UL 964

STANDARD FOR SAFETY

Electrically Heated Bedding

UL Standard for Safety for Electrically Heated Bedding, UL 964

Twelfth Edition, Dated August 31, 2011

Summary of Topics

This revision of UL 964 dated September 18, 2020 includes a new Supplement SA with requirements that cover remotely operated electrically heated bedding, including smart enabled.

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 new requirements are substantially in accordance with Proposal(s) on this subject dated March 27, 2020 and July 15, 2020.

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UL 964

Standard for Electrically Heated Bedding

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Second Edition – June, 1935
Third Edition – September, 1942
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August 31, 2011

This ANSI/UL Standard for Safety consists of the Twelfth Edition including revisions through September 18, 2020.

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 These requirements cover electrically heated blankets, comforters, quilts, sheets, mattress pads, mattresses, foot warmers, throw blankets and similar bedding.

1.2 These products are for use in accordance with the National Electrical Code, ANSI/NFPA 70, on single-phase alternating-current supply circuits operating at a nominal potential of 110 to 120 V ac.

1.3 All bedding is cord-connected and is supplied with either a switch or one or two user-adjustable temperature-control units. Bedding may be thermostatically controlled.

1.4 Bedding intended for connection to other than a nominal 120 V ac supply voltage, and bedding for use with waterbeds, mechanical beds and the like, are to be subject to additional investigation, with consideration given to their intended use.

2 Components

2.1 A component of a product covered by this standard shall:

a) Comply with the requirements for that component as indicated in this standard;

b) Be used in accordance with its rating(s) established for the intended conditions of use;

c) Be used within its established use limitations or conditions of acceptability;

d) Additionally comply with the applicable requirements of this end product standard; and

e) Not contain mercury.

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.

Exception No. 1: A component of a product covered by this standard is not required to comply with a specific component requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product;

b) Is superseded by a requirement in this standard; or

c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

Exception No. 2: A component complying with a component standard other than those cited in this standard is acceptable if:

a) The component also complies with the applicable component standard identified in this standard; or

b) The component standard:

1) Is compatible with the ampacity and overcurrent protection requirements NFPA 70, where appropriate;

2) Considers long-term thermal properties of polymeric insulating materials in accordance with Polymeric Materials – Long Term Property Evaluations, UL 746B; and

3) Any use limitations of the other component standard is identified and appropriately accommodated in the end use application. For example, a component used in a household application, but intended for industrial use and complying with the relevant component standard may assume user expertise not common in household applications.

2.2 A component that is also intended to perform other functions, such as over current protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable standard(s) that cover devices that provide those functions.

Exception: Where these other functions are not required for the application and not identified as part of markings, instructions, or packaging for the appliance, the additional component standard(s) need not be applied.

2.3 A component not anticipated by the requirements of this standard, not specifically covered by the component standards identified in this standard, and that involves a potential risk of electric shock, fire, or personal injury, shall be additionally investigated in accordance with the applicable standard.

2.4 With regard to a component being additionally investigated, reference to construction and performance requirements in another end product standard is appropriate where that standard anticipates normal and abnormal use conditions consistent with the application of this standard.

2.5 Materials used in a Class 105 (A) insulation system shall comply with the Normal Temperature Test, Section 19. Materials used in an insulation system that operates above Class 105 (A) temperatures shall comply with the Standard for Systems of Insulating Materials – General, UL 1446.

3 Units of Measurement

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

4 Undated 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.

5 Glossary

5.1 For the purposes of this Standard, the following definition applies.

5.2 CLASS 2 SUPPLY – A secondary circuit supplied by a Class 2 power supply that complies with the Standard for Class 2 Power Units, UL 1310.

5.3 LOW-VOLTAGE CIRCUIT – A circuit involving a potential of not more than 30 volts and supplied by a primary battery, by a standard Class 2 transformer, or by a combination of a transformer and a fixed impedance that, as a unit, complies with all the performance requirements for a Class 2 transformer. A circuit derived from a line-voltage circuit by connecting resistance in series with the supply circuit as a means of limiting the voltage and current is not considered to be a low-voltage circuit.

5.4 SEMICONDUCTOR HEATER WIRE – A heating element consisting of two conductors separated by a conductive material which has a rapid non-linear increase in resistance when the temperature is raised through a particular range.

5.5 THROW BLANKET – An electric blanket intended for use in indoor locations but not specifically for use only on beds. Electric throw blankets are typically smaller in overall size than blankets intended for use on beds. The length is typically less than 75 inches (109.5 cm) and/or the width is typically less than 38 inches (96.5 cm).

CONSTRUCTION

6 Covering of Electrical Parts

6.1 Except for the connector attached to the bedding, all electrical parts of the bedding shall be enclosed in a shell or other covering of a fabric in which there are no openings. All stuffing, padding, springs, and similar nonelectrical components of bedding shall be outside this covering and shall not be detrimental to the covering or its electrical contents.

6.2 All seams in the fabric enclosing electrical parts shall be strongly stitched or otherwise equivalently secured.

7 Insulation

7.1 Electrical insulation is to be considered with respect to its acceptability for the particular application. If 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, and injury to persons involved, in conjunction with conditions of actual service. All of these factors are to be considered with respect to thermal aging.

7.2 Ordinary vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not as the sole support for uninsulated live parts where shrinkage, current leakage, or warpage may introduce a risk of fire or electric shock. Thermoplastic materials are not considered to be acceptable for the sole support of uninsulated live parts, unless they have been found to have the necessary strength and rigidity, resistance to heat, resistance to flame propagation, dielectric properties, and other properties acceptable for the application. All of these factors are to be considered with respect to thermal aging.

7.3 An insulating liner shall be acceptable for the purpose. Vulcanized fiber or a similar material employed where spacings would otherwise be unacceptable shall be 1/32 inch (0.8 mm) thick or thicker, and shall be so located or of such material that it cannot be adversely affected by arcing. However, 1/64 inch (0.4 mm) or thicker vulcanized fiber is acceptable in conjunction with an additional air spacing of 50 percent or more of the spacing required for air alone. Barriers shall be secured in place by a means other than friction between surfaces. The elasticity of tubing shall not be depended upon to hold the tubing in place.

7.4 The heating element shall be electrically insulated for its entire length so that it is not in contact with the shell or other covering fabric at any point. The insulated heating element shall be appliance-wiring material acceptable for the application. The insulated heating element shall be so secured in position that there is no undue stress on it during use, handling, and cleaning of the bedding. At least 9 inches (229 mm) of the foot of a blanket, sheet, quilt or comforter that can be tucked in during normal use shall be devoid of all electrical parts other than the male half of the bedding connector and the portion of the insulated heating element leading to the connector.

Exception: Bedding constructed with self-limiting semiconductor heater wire is able to be provided with electrical parts to the perimeter of the bedding.

7.5 Heater wire, including semiconductor heater wire, shall comply with the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581. Semiconductor heater wire shall additionally comply with the requirements for thermistor-type devices, UL 1434.

7.6 Flexural relief shall be provided for the conductors that exit the male-connector body of a blanket, sheet, quilt, or comforter.

7.7 Each thermostat and other live part within the shell or other covering fabric shall not have any sharp edges and shall be electrically insulated with insulating tubing acceptable for the voltage and temperature involved. The insulation on each part shall be:

a) Bonded, a watertight seal is required, to the insulation on the heating element or other wiring connected to the part; and

b) At least as thick at the bond and elsewhere as the insulation on the heating element or other wiring connected to the part.

7.8 A splice in wiring within a thermostat shall be insulated if permanence of spacing from the splice to other metal parts of the thermostat is not provided.

7.9 Polymeric electrical insulating materials and enclosures shall comply with the applicable requirements of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

7.10 The requirements for supplemental insulation (e.g. tape, sleeving or tubing) are not specified unless the insulation or device is required to fulfill 7.1 – 7.4 or a performance requirement of this standard. In such cases:

a) Insulating tape shall comply with the Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape, UL 510;

b) Sleeving shall comply with the Standard for Coated Electrical Sleeving, UL 1441;

c) Tubing shall comply with the Standard for Extruded Insulating Tubing, UL 224.

8 Spacings

8.1 Except as indicated in 8.2 – 8.4, over surface and through-air spacings no smaller than 1/16 inch (1.6 mm) shall be maintained from uninsulated live parts to:

a) Uninsulated live parts of opposite polarity; and

b) Accessible metal parts.

Exception: The spacings may be less than specified in 8.1 if in compliance with the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment UL 840. The following parameters shall be used unless the microenvironment is further evaluated and found to comply with other parameters:

a) Overvoltage shall be II;

b) Pollution Degree shall be 2; and

c) Material Group IIIb.

If a circuit employs a voltage limiting device for application of the requirements in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment UL 840, the device shall comply with the Standard for Surge Protective Devices, UL 1449.

8.2 Within a thermostat, except at the contacts, the spacings between uninsulated live parts on opposite sides of the contacts shall not be less than 1/32 inch (0.8 mm) through air and 3/64 inch (1.2 mm) over the surface of insulating material.

8.3 The spacings mentioned in 8.1 and 8.2 do not apply to the inherent spacings of a component. Such spacings are to be considered under the requirements for the component in question.

8.4 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.

9 Temperature Limitation

9.1 Bedding shall be provided with means to preclude the attainment of unacceptable temperatures, see 19.1.1 – 19.1.3 and 31.1.1, on any part of the bedding.

9.2 Means to avert the attainment of unacceptable temperatures may be inherent in the construction of bedding – such as a low-wattage heating element – thus necessitating no thermostats or external control.

9.3 Thermostats shall be durable, reliable, uniform in operation, and sufficiently sensitive for their intended use as determined by compliance with Thermostats in Bedding, Section 37, and other applicable requirements.

9.4 If proper performance of a thermostat depends upon the integrity of a closed chamber, the construction shall preclude moisture leaks, which may affect the uniformity and reliability of operation.

9.5 A thermostat in the bedding shall not be adjustable by the user of the bedding and shall be covered or sealed to preclude the entrance of dirt and lint.

9.6 Materials employed in a thermostat shall not be affected adversely by any operating conditions presented by the tests described in these requirements.

9.7 Plated steel, except that the bimetal need not be plated, may be used for a current-carrying part in a thermostat provided that the part is protected by supplementary means (such as sealed sleeving) against any conditions involving moisture to which the thermostat may be subjected during use and cleaning of the bedding.

9.8 If thermostats or other types of discrete temperature sensing devices are used in the bedding itself, they shall be sufficient in number in accordance with 9.10, and shall be appropriately located to enable the bedding to comply with 9.9, 19.1.1 – 19.1.3, 31.1.1, 31.4.1 – 31.4.3, 31.6.1 – 31.6.4, 31.6.6, and 31.6.7. No section of the heating element shall be in series with fewer than two discrete sensing devices when thermostats or other types of discrete sensing devices are employed.

9.9 Compliance with the requirement in 9.8 is to be determined by appropriate testing that, in the case of a sheet, overblanket, quilt, or comforter, is to include the bunching test described in 31.6.1 – 31.6.4, 31.6.6 and 31.6.7.

9.10 A blanket, sheet, quilt, or comforter incorporating discrete sensing devices and intended for use on a twin, double, queen or king-size bed shall comply with each of the following:

a) At least 10 discrete sensing devices are to be used in a size intended for a twin bed and in each half of a king-size bed. Twelve or more devices are to be used in a size intended for a double or queen-size bed.

Exception: A blanket, sheet, quilt, or comforter tested as specified in 31.5.1 and 31.6.5 may employ fewer sensors.

b) The top row of discrete sensing devices in a size intended for a twin bed, in a size intended for a double or queen bed, and in each half of a size intended for a king-size bed is to be secured against migration during use, handling, and cleaning of the product.

9.11 When a product employing a temperature control system employs an electronic circuit intended to provide a degree of protection against the risk of fire, electric shock, or injury if a fault should occur in the wire, the circuit shall comply with the requirements for tests for Safety-Related Controls Employing Solid-State Devices, UL 991. When the electronic circuit is provided with a fuse which is intended to open as a result of a fault in the wire, rendering the product inoperable, the fuse shall comply with the Standard for Low-Voltage Fuses – Part 1: General Requirements, UL 248-1, and the Standard for Low-Voltage Fuses – Part 14: Supplemental Fuses, UL 248-14.

Exception: Controls complying with the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, including Annex H, fulfills the above requirements of the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991.

9.12 Software relied on to comply with this standard shall comply with the Standard for Software in Programmable Components, UL 1998.

Exception: Controls complying with the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, including Annex H, fulfills the above requirements of the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991.

9.13 A thermal cutoff shall comply with the Standard for Thermal-Links (Thermal Cutoffs) for Use in Electrical Appliances and Components, UL 60691.

9.14 The following test parameters are to be used in the investigation of the circuit covered by 9.11 for compliance with the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991:

a) With regard to electrical supervision of critical components, a controller shall not permit electric bedding from exceeding temperature limits specified in 19.1.1 and 19.1.2 of this standard.

b) A field strength of 3 V per meter is to be used for the Radiated EMI Test.

c) The Composite Operational and Cycling Test is to be conducted for 14 days at temperature extremes of 0°C (32°F) and 25°C (77°F).

d) Exposure Class H3 is to be used for the Humidity Test.

e) A vibration level of 5 g is to be used for the Vibration Test.

f) When a Computational Investigation is conducted, λ_p shall not be greater than 6 failures/10^6 hours for the entire system. The Operational Test is to be conducted for 14 days.

g) When the Demonstrated Method Test is conducted, the multiplier is to be based on the continuous usage level for nonindustrial use with a minimum multiplier and test acceleration factor declared by the manufacturer.

h) Compliance to the Overload and Endurance Test of the Standard for Temperature-Indicating and –Regulating Equipment, UL 873, satisfies this requirement.

i) For the Electrical Fast Transient Burst Test, test level 3 is to be used.

Exception: Controls complying with the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9, including Annex H, fulfills the above requirements of the Standard for Requirements for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991.

9.15 When a product employing a temperature control system employs an software intended to provide a degree of protection against the risk of fire, electric shock, or injury if a fault should occur in the software programming or algorithm, the circuit shall comply with the requirements of Standard for Software in Programmable Components, UL 1998.

Exception: Controls complying with the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9, including Annex H, as software Class B fulfills the above requirements of the Standard for Software in Programmable Components, UL 1998.

10 Control Units

10.1 The enclosure of a control unit shall be of material acceptable for the particular application and, except for ventilation openings, shall completely enclose all uninsulated live parts and film-coated wire.

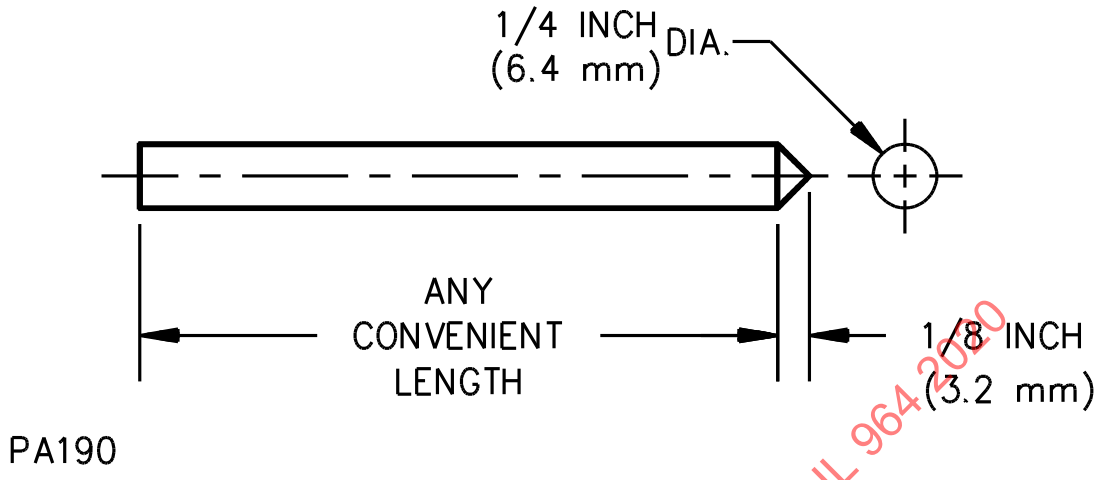
10.2 A ventilation opening in a control unit is acceptable if the probe illustrated in Figure 10.1 – inserted point first as far as possible into the opening does not:

a) Enter the opening farther than 1/8 inch (3.2 mm); and

b) Touch any uninsulated live part or film-coated wire.

Figure 10.1

Probe



10.3 The enclosure of a control unit shall have the strength and rigidity to resist the abuses (such as falling off a table) likely to be encountered during use. The degree of resistance inherent in the enclosure 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 to persons.

10.4 Among the factors to be taken into consideration when determining the acceptability of an enclosure are its:

a) Physical strength;

b) Resistance to impact;

c) Moisture-absorptive properties;

d) Combustibility;

e) Resistance to corrosion; and

f) Resistance to distortion.

For a nonmetallic enclosure, all of these factors are to be considered with respect to thermal aging.

10.5 The temperature circuitry in a control unit shall be such that its calibration cannot be changed by the user unless he disassembles the control if such change could result in a condition involving risk of fire, electric shock, or injury to persons.

10.6 A knob that is depended upon to maintain the control calibration may be secured by friction alone if the construction is such that:

a) It cannot be removed by hand – fingers only, no tools; and

b) No live parts are exposed when the knob is removed.

10.7 A control unit shall be capable of performing over the entire range of its adjustment, and shall not in itself constitute a risk of fire under any condition of operation.

10.8 A control unit shall comply with the Control Units Tests, Section 18, unless, with the control unit short-circuited, testing does not increase the risk of fire or shock.

10.9 Malfunction of any one component in the control unit shall not result in a condition involving risk of fire, electric shock, or injury to persons either in the bedding or in the control unit itself.

10.10 A current-carrying part of a control unit shall be of copper, a copper-base or other corrosion-resistant alloy, or plated steel.

Exception: Unplated steel is acceptable in the bimetal element.

10.11 A temperature control shall comply with the:

a) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9; or

b) Standard for Temperature-Indicating and –Regulating Equipment, UL 873.

Exception No. 1: A thermostat used in a heating pad assembly that complies with Temperature Limitation, Section 9 of this end product standard is considered to meet the intent of this requirement.

Exception No. 2: For a control,, the failure of which would not increase the risk of electric shock, fire, or personal injury, need only be subjected to the applicable requirements of this end product standard.

10.12 A timer used to comply with the maximum temperature requirements of this standard shall be evaluated per 10.13.

10.13 When a product employing a temperature control system employs an electronic circuit intended to provide a degree of protection against the risk of fire, electric shock, or injury if a fault should occur in the wire, the circuit shall comply with the requirements of the Standard for:

a) Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, including Annex H; or

b) Tests for Safety-Related Controls Employing Solid-State Devices, UL 991.

10.14 Software relied on to comply with this standard shall comply with the Standard for:

a) Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1 including Annex H, as software Class B; or

b) Software in Programmable Components, UL 1998.

10.15 When the electronic circuit is provided with a fuse which is intended to open as a result of a fault in the wire, rendering the product inoperable, the fuse shall comply with the Standard for Low-Voltage Fuses – Part 1: General Requirements, UL 248-1, and the Standard for Low-Voltage Fuses – Part 14: Supplemental Fuses, UL 248-14.

10.16 A thermal cutoff shall comply with the Standard for Thermal-Links (Thermal Cutoffs) for Use in Electrical Appliances and Components, UL 60691.

11 Switches

11.1 Bedding that is not provided with a control unit shall be provided with a through-cord switch having an "off" position. The switch shall be acceptable for the particular application, shall have current and voltage ratings at least equal to the load controlled, and, in the case of multiple-heat bedding, shall have positions that facilitate adjustment of the bedding temperature.

11.2 A splice in wiring within a switch shall be insulated if permanence of spacings from the splice to other metal parts is not provided.

11.3 The switch or control unit mentioned in 11.1 that is used for appliance on-off operation shall be connected to the ungrounded conductor of the power supply cord. Table 13.1 specifies the polarity identification of the power supply cord conductors.

11.4 Mechanical air-gap type switches shall comply with one of the following, as applicable:

a) The Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1; or

b) The Standard for Special-Use Switches, UL 1054;

c) The Standard for General-Use Snap Switches, UL 20; or

d) The Standard for Nonindustrial Photoelectric Switches for Lighting Control, UL 773A.

Exception No. 1: Switching devices that comply with the appropriate Standard for specialty applications (e.g. transfer switch equipment), industrial use (e.g. contactors, relays, auxiliary devices), or are integral to another component need not comply.

Exception No. 2: A switching device in a low-energy circuit of 5.3 need not comply with this requirement.

12 Internal Wiring

12.1 Internal wiring, including heater wire, composed of insulated conductors shall comply with the Standard for Appliance Wiring Material, UL 758.

Exception No. 1: Insulated conductors need not comply with the Standard for Appliance Wiring Material, UL 758 if they comply with one of the following:

a) The Standard for Thermoset-Insulated Wires and Cables, UL 44;

b) The Standard for Thermoplastic-Insulated Wires and Cables, UL 83;

c) The Standard for Fixture Wire, UL 66; or

d) The appropriate UL standard (s) for other insulated conductor types specified in Chapter 3, Wiring Methods and Materials, of NFPA 70.

Exception No. 2: Insulated conductors for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit not involving the risk of fire or personal injury need not comply with the Standard for Appliance Wiring Material, UL 758.

13 Supply, Control, Pigtail, and Interconnecting Cords

13.1 For connection to the supply circuit, each appliance shall be provided with a length of two-conductor flexible cord, terminating in a polarized 2-wire attachment plug. The flexible cord shall be:

a) Throw Blankets – Type SPT-2 or heavier.

b) All other applications – Type SP-1, SPE-1, or SPT-1 or heavier.

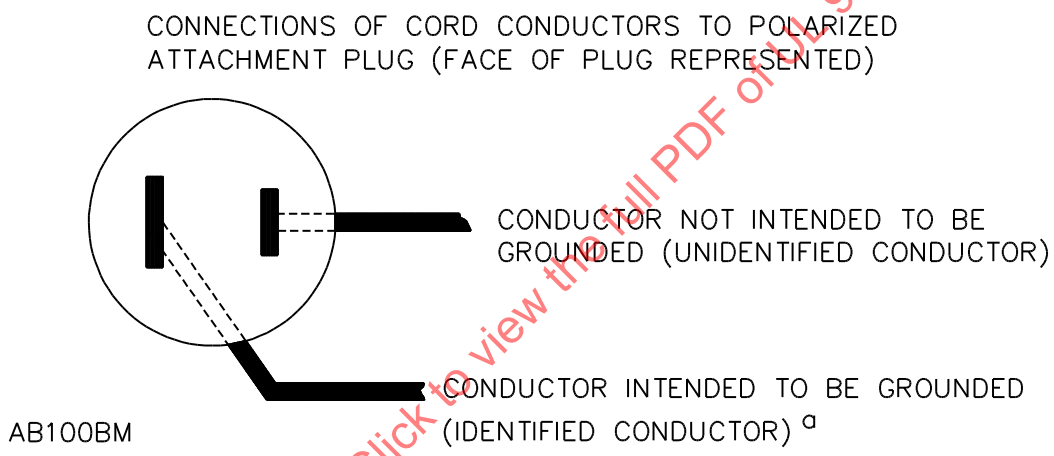
13.2 This cord (supply cord) shall not be less than 6 feet (1.8 m) long, when measured from the face of the plug to the point at which the cord enters the switch or control unit.

13.3 A cord set, power supply cord, or interconnecting cord shall comply with the Standard for Cord Sets and Power Supply Cords, UL 817.

13.4 The attachment plug connections shall comply with Figure 13.1, and the polarity identification of the flexible cord shall comply with Table 13.1.

Figure 13.1

Connections to attachment plug



[a] Signifies a conductor identified in accordance with Table 13.1

Table 13.1
Polarity identification of flexible cords

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

[a] Only the cords – other than Type SP-1, and SPT-1 – having no braid on any individual conductor.

Table 13.1 Continued on Next Page

Table 13.1 Continued

Method of identification	Acceptable combinations	
	Wire intended to be grounded[d]	Other wire[d]
[b] Only for Type SP-1, SP-2, SPT-1, and SPT-2 cords.		
[c] Only for Type SPT-1 and SPT-2 cords.		
[d] For jacketed cord.		

13.5 The ampacity of the supply cord shall not be less than the current stated or implied in the ratings marked on the bedding.

13.6 The wiring (control cord) between the switch or a control unit and the female half of the bedding connector and the wiring (pigtail cord), if any, between the male half of the bedding connector and the bedding itself shall be:

a) Throw Blankets – Type SPT-2 or heavier flexible cord containing two or more circuit conductors with no grounding conductor, or shall be appliance-wiring material of the Type SPT-2 or the equivalent or heavier construction containing two or more circuit conductors- no grounding conductor; and

b) All other appliances – Type SPT-1, SPE-1, SP-1, or heavier flexible cord containing two or more circuit conductors with no grounding conductor, or shall be appliance-wiring material of the Type SPT-1, SPE-1, SP-1 or the equivalent or heavier construction containing two or more circuit conductors- no grounding conductor.

Exception: Any type of wiring is usable when:

a) Supplied by a Class 2 source of supply, see 5.2;

b) It operates at a current of less than that indicated in 23.2 when conductor insulation is removed; or

c It disconnects power in the event of any of the conditions noted in 22.2.

13.7 The female connector on the control cord shall not accommodate any attachment plug with an American National Standard Institute (ANSI) configuration of contacts.

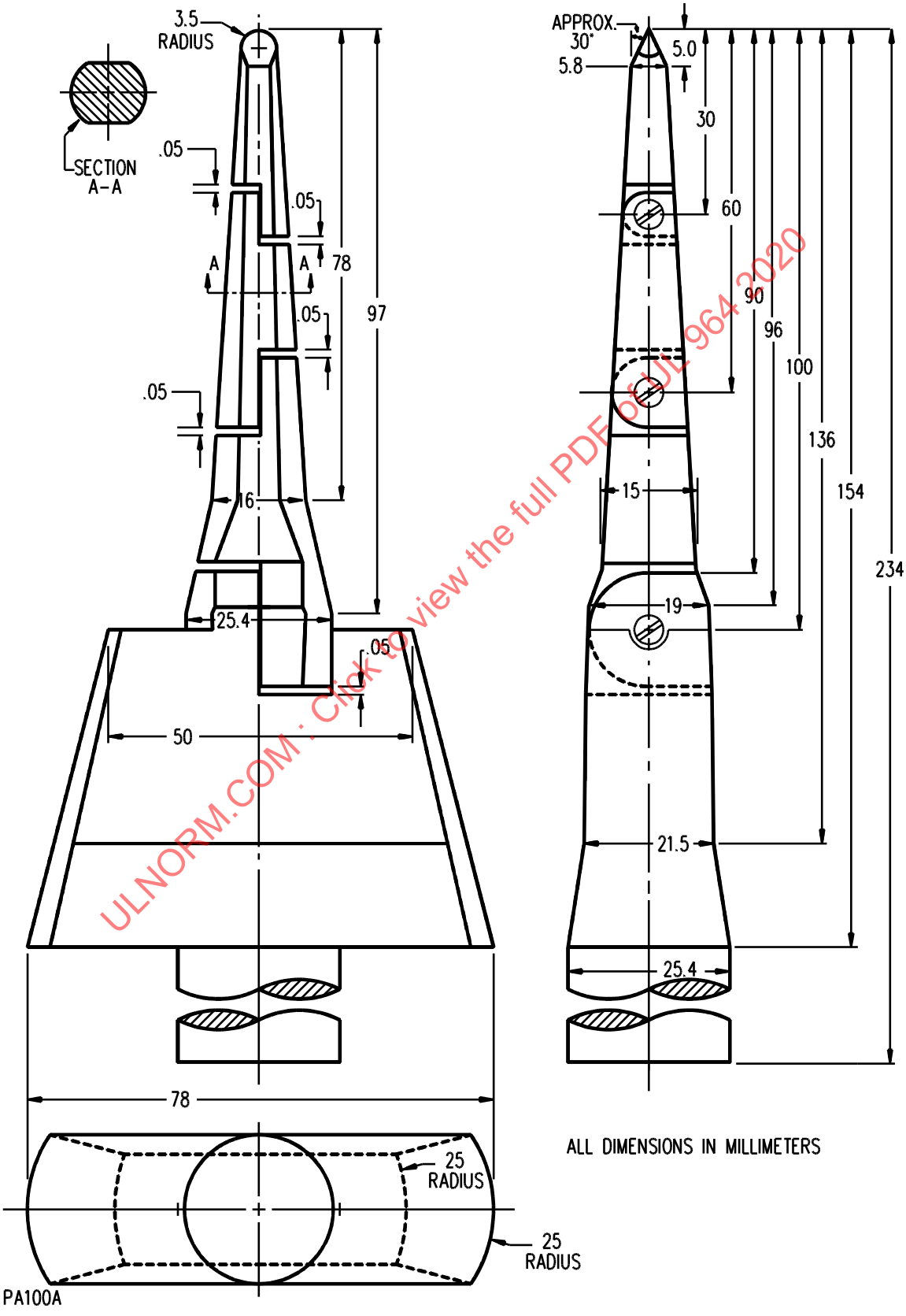
13.8 The male connector attached (pigtail or other) to the bedding shall not fit into any receptacle, current tap, or cord-connector body with an American National Standard configuration of contacts.

13.9 The bedding connector shall be rated for 125 V, and shall have a current rating at least equal to the stated or implied current in the ratings marked on the bedding.

13.10 To reduce the likelihood of unintentional contact that may involve a risk of electric shock from uninsulated live parts, mating connectors shall be guarded or recessed so that live contacts are not exposed while the female and male connectors are fully mated or during engagement or withdrawal. The probe illustrated in Figure 13.2 is to be applied to any depth that the recessing will permit; and is to be rotated, changed in configuration or angled before, during and after application to any position that is necessary to examine the connectors.

Figure 13.2

Articulate probe with web stop



13.11 The probe mentioned in 13.10 is to be used as an instrument to judge accessibility and not as an instrument to judge the strength of a material; it is to be applied with a 3 lbf (13 N) to determine accessibility.

13.12 Wiring between two control units (interconnecting cord) shall be Type SPT-1, SPE-1, SP-1, or heavier flexible cord containing two or more circuit conductors – no grounding conductor – or shall be appliance-wiring material of the Type SPT-1, SPE-1, SP-1, the equivalent or heavier construction containing two or more circuit conductors – no grounding conductor.

13.13 Except as noted in 13.14, both ends of each supply, control, pigtail, and interconnecting cord shall be permanently attached. Strain relief shall be provided on all cords to reduce the possibility of mechanical stress on the cord being transmitted to any wiring connection. See 32.1 and 32.2.

13.14 A switch shall be provided with a means for strain relief unless all connections in the switch, except for a soldered joint in the slack portion of the through conductor, are riveted or welded, or unless such connections are made by means of eyelets, pressure wire connectors, closed-loop tangs, soldered loops in the conductor, or soldered joints where mechanical security is provided without depending upon the solder. Terminal binding screws shall not be able to unthread completely after the switch is assembled.

13.15 The supply and control cords shall be secured to a switch such that the conductor insulation and the braid, if any, are kept from slipping to the extent that the conductor is exposed or a short circuit might occur.

14 Connections

14.1 All electrical connections shall be mechanically secure, shall provide necessary electrical continuity and conductivity, and shall be insulated in compliance with 7.5. A soldered connection shall be made mechanically secure before being soldered if breaking or loosening of the connection can result in any condition of risk of fire or electric shock. Consideration shall be given to flexure and other conditions of use when determining the acceptability of electrical connections. Mechanical splicing devices shall be acceptable for the application. Each connection to a thermostat shall be provided with a means for strain relief.

14.2 Connectors complying with any of the following fulfill 14.1:

a) Quick-connect terminals, both connectors and tabs, for use with one or two 22 – 10 AWG copper conductors, having nominal widths of 0.110, 0.125, 0.187, 0.205, and 0.250 inch (2.8, 3.2, 4.8, 5.2, and 6.3 mm), intended for internal wiring connections in appliances, or for the field termination of conductors to the appliance, complying with the Standard for Electrical Quick-Connector Terminals, UL 310.

Exception No. 1: Other sizes of quick-connect terminals shall be investigated with respect to crimp pull out, insertion-withdrawal, temperature rise, and all tests shall be conducted in accordance with the Standard for Electrical Quick-Connector Terminals, UL 310.

Exception No. 2: A connector that complies with the Standard for Electrical Quick-Connector Terminals, UL 310 may be used with an appropriately sized tab that complies with the Table for Dimensions of Production and Test Tabs in Inches and the Figure for Dimensions of Production and Test Tabs of UL 310. The connector is the part of a quick-connect terminal that is pushed onto the male tab, and the tab is the part that receives the female connector.

b) Single and multipole connectors for use in data, signal, control and power applications within and between electrical equipment, and that are intended for factory assembly to copper or copper alloy conductors, or for factory assembly to printed wiring boards, complying with the Standard for Component Connectors for Data, Signal, Control and Power Applications, UL 1977.

c) Wire connectors complying with the Standard for Wire Connectors, UL 486A-486B.

d) Splicing wire connectors shall comply with the Standard for Splicing Wire Connectors, UL 486C.

e) Equipment wiring terminals for use with all alloys of copper, aluminum, or copper-clad aluminum conductors, shall comply with the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

f) Terminal blocks shall comply with the Standard for Terminal Blocks, UL 1059, and, if applicable, be suitably rated for field wiring.

Exception: A fabricated part performing the function of a terminal block need not comply with the Standard for Terminal Blocks, UL 1059 if the part complies with the requirements of Insulation, Section 7 and Spacings, Section 8 of this standard. This exception does not apply to protective conductor terminal blocks.

PERFORMANCE

15 General

15.1 Electrically heated bedding shall be investigated by means of the tests described in Sections 16 – 38, performed on one representative bedding product, on three representative associated control units (if any), and on each of six representative thermostats, if thermostats are employed. The Roller Flexing Test, Section 26, is able to be performed on a second representative foot warmer or mattress pad. See Note a of Table 15.2. Unless otherwise specified, all tests are to be made on unaged or otherwise untested representative products, and specimens of any external layer of fabric blends on the bedding. In general, bedding blends shall be tested as indicated in Table 15.1. Unless otherwise specified, all tests are to be performed in a draft free location at a temperature of 25 ±5°C (77.0 ±9.0°F).

Table 15.1
Testing of bedding blends

Test	Number of blends to be tested
Laundering Flammability of Bedding Ease of Ignition	Every blend used
All other tests	1 representative blend

15.2 The inch-thick felt mentioned in 19.2.2, 31.2.1, and 31.6.4 is to be minimum 1-inch thick (25 mm), 100 percent standard-weight, all-cattle-hair, punched felt with center reinforcement consisting of burlap having a mass of 5 oz/yd^2 (170 g/m^2). The felt is to have a mass of 105 ±15 oz/yd^2 (3.56 ±0.51 kg/m^2).

Exception: SAE J314, Grade F-11, minimum one inch-thick wool felt is also acceptable.

15.3 The test mattress mentioned in 19.1.4, 31.1.2, 31.4.1, and 31.6.2 is to consist of two 1-inch thick (25-mm thick) coarse hair pads as described in 15.2 that are to be attached to a nominal 1/2-inch (12.7 mm) or thicker plywood sheet. The mattress is to be of a size that accommodates the blanket when laid out flat.

15.4 The test sequence for a complete product shall be in accordance with Table 15.2.

Table 15.2
Test sequence for a complete product

Test	Blanket, sheet, quilt, or comforter	Foot warmer or Mattress pad[a]	Mattress	Throw Blankets
Input	Section 16	Section 16	Section 16	Section 16
Control Impact and Calibration	Section 17	Section 17	Section 17	Section 17
Control Units Tests	Section 18	Section 18	Section 18	Section 18
Normal Temperature	19.1.1 – 19.1.6	19.2.1 – 19.2.3	19.2.1 – 19.2.3	19.1.1 –19.1.6
Flexing (Product)	20.1.1 – 20.1.11	20.1.1 – 20.1.11	20.2.1 and 20.2.2	20.1.1 – 20.1.11
Connector Flexing	Section 21	Section 21	Section 21	Section 21
Throw Blanket Cord Flexing	NA	NA	NA	Section 22
Leakage Current	Section 23	Section 23	NA	Section 23
Dielectric Voltage-Withstand	Section 24	Section 24	NA	Section 24
Laundering	Section 25	Section 25	NA	Section 25
Roller Flexing	NA	Section 26	Section 26	NA
Leakage Current (Repeated)	27.1	27.2	NA	27.1
Dielectric Voltage-Withstand (Repeated)	Section 28	Section 28	NA	Section 28
Normal Temperature (Repeated)	Section 29	Section 29	Section 29	Section 29
Immersion (Pendant and Pendant-Like Controls Only)	Section 30	NA	NA	Section 30
Abnormal Temperature Tests:				
First Method of Folding (1, 2, and 3 Fold)	31.2.1 – 31.2.3	31.2.1 – 31.2.3	NA	31.2.1 – 31.2.3
Second Method of Folding (3 Inch Folding Without Covering Thermostats)	31.3.1(a)	NA	NA	31.3.1(a)
Third Method of Folding (6 Fold)	31.3.1(b)	NA	NA	31.3.1(b)
3 Thickness Fold (Parallel & Perpendicular To Heating Element Runs)	31.4.1 and 31.4.2	31.4.1 and 31.4.2	NA	31.4.1 and 31.4.2
5 Thickness Fold (With and Without Felt)	31.4.3	31.4.3	NA	31.4.3
Multi-Thickness Fold	31.5.1	NA	NA	31.5.1
Bunch Test	31.6.1 – 31.6.7	NA	NA	31.6.1 – 31.6.7
Fully Blanketed	NA	NA	31.7.1	NA
Disabled Control [b]	31.8.1 and 31.8.2	31.8.1 and 31.8.2	31.8.1 and 31.8.2	31.8.1 and 31.8.2
Pull-out	Section 32	Section 32	Section 32	Section 32
Final Mattress Tests	NA	NA	Section 33	NA
Flammability of Shells	Section 34	Section 34	Section 34	Section 34
Ease of Ignition	Section 35	Section 35	Section 35	Section 35
Effect of Cleaning Solvents on Bedding	Section 36	Section 36	NA	Section 36
Thermostats in Bedding	Section 37	Section 37	Section 37	Section 37
Abnormal Operation Test for Products Employing Semiconductor Heater Wire	Section 38	Section 38	Section 38	Section 38

Table 15.2 Continued on Next Page

Table 15.2 Continued

Test	Blanket, sheet, quilt, or comforter	Foot warmer or Mattress pad[a]	Mattress	Throw Blankets
NA – Not applicable [a] – When only one representative foot warmer or mattress pad is used for testing, the complete test sequence, as indicated above, shall be followed. When the Roller Flexing Test, Section 26, is performed on a second, separate representative foot warmer or mattress pad (see 15.1), the Leakage Current Test – Repeated, Section 27, and the Dielectric Voltage-Withstand Test – Repeated, Section 28, shall be performed: a) On the first representative product following the Laundering Test; and b) On the second representative product following the Roller Flexing Test. [b] – When Control relied on and open circuit in one or more heating elements causes improper control operation.				

15.5 All tests are to be conducted with the sample connected to a 120 Vac source of supply, unless otherwise indicated.

16 Input Test

16.1 The wattage or current input to a product shall not be more than 105 percent of the rated wattage or current when the appliance is operated at 120 V ac while in a well-heated condition (see 41.3).

17 Control Impact and Calibration Test

17.1 The enclosure of each of three representative control units shall withstand the impact due to dropping without exposure of uninsulated live parts and, unless short-circuited during the normal temperature test, or unless the impact due to dropping results in a fail-safe condition, shall not show a plus variation of more than 10° C (18° F) in its maximum cut-off temperature when the control is tested in accordance with 17.2 – 17.4.

17.2 Each of three representative control units is to be connected to the bedding with which it is associated. Each control is to be adjusted to its highest setting, and the cut-off temperature is to be measured by means of a thermocouple located immediately adjacent to the sensing element in the control unit itself. The location of the thermocouple must be positively marked so that it can be replaced after the dropping described in 17.3.

17.3 Each of the three control units, while energized, is then to be subjected to drops from a height of 3 ft (914 mm) onto a hardwood surface. Each unit is to be dropped three times in a manner such that the control will strike in three different positions. Following the dropping, a check is to be made for exposure of live parts with the probe mentioned in 10.2 while the control is de-energized, and then – unless the control is found to be in a fail-safe condition– the cut-off temperature of each control is to be measured again with the thermocouple located in exactly the original position.

17.4 For the control impact and calibration tests described in 17.1, a controlled ambient temperature of 25.0 ±2.0°C (77.0 ±3.6°F) is specified.

18 Control Units Tests

18.1 Unless short-circuited so that it will not cycle during the Normal Temperature Test, Section 19, the test sequence for the representative control units shall be: Calibration (18.2 – 18.4), Overload (18.5 and 18.6), Endurance (18.7 and 18.8), Calibration (Repeated) (18.9 and 18.10), Dielectric Voltage-Withstand (18.11), and Short Circuit (18.12 – 18.14).

18.2 The cutoff temperature of each of the three control units shall be measured before any tests have been conducted.

18.3 In the temperature test mentioned in 18.2, a controlled ambient temperature of 25.0 ±2.0°C (77.0 ±3.6°F) is specified.

18.4 The cutoff temperature is to be measured on each of the three units, described under the tests on the complete bedding, 18.1 – 18.4. The temperature may be measured by means of a thermocouple immediately adjacent to the bimetal inside each control unit.

18.5 A switch and a thermostat employed in a control unit shall be capable of performing successfully when three representative control units are subjected to an overload test as described in 18.6. There shall not be electrical or mechanical malfunction of the device.

18.6 The overload test on each of the three control units is to consist of 100 cycles of operation. For the test, each control unit and the bedding are to be connected together in the intended manner, and the assembly connected to a supply circuit having a voltage of 144 V ac.

18.7 A switch and a thermostat employed in a control unit shall be capable of performing successfully when three representative control units are subjected to an endurance test as described in 18.8. There shall not be electrical or mechanical malfunction of the device.

18.8 For each switch or thermostat, the endurance test is to consist of 6000 cycles of operation at rated load and 120 V ac.

18.9 Following the overload and endurance tests, the cutoff temperature of the control unit shall be measured again on each of the three control units. The cutoff temperature on each unit shall not show a plus variation of more than 10°C (18°F) from the original cutoff temperature on that unit.

18.10 In the temperature test mentioned in 18.9, a controlled ambient temperature of 25.0 ±2.0°C (77.0 ±3.6°F) is specified.

18.11 The control unit shall be capable of withstanding for 1 minute without breakdown the application of an essentially sinusoidal potential of 1000 V plus twice rated voltage, between all live parts and all exposed dead metal parts, when three representative control units are tested in accordance with 24.2.

18.12 There shall not be emission of flame or molten metal from the enclosure of any of three representative control units when the units are caused to interrupt a current resulting from the substitution of a short circuit for the normal bedding load.

18.13 To determine whether a control unit complies with the requirement in 18.12, the bedding load is to be disconnected and the output terminals of each control unit are to be short-circuited. The enclosure of each control unit is to be covered with loosely packed surgical cotton. Each control unit, in series with a 20 A plug fuse, is then to be connected to a supply circuit of 120 V ac. If the fuse is not opened, or if the control unit is still operative after the fuse has opened, the test is to be repeated with a 30 A plug fuse substituted for the 20 A fuse. The opening of either or both of the fuses is acceptable, but ignition of the cotton or emission of flame or molten material from the control unit is not acceptable.

18.14 This test is to be performed in accordance with 18.12 and 18.13 on three representatives of a control unit that is associated with a thermostat-type bedding appliance. For a product without a thermostat, where the protective circuit is dependent on the control, each of the three control units is to be short-circuited for each of the circuits involved in the control– all possible combinations of connections between the control and the bedding – and the end result in all cases is to be as noted in 18.13.

19 Normal Temperature Test

19.1 Blankets, sheets, quilts, and comforters

19.1.1 When a product is tested in accordance with 19.1.4 and 19.1.5, the temperature on the surface of the assembly, measured by a probe positioned between the product and the mattress, shall not be higher than 65°C (149°F).

19.1.2 When a product is tested in accordance with 19.1.4 and 19.1.6, the temperature on any portion of the heating element, as measured by means of thermocouples, shall not attain a temperature higher than 90°C (194°F) during an initial heating period of 30 minutes for non thermostatically controlled systems; and 20 minutes after the first opening of a thermostat and subsequently, the temperature shall not be higher than 75°C (167°F).

19.1.3 When a product is tested in accordance with 19.1.4 – 19.1.6, the temperature on electrical insulating materials, such as those used in thermostats and controls, shall not be higher than the limit established for each such material.

19.1.4 To determine compliance with the requirements in 19.1.1 – 19.1.3, the complete product is to be laid out flat as in actual service on the test mattress (see 15.3) and connected to a supply circuit, completely covered with two wool blankets each with a mass of approximately 3-3/4 lb (1.7 kg). The supply-circuit voltage is to be 120 V ac. The temperature of the ambient air is to be within the range of 0 – 25.0°C (32.0 – 77.0°F), the specific temperature being that which results in the most severe operating conditions. The control unit is to be short-circuited so that it will not cycle during the test, unless units were subjected to the control impact and calibration test in accordance with 17.1 – 17.3; but, if a control is to remain in the circuit, the one having the highest cut-off temperature is to be used and, if adjustable, is to be set for maximum temperature. Operation is then to be continued until thermal equilibrium is attained but, if any internal thermostats interrupt operation, the test is to be completed with one or both blankets removed in order to determine the most severe operating condition. See 17.1.

19.1.5 Thermocouples used for determining the temperature of the surface of a blanket, sheet, quilt or comforter are soldered to the middle of a blackened sheet of copper or brass 2.56 inches (65 mm) square and 0.02 inch (0.5 mm) thick. The plates are positioned to cover the maximum number of heating element runs possible with one side parallel to the direction of the run.

19.1.6 Thermocouples used for determining the temperature of the heating element are tied to the heating element by textile thread, over a length of at least 0.4 inch (10 mm) adjacent to the junction.

19.2 Mattresses, foot warmers, and mattress pads

19.2.1 When a product is tested in accordance with 19.2.2 and 19.2.3, the temperature at any point on or in the complete product:

a) Shall not be higher than 90°C (194°F) on the insulation of the heating-element wire;

b) On electrical insulating material, such as those used in thermostats and controls, shall not be higher than the established temperature limit for such material, as specified in Table 19.1.

Table 19.1
Maximum temperatures

Materials	Degrees	
	C	F
1. Rubber – or thermoplastic-insulated conductors	60[a]	140[a]
2. Cotton or other combustible material	105	221
3. Fiber employed as electrical insulation	90	194
4. Phenolic composition used as electrical insulation or as a part whose deterioration would result in a risk of fire or electric shock	150[a]	302[a]
5. Class 105 (Class A) insulated relay or solenoid winding	90[b]	194[b]

[a] The limitation on phenolic composition, rubber insulation, and thermoplastic insulation does not apply to a compound that has been investigated and found to have special heat-resistant properties.

[b] A maximum temperature of 110°C (230°F) is acceptable if determined by the resistance method by comparing the resistance of the winding at the temperature to be determined with the resistance at a known temperature according to the formula shown in Figure 19.1.

Figure 19.1
Change of resistance calculation

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

t_1 is the room temperature (°C) at the beginning of the test

t_2 is the temperature of the coil (°C) at the end of the test

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

k is 234.5 for copper, 225.0 for electrical conductor grade aluminum

NOTE: Values of the constant for other grades must be determined.

19.2.2 To determine whether a mattress pad or foot warmer complies with the requirement in 19.2.1 the complete product is to be laid out flat as in actual service on the test mattress as described in 15.3, and connected to a supply circuit of 120 V ac. If a multiple-position switch is provided in the cord, the switch is to be set for the highest heat. Half of the pad or foot warmer, from the center to the end, is then to be covered with 1-inch (25-mm) thick felt pads (see 15.2) on which are to be placed, but not covering any thermostats that may be employed, dummy weights consisting of sand bags totalling 210 lbf (934 N or 95.3 kgf). Otherwise, including the wool blankets and the short circuiting of any control unit employed, the test is to be conducted in accordance with 19.1.4 – 19.1.6.

19.2.3 The test is then to be repeated with the other half of the product covered. The test for a mattress is to be the same as for a mattress pad, except that the mattress is to be placed directly on a nominal 1/2-inch (12.7-mm) or thicker plywood surface.

20 Flexing Test

20.1 General

20.1.1 When the product is flexed as described in 20.1.2 – 20.1.11, there shall not be:

a) Loosening of the male connector body;

b) Unraveling, breakage or loosening of the stitching at the ends of the dividers for a distance greater than 3/4 inch (19 mm);

c) Breakage or loosening of any wiring connections;

d) Appreciable shifting of position of the heating element within the shell; or

e) Breakage of the heating-element conductor or other interruption of the electrical circuit through the product.

20.1.2 The product is to be tested in an apparatus similar to that shown in Figure 20.1 and Figure 20.2. The apparatus has a rotating drum 6.3 inches (160 mm) in diameter and of a length that accommodates the length of the product. Below this is a 0.98 inch (25 mm) square section bar that is free to rotate and at such distance below the drum that the product can be formed into a loop about the two, as shown in Figure 20.1.

Figure 20.1

Flexing machine

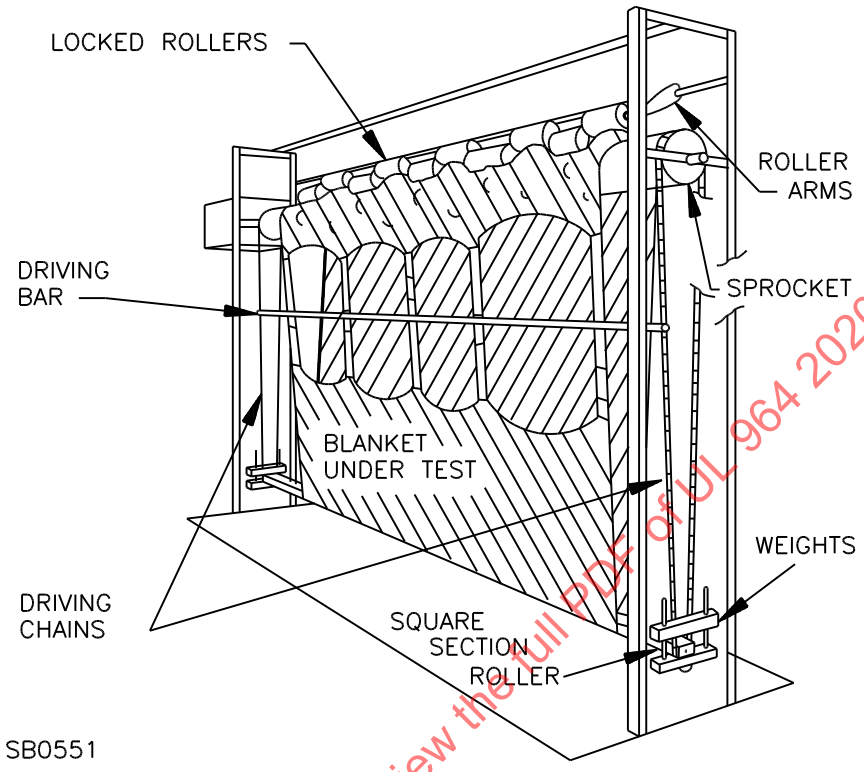
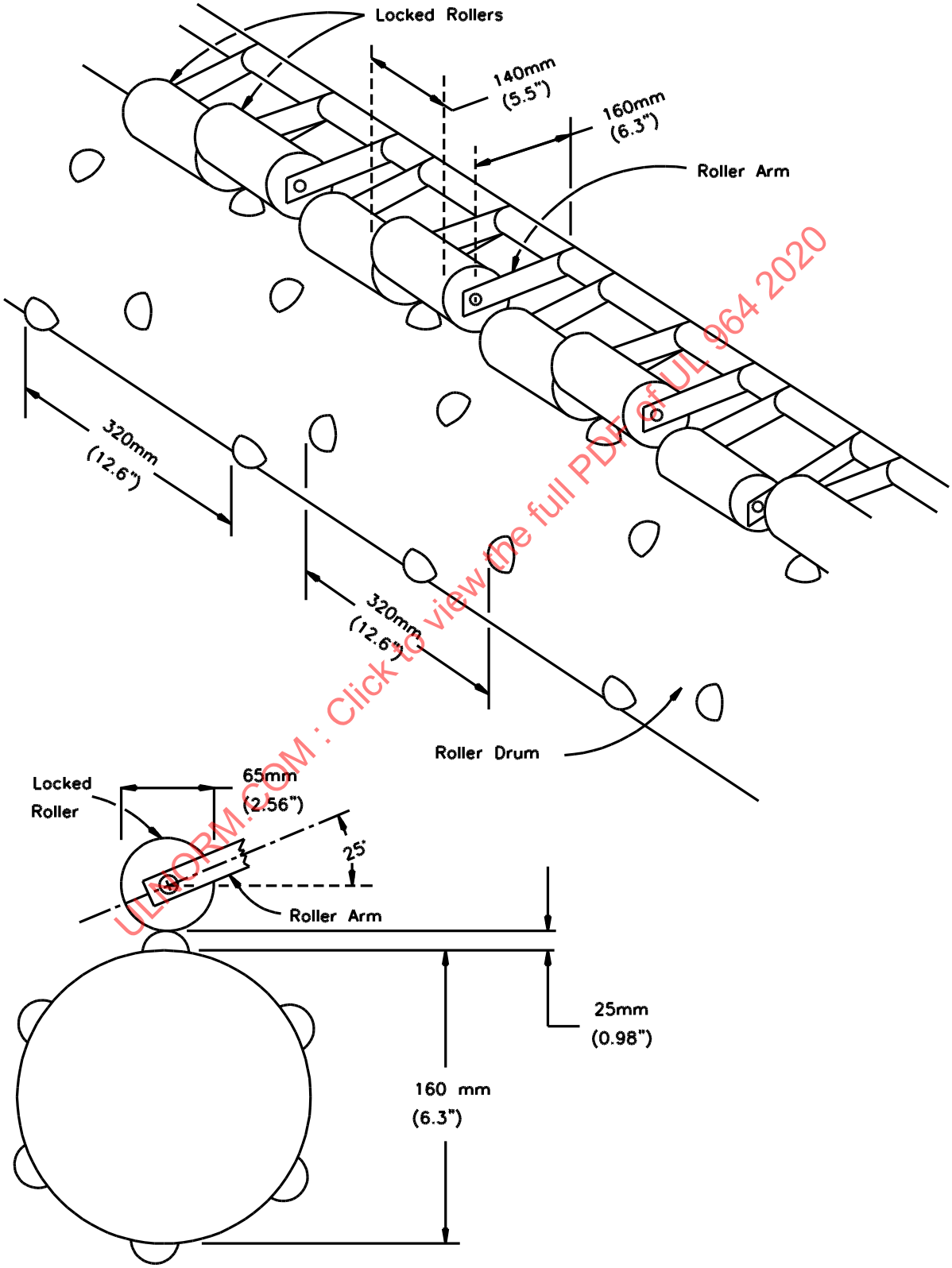


Figure 20.2

Roller assembly



20.1.3 Attached to the drum are a number of projections cut from solid rubber balls 2.36 ±0.10 inch (60 ±2.5 mm) in diameter, having an ISO standard hardness of 40/50 so that the height of each projection above the surface of the roller is 0.98 inch (25 mm). The projections are arranged in six rows equally spaced around the circumference of the roller as shown in Figure 20.2, the distance between the projections in each row being 12.6 inches (320 mm). Alternate rows are displaced so that the projections in one row are intermediate between those in the next. The drum is free to rotate about its carrier shaft.

20.1.4 The bearing carriers for the square section bar are mounted in guide rails so that they are free to move up and down thus keeping the product under tension. They have provision for removable weights so that the total mass of the bottom roller assembly and carriers is 12 lb/yd (6 kg/m) of attached edge of the product or 14 lb (6.4 kg), whichever is greater.

20.1.5 Above the roller drum are a number of smooth hardwood cylinders 2.56 inches (65 mm) in diameter, 5.5 inches (140 mm) long, each cylinder being carried by a pair of pivoted arms such that the distance between the axis of the cylinder and the centerline of the pivot is 6.3 inches (160 mm). The pivot bar is so positioned that the cylinders lie in contact with the drum at its highest point when there is no product in position and the axis of the arms is at an angle of 25 degrees to the horizontal.

20.1.6 The weight of the cylinder assembly is such that under these conditions the force exerted by the cylinder on the drum is 1.15 lbf (5.1 N). The cylinders are secured to the pivoted arms so that they cannot rotate about their axis.

20.1.7 The cylinders are positioned so that as the drum rotates, the projections pass under the center of the cylinders and the number of cylinders is such that every projection passes under a cylinder.

20.1.8 A chain sprocket with a pitch circle diameter of 9 inches (230 mm) about which is an endless chain that passes around a square section roller is secured to each end of the drum carrier shaft. The chains carry a driving bar to which are attached adjustable webbing straps with clips so that the product may be attached to the driving bar, the product and straps forming a continuous belt that is tensioned by the square section roller. Straps are provided to keep the product from rucking. Any nondetachable flexible cord is supported so that it will not affect the results of the tests.

20.1.9 The product is driven around the machine by rotating the driving sprockets at a speed of 33 revolutions-per-minute and the drum and bar are caused to rotate by the product. The wooden cylinders rise over the projections as the product passes between the cylinders and projections.

20.1.10 Means are provided to raise the cylinders when there is no product material between them and the drum so as not to damage the test apparatus. The product is caused to pass around the rollers as follows:

a) One thousand times with an end attached to the driving bar and one surface in contact with the roller;

b) One thousand times with the same end attached to the driving bar and the other surface in contact with the roller;

c) One thousand times with side remote from the cord entry attached to the driving bar and one surface in contact with the roller; and

d) One thousand times with the same side attached to the driving bar and the other surface in contact with the roller.

20.1.11 The locked rollers resting on the rotating rollers are mechanically lifted clear when the driving bar passes beneath in order that the surfaces will not be scored.

20.2 Flexing of mattresses

20.2.1 A mattress shall comply with the requirement in 20.1.1 when the mattress is flexed in accordance with 20.2.2.

20.2.2 The mattress is to be laid flat on a plane surface, but it need not be connected to a supply circuit. The head section of the mattress – approximately 18 inches (457 mm) from the top edge – is to be bent up ten times at right angles to the main body of the mattress. This flexing is to be repeated at the foot section of the mattress. The same flexing is then to be performed 20 times at each side.

21 Connector Flexing Test

21.1 Each of 6 representative female cord connectors with cord attached shall be subjected to 900 cycles of the cord flexing test described in 21.3. Noncompliance of any one sample of the set shall be considered noncompliance for the group.

21.2 After being subjected to the flexing test there shall be:

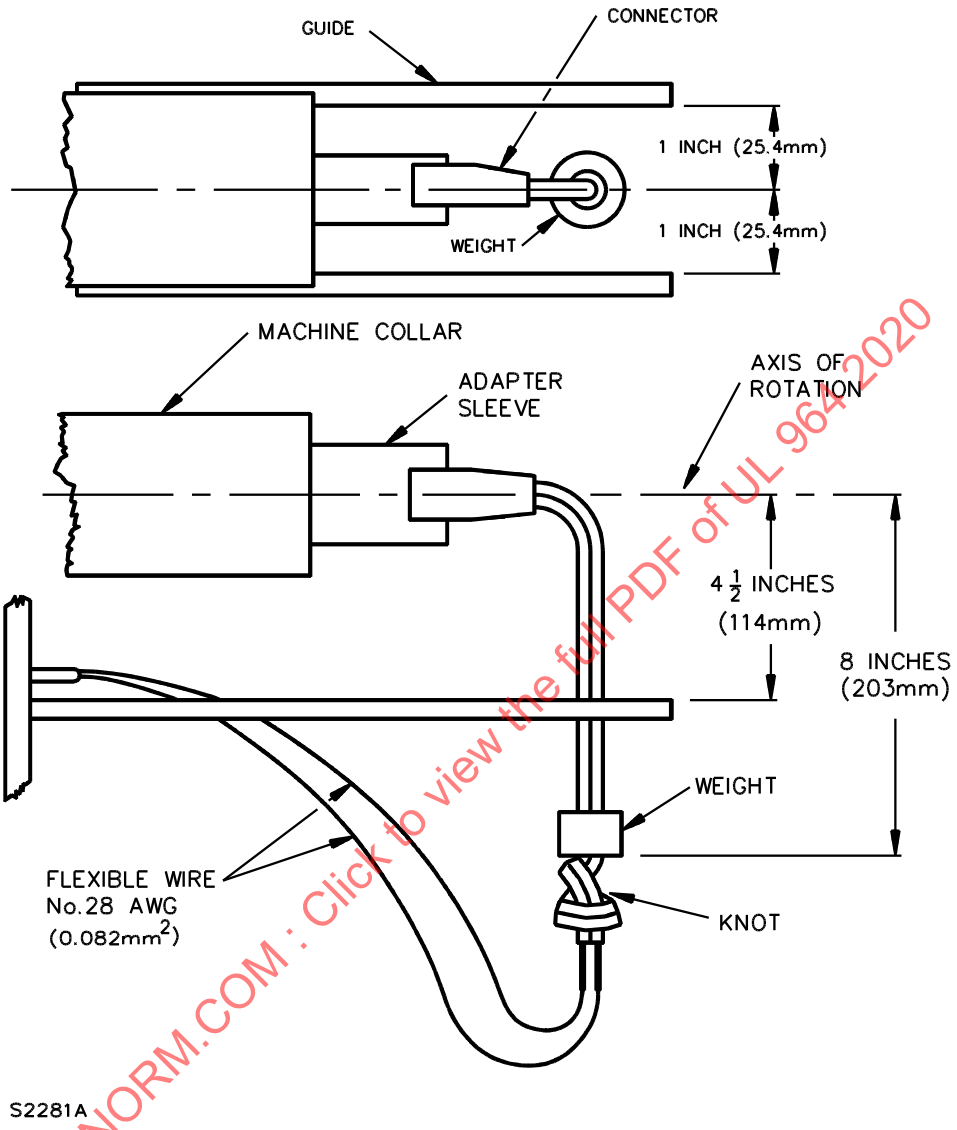
a) No breakage of the cord or exposure of an uninsulated conductor strand; and

b) No breakdown when each cord is subjected to a 1000 V dielectric voltage-withstand test between the individual conductors of the flexible cord.

21.3 Each unit is to be mounted in a guide with a 1/4 lb (113 g) doughnut-shaped weight attached to approximately 10 inches (254 mm) of cord, 8 inches (203 mm) from the point at which the cord enters the connector. The 10-inch length of cord is then to be spliced to a length of 28 AWG (0.082 mm^2) flexible wire, which is then to be connected to the flexing machine. The setup is to be such that the cord-connector can be rotated 540 degrees about the axial center of the cord. A typical setup is illustrated in Figure 21.1. The rate of flexing is to be at least 10 cycles per minute. Each cycle, starting with the connector in a vertical position, is to consist of 540 degrees of rotation in one direction and then 540 degrees in the reverse direction back to the starting point. During the test the supply cord is to carry the same current as it does in the electric product. The ambient air temperature is to be 25 ±2.0°C (77 ±3.6°F) during the test.

Figure 21.1

Flexing test apparatus[a]



[a] A cycling machine manufactured by R. J. Wilson Associates, Hingham, MA is acceptable. Other cycling machines with like properties will also be acceptable.

22 Throw Blanket Cord Flexing Test

22.1 Each cord/bushing or cord/fitting interface of an in-line control assembly intended for use with electric throw blankets shall:

a) Comply with 22.2 when tested as described in 22.3 – 22.8;

b) Be supplied by a Class 2 source of supply, see 5.2;

c) Operate at a current of less than that indicated in 23.1 when conductor insulation is removed; or

d) Disconnect power in the event of any of the conditions noted in 22.2. The reliability of solid-state controls shall comply with the requirements of the Standard for Safety-Related Controls Employing Solid-State Devices, UL 991.

22.2 The test shall not result in:

a) Breakage of internal conductors;

b) Exposure of conductors through insulation; and

c) Dielectric breakdown.

22.3 Six assemblies are subjected to the test. Noncompliance of any one sample of the set shall be considered noncompliance for the group.

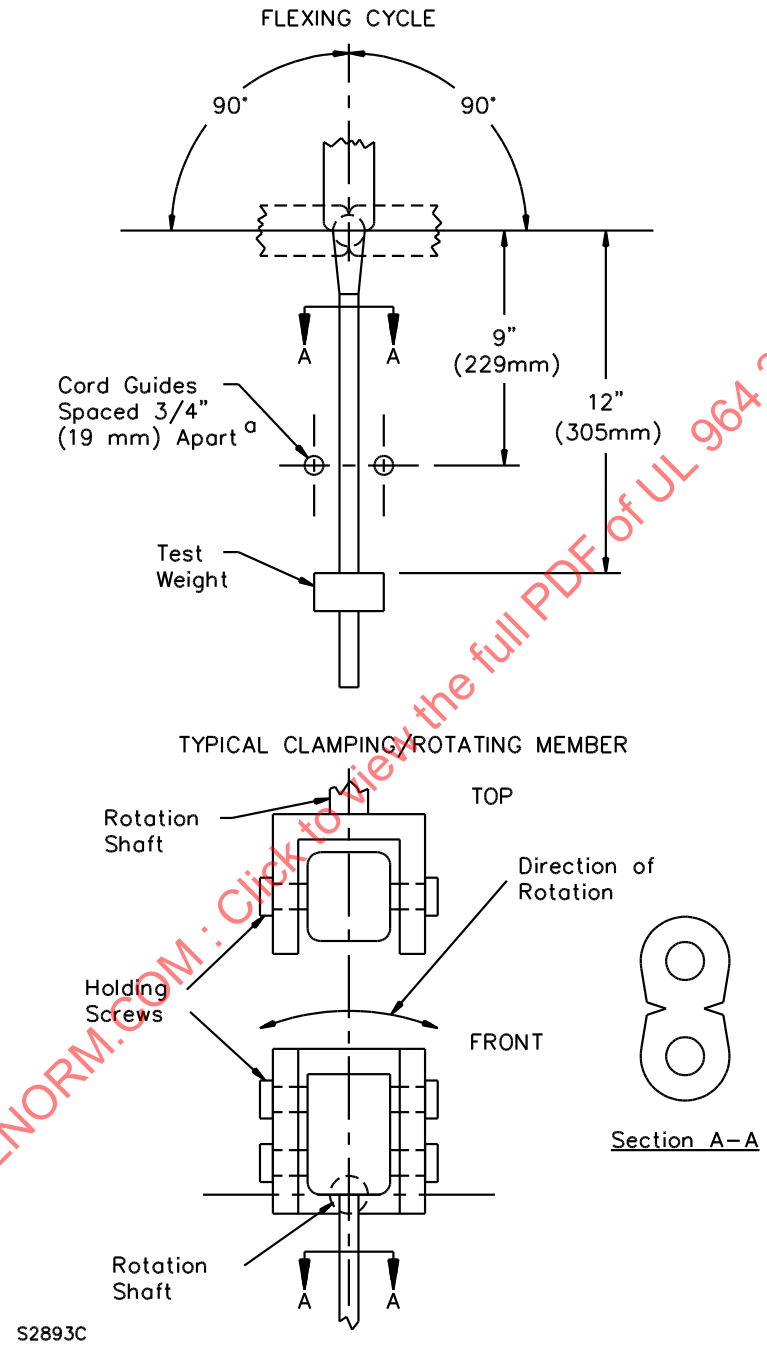
22.4 Each sample is to be secured to the flexing apparatus so that the flexible cord assumes the natural bend permitted by the fitting construction. The major axis of any right cross section of the cord is to be parallel to the longitudinal axis of the rotation shaft of the test fixture shown in Figure 22.1 so as to allow the cord to flex without any twisting of the parallel conductors. The test weights are to be as follows:

a) For Type HPN, 10 ounces (284 g); and

b) For all other types, 4 ounces (113 g).

Figure 22.1

Flexing test apparatus



[a] Cord guides are used only to control oscillation of the flexible cord during testing and therefore are adjustable, when necessary, so that the cord does not contact the guides in a manner that increases the degree of bend present at its entry to the fitting during the test.

22.5 The control is to be secured in the jaws of the flexing machine so that the point of cord exit is at the center of rotation. The rotating jaws are to be adjusted to rotate to an angle of 90° to each side of the centered position. At the centered position, the cord is to hang vertically and the weight, selected in accordance with 22.4, attached to each cord approximately 12 inches (305 mm) from the point of rotation. See 22.1.

22.6 Each sample is to be energized from its rated source of supply with a load adjusted to draw maximum rated current of the controller.

22.7 Each representative device is to be subjected to lexing cycles until a conductor in each device has opened (as determined by a continuously-monitoring detection circuit), or until 5000 cycles are completed, whichever comes first. A conductor that opens prior to completion of 5000 cycles shall be considered noncompliant. A flexing cycle consists of: rotation of the jaws from the vertical (centered) position 90° to one side; back past the vertical position 90° to the other side of vertical; and back to the vertical (centered) position. The rate of testing shall be maximum 10 cycles per minute.

22.8 The dielectric test of 18.11 shall be conducted at the conclusion of 22.6 with the bushing and a minimum of 3 inches (76.3 mm) of the cord adjacent to the bushing or entry point wrapped in foil.

22.9 Each interconnection cord/bushing or cord/fitting interface located on the load side of an in-line control assembly intended for use with electric throw blankets shall:

a) Comply with 22.1;

b) Be supplied by a Class 2 source of supply, see 5.2;

c) Operate at a current of less than that indicated in 23.1 when conductor insulation is removed; or

d) Disconnect power in the event of any of the conditions noted in 22.2. The reliability of solid-state controls shall comply with the requirements of the Standard for Safety-Related Controls Employing Solid-State Devices, UL 991.

23 Leakage Current Test (All Products Except Mattresses)

23.1 After immersion of the product proper – no controls, cord connectors and the like – for 1 hour in a salt solution as described in 23.2, the leakage current shall not be higher than 5.0 mA when an a-c potential of 120 V, or 0.5 mA when a d-c potential of 120 V, is applied between the solution and live parts of the product. The connections to the plug of the product and any associated controls shall remain dry and out of the solution throughout the test.

23.2 The salt solution is to consist of 8 g of sodium chloride (NaCl) per liter. A metal tub is to be employed as a container.

24 Dielectric Voltage-Withstand Test (All Products Except Mattresses)

24.1 While still immersed in the salt solution mentioned in 23.1 and 23.2, the bedding shall be capable of withstanding for 1 minute without breakdown a 60 Hz essentially sinusoidal potential of 1000 V plus twice its rated voltage applied between the solution and live parts of the product. The connections to the plug of the product and any associated controls shall remain dry and out of the solution throughout the test.

24.2 To determine whether a product complies with the requirement in 24.1, the product is to be tested by means of a 500 VA or larger-capacity transformer whose output voltage is essentially sinusoidal and can be varied. The applied potential is to be increased at a uniform rate from zero until the required test level is reached, and is to be held at that level for 1 minute.

25 Laundering (All Products Except Mattresses)

25.1 A representative product shall be subjected to five consecutive washings and dryings in the most severe manner described in the manufacturer's instructions for the bedding material employed or, if not specified in the manufacturer's instructions, the product shall be laundered as indicated in 25.2, or according to the manufacturer's instructions. In decreasing order of severity are considered to be home machine and hand washing.

25.2 Unless otherwise specified by the manufacturer's instructions the product is to be laundered as outlined in (a) or (b):

a) A product to be laundered in an automatic washer shall be laundered as follows:

The washer is to be filled with warm water and a minimum amount of all-purpose powdered detergent or mild soap chips is to be added and dissolved by agitation. The product is then to be placed in the washer and allowed to soak for 5 minutes followed by 2 minutes of slow agitation and spin drying at normal speed. The washer is then to be filled for a cool rinse, agitated for 1 minute, and spun at normal speed. A second, identical rinse is to be made. The product is then to be draped over a clothes line and allowed to dry until damp, or it may be damp-dried in an automatic dryer on high heat for 5 minutes. The product is then to be formed to its original shape and size on a flat surface until completely dry. This laundering process is to be repeated four times (a total of five launderings) before the product is immersed in the salt solution as required in 25.1.

b) A product permanently marked to be washed by hand only is to be laundered as follows:

A large tub is to be filled with warm water and a minimum amount of all-purpose powdered detergent or mild soap chips is to be added and dissolved by agitation. The bedding is then to be placed in the tub and allowed to soak for 5 minutes followed by 15 minutes of vigorous scrubbing with a washboard, scrubbing brush, or similar scrubbing aid. The tub is then to be filled with cool water and rinsed until all cleaning agents are removed. A second identical rinse is then to be made. The product is then to be draped over a clothes line and allowed to dry until damp. The product is then to be formed to its original shape and size on a flat surface until completely dry. This laundering process is to be repeated four times (a total of five launderings) before the product is immersed in the salt solution as required in 25.1.

25.3 After the product is laundered as described in 25.1 and 25.2, there shall not be:

a) Loosening of the male connector body;

b) Unraveling, breakage or loosening of the stitching at the ends of the dividers for a distance greater than 3/4 inch (19 mm);

c) Breakage or loosening of any wiring connections;

d) Appreciable shifting of position of the heating element within the shell; or

e) Breakage of the heating-element conductor or other interruption of the electrical circuit through the product; or water inside the seal around a thermostat.

26 Roller Flexing Test (Mattresses, Mattress Pads, and Foot Warmers)

26.1 The product shall comply with the requirement in 20.1.1 when it is flexed in accordance with 26.2.

26.2 The flexing of a mattress, foot warmer, or mattress pad is to be conducted in the following manner. The product is to be connected to a supply circuit of 120 V ac, a mattress is to be laid out on a plane

surface, and a mattress pad or foot warmer is to be laid out flat on a test mattress consisting of six 1-inch thick (25-mm thick) coarse hair pads as described in 15.2. The flexing is to be done by means of a roller that exerts a force of 250 lbf (1112 N or 113.4 kgf) and has a length of 34 inches (864 mm) and a hexagonal cross-section approximately 19 inches (483 mm) in diameter. The roller is to be moved back and forth for 3000 cycles lengthwise on the product, and its track is to be varied sufficiently so that the entire width of the bedding is affected. This flexing is then to be repeated with the roller being moved in a crosswise direction on the product.

27 Leakage Current Test – Repeated (All Products Except Mattresses)

27.1 After being laundered as described in 25.1 or 25.2, a blanket, sheet, quilt, or comforter shall comply with the requirement in 23.1.

27.2 Following the Roller Flexing Test, Section 26, a mattress pad and a foot warmer shall comply with the requirements in 23.1.

28 Dielectric Voltage-Withstand Test – Repeated (All Products Except Mattresses)

28.1 After having been subjected to the Repeated Leakage-Current Test, Section 28, the product shall comply with the requirements in 24.1 and 24.2.

29 Normal Temperature Test – Repeated (All Products)

29.1 Following the Repeated Dielectric Voltage-Withstand Test, Section 28, or following the Roller Flexing Test, Section 26, in the case of a mattress, the normal temperature test shall be repeated, and the product shall comply with the applicable requirements in Section 19.

30 Immersion Test (Blankets, Sheets, Quilts, and Comforters)

30.1 A pendant control or similar device connected to bedding by means of a cord integral with the bedding shall comply with the leakage-current requirements of 23.1 and the dielectric voltage-withstand requirements of 24.1 immediately after being subjected to the immersion test described in 30.2.

30.2 Each of three representatives of the pendant control or other device is to be immersed for a period of 24 hours in a solution containing 8 g of common table salt per liter of distilled water at 22 – 25°C (72 – 77°F).

30.3 The test described in 30.2 shall not result in the entrance of water into the interior of the device as determined by examination following disassembly after the leakage current and dielectric voltage-withstand tests.

31 Abnormal Temperature Tests

31.1 General

31.1.1 The temperature at any point on the insulation of the heating element wire shall not be higher than 160° C (320° F) when the product is tested in accordance with the applicable requirements in 31.1.2, 31.1.3, 31.2.1 – 31.2.3, 31.3.1, 31.4.1 – 31.4.3, and 31.5.1.

31.1.2 In the tests described in 31.2.1 – 31.2.3, 31.3.1, 31.4.1 – 31.4.3, and 31.5.1, a controlled ambient temperature of 25.0 ±2.0°C (77.0 ±3.6°F) is specified. The product is to be laid out flat on a test mattress as described in 15.3 and connected to a supply circuit of 120 V ac. The control, if adjustable, is to be set to give the highest heat.

31.1.3 The tests described in 31.2.1 – 31.2.3, 31.3.1, 31.4.1 – 31.4.3, and 31.5.1 are applicable to conventional products that typically consist of parallel runs of heater wire with or without discrete temperature sensing devices for overheat protection. For unconventional products, consideration shall be given to the need for modifying the tests described in 31.2.1 – 31.2.3, 31.3.1, 31.4.1 – 31.4.3, and 31.5.1.

31.2 First method of folding

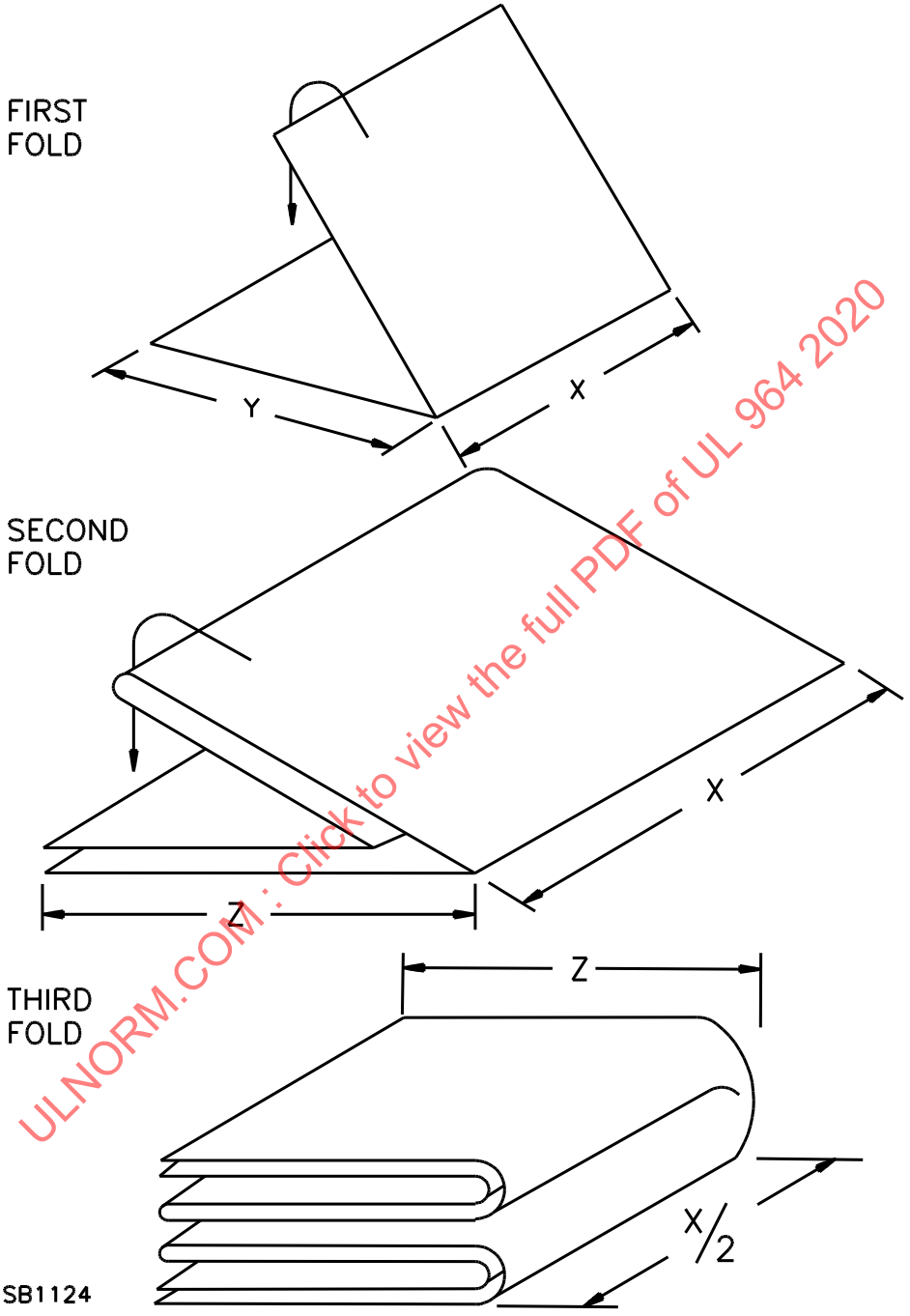
31.2.1 After the product has been folded as specified in 31.2.2, 31.2.3, and 31.3.1, a 1-inch thick (25-mm thick) circular felt pad (see 15.2) having a diameter of 10 – 18 inches (254 – 457 mm) is to be placed on top of the upper layer at the center of the product. Within this range of sizes, the pad is to be the largest that can be applied to the product without covering any part of a discrete sensing device. Operation is to be continued until thermal equilibrium is reached or until a nonautomatically resetting control opens the circuit. Temperatures are to be measured at one or more points on each layer of the folded product by means of thermocouples with their junctions secured directly to the insulation on the heating element by thread or the equivalent.

31.2.2 The product shall be folded for two folds as shown in Figure 31.1, unless the relative location of the thermostats is such that a different procedure is necessary to determine that equivalent abnormal conditions will be represented. The product is to be operated with the second fold.

31.2.3 The test described in 31.2.1 and 31.2.2 is to be repeated with the product folded a third time as shown in Figure 31.1. The third fold is to be at the center of the top surface but at right angles to the first two folds.

Figure 31.1

First method of folding a product for Abnormal Temperature Test



Note: X is the short side of the product, Y is half of the long side of the product, and Z (Y/2) is one quarter of the long side of the product.

31.3 Second and third method of folding

31.3.1 The product is to be operated again after being unfolded and refolded as follows (also, see 31.2.1):

a) The top edge of a product provided with thermostats is to be so folded over crosswise – the fold at right angles to the major axis of the bedding – that the maximum rectangular unprotected area results adjacent to the fold. Then starting at the fold, as many successive 3-inch (76-mm) folds as possible are to be made without covering any of the thermostats. The test is to be repeated starting with the bottom edge. See Figure 31.2.

b) The top edge of a product having no thermostats is to be folded over crosswise so that the end one-third covers the center one-third of the area of the product. Then, starting at the fold, six successive 3-inch (76-mm) folds are to be made. The test is to be repeated starting with the bottom edge. See Figure 31.3.

Figure 31.2

Second method of folding for Abnormal Temperature Test

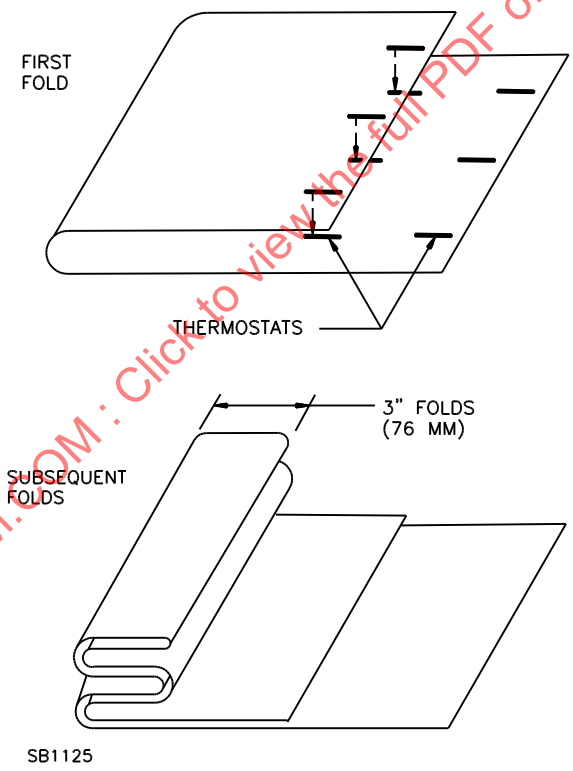
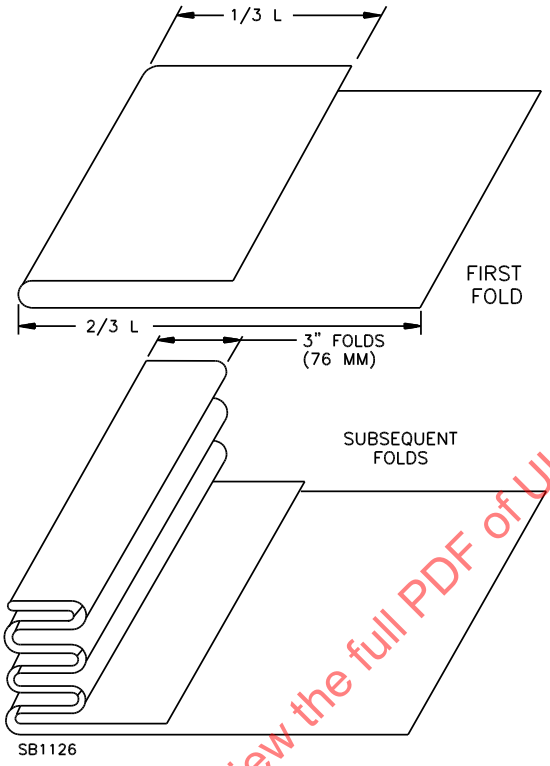


Figure 31.3

Third method of folding for Abnormal Temperature Test



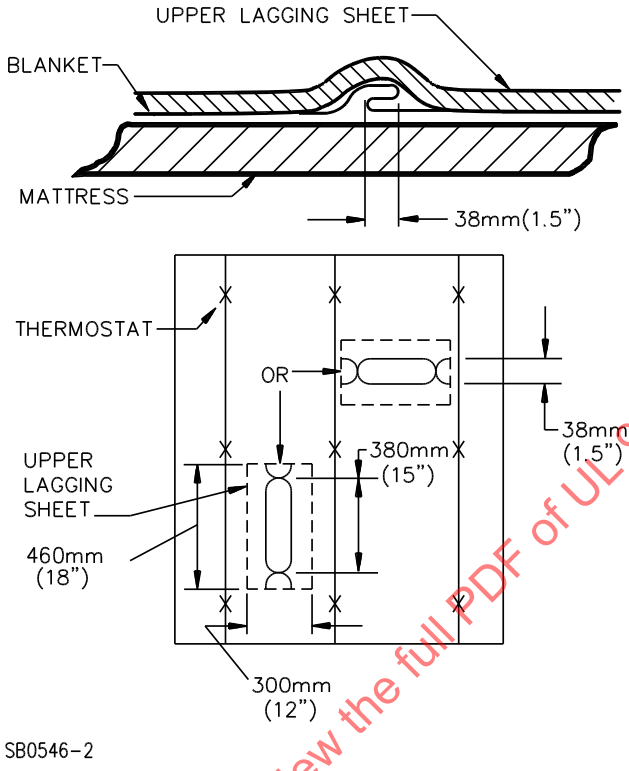
31.4 Three thickness and five thickness fold

31.4.1 All products except mattresses shall be subjected to the folding test described in 31.4.2 and 31.4.3. The product is to be placed on the test mattress as described in 15.3 and connected to a supply circuit of 120 V ac. The control, if adjustable, is to be set to give the highest heat.

31.4.2 The product is to be subjected to a three thickness fold, the fold having a width of approximately 1.5 inches (38 mm) and a length of approximately 15 inches (380 mm) as shown in Figure 31.4, in the most unfavorable manner – closest concentration of element wires – and position – not covering thermostats. The fold is to be made both parallel and perpendicular to the direction of the runs of the heating element and is to be fanned out at the ends. A section of the felt lagging material described in 15.2 and having approximate dimensions of 12 by 18 by 1 inch (300 by 460 by 25 mm) thick is to be placed on top of the three folds in the most unfavorable manner. The product is to be operated until thermal equilibrium is attained, and the maximum temperature on the heating element shall not exceed the limits enumerated in 31.1.1.

Figure 31.4

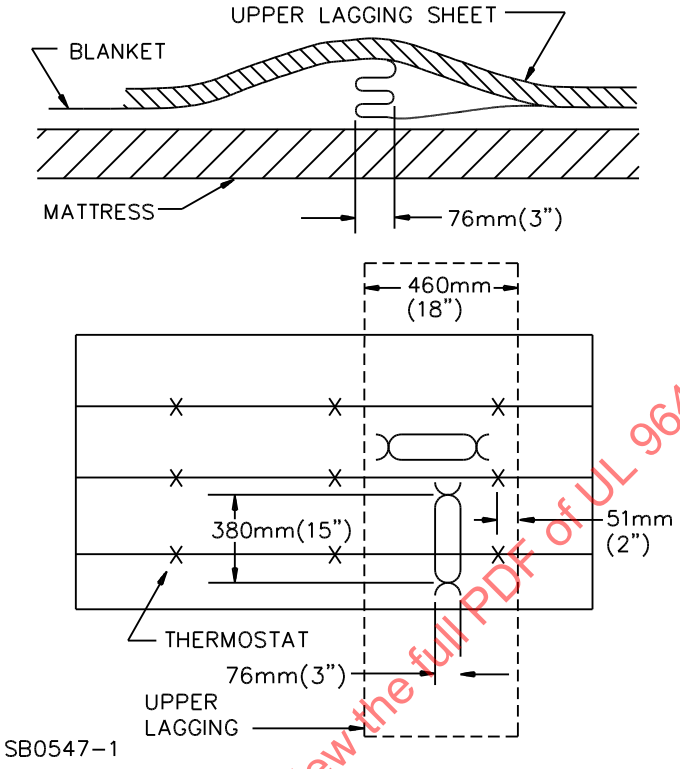
Three-thickness test



31.4.3 The product is to be subjected to a fold of five thicknesses of any width up to a maximum of 3 inches (76 mm), chosen to produce the most unfavorable result, arranged over a 15 inch (380 mm) length both parallel and perpendicular to the direction of the runs of the heating element and is to be fanned out at the ends. The wired area, including the fold, is to be covered by felt lagging material 18 inches (460 mm) wide, that extends across the full width of the product and is to be parallel to the shorter edges of the product, see Figure 31.5. The lagging materials shall cover the fold and extend over the nearest row of thermostats including 2 inches (51 mm) thereafter. The test is to be repeated without any covering if the absence of the felt produces a more unfavorable result. The maximum temperature on the heating element insulation shall not exceed the limits enumerated in 31.1.1.

Figure 31.5

Five-thickness test



31.5 Multi-thickness fold

31.5.1 During the testing of bedding, such as an over-blanket, sheet, comforter, or the like, that does not incorporate discrete temperature sensing devices, or that employs fewer than the minimum number specified in 9.10, the folding test described in 31.4.3 and illustrated in Figure 31.5 shall be modified as follows until the most unfavorable result is produced:

a) Any number of thicknesses, to a maximum of eleven, may be made in the manner illustrated in Figure 31.5;

b) The length of the folded material may be varied to a maximum of 30 inches (762 mm); and

c) The width and length of the felt lagging material may be varied so as to provide maximum coverage of the folded area without covering any discrete temperature-sensing devices, if provided.

31.6 Bunch test

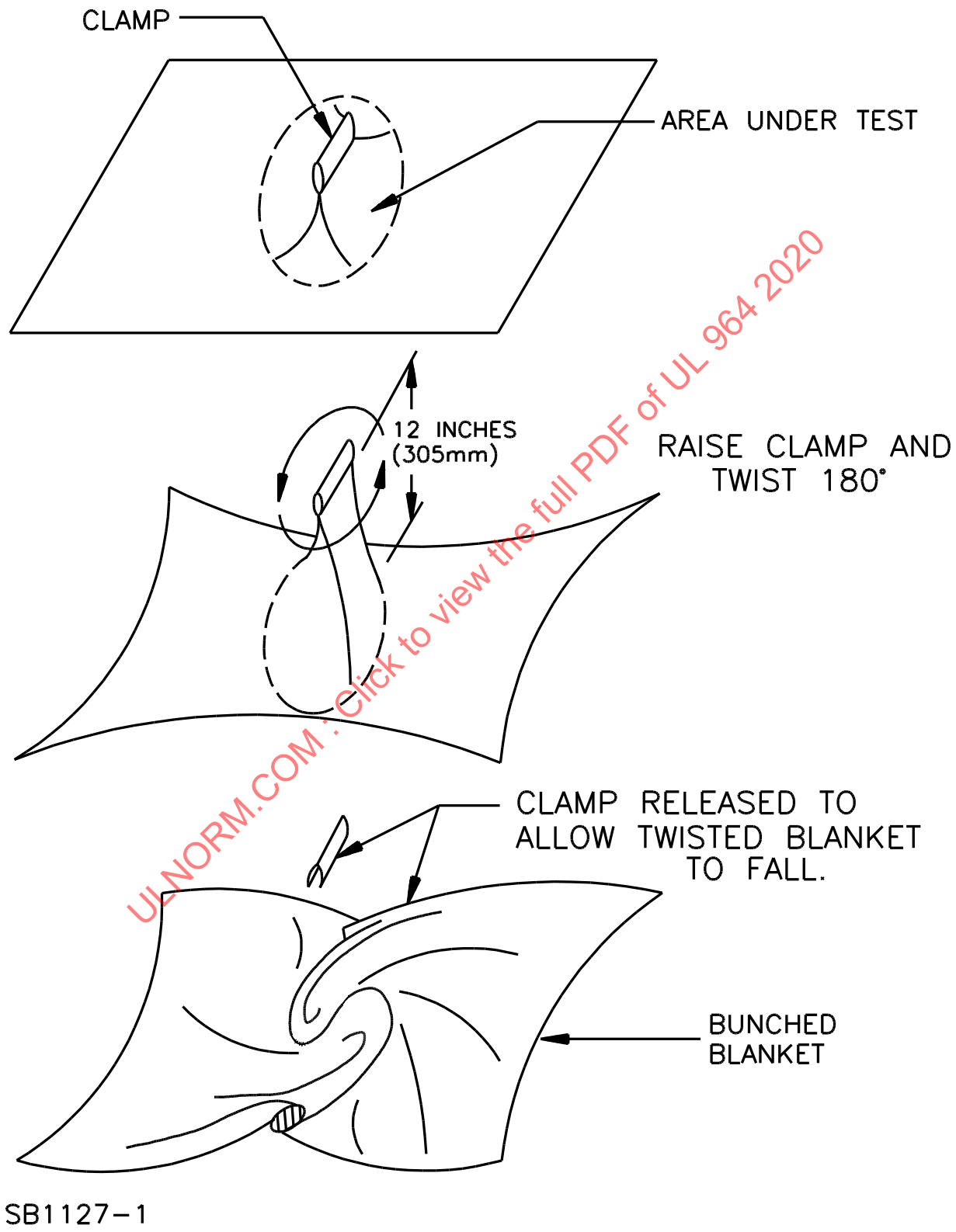
31.6.1 Three representative blankets, sheets, or similar bedding intended to be placed over the user shall be subjected to the bunching test while energized at a 120 V ac potential, described in 31.6.3 – 31.6.7. A controlled ambient temperature of 25.0 ±2.0° C (77.0 ±3.6° F) is specified. Neither the test bedding, nor the cotton sheet referred to in 31.6.2 shall become charred – that is, there shall not be deterioration of the product or cotton sheet fiber, including melting and embrittlement. Discoloration alone shall not be considered unacceptable.

31.6.2 A bleached, white, 100-percent cotton sheet is to be laid out flat on top of a mattress constructed as described in 15.3. The sheet is to be secured at the edges to keep it from shifting when the test bedding is bunched. The test bedding is to be laid out flat on top of the sheet.

31.6.3 The approximate center of an unprotected portion of the wired area of the product (see 31.6.6) is to be grasped by a wooden clamp (see 31.6.7). The clamp is to be raised vertically through a distance of 12 inches (305 mm) so that the product material, including any discrete sensing devices, surrounding the clamp is uniformly drawn toward the center. The clamp is to be rotated 180 degrees on its minor axis and the product released so that the twisted material falls back on the approximate center of the test area. See Figure 31.6.

Figure 31.6

Method of bunching for bunch test



31.6.4 A 20-inch (508-mm) diameter, 1-inch (25-mm) thick felt pad, constructed of the material described in 15.2, is to be gently placed on top of the product so that the center of the pad contacts the center of the twisted material, and so that the perimeter of the pad does not extend beyond the wired area. A 5-lb (2.27 kg), 5-inch (127-mm) diameter disc is to be placed on the top center of the pad for 1 minute while the perimeter of the pad is gently pressed down to ensure contact with the product. The weight is then to be removed and the product energized as specified in 19.1.4 for 7 hours.

31.6.5 When testing a product, such as an over-blanket, sheet, comforter, and the like, that does not incorporate discrete temperature sensing devices, or that employs fewer than the minimum number specified in 9.10, the diameter of the cover pad described in 31.6.4 may be varied within the inclusive range of 10 – 20 inches (254 – 508 mm) in order to produce the most unfavorable result.

31.6.6 The wired area referred to in 31.6.3 is that part of the product bordered by the outermost runs or loops of the heater wire. The unprotected wired area selected for the test is normally the area corresponding to the largest circle that can be placed within the wired area without enclosing a discrete sensing device. However, any portion of the wired area may be selected provided that the perimeter of the circular cover pad mentioned in 31.6.4 does not extend beyond the wired area after the product is twisted and the center of the circular pad contacts the center of the twisted material.

31.6.7 The wooden clamp referred to in 31.6.3 shall consist of two pieces, each approximately 1/4-inch (6.4-mm) thick, with a gripping surface measuring 4 inches by 1 inch (102 mm by 25.4 mm). The product is to be grasped so that the long edge (major axis) of the clamp runs parallel to the heater wire.

31.7 Fully blanketed

31.7.1 A mattress shall comply with the requirements in 19.2.1 – 19.2.3, except that the test shall be made with the felt pads, weights, and blankets covering the entire bedding. A controlled ambient temperature of 25.0 ±2.0°C (77.0 ±3.6°F) is specified.

31.8 Disabled control

31.8.1 If the control unit is allowed to function during the Normal Temperature Test, Section 19, and, if an open circuit in one or more sections of the heating element causes the control not to function or to function improperly, the Normal Temperature Test is to be repeated with one or more sections of the heating element open-circuited.

31.8.2 In addition to the abnormal tests described in this section, a product incorporating an unusual construction shall be subjected to tests deemed necessary for the application.

32 Pull Out Test

32.1 Except that the attachment plug is to be excluded, the attachment and strain relief provided at each end of each supply, control, interconnecting, and pigtail cord and the attachment of the half of each bedding connector attached to the bedding without a pigtail cord shall withstand for 1 minute the stress indicated in Table 32.1.

Table 32.1
Stresses to be used in Pull Out Test

Parts of the complete bedding between which stress is to be applied	Stress
Between the supply cord and the control unit or switch to which the cord is attached Between any interconnecting cord and the control unit at one end of the cord and then, separately, the control unit at the other end of the cord Between the control cord and the control unit or switch at one end of the cord and then, separately, the half of the bedding connector at the other end of the cord Between any pigtail cord and the half of the bedding connector at one end of the cord	25 lbf (111 N)
Between any pigtail cord and the bedding to which the cord is connected	35 lbf[a] (156 N)
Between the half of any bedding connector attached to the bedding without a pigtail cord and the bedding to which the connector is attached	20 lbf (89 N)
[a] For a mattress the stress shall be 50 lbf (222 N).	

32.2 To determine whether the complete product complies with the requirements in 32.1, each cord and pigtailless bedding connector is to be subjected to the pull specified in Table 32.1. An appropriate weight is to be gently applied to the cord or pigtailless connector to put the stress at the point of cord or pigtailless-connector attachment for a period of 1 minute while the control unit, switch, connector, or the bedding is securely immobilized – bedding other than a mattress is to be hung vertically across its full width with 1 foot (305 mm) of its length hanging free above the point of pigtail or connector attachment. In the case of each connector to which a cord is attached, each control unit, and each switch, the cord connections at terminals are to be severed or disconnected prior to the test. The strain relief is not acceptable if at the point of severance or disconnection:

a) The ends of the conductors are seen to separate by any amount;

b) The insulation on the conductors is seen to slip off of any conductor to any degree; or

c) There is any other appreciable manifestation of stress having resulted on the connections.

The attachment and strain relief of a pigtail cord or pigtailless connector to the bedding is not acceptable if:

a) The pigtail cord or the connector becomes loose or detached;

b) There is any displacement of the heating element or other wiring internal to the bedding; or

c) There is any loosening or breaking of any electrical connection.

Exception: The cord connection at terminals need not be severed or disconnected in a control unit or switch if:

a) They are riveted or welded;

b) Such connections are made by eyelets, pressure wire connectors with closed loop tangs, soldered loops in the conductor; or

c) At soldered connections mechanical security is provided before soldering.

Terminal binding screws shall be prevented from unthreading completely when a control unit or switch is assembled.

32.3 The test shall be conducted with the pull force applied in the direction most likely to transmit strain to the strain relief and internal wiring. Tests in multiple directions, using separate samples, shall be conducted when there is uncertainty as to the most severe direction.

32.4 The cord and strain relief means shall not be in contact with the clamping or support means during the test.

33 Final Mattress Tests

33.1 Following the Abnormal Temperature Tests, Section 31, and the Pull Out Test, Section 32, a mattress shall be disassembled and the heating-element carrier removed. This carrier, with the element still contained, shall then be subjected to the Leakage Current Test, Section 23, and the Dielectric Voltage-Withstand Test, Section 24.

34 Flammability of Shells

34.1 The shells of electrically heated bedding, and any external layer of fabric on the bedding, shall be tested as described in 34.18 – 34.25.

34.2 There shall not be charring or burning of the paper monitor as the result of ignition, surface flash, or burning of the bedding under test.

34.3 Representative bedding shall consist of a strip of fabric, from each product to be tested, whose width is approximately 45 inches across the product by 3 inches (1140 by 76 mm). Fifteen individual specimens are then to be cut from this strip, each with the following dimensions: 2.75 ±0.13 by 2.75 ±0.13 inches (69.9 ±3.3 by 69.9 ±3.3 mm).

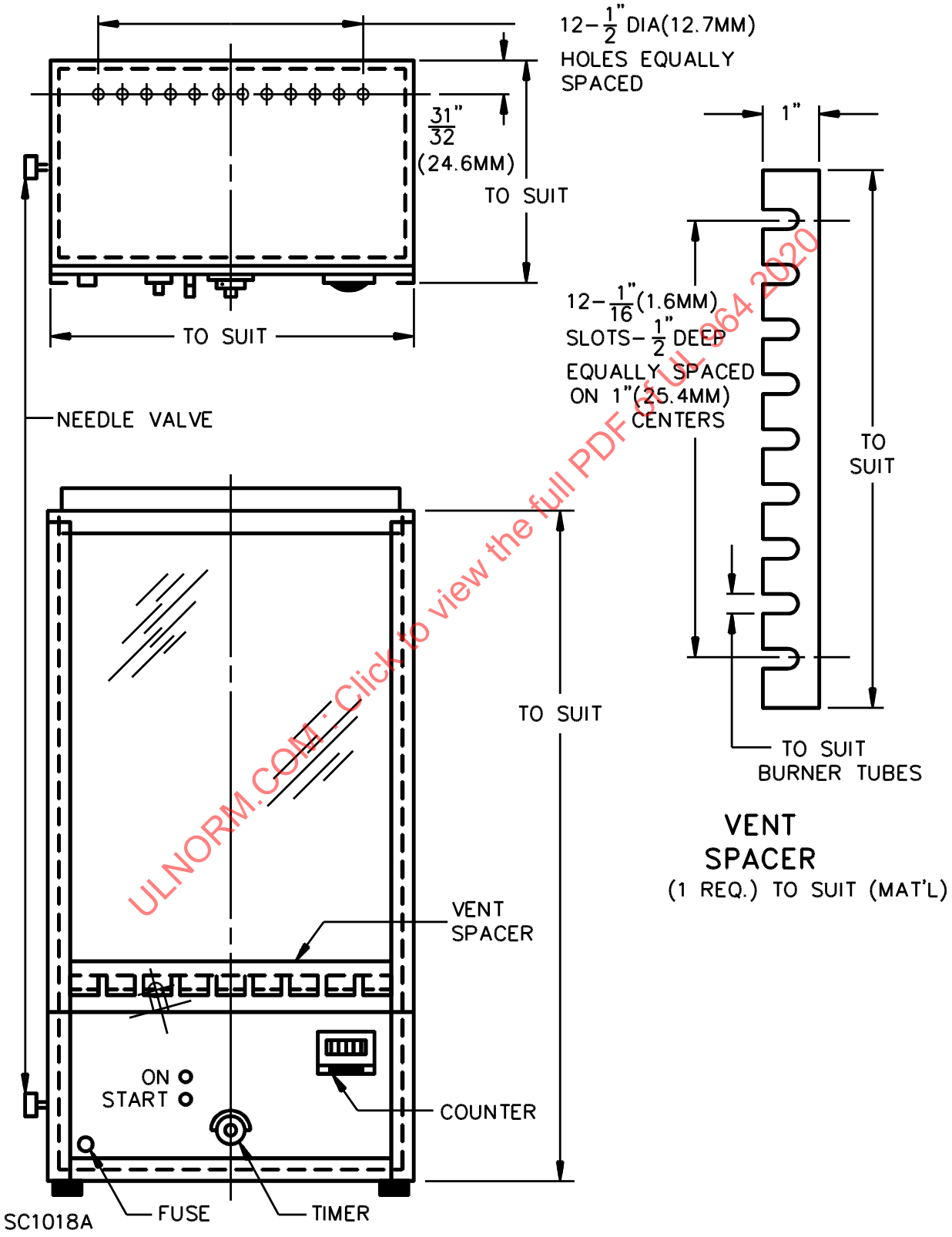
34.4 Five of the specimens are to be tested face up and designated Group A. Five of the specimens are to be tested face down and designated Group B. The remaining five specimens are to be tested either face up or face down as described in 34.5.

34.5 If two or more specimens from either Groups A or B or any combination thereof do not pass, as described in 34.1, this would constitute unacceptability for that product. If only one specimen does not pass, then the five additional specimens are to be tested, either face up or face down, whichever mode was used on the original specimen. All five of the new test specimens shall have acceptable results.

34.6 The test chamber shall be a metal cabinet with inside dimensions of 14-1/2 inches (368 mm) wide, 8-1/2 inches (216 mm) deep, and 13-3/4 inches (349 mm) high, and outside dimensions to suit. The front of the cabinet shall be a close-fitting door (sliding or hinged) with a transparent insert to permit observation of the entire test. Vent holes shall be distributed across the bottom portion of the front panel of the chamber and the rear portion of the cover of the test chamber as shown in Figure 34.1.

Figure 34.1

Test chamber



34.7 The test cabinet shall be equipped with control elements that will control the time of flame impingement on the specimen to ±0.05 seconds. The control system shall consist of two parts:

a) An adjustable timer that actuates the burner mechanism; and

b) A counter that is actuated by the burner mechanism when the burner is in position to impinge the flame on the specimen.

34.8 The specimen holder shall consist of two rectangular aluminum plates held together with acceptable fastenings. See Figure 34.2 and Figure 34.3.

Figure 34.2

Specimen holder assembly

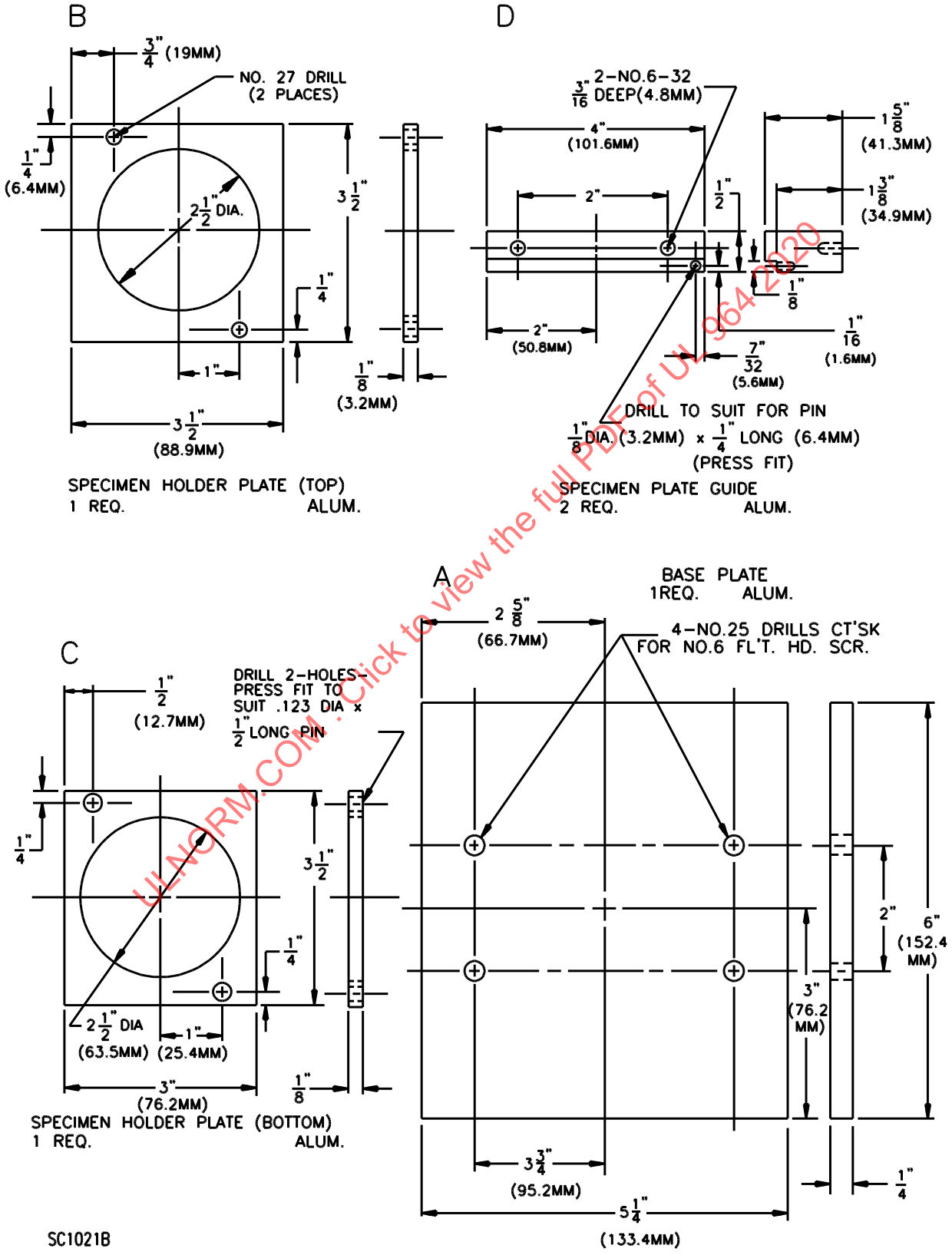
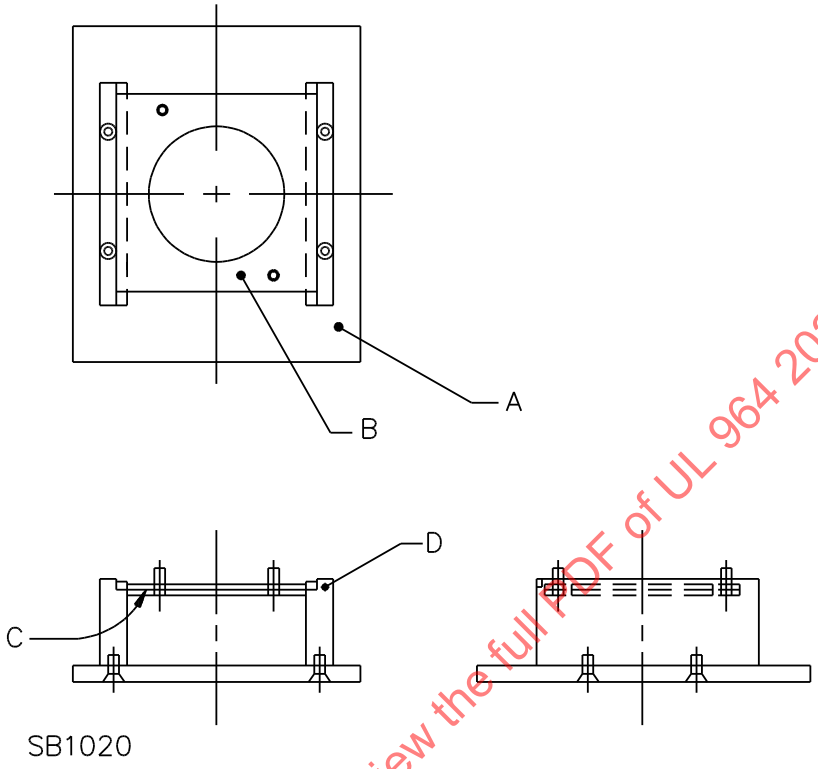


Figure 34.3

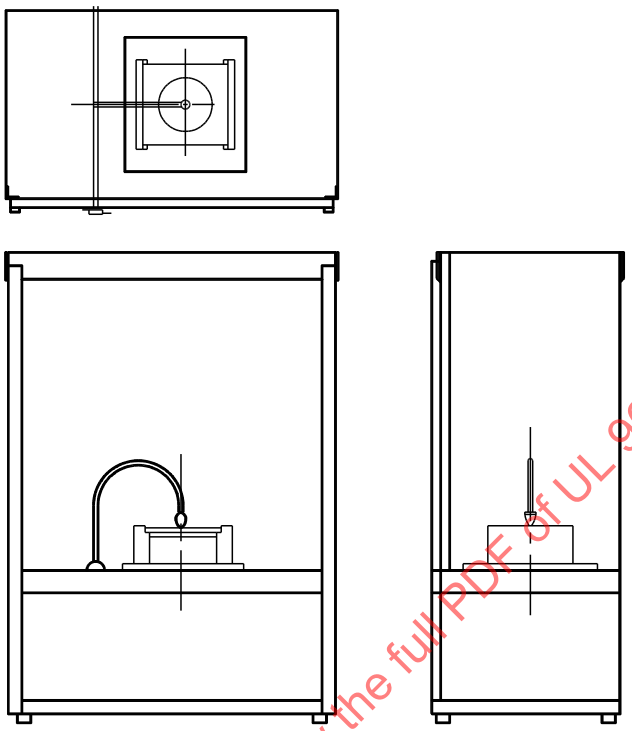
Specimen holder assembly



34.9 The specimen holder base shall be made of metal as detailed in Figure 34.2 and Figure 34.3 and shall maintain the specimen holder in a horizontal position in the approximate center of the test chamber floor. See Figure 34.4. The specimen holder base shall be rigidly held in place by an acceptable means, such as, screwed to the floor of the test cabinet or held by means of side guides.

Figure 34.4

Specimen holder assembly



34.10 The burner shall be as detailed in Figure 34.5. The gas input line to the burner shall be equipped with a needle valve that is used to control the flame length.

Figure 34.5

Burner

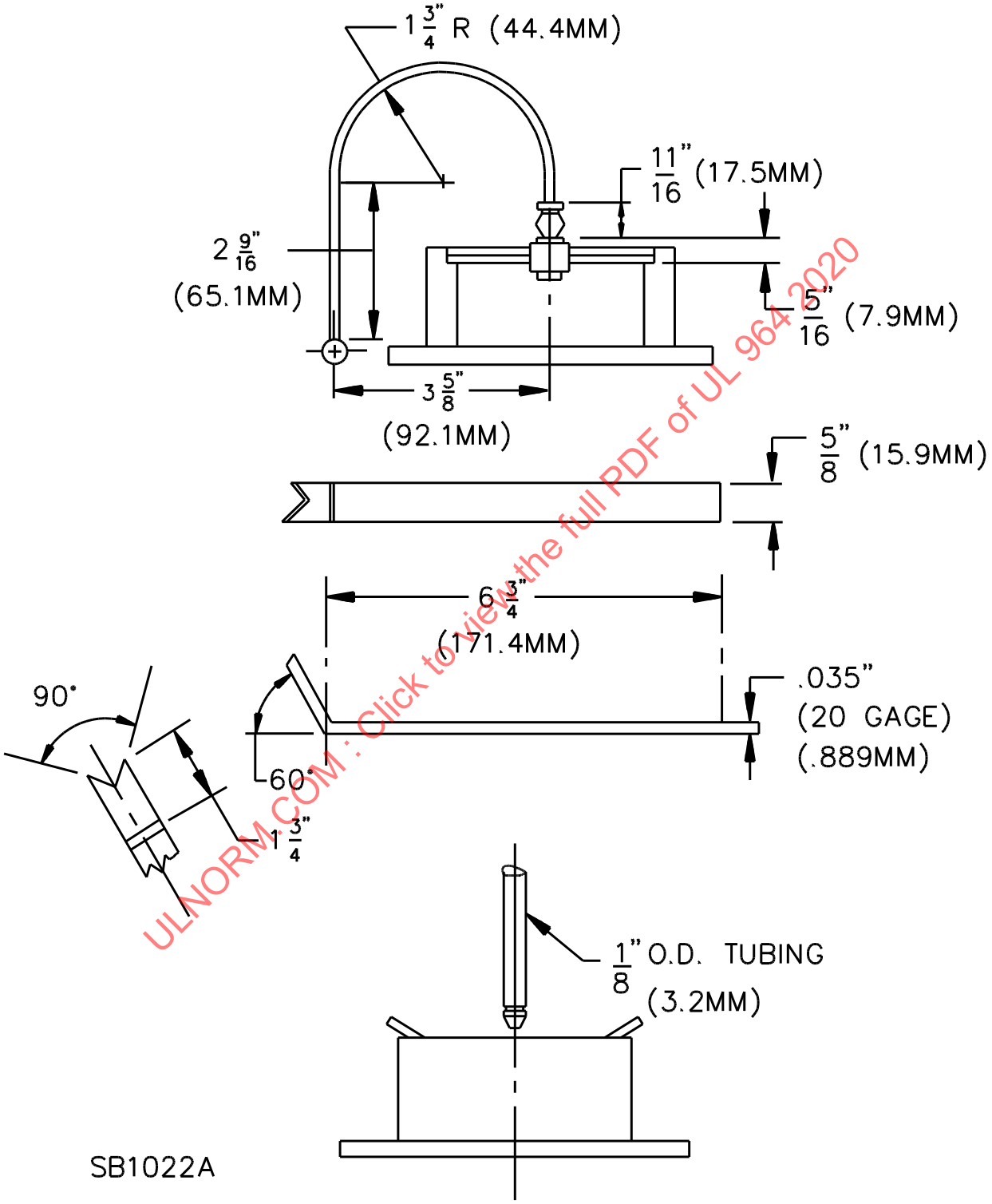
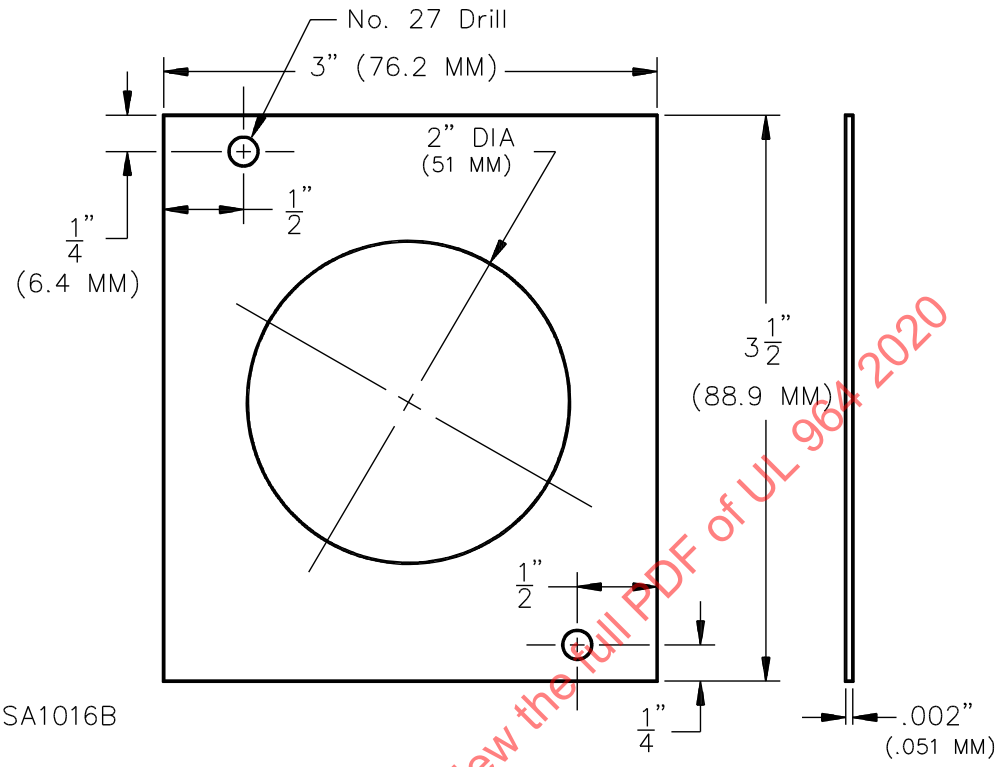


Figure 34.6

Paper indicator



34.11 There shall be a pressure regulator to furnish gas to the burner under a gauge pressure of 2-1/2 ±1/2 lbf/in^2 (129 ±26 mm mercury gauge or 17 ±3 kPa) at the needle valve inlet.

34.12 The gas shall be at least 97 percent pure technical grade methane.

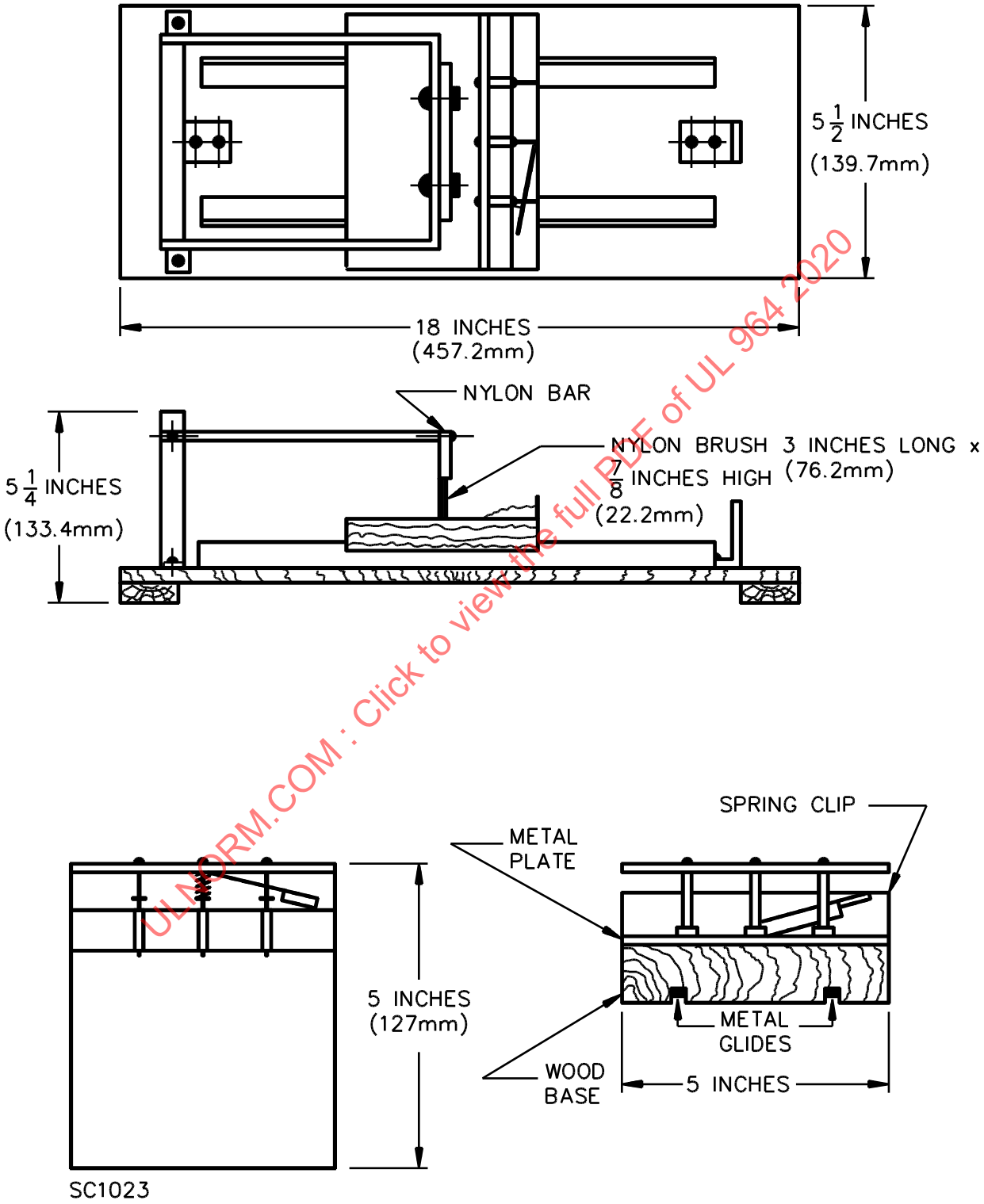
34.13 A hood or an enclosure shall be used to provide a draft-protected environment surrounding the test chamber. This enclosure shall have a fan or equivalent means for exhausting smoke or toxic gases or both produced by testing.

34.14 White paper that conforms to the Federal Specification for Lens Paper, A-A-50177, shall be used as a monitor to determine if ignition has occurred. This paper shall be cut into a 3-1/2 by 3 inch (89 by 76 mm) rectangle with holes punched as shown in Figure 34.6.

34.15 A brushing device similar to the one shown in Figure 34.7 shall be used to brush up the nap or fiber on specimens that have raised fiber surfaces. The brush shall consist of two staggered rows of stiff nylon bristles, 0.016 inch (0.40 mm) diameter with 20 bristles per tuft and four tufts per inch (per 25 mm). The tufts shall be cut to a uniform length of 0.75 inch (19 mm). The downward force of the brush shall be 75.0 ±10 g.

Figure 34.7

Brushing device



34.16 A forced circulation drying oven capable of maintaining the specimens at 105 ±2.8°C (221 ±5°F) shall be used to dry the specimens while mounted in the specimen holders.

34.17 An airtight and moisture-tight desiccating chamber shall be used for cooling mounted specimens after drying. Anhydrous silica gel with an indicator shall be used as the desiccant in the desiccating chamber. The desiccant shall be replaced or reactivated when it becomes inactive.

34.18 The specimens are to be washed in a neutral soap solution as indicated in 34.19. Neutral chip soap may be used.

34.19 The specimens are to be put into a 3-US-gallon-capacity (11 L) right-circular cylindrical container having approximate dimensions 13 inches (330 mm) long by 8-3/4 inches (222 mm) in diameter, that is fitted with a watertight cover at one end, preferably of metal. The container is to be mounted on a shaft whose longitudinal axis is in the same plane as the longitudinal axis of the container, intersects the longitudinal axis of the container at an angle of 50 degrees, and intersects the outside surface of the container at a point equidistant from the ends of the container. The shaft is to be oriented so that the longitudinal axis of the container is vertical while the container is in one of the two positions of rotation in which the plane of the axes is vertical. Soft water at a temperature of 35.0 – 37.8°C (95.0 – 100.0°F) and into which 0.5 percent by weight of the neutral soap mentioned in 34.18 has been thoroughly mixed is to be poured into the container in an amount equal to 30 times the mass of the specimens dry. The specimens are to be worked gently in the solution for 5 minutes by rotating the shaft on which the container is mounted at a rate of 45 – 50 revolutions per minute, after which they are to be rinsed twice in 26.7°C (80.0°F) water, spun to remove most of the water, and then laid flat on a horizontal surface and allowed to dry completely at room temperature.

34.20 After the washed specimens have dried thoroughly. They are to be individually brushed as follows: clamp the specimen on the carriage of the brushing device and pull the carriage with the specimen underneath the brush, brushing the specimen surface once in the direction which raises the nap or fibers as much as possible. Before brushing the next specimen, the tufts of the brush should be cleared of residual fibers. After brushing, with the bottom plate of the holder on a mounting plate, mount the specimen in the specimen holder. Avoid handling the specimens except on the edges. Mount the specimens and paper monitors in the following order: bottom plate, specimen, paper monitor, top plate. Place the paper monitor such that the two small holes fit over the guide pins on the bottom plate of the specimen holder. This shall set the large circular hole in the paper monitor concentric with the hole in the top plate of the specimen holder.

34.21 Place the mounted specimens in a drying oven in a manner that will permit free circulation of air at 105 ±2.8°C (221 ±5°F) around them for at least 30 minutes. Remove the mounted specimens from the oven and place them in a desiccator to cool, taking care that the brushed surface of each specimen is not touched. No more than five specimens shall be placed in each desiccator at one time. Specimens shall remain in the desiccator at least 30 minutes and no more than 60 minutes.

34.22 Adjust the burner actuating linkage so that the burner tip, in the actuated position, is 0.31 inch (7.9 mm) from the specimen surface. With the burner in the actuated position, move the base and holder assembly away from the burner tube so that the burner tip is 0.13 inch (3.3 mm) off center. Secure holder assembly to floor.

34.23 The timer shall be adjusted so that the burner, when actuated, remains in position to impinge the flame on the specimen for 1 ±0.05 seconds. This is accomplished by actuating the control elements thereby sweeping the burner forward, reading the time on the counter, and adjusting as necessary.

34.24 With the hood fan turned off and the burner in the relaxed position, use the needle valve to adjust the flame length to 0.63 inch (16 mm) from the tip of the burner parallel to the floor of the cabinet

measuring only the clearly visible, yellow portion of the flame. A gauge for this adjustment is shown in Figure 34.5.

34.25 Remove the mounted specimens from the desiccator one at a time and insert them in the cabinet for testing. Close the cabinet door and actuate the burner mechanism. The control equipment will automatically cause the flame to impinge on the surface of the specimen for 1 ±0.05 seconds. If more than 30 seconds elapse between removal of a specimen from the desiccator and the initial flame impingement, that specimen shall be reconditioned prior to testing. When combustion has stopped, as evidenced by absence of flame and afterglow, remove the mounted specimen from the cabinet and place it on a flat surface. The surface shall be a white paperboard sheet. Determine for each specimen whether or not the paper monitor is charred or burned at any point. See 34.2.

35 Ease of Ignition Test

35.1 Six specimens of the shell of electrically heated bedding, and any external layer of fabric on the bedding, each measuring 3.94 inches by 7.87 inches (100 mm by 200 mm), are to be tested in the apparatus shown in Figure 35.1, Figure 35.2, and Figure 35.3.

Figure 35.1

Ease of ignition test

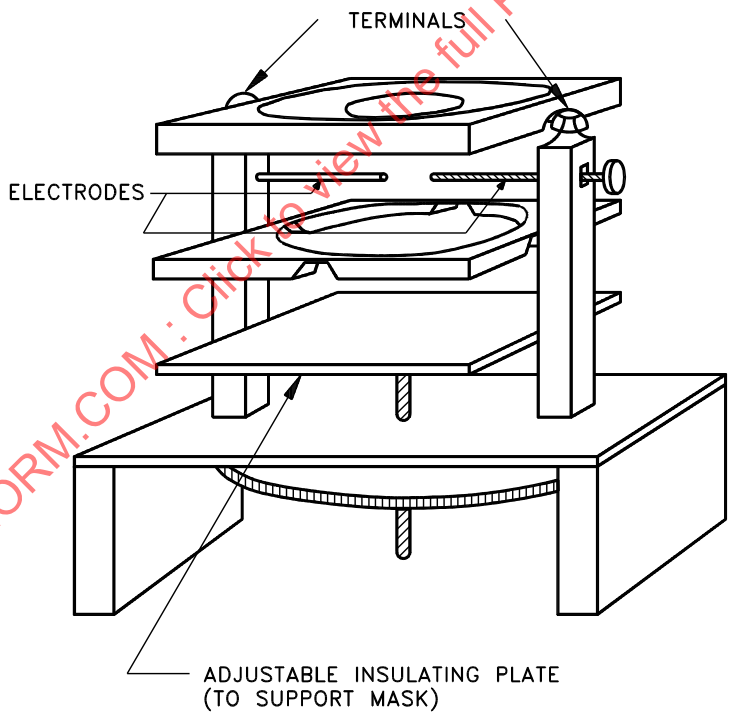


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Figure 35.2

Lower mask