise indicated, the text of the instructions shall be verbatim to, or in equally definitive terminology as, All Appliances, Section 57 and Specific Appliances, 58, except where specific conflict in the application of the text to a product exists or risk alluded to has been reduced. The items may be numbered, and the phrases "Read all Instructions" and "Save these Instructions" shall be first and last, respectively, in a list of items. Other important and safeguard items considered appropriate by the manufacturer may be inserted.

56.8 The manufacturer's instructions shall include a statement indicating that preheating of the appliance is not necessary if preheating the appliance prior to the temperature or abnormal tests was waived based on such instruction. See 35.1.29.

56.9 For a dual voltage rated appliance, procedures to be followed in changing the voltage selector, if provided and providing the correct supply connection means for each voltage setting shall be provided. In addition, the following wording or equivalent shall be provided: "For use in the U.S.A., the voltage selector switch should be placed in the 120 volt position. For use in several countries overseas, the voltage selector may need to be placed in the 240 volt position. Confirm the voltage available at each overseas location before using the appliance. For connection to a 240 volt supply, use an attachment plug adapter of the proper configuration for the power supply receptacle."

56.10 An appliance provided with a 2-wire polarized attachment plug shall include the following or equivalent wording: "This appliance has a polarized plug (one blade is wider than the other). To reduce the risk of electric shock, this plug is intended to fit into a polarized outlet only one way. If the plug does not fit fully into the outlet, reverse the plug. If it still does not fit, contact a qualified electrician. Do not attempt to modify the plug in any way."

## 57 All Appliances

57.1 The following applies to all appliances.

### IMPORTANT SAFEGUARDS

When using electrical appliances, basic safety precautions should always be followed including the following:

1. Read all instructions
2. Do not touch hot surfaces. Use handles or knobs.
3. To protect against electrical shock do not immerse cord, plugs, or (state specific part or parts in question) in water or other liquid.
4. Close supervision is necessary when any appliance is used by or near children.
5. Unplug from outlet when not in use and before cleaning. Allow to cool before putting on or taking off parts.
6. Do not operate any appliance with a damaged cord or plug or after the appliance malfunctions or has been damaged in any manner. Return appliance to the nearest authorized service facility for examination, repair, or adjustment.
7. The use of accessory attachments not recommended by the appliance manufacturer may cause injuries.
8. Do not use outdoors (this item may be omitted if the product is specifically intended for outdoor use).
9. Do not let cord hang over edge of table or counter, or touch hot surfaces.
10. Do not place on or near a hot gas or electric burner, or in a heated oven.
11. Extreme caution must be used when moving an appliance containing hot oil or other hot liquids.
12. Always attach plug to appliance first, then plug cord into the wall outlet. To disconnect, turn any control to "off", then remove plug from wall outlet.
13. Do not use appliance for other than intended use.
14. Save these Instructions.

## 58 Specific Appliances

### 58.1 Baby food warmers/servers

1. "Before serving be sure food is at safe temperature."
2. "Before serving, unplug cord from wall outlet and dish. Do not leave cord within child's reach."

### 58.2 Broiler-ovens

1. "Use extreme caution when removing tray or disposing of hot grease."
2. "Do not clean with metal scouring pads. Pieces can break off the pad and touch electrical parts, creating a risk of electric shock."

### 58.3 Bun/bread-warmers (fabric enclosed heater)

1. "Do not use metallic fasteners to hold the fabric in place. Sharp utensils should not be used."
2. "Do not crush or fold the heater."

### 58.4 Outdoor electric barbecues/grills

1. "Fuel, such as charcoal briquettes, is not to be used with appliance."
2. "Use only on properly grounded outlet."

### 58.5 Nonmetallic pots

1. "Avoid sudden temperature changes, such as adding refrigerated foods into a heated pot." (This may be omitted for vessels of materials which are capable of withstanding such temperature extremes).

### 58.6 Toasters

1. "Oversize foods, metal foil packages, or utensils must not be inserted in a toaster as they may involve a risk of fire or electric shock."
2. "A fire may occur if toasters are covered or touching flammable material, including curtains, draperies, walls, and the like, when in operation."
3. "Do not attempt to dislodge food when toaster is plugged in." (This may be omitted if toaster employs sheathed type heating elements.)

### 58.7 Toaster-ovens (not broilers)

1. "Oversize foods or metal utensils must not be inserted in a toaster-oven as they may create a fire or risk of electric shock."
2. "A fire may occur if the toaster-oven is covered or touching flammable material, including curtains, draperies, walls, and the like, when in operation. Do not store any item on top of the appliance when in operation."
3. "Do not clean with metal scouring pads. Pieces can break off the pad and touch electrical parts involving a risk of electric shock."
4. "Extreme caution should be exercised when using containers constructed of other than metal or glass."
5. "Do not store any materials, other than manufacturers recommended accessories, in this oven when not in use."
6. "Do not place any of the following materials in the oven: (List all materials – that is, paper, cardboard, plastic, and the like)."
7. "Do not cover crumb tray or any part of the oven with metal foil. This will cause overheating of the oven."
8. The manufacturer shall explain how the toaster-oven is turned off. (An off means must be provided other than unplugging the cord.)

### 58.8 Appliances with detachable handles

1. "Be sure that handles are assembled and fastened properly."
2. (The manufacturer shall supply explicit instructions detailing the proper assembly of the handles.)
3. (The manufacturer shall explain how improper assembly of the handles can be determined.)

*Exception: Items 2 and 3 may be located in any part of the Instruction Manual provided that the important safeguards state "See instructions regarding handles on Page \_\_\_\_\_" or the equivalent wording.*

### 58.9 Under cabinet and wall mounted appliances

1. "To reduce the risk of fire, do not place any heating or cooking appliance beneath the appliance."
2. "To reduce the risk of fire, do not mount unit over or near any portion of a heating or cooking appliance."

3. "To reduce the risk of electric shock, do not mount over a sink."
4. "To reduce the risk of fire, do not store anything directly on top of the appliance surface when the appliance is in operation."

#### 58.10 Dual voltage rated appliances.

1. Be sure dual voltage selector, if provided, is in correct voltage position before operating. Before plugging in, read the information about the dual voltage contained in instruction section of this manual."
2. "This appliance was set at the factory to be operated at \_\_\_\_ volts. Refer to operating instructions section of this manual for conversion to \_\_\_\_ volt operation" or equivalent. The blanks are to be filled in with the appropriate voltage information.

*Exception: This construction does not apply if an appliance operates over a range of voltages and requires no adjustment by the user, such as an appliance that employs a positive temperature coefficient (PTC) heating element intended for use over a range of voltages and requiring no adjustment by the user.*

#### 58.10.1 Glass/Ceramic food warming surfaces:

- 1) Do Not Cook on Broken Cook-Top – If cook-top should break, cleaning solutions and spillovers may penetrate the broken cook-top and create a risk of electric shock.
- 2) Clean Cook-Top with Caution – If a wet sponge or cloth is used to wipe spills on a hot cooking area, be careful to avoid steam burn, some cleaners can produce noxious fumes if applied to a hot surface.

Added 58.10.1 effective November 17, 1999

58.11 A cautionary marking that is required to be on an appliance shall be repeated in its entirety or with an equivalent wording in the instruction manual. The marking may be included in the Important Safeguards.

### 59 User Maintenance

59.1 The instruction manual shall include instructions and caution statements for cleaning, user-maintenance (such as lubrication or non-lubrication) operations recommended by the manufacturer, and shall warn a user that any other servicing should be performed by an authorized service representative. The manual or other literature packaged with the product shall also indicate that the product is for household use.

59.2 Instructions for mounting an under-cabinet or wall mounted appliance shall be provided. The actual instructions shall be located on the appliance, or in the literature packed with the appliance. The actual instructions shall not be in the Important Safeguards, however, there may be a reference to them in the Important Safeguards. (Such as "Wall or under-the-cabinet mounting should follow the directions in the installation instructions.")

No Text on This Page

## APPENDIX A

### Standards for Components

Standards under which components of the products covered by this standard are evaluated include the following:

Title of Standard – UL Standard Designation

---

Attachment Plugs and Receptacles – UL 498  
Cord Sets and Power-Supply Cords – UL 817  
Extruded Insulating Tubing – UL 224  
Flammability of Plastic Materials for Parts in Devices and Appliances, Tests for – UL 94  
Flexible Cord and Fixture Wire – UL 62  
Motors, Electric – UL 1004  
Polymeric Materials – Long Term Property Evaluations – UL 746B  
Polymeric Materials – Short Term Property Evaluations – UL 746A  
Polymeric Materials – Use in Electrical Equipment Evaluations – UL 746C  
Printed-Wiring Boards – UL 796  
Quick-Connect Terminals, Electrical – UL 310  
Sleeving, Coated Electrical – UL 1441  
Switches, Clock Operated – UL 917  
Switches, Special-Use – UL 1054  
Systems of Insulating Materials – General – UL 1446  
Tape, Polyvinyl Chloride, Polyethylene and Rubber Insulating – UL 510  
Temperature-Indicating and -Regulating Equipment – UL 873  
Terminal Blocks – UL 1059  
Thermal Cutoffs for Use in Electrical Appliances and Components – UL 1020  
Wires and Cables, Rubber-Insulated – UL 44  
Wires and Cables, Thermoplastic-Insulated – UL 83  
Wire Connectors and Soldering Lugs for Use with Copper Conductors – UL 486A  
Wire Connectors for Use With Aluminum Conductors – UL 486B

No Text on This Page



**APPENDIX B****Food Color Charts**

A good brown color is to be as close to the middle color shown as practical, but not lighter than the lightest color or darker than the darkest color.

A color photo of this chart accompanies this computer file

Toast Color Chart

Waffle Color Chart

French Fries Color Chart

(12/31/84)

No Text on This Page

**May 28, 2002**  
**Superseded requirements for**  
**the Standard for**  
**Electric Household Cooking and Food Serving Appliances**  
**UL 1026, Fourth Edition**

The requirements shown are the current requirements that have been superseded by requirements in this edition. To retain the current requirements, do not discard the following requirement until the future effective dates are reached.

13.2 In determining that a heating element is adequately supported, consideration is to be given to sagging, loosening, and other adverse conditions of the element resulting from continuous heating. For an open-wire (uninsulated resistance wire) heating element consideration is also to be given to breakage at any point.

41.1.2 To determine whether an appliance complies with the requirement in 41.1.1, it is to be tested as follows: water is to be used for the test, and is to be poured into the reservoir through an orifice 3/8 inch (9.5 mm) in diameter. The reservoir is to be filled to the level recommended by the manufacturer if such level is plainly marked; otherwise, the reservoir is to be filled to maximum capacity. Additional water, equal to 50 percent of the volume just mentioned (but not more than 1 pint), is then to be poured into the reservoir. Usually, determination of whether uninsulated live parts have become wet as a result of the overflow is to be by means of visual inspection, but this may be supplemented by an insulation-resistance test, a dielectric voltage-withstand test, or both if judged to be appropriate.

No Text on This Page