UL 482

STANDARD FOR SAFETY

Portable Sun/Heat Lamps

UL Standard for Safety for Portable Sun/Heat Lamps, UL 482

Ninth Edition, Dated September 2, 2005

Summary of Topics

This revision of ANSI/UL 482 dated March 20, 2020 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated November 29, 2019.

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UL 482

Standard for Portable Sun/Heat Lamps

The First and the Second editions were titled Standard for Therapeutic Lamps.

First Edition – May, 1957
Second Edition – May, 1973
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Fourth Edition – October, 1975
Fifth Edition – April, 1981
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Ninth Edition

September 2, 2005

This ANSI/UL Standard for Safety consists of the Ninth edition including revisions through March 20, 2020.

The most recent designation of ANSI/UL 482 as a Reaffirmed American National Standard (ANS) occurred on February 7, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 This Standard covers sun lamps, heat lamps and combination sun and heat lamps rated at not more than 125 V. A sun lamp is intended for production of ultraviolet radiation for skin tanning. A heat lamp is intended for production of infrared radiation. A combination sun and heat lamp is intended for production of both ultraviolet and infrared radiation. In the text of this Standard, the term sun/heat lamp is intended to cover all types.

1.2 This Standard covers portable sun/heat lamps intended for use by nontechnically qualified persons in homes, sports facilities, health spas and similar establishments and intended for connection to a power-supply circuit by a flexible cord for use in accordance with the National Electrical Code, ANSI/NFPA 70.

1.3 This Standard does not cover lamps intended primarily to provide illumination (although some visible radiation may be produced during the operation of a sun/heat lamp).

1.4 This Standard does not cover sun or heat lamps intended for professional use. Professional use lamps are those for use by technically qualified persons in hospitals, nursing homes, medical care centers, clinics, medical offices, laboratories, and similar establishments for therapeutic purposes. The therapeutic lamps are covered by the requirements for medical and dental equipment.

1.5 Ultraviolet lamps intended for high intensity, short duration – 2 minute maximum first exposure time for most sensitive skin – operation will be subject to an appropriate investigation for any additional requirements as are applicable to a lamp with this feature.

1.6 This Standard does not cover bulbs alone but complete appliances.

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 generally used in the products covered by this Standard.

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.

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

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.

3 Units of Measurement

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

3.2 Unless indicated otherwise all voltage and current values mentioned in this Standard are root-mean-square (rms).

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 Portable sun lamps are subject to the Radiation Control for Health and Safety Act of 1968, and the Federal Food, Drug and Cosmetic Act, as amended by the Safe Medical Act of 1990 and the Medical Device Amendments of 1992.

6 Frame and Enclosure

6.1 A sun/heat lamp shall be so formed and assembled that it has the strength and rigidity necessary to resist the abuses to which it is likely to be subjected without increasing its risk of fire, electric shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

6.2 A sun/heat lamp shall have an enclosure of metal or of noncombustible, nonabsorptive insulating material such as glass, marble, phenolic composition, or of a material determined to be acceptable for the application.

6.3 Among the factors taken into consideration when determining the acceptability of a nonmetallic enclosure are:

a) The mechanical strength,

b) Resistance to impact,

c) Moisture-absorptive properties,

d) Combustibility and resistance to ignition from electrical sources,

e) Dielectric strength, insulation resistance, and resistance to arc tracking, and

f) Resistance to distortion and creeping at temperatures to which the material may be subjected under conditions of intended or abnormal usage.

The material is not to display a loss of these properties beyond the minimum acceptable level as a result of aging. See the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

6.4 The continuity of the grounding system shall not rely on the dimensional integrity of the nonmetallic material.

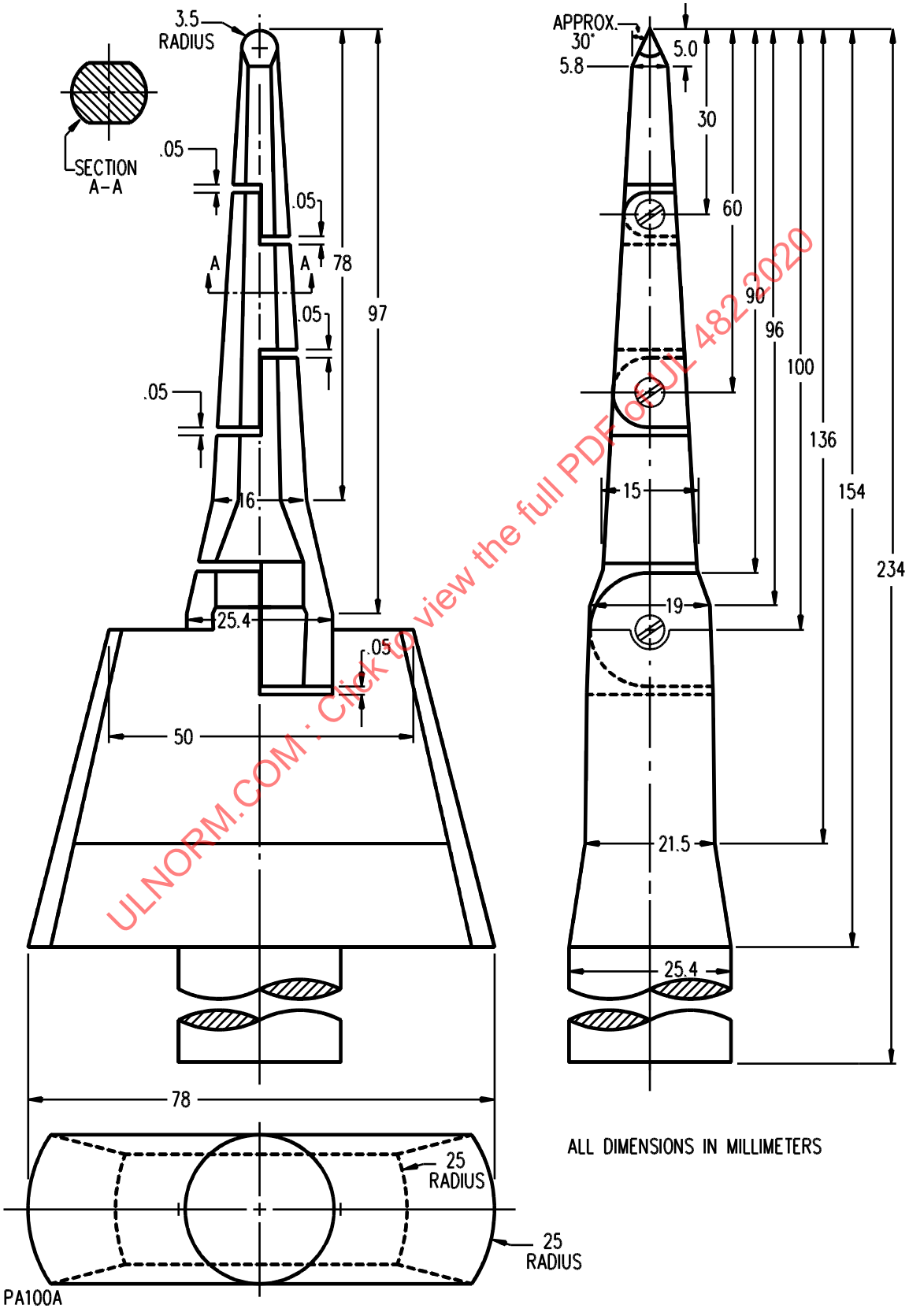
6.5 Electrical parts of a sun/heat lamp shall be so located or enclosed that protection against unintentional contact with uninsulated live parts, other than the contacts of a lampholder, is provided.

6.6 An opening in an enclosure that contains live or current-carrying parts shall prevent entrance of a 1 inch (25.4 mm) diameter rod and is acceptable if a probe as illustrated in Figure 6.1, inserted through the

opening, cannot touch any uninsulated live part or coated-magnet wire that may cause an electric shock. The probe shall be applied in all possible articulated positions before, during, and after insertion.

Figure 6.1

Articulate probe



6.7 During the examination of an appliance in connection with the requirements in 6.5, a part of the outer enclosure that may be removed, without the use of tools, by the user of the appliance (to permit the attachment of accessories, to allow access to means for making operating adjustments, or for another reason) is to be disregarded – that is, it will not be assumed that the part in question affords protection against the risk of electric shock.

6.8 The stability of a sun/heat lamp having a stand shall be such that it will not easily overturn under conditions of expected use.

6.9 A sun/heat lamp shall be so constructed that it will not tip over when resting on an inclined plane having an angle of 8 degrees with the horizontal.

6.10 Except for parts needed to perform a working function, an edge, projection, or corner of an enclosure, opening, frame, guard, handle, or the like shall be smooth and well rounded and not so sharp as to constitute a risk of injury to persons in intended use or during user maintenance.

6.11 A guard that is not permanently secured in place is to be investigated to determine its acceptability for the application.

7 Mechanical Assembly

7.1 A sun/heat lamp shall have all parts secured in an effective manner.

7.2 A switch that is housed in the enclosure of a lamp, and a lamp- or element-holder, shall be mounted securely and prevented from turning by means other than friction between surfaces.

7.3 A lockwasher properly applied is acceptable as a means to prevent turning of a stem-mounted switch.

8 Corrosion Protection

8.1 Iron and steel parts shall be protected against corrosion by galvanizing, plating, painting, enameling, or other equivalent means if the deterioration of such parts would be likely to result in an increased risk of fire, electric shock, or injury to persons.

8.2 If the oxidation of iron or steel due to the exposure of the metal to air and moisture is not likely to be appreciable – thickness of metal and temperature also being factors – the surfaces of sheet steel and cast iron parts in an enclosure may not be required to be protected against corrosion. The requirement of 8.1 does not apply to bearings, laminations, and the like.

9 Electrical Potentials

9.1 If a sun/heat lamp employs an autotransformer, no part of the lamp shall exceed a potential of 150 V to ground or to either conductor of the power-supply cord, when it is connected to a supply circuit of maximum rated voltage under any condition of operation, including open-circuit winding. If such a lamp employs a 2-winding transformer, the maximum difference of potential in the secondary shall be 300 V or less under any condition of operation, including open-circuit secondary.

Exception No. 1: A sun/heat lamp need not comply with this requirement if it employs an interlock that de-energizes the appliance during removal of a screen or lens necessary for relamping. See 15.3 and 15.4.

Exception No. 2: A fluorescent sun/heat lamp employing circuit interrupting lampholders need not comply with this requirement.

10 Cords and Plugs

10.1 If a sun/heat lamp is provided with a directly attached flexible cord, an attachment plug shall be provided on the cord for connection to the supply circuit. If a directly attached flexible cord is not provided, the lamp shall have terminals using male pins, blades, or the equivalent that will accommodate an acceptable plug. See 10.4, 10.5 and 19.2.

10.2 A sun/heat lamp employing a screw shell-type lampholder shall have an attachment plug of either the grounding or polarized type. The grounded conductor of the cord is to be connected to the screwshell of the lampholder and to the grounded blade of the attachment plug. See 33.7.

10.3 The ampacity of the flexible cord shall be not less than the rated current of the sun/heat lamp.

10.4 Flexible cord provided as part of a sun/heat lamp shall be:

a) Type SP-1 or SPT-1, or heavier;

b) Type HPD or HPN if the lamp produces a temperature of more than 121°C (250°F) on a surface with which the cord is likely to make contact; or

c) A type having such properties that it will be at least equally serviceable for the particular application.

10.5 The length of the power-supply cord shall be a minimum of 6 ft (1.83 m) and a maximum of 10 ft (3.05 m) when measured from the point of entry into the enclosure to the plane of the face of the attachment plug.

Exception: The power-supply cord may be a maximum length of 25 ft (7.62 m) if it is Type SJ, SJE, SJO, SJT, SJTO, or the equivalent.

10.6 If an external cord, such as that used for remote control, is connected to primary circuitry, it shall comply with the requirements in 10.4, 10.5, and 10.7.

10.7 Strain relief shall be provided in the lamp and in fittings of the power-supply cord and any external cord connected to primary circuitry so that a stress on the cord will not be transmitted to the terminals or wiring inside the lamp or to the terminals of fittings. See the Strain Relief Test, Section 27.

10.8 If a knot in a flexible cord serves as strain relief, the surface against which the knot may bear or with which it may come in contact shall be free from projections, sharp edges, burrs, fins, and the like that might damage the insulation of the conductors.

10.9 Means shall be provided to prevent the cord from being pushed into the appliance through the cord entry hole if such displacement is likely to subject the cord to mechanical damage, expose the cord to a temperature higher than that for which the cord is rated, or reduce spacings below acceptable values.

11 Bushings

11.1 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 smoothly rounded surface against which the cord may bear. If Type SP-1, SPT-1, SP-2, SPT-2, HPN, HPD or other cord lighter than HSJ is used, 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 acceptable for the particular application.

11.2 If the cord hole is in porcelain, phenolic composition, or other acceptable nonconducting material, a smoothly rounded surface is considered to be the equivalent of a bushing.

11.3 Ceramic materials and some molded compositions are acceptable generally for insulating bushings; but separate bushings of wood, so-called hot-molded shellac and tar compositions, or rubber materials are not acceptable.

11.4 Fiber may be used 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 adversely affected by conditions or ordinary moisture.

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

12 Internal Wiring

12.1 Insulated conductors used for the internal wiring of a sun/heat lamp shall be acceptable for the temperature and voltage to which they will be subjected in service.

12.2 An enclosure that houses wires shall be smooth and entirely free from sharp edges, burrs, fins, and the like, that may cause abrasion of the insulation on conductors.

12.3 Insulated wires may be bunched and passed through a single opening in a metal wall within the enclosure of the sun/heat lamp.

12.4 The screw-shell of a lampholder and the terminal intended to be connected to the grounded circuit conductor, if any, of the attachment plug shall be connected to that conductor of the cord which is identified as the grounded circuit conductor. No single-pole switch shall be connected in that conductor.

12.5 A splice shall be made mechanically secure and shall provide good electrical contact.

12.6 A splice shall be provided with insulation equivalent to that of the wires involved unless permanence of spacing between the splice and other metal parts is provided.

13 Insulating Materials

13.1 Insulating washers, bushings, and the like that are integral parts of a sun/heat lamp, and bases or supports for the mounting of live parts shall be of a moisture-resistant material that will not be adversely affected by the temperatures to which they will be subjected under conditions of intended use.

13.2 Insulating material used in a sun/heat lamp is to be considered 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 sole support of live parts. Some other materials that are not acceptable for general use, such as magnesium oxide, may be accepted if used in conjunction with other more appropriate insulating materials or if so located and protected against mechanical damage and the absorption of moisture. If an investigation is necessary to determine the acceptability of a material, consideration will be given to its mechanical strength, dielectric strength, insulation resistance, heat-resistant qualities, the degree to which it is enclosed or protected, and any other features that have a bearing on the risk of fire, electric shock, and injury to persons involved in conjunction with the conditions of intended service.

13.3 In the mounting or supporting of small, fragile, insulating parts, screws or other fastenings should not be so tight as to result in cracking or breaking these parts due to expansion and contraction.

13.4 Combustible or electrically conductive heat-insulating material shall not make contact with uninsulated live parts of the lamp.

14 Lampholders

14.1 A female screw-shell used as a holder for a bulb or heating element shall be of copper or copper alloy and shall be plated with nickel or equivalent oxidation-resistant metal if it operates at a temperature of more than 200°C (392°F); or the screw-shell shall be of other acceptable material.

14.2 A lampholder for a sun lamp shall be of a type other than the conventional right hand thread of the Edison medium base size.

15 Switches and Interlocks

15.1 A switch provided as a part of a sun/heat lamp shall be of a type intended for the particular application, and shall have a current and voltage rating not less than that of the load which it controls. A switch that controls a tungsten-filament lamp shall be acceptable for such use.

15.2 A switch provided as part of a sun/heat lamp that uses a transformer shall have a voltage rating not less than that of the primary of the transformer. Unless accepted as being appropriate for that purpose, the switch shall have a current rating not less than twice the current input to the transformer, when loaded to the maximum intended value.

15.3 An interlock used to de-energize the product during removal of a screen or lens necessary for relamping shall be such that it cannot be readily defeated without:

a) Damaging the product; or

b) Making wiring connections or alterations.

15.4 The actuator of a switch employed as an interlock shall be located or guarded so as to reduce the risk of injury to persons resulting from unintentional operation of the switch. The actuator shall be guarded by recessing, ribs, barriers, or the like.

16 Timers

16.1 A sun lamp shall be provided with a timer as part of the lamp to function so as to automatically de-energize the lamp at the termination of the time setting on the timer. The timer may be either built-in (integral with the construction of the appliance) or in series with the supply cord.

16.2 If the timer is in series with the supply cord, and is separable from the lamp, the interconnection shall be of a nonstandard configuration to preclude by-passing of the timer.

16.3 A sun lamp timer shall have a maximum time setting equal to the maximum recommended exposure time indicated in the instructions accompanying the sun lamp. In addition, the timer shall have a number of time settings that correspond with the time intervals for different exposure distances and expected results as indicated by the marking on the sun lamp. See 33.12.

16.4 A sun lamp timer shall not have a permanent on position. No timer interval shall have an error greater than ±10 percent of the maximum timer interval of the product.

16.5 The timer may be equipped with an audible or visual signal to warn of pending shutdown.

16.6 A sun lamp timer shall provide the user with a means to manually terminate radiation emission, unless a separate control is provided for this purpose. Disconnecting the supply cord or removal of the lamp from its holder is not acceptable.

17 Protective Eyewear

17.1 Each sun lamp shall be provided with at least one set of protective eyewear per person recommended in the instructions to be exposed simultaneously to the sun lamp.

17.2 The protective eyewear shall be close fitting and shall protect the eye area from both the front and the sides.

17.3 The spectral transmittance of protective eyewear shall not exceed a value of 0.001 over the wavelength range greater than 200 nanometers through 320 nanometers and a value of 0.01 over the wavelength range greater than 320 nanometers through 400 nanometers, and shall be sufficient over the wavelengths greater than 400 nanometers to enable the user to see clearly enough to read the markings and reset the timer.

18 Spacings

18.1 Except as noted in 18.2, the spacing between uninsulated live parts of opposite polarity, and between an uninsulated live part and a dead-metal part, shall not be less than the value indicated in Table 18.1. 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 the required spacing will be maintained under all operating conditions.

Table 18.1
Minimum spacings

Voltage involved, in volts	Minimum spacings in inches (mm)	
	Through air	Over surface
0 – 250	1/16 (1.6)	1/16 (1.6)
251 – 300	1/4 (6.4)	1/4 (6.4)

18.2 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. Within a thermostat, except at contacts, the spacing between uninsulated live parts on opposite sides of the contacts is 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. The construction is to be such that the spacings will be maintained permanently. The requirement of 18.1 does not apply to the inherent spacings of a component part of the lamp, such as a snap switch; such spacings are determined on the basis of the requirements for the component in question. See 2.1.

18.3 The spacings and sizes of pin terminals provided on a sun/heat lamp using a detachable heater-cord set shall comply with the requirements given in the Standard for Attachment Plugs and Receptacles, UL 498.

19 Grounding

19.1 If a grounding conductor is provided in the supply cord, all exposed dead-metal parts shall be connected to the grounding conductor.

19.2 A grounding conductor covering of the flexible cord shall be green with or without one or more yellow stripes. The grounding conductor shall be secured to the frame or enclosure of the appliance, which is intended to be grounded, by means of a screw that is not likely to be removed during any servicing operation not involving the power-supply cord, or by other equivalent means. Solder alone shall not be used for securing the grounding conductor. The grounding conductor shall be connected to the grounding blade of the attachment plug.

PERFORMANCE

20 General

20.1 If a sun/heat lamp is intended (mechanically and electrically) for use with lamps of two or more different types, the input test shall be conducted by using the lamp that results in maximum input, and the temperature test shall be conducted with the lamp that results in maximum temperature rises.

Exception: If a sun/heat lamp is marked to indicate that it is intended for use with a lamp of a particular type, the tests are to be conducted by using such lamp.

21 Leakage Current Test

21.1 The leakage current of a sun/heat lamp rated for a nominal 120 V supply when tested in accordance with 21.3 – 21.6 shall not be more than 0.5 mA.

21.2 Leakage current refers to all currents, including capacitively coupled currents, that may be conveyed between exposed conductive surfaces of a sun/heat lamp and ground or other exposed conductive surfaces of the sun/heat lamp.

21.3 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 the risk of electric shock as defined in 6.5 – 6.7. 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 that do not present a risk of electric shock, such as those supplied from an isolating transformer device operating at a potential not exceeding 30 V rms or 42.4 V peak.

21.4 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 (3.9 by 7.9 inches) 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 sun/heat lamp.

21.5 The measurement circuit for leakage current is to be as shown in Figure 21.1. The ideal measurement instrument is defined in items (a) – (d). The meter that is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the defined instrument. The meter used need not have all the attributes of the defined instrument.

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

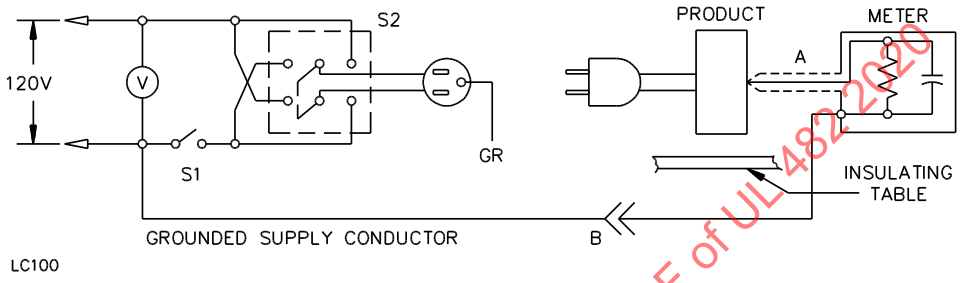
b) The meter is to indicate 1.11 times the average of the full-wave rectified composite waveform of the voltage across the resistor or current through the resistor.

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 currents) that is equal to the ratio of the impedance of a 1500 ohm resistor shunted by a 0.15 µF capacitor to 1500 ohms. At an indication of 0.5 mA, the measurement is to have an error of not more than 5 percent.

d) Unless the meter is being used to measure leakage from one part of a sun/heat lamp to another, the meter is to be connected between the accessible parts and grounded supply conductor.

Figure 21.1

Leakage current measurement circuit



Notes:

A – Probe with shielded lead.

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

21.6 A sample of the sun/heat lamp is to be tested for leakage current starting with the as-received condition, but with 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 voltage is to be adjusted to 120 V. The test sequence with reference to the measuring circuit (Figure 21.1) is to be as follows:

a) With the switch S1 open, the sun/heat lamp is to be connected to the measuring circuit. Leakage current is to be measured using both positions of switch S2, and with the sun/heat lamp switching devices in all their operating positions.

b) Switch S1 is then to be closed, energizing the sun/heat lamp, and within a period of 5 seconds, the leakage current is to be measured using both positions of switch S2 and with the sun/heat lamp switching devices in all their operating positions.

c) Leakage current is to be monitored until thermal stabilization. Both positions of switch S2 are to be used in determining this measurement. Thermal stabilization is considered to be obtained by operation as in the normal temperature test.

22 Input Test

22.1 The current or power input to a sun/heat lamp shall not be more than 110 percent of the marked rating when the lamp is operated from a circuit of rated voltage.

22.2 To determine compliance with the requirement of 22.1, the input is to be measured with the lamp at normal operating temperature. For the input test, the rated voltage of a lamp having a marked voltage range (such as 110 – 120 V) is considered to be the mean of the range.

23 Irradiance Ratio Test

23.1 For each sun lamp, the ratio of the irradiance within the wavelength range of greater than 200 nanometers through 260 nanometers to the irradiance within the wavelength range of greater than 260 nanometers through 320 nanometers shall not exceed 0.003 at any distance and direction from the product or lamp.

23.2 The measurements shall be made under those operational conditions and procedures as recommended by the manufacturer that maximize the emission of radiation. The measuring instrument shall be so positioned and so oriented as to result in the maximum detection of the radiation by the instrument. The lamp voltage, current and position recommended by the manufacturer shall be used.

23.3 In determining compliance with 23.1 all measurement errors and statistical uncertainties in the measurement process and, wherever applicable, changes in radiation emission or degradation in radiation safety with age of the product are to be considered.

24 Temperature Test – Normal Operation

24.1 A sun/heat lamp shall not attain a temperature at any point high enough to constitute a risk of fire or to damage any material used in the appliance, nor to indicate temperature rises at specific points greater than those indicated in Table 24.1.

24.2 During the test, the sun/heat lamp is to be supported in the intended manner on a horizontal softwood surface covered with two layers of white tissue paper. The test is to be continued until constant temperatures have been attained. See 24.6. Any timer contacts are to be shorted during this test.

24.3 An automatic temperature-regulating or limiting control or other protective device provided as a part of a sun/heat lamp is to be shunted out of the circuit during the temperature tests, unless the control has been shown by an appropriate investigation to be reliable, and unlikely to be defeated by the user.

24.4 All values for temperature rises in Table 24.1 are based on an assumed ambient temperature of 25°C (77°F); however, tests may be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F).

24.5 Temperatures are to be measured by thermocouples consisting of wires not larger than 24 AWG (0.21 mm^2) and not smaller than 30 AWG (0.05 mm^2). The thermocouples and the related instrument are to be accurate and calibrated in accordance with standard laboratory practice. The thermocouple wires are to conform with the requirements specified in the Tolerances on Initial Values of EMF versus Temperature tables in the Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples, ANSI/ASTM E230/E230M. Thermocouples using iron and constantan 30 AWG (0.05 mm^2) wires are to be used with a potentiometer-type instrument whenever a referee temperature measurement by thermocouple is necessary.

24.6 A temperature is considered to be constant when three successive readings, taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5-minute intervals, indicate no change.

24.7 If the retention of the asbestos insulation of a heater cord depends upon a fabric braid, the braid shall not be removed nor subjected to a temperature rise of more than 65°C (117°F) unless other means are provided to hold the insulation in place. The jacket of Type HSJ cord shall not be subjected to a temperature rise of more than 35°C (63°F), and that of Type HS to a rise of more than 50°C (90°F), if the protection afforded by the jacket is required.

Table 24.1
Maximum acceptable temperature rises

Materials and component parts		Degrees C	Degrees F
1.	Class A insulation systems on coil windings of a-c motors (not including universal motors) thermocouple or resistance method[a]:		
	a) In open motors and on vibrator coils	75	135
	b) In totally enclosed motors	80	144
2.	Class 130 insulation systems on windings of relays, solenoids, or the like:		
	Thermocouple method[a]	85	153
	Resistance method	105	189
3.	Class B insulation systems on coil windings of a-c motors (not including universal motors) thermocouple or resistance method[a]:		
	a) In open motors and vibrator coils	95	171
	b) In totally enclosed motors	100	180
4.	Class 105 insulation systems on windings of relays, solenoids, or the like:		
	Thermocouple method[a]	65	117
	Resistance method	85	153
5.	Rubber- or thermoplastic-insulated wires and cords[b,c]	35	63
6.	Varnished-cloth insulation	60	108
7.	Other types of insulated wires	c	c

Table 24.1 Continued on Next Page

Table 24.1 Continued

Materials and component parts		Degrees C	Degrees F
8.	Fiber used as electrical insulation or as bushings	65	117
9.	Wood or other combustible material	65	117
1-0.	Surface on which the lamp is supported, except as noted in item 11.	125	225
1-1.	Wall supporting a pin-up lamp	65	117
1-2.	Phenolic composition, other than in a flatiron or appliance plug, used as electrical insulation or as a part whose deterioration would result in risk of fire, electric shock, or injury to persons.[b]	125	225
1-3.	Flatiron or appliance plug face	175	315
1-4.	Sealing compounds	d	d
1-5.	Capacitors	25°C (77°F) less than the marked limit	

[a] See 24.12 and 24.13

[b] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and found acceptable as having heat-resistant properties. See also 24.7.

[c] For standard insulated conductors other than those mentioned in items 5 and 6, reference should be made to the National Electrical Code, ANSI/NFPA No. 70, and the maximum temperature rise in any case is 25°C (77°F) less than the acceptable temperature limit of the wire in question.

[d] 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 Standard Test Methods for Softening Point by Ring-and-Ball Apparatus, ASTM E28-92.

24.8 Stainless steel and other corrosion-resistant alloys may be used for current-carrying parts in a sun/heat lamp without restriction as to temperature. Plated iron or steel may be used for current-carrying parts where the material is subjected to temperature of more than 100°C (212°F), but plain (unplated) iron or steel is not acceptable, regardless of temperature.

24.9 A sun lamp is to be connected to a circuit of maximum rated voltage for the temperature test.

24.10 A heat lamp having a rated voltage of more than 120 V or less than 110 V is to be connected to a supply circuit of rated voltage for the temperature test; however, if the wattage input to the lamp when so connected is less than the marked wattage rating, the lamp is to be connected to a supply circuit of voltage high enough to cause a wattage input to the lamp equal to its marked rated wattage. If its voltage rating is within the range of 110 to 120 V, inclusive, the lamp is to be connected to a supply circuit of a voltage to cause a wattage input equal to:

$$W_m \frac{120^2}{V_m{}^2}$$

in which:

W_m is the marked rated wattage of the lamp and

V_m is the marked rated voltage of the lamp;

but, in any case, the voltage of the supply circuit is not to be less that the rated voltage.

24.11 With reference to 24.10, the rated wattage of a lamp rated in amperes (rather than watts) is considered to be the product of the rated voltage by the rated current.

24.12 The temperature of a coil or winding is to be measured by means of thermocouples mounted on the outside of the coil wrap and by the change of resistance method. 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, only the change-of-resistance method need be used. For the thermocouple-measured temperature of a coil of an a-c motor, other than a universal motor, (items 1 and 3 in Table 24.1), the thermocouple is to be mounted on the integrally applied insulation of the conductor.

24.13 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 than the maximum temperature rise indicated in Table 24.1 by the amount specified in Table 24.2 provided that the temperature rise of the coil by the change-of-resistance method is not more than specified in Table 24.1.

Table 24.2
Additional thermocouple rise

Item in Table 24.1	Additional thermocouple rise	
	°C	°F
Part (a) of item 1	5	9
Item 2	20	36
Part (a) of item 3	10	18
Item 4	15	27

24.14 The temperature rise of a winding by the change-of-resistance method is to be calculated from the formula (windings are to be at room temperature at the start of the test):

$$\Delta t = \frac{R}{r}(k + t_1) - (k + t_2)$$

in which:

Δt is the temperature rise,

R is the resistance of the coil at the end of the test,

r is the resistance of the coil at the beginning of the test,

t_1 is the room temperature °C at the beginning of the test,

t_2 is the room temperature °C at the end of the test, and

k is 234.5 for copper, 225.0 for electrical conductor grade (EC) aluminum.

Values of the constant for other grades must be determined.

24.15 If it is necessary to de-energize the winding before measuring R, the value of R at shutdown may be determined by taking several resistance measurements at short intervals, beginning as quickly as possible after the instant of shutdown. A curve of the resistance values and the time may be plotted and extrapolated to give the value of R at shutdown.

24.16 During the temperature test, the temperature of a surface that may be contacted by the user shall not be more than as indicated in Table 24.3. If the test is conducted at a room temperature of other than 25°C (77°F), the results are to be corrected to that temperature.

Table 24.3
Maximum surface temperatures

Location	Composition of surface[a]	
	Metallic	Nonmetallic
Handles or knobs that are grasped for lifting, carrying or holding	50°C (122°F)	60°C (140°F)
Handles or knobs that are contacted but do not involve lifting, carrying or holding	60°C (140°F)	85°C (185°F)

[a] A handle, knob, or the like made of a material other than metal, that is plated or clad with metal having a thickness of 0.005 inch (0.127 mm) or less is to be considered as a nonmetallic part.

25 Endurance Test

25.1 The sun lamp timer shall acceptably complete 6000 cycles of mechanical operation without malfunction and must be operable at the end of the test. Each cycle of operation is to consist of rotating the timer knob to the maximum time position and allowing the timer to operate to the off position.

25.2 Unless the timer contacts have been found to be acceptable for the purpose, they shall be subjected to 50 cycles conditioning. The conditioning load is to consist of an inductive load having a power factor of 70 to 80 percent adjusted to 150 percent of the operating current of the lamp. The endurance load is to consist of a tungsten lamp load equal to the operating current of the lamp. The rate of operating is to be such that a minimum of 55 seconds is provided for cooling of the lamp load between cycles. A synthetic tungsten lamp load having equivalent characteristics or a synthetic load that represent the actual current characteristic of the particular lamp load, including inrush, may be used in place of the tungsten lamp load.

26 Temperature Test – Abnormal Operation

26.1 A sun/heat lamp overturned in any position on a softwood surface covered with a double layer of cloth shall not cause the cloth or wood to glow or flame.

26.2 After having been pushed over, the lamp is to be operated under the most severe conditions that will result when it comes to rest without further guiding or propping.

26.3 A sun/heat lamp with its rays directed against a vertical softwood surface covered with a double layer of cloth at any distance from the lamp shall not cause the cloth or wood to glow or flame. The vertical wood surface shall abut a horizontal surface supporting the lamp.

26.4 The distance between the lamp and the vertical wood surface is to be such that maximum heating will occur on the latter.

26.5 A sun/heat lamp, loosely covered with a double layer of cloth, shall not cause the cloth to glow or flame.

26.6 The lamp is to be operated until constant temperatures are attained before covering it with a cloth.

26.7 Wherever cloth is mentioned in the abnormal tests, the cloth is to be bleached cheesecloth, running 14 – 15 yd^2/lb (approximately 26 – 28 m^2/kg) and having what is known in the trade as a "count of 32 by

28", that is, for any square inch 32 threads in one direction and 28 threads in the other direction (for any square centimeter, 13 threads in one direction and 11 in the other direction).

26.8 If abnormal conditions in addition to those described in 26.1, 26.3 and 26.5 are likely to be obtained in actual service, a sun/heat lamp shall not involve a risk of fire when operated under such abnormal conditions.

26.9 To determine if a risk of fire actually exists, a separate burnout or abnormal heating test is to be conducted with the lamp operating continuously until the ultimate result has been determined. During the test, the lamp is to be supported on white tissue paper on a softwood surface. Among the abnormal conditions to be considered is operation of the lamp with rays directed downward toward the supporting surface to the greatest degree possible.

26.10 An automatic temperature-regulating or -limiting control or other protective device provided as a part of a sun/heat lamp is to be shunted out of the circuit during the temperature tests, unless the control has been shown by an appropriate investigation to be reliable, and unlikely to be defeated by the user.

26.11 When operated under such abnormal conditions, a lamp is considered to involve a risk of fire if there is any emission of flame or molten metal or if operation of the lamp results in the glowing or flaming of combustible material upon which it may be placed.

26.12 A heat lamp with reference to the abnormal tests will generally require continuous operation for 7 or 8 hours in order to determine that the ultimate result has been observed. Any timer contacts are to be shorted during the abnormal tests.

26.13 A sun lamp with reference to the abnormal tests will generally require continuous operation for 7 or 8 hours in order to determine that the ultimate result has been observed. The timer contacts are to be shorted during the abnormal tests.

Exception: If the timer has been tested and found to operate acceptably for 100,000 cycles of mechanical and electrical operation following the procedure in 25.1 and 25.2, a sun lamp is first to be brought up to constant temperature before introducing the abnormal condition. The timer is then to be set at 10 minutes and the abnormal condition introduced.

26.14 If a sun/heat lamp employs one or more semiconductors, transistors, or similar components, a risk of fire, electric shock, or injury to persons condition shall not develop when the circuit between any two terminals of any such component is short circuited or is opened at any terminal. If an electrolytic capacitor is employed a risk of fire, electric shock, or injury to persons condition shall not develop when the capacitor is shorted. Only one simulated fault condition is to be imposed at one time.

27 Strain Relief Test

27.1 The power-supply cord of a sun/heat lamp and any external cord connected to primary circuitry shall be capable of withstanding a straight pull of 35 lbf (156 N) applied between the cord and the sun/heat lamp for 1 minute.

27.2 The 35 lbf (156 N) pull is to be applied by suspending a 35 lb (15.9 kg) weight from the cord with the force applied in a direction normal to the plane of the cord-entry hole, with all cord conductors severed immediately adjacent to the terminals or splices. If there is movement of the cord more than 1/16 inch (1.6 mm) at the point where the connections are severed, the strain relief is not acceptable.

27.3 Strain relief shall be provided so that a pull exerted on the flexible cord will not be transmitted directly to binding-screw terminals of the attachment plug. The assembly shall be capable of withstanding a straight pull of 30 lbf (133 N) applied between the cord and the plug.

27.4 With the attachment plug securely held by the blades, the pull is to be applied for 1 minute to the flexible cord, in a direction perpendicular to the plane of the cord-entry hole. The results of the test are not acceptable if any cord conductor is detached from its terminal in the plug.

28 Adhesion of Labels Test

28.1 To determine if a pressure sensitive label or a label secured by cement or adhesive is of a permanent nature, representative samples that have been subjected to the tests outlined in 28.2 – 28.5 shall meet the following conditions:

a) Each label shall demonstrate good adhesion and the edges shall not be curled.

b) The label shall resist defacement or removal as demonstrated by scraping across the test panel with a flat metal blade 1/32 inch (0.8 mm) thick, held at a right angle to the test panel.

c) The printing shall be legible and shall not be defaced by rubbing with thumb or finger pressure.

28.2 For each of the two types of conditioning mentioned in 28.3 and 28.5, three samples of the label are to be applied to the same test surface as anticipated in the intended application. The labels are to be applied to the test surface not less than 24 hours prior to testing.

28.3 Three samples of the labels are to be evaluated as received.

28.4 Evaluation of samples at the end of the test as indicated in 28.5 is to be made:

a) Immediately following removal from the test medium, and

b) After exposure to room temperature for 24 hours following removal from the test medium.

28.5 Three samples of the labels under test are to be placed in a full-draft circulating-air oven maintained at the temperature indicated in Table 28.1 for 240 hours.

Table 28.1
Oven temperature

Maximum normal operating temperature of surface of applied label		Air oven test temperature	
°C	°F	°C	°F
60 or less	140 or less	87	189
80	176	105	221
100	212	121	250
125	257	150	302
150	302	180	356

29 Dielectric Voltage-Withstand Test

29.1 A sun/heat lamp shall be capable of withstanding without breakdown for 1 minute the application of a 60 Hz essentially sinusoidal potential between live parts and dead metal parts, with the lamp at the temperature attained in use. For a circuit that operates at a voltage of 250 V or less the potential shall be 1000 V; for a circuit that operates at a voltage of more than 250 V the test potential shall be 1000 V plus twice the operating voltage of that circuit. If the lamp uses a 2-winding transformer, it shall also be capable of withstanding without breakdown for 1 minute the application of a 60 Hz essentially sinusoidal potential of 1000 V plus twice the higher operating voltage of the two windings, between primary and secondary circuits.