UL 462

STANDARD FOR SAFETY

Heat Reclaimers for Gas-, Oil-, or Solid Fuel-Fired Appliances

UL Standard for Safety for Heat Reclaimers for Gas-, Oil-, or Solid Fuel-Fired Appliances, UL 462

Third Edition, Dated December 13, 2010

Summary of Topics

This revision to UL 462 is being issued to remove the reference to the withdrawal date of UL 873 and to address universal upkeep of UL Standards for Safety. These revisions are considered to be non-substantive and not subject to UL's STP process.

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

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

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UL 462

Standard for Heat Reclaimers for Gas-, Oil-, or Solid Fuel-Fired Appliances

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Third Edition

December 13, 2010

This UL Standard for Safety consists of the Third Edition including revisions through September 26, 2013.

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 http://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover heat reclaimers which are intended to recover a portion of heat from the flue gases of gas-, oil-, or solid fuel-fired appliances for the purpose of heating space or water. They are for installation on the vent or chimney connectors of the appliances which are for attachment to a Type B or Type L vent or a metal or masonary chimney. The heat reclaimers are covered for the maximum flue gas temperature marked on the heat reclaimer, which does not exceed 1000°F (538°C).

1.2 The heat reclaimers are intended for installation by a qualified agency in accordance with the manufacturer's instructions and the Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances, NFPA 211 or with the National Fuel Gas Code, NFPA 54/ANSI Z223.1.

1.3 These heat reclaimers intended for connection to an electrical supply are to be rated 240 volts or less, and are for installation in accordance with the requirements for ordinary locations in the National Electrical Code, NFPA 70.

1.4 Heat reclaimers which include plumbing connections are to be installed in accordance with the applicable plumbing codes.

2 Components

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

2.2 A component need not comply with a specific requirement that:

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

b) Is superseded by a requirement in this standard.

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

2.4 Specific components are recognized as being 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 for which they have been recognized.

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 purpose of this standard, the following definitions apply.

5.2 CHIMNEY CONNECTOR – The pipe which connects a fuel-burning appliance to a chimney.

5.3 COMBUSTIBLE MATERIAL, COMBUSTIBLE PRODUCTS, NONCOMBUSTIBLE MATERIALS – These terms, as used in this standard, are defined in the Standard Glossary of Terms Relating to Chimneys, Vents, and Heat-Producing Appliances, NFPA 97M.

5.4 DRAFT DIVERTER – (Also referred to as a Draft Hood.) A device built into a gas burning appliance or made a part of the vent connector from an appliance, which is intended to:

a) Provide for the ready escape of the flue gases from the appliance in the event of no draft, back draft, or stoppage beyond the draft diverter,

b) Prevent back draft from entering the heating appliance, and

c) Neutralize the effect of stack action of the chimney or gas vent upon the operation of the appliance.

5.5 DRAFT REGULATOR, BAROMETRIC – A device which functions to maintain a desired draft in the oil-fired appliance by automatically reducing the chimney draft to the desired value.

5.6 ELECTRICAL CIRCUITS:

a) High-Voltage Circuit – For the purpose of this standard, a circuit involving a potential of not more than 240 volts and having circuit characteristics in excess of those of a low-voltage or an isolated limited secondary circuit.

b) Low-Voltage Circuit – A circuit involving a potential of not more than 30 volts alternating current (ac) [42.4 volts peak or direct current (dc)] and supplied by a primary battery or by a standard Class 2 transformer, or by a combination of transformer and fixed impedance which, as a unit, complies with all the performance requirements for a Class 2 transformer. (A circuit derived from a source of supply classified as a high-voltage circuit, using resistance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low-voltage nor an isolated limited secondary circuit.)

c) Safety-Control Circuit – A circuit involving one or more safety controls.

5.7 SOLID FUEL-FIRED APPLIANCE – A heating appliance which has a freestanding fire chamber assembly of the circulating or direct radiation type. Solid fuel units are for attachment to a residential type chimney available for use with low-heat appliances and may be used to burn solid fuels commonly used in fireplaces. These units may be thermostatically controlled.

5.8 VENT CONNECTOR – The pipe which connects a gas-burning appliance to a vent.

CONSTRUCTION

6 Components

6.1 See 2.1 – 2.4 for requirements covering the construction and use of components on the heat reclaimers covered by this standard.

7 Assembly

7.1 All components necessary for the intended function of the heat reclaimer shall be included with the product.

7.2 A joint in the metal surface of a heat reclaimer which forms a passageway for the flue gases shall be tight, as attained by being welded, lock-seamed, riveted, bolted, or equivalent means. A joint shall not depend primarily on cement for tightness.

7.3 A heat reclaimer shall be provided with means other than vent or chimney connection for support of the assembly when it is installed.

7.4 A heat reclaimer for oil- and solid fuel-fired appliances shall include means for cleaning the passageways for flue gases without having to disassemble the heat reclaimer.

7.5 With respect to 7.4, an independently removable access panel that can be removed and replaced by use of conventional tools without moving the heat reclaimer from its installed position is not considered disassembly. When closed, this access panel shall form a tight seal to prevent leakage of flue gases.

7.6 A heat reclaimer shall be constructed so there is no reduction in the total free venting area as compared to the cross-sectional area of a chimney or vent connector pipe on which the heat reclaimer is to be installed. Also, it shall not significantly impede the flow of vent gases. This is to be determined by tests in accordance with Draft Loss Test, Section 28.

7.7 Unless a heat reclaimer that is intended to heat water is limited for installation on a water heating appliance and connected to the appliance such that the temperature of the water is regulated and limited by the controls on the appliance, it shall be provided with means to limit the temperature of the water flowing through the heat reclaimer to 210°F (99°C). See 27.2.1 – 27.2.2.

7.8 If a heat reclaimer is provided with a temperature-operated control for operation of the blower or a pump motor and the control is required to achieve conformance with 6.1.7, the temperature operated control shall comply with the Standard for Limit Controls, UL 353.

7.9 The heat exchanger of a heat reclaimer intended to heat water shall be of sufficient strength to withstand the Hydrostatic Strength Test as described in Section 29.

8 Materials

8.1 The outer casing or jacket of a heat reclaimer shall be made of steel or equivalent material, reinforced or formed if necessary, so that it is not likely to be damaged through handling in shipment, installation, and use. Sheet metal casings shall be made of steel having a minimum thickness of 0.020 inch (0.51 mm) if uncoated, or 0.023 inch (0.58 mm) if galvanized, or of nonferrous sheet metal having an average thickness of not less than 0.029 inch (0.74 mm), and all surfaces shall be protected against corrosion. The finish on the outer casing or jacket of the heat reclaimer shall not be damaged by heat during any of the tests.

8.2 A flueway of a heat reclaimer shall be constructed of cast iron or galvanized sheet steel having thickness of at least 0.032 inch (0.8 mm) for a heat reclaimer up to 16 inches (406 mm) in diameter, whereby the flue collar size determines the size of the heat reclaimer. For a heat reclaimer greater than 16 inches diameter the flueway of the same materials shall be at least 0.056 inch (1.42 mm) thick. Materials which provide equivalent rigidity, strength, durability and resistance to corrosion may be used.

8.3 A flue collar forming part of a heat reclaimer serving as a means of attachment to the vent or chimney connector pipe shall have the rigidity, heat resistance,and corrosion resistance at least equivalent to that of galvanized sheet steel having a thickness of not less than specified in Table 8.1.

Table 8.1
Minimum thickness of flue collars

Diameter of flue collar, inches (mm)	Minimum wall thickness, inch (mm)
Less than 6 (152)	0.019 (0.48)
from 6 (152) to 10 (254)	0.023 (0.58)
over 10 (254) up to 16 (406)	0.029 (0.74)
over 16 (406)	0.056 (1.42)

8.4 A radiation shield or baffle employed to prevent temperatures greater than those specified in Table 25.2 for electrical components shall be so constructed, formed, and supported, for the intended positioning and to prevent distortion or sagging in service. It shall be protected against corrosion and the finish shall not be damaged by heat when the heat reclaimer is tested under these requirements if the deterioration of the finish may cause temperatures greater than those specified in Table 25.2 on parts which it is intended to shield.

8.5 Alloys containing more than 1 percent magnesium shall not be used if the reflectivity of the material is employed to reduce the risk of fire.

9 Electrical Enclosures

9.1 General

9.1.1 Uninsulated live high-voltage parts shall be enclosed or guarded so that unintentional contact by persons during intended use of the equipment is not likely. This applies also to such parts located in a compartment into which access is required for intended care of the heat reclaimer, such as resetting controls, replacing filters, lubrication, cleaning, or the like.

9.1.2 The enclosure shall prevent the emission of molten metal, burning insulation, flaming particles, or the like, through openings onto combustible material.

9.1.3 Among the factors taken into consideration when judging the acceptability of an enclosure are:

a) Mechanical strength,

b) Resistance to impact,

c) Moisture absorptive properties,

d) Flammability,

e) Resistance to corrosion, and

f) Resistance to distortion at temperatures to which the enclosure may be subjected under all conditions for use.

For a nonmetallic enclosure or part of an enclosure, all these factors are considered with respect to thermal and chemical aging.

9.1.4 Sheet metal for the individual enclosure of electrical components shall comply with Table 9.1 or 9.2, as applicable.

Table 9.1
Minimum thickness of sheet metal for enclosures – carbon steel or stainless steel

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness in inches (mm)			
Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length		Uncoated (MSG)		Metal coated (GSG)	
inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)				
4.0	(10.2)	Not limited		6.25	(15.9)	Not limited		0.020[d]	(0.51)	0.023[d]	(0.58)
4.75	(12.1)	5.75	(14.6)	6.75	(17.1)	8.25	(21.0)	(24)		(24)	
6.0	(15.2)	Not limited		9.5	(24.1)	Not limited		0.026[d]	(0.66)	0.029[d]	(0.74)
7.0	(17.8)	8.75	(22.2)	10.0	(25.4)	12.5	(31.8)	(22)		(22)	
8.0	(20.3)	Not limited		12.0	(30.5)	Not limited		0.032	(0.81)	0.034	(0.86)
9.0	(22.9)	11.5	(29.2)	13.0	(33.0)	16.0	(40.6)	(20)		(20)	
12.5	(31.8)	Not limited		19.5	(49.5)	Not limited		0.042	(1.07)	0.045	(1.14)
14.0	(35.6)	18.0	(45.7)	21.0	(53.3)	25.0	(63.5)	(18)		(18)	
18.0	(45.7)	Not limited		27.0	(68.6)	Not limited		0.053	(1.35)	0.056	(1.42)
20.0	(50.8)	25.0	(63.5)	29.0	(73.7)	36.0	(91.4)	(16)		(16)	

Table 9.1 Continued on Next Page

Table 9.1 Continued

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness in inches (mm)	
Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length		Uncoated (MSG)	Metal coated (GSG)
inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)		

[a] A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal that is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and that has sufficient torsional rigidity to resist the bending moments that may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by designs that will produce a structure that is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes: (1) a single sheet with single formed flanges (formed edges), (2) a single sheet that is corrugated or ribbed, and (3) an enclosure surface loosely attached to a frame, for example, with spring clips

[b] The width is the smaller dimension of a rectangular sheet metal piece that is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.

[c] For panels which are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide.

Table 9.2
Minimum thickness of sheet metal for enclosures – aluminum, copper, or brass

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness,
Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length		
inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)	inch (mm)
3.0	(7.6)	Not limited		7.0	(17.8)	Not limited		0.023
3.5	(8.9)	4.0	(10.2)	8.5	(21.6)	9.25	(24.1)	(0.58)
4.0	(10.2)	Not limited		10.0	(25.4)	Not limited		0.029
5.0	(12.7)	6.0	(15.2)	10.5	(26.7)	13.5	(34.3)	(0.74)
6.0	(15.2)	Not limited		14.0	(35.6)	Not limited		0.036
6.5	(16.5)	8.0	(20.3)	15.0	(38.1)	18.0	(45.7)	(0.91)
8.0	(20.3)	Not limited		19.0	(48.3)	Not limited		0.045
9.5	(24.1)	11.5	(29.2)	21.0	(53.3)	25.0	(63.5)	(1.14)
12.0	(30.5)	Not limited		28.0	(71.1)	Not limited		0.058
14.0	(35.6)	16.0	(40.6)	30.0	(76.2)	37.0	(94.0)	(1.47)
18.0	(45.7)	Not limited		42.0	(106.7)	Not limited		0.075
20.0	(50.8)	25.0	(63.5)	45.0	(114.3)	55.0	(139.7)	(1.91)

[a] A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal that is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and that has sufficient torsional rigidity to resist the bending moments that may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by designs that will produce a structure that is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes: (1) a single sheet with single formed flanges (formed edges), (2) a single sheet that is corrugated or ribbed, and (3) an enclosure surface loosely attached to a frame, for example, with spring clips

[b] The width is the smaller dimension of a rectangular sheet metal piece that is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.

[c] For panels which are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide.

9.1.5 Steel enclosures shall be protected against corrosion by painting, plating, or other equivalent means.

9.1.6 If insulating material other than electrical insulation is provided within the enclosure, consideration is given to the burning characteristics and combustibility of the material and the proximity of an ignition source.

9.1.7 All intended mounting positions of the heat reclaimer are to be considered when determining if it complies with the requirement of 9.1.2 and 9.1.6.

9.2 Doors and covers

9.2.1 A cover or access panel of an enclosure for uninsulated live parts shall be provided with means for securing it in place.

9.2.2 A hinged or pivoted panel or cover shall be positioned or arranged so that it is not subject to falling or swinging due to gravity or normal vibration in such a manner as to cause injury to persons by the panel or cover, or by the hazardous moving parts or uninsulated live parts that are accessed due to opening of the cover.

9.2.3 The equipment shall be so arranged that an overcurrent protective device such as a fuse, the intended protection functioning of which requires renewal, can be replaced, and manual-reset devices can be reset without removing parts other than a service cover or panel and a cover or door enclosing the heat reclaimer. See 9.2.6.

9.2.4 A required protective device shall be inaccessible from outside the heat reclaimer without opening a door or cover, except that the operating handle of a circuit breaker, the operating button of a manually operable motor protector, the reset button of a manually resettable temperature switch, and similar parts may project outside the heat reclaimer enclosure.

9.2.5 A fuseholder shall be so constructed, installed, or protected that adjacent uninsulated high-voltage live parts within 4 inches (102 mm), other than the screw shell of a plug fuseholder, cartridge fuse clips, or wiring terminals to the fuseholder, will not be exposed to contact by persons removing or replacing fuses. An insulating barrier of vulcanized fiber or similar material employed for this purpose shall be not less than 0.028 inch (0.71 mm) in thickness.

9.2.6 The door or cover of an enclosure shall be hinged if it gives access to fuses or any motor overload protective device, the intended protective functioning of which requires renewal, or if it is necessary to open the cover in connection with the intended operation of the protective device such as resetting a manual reset overload protective device.

Exception: A hinged cover is not required if the only fuses enclosed are:

a) Control-circuit fuses of 2 amperes or less, provided the fuses and control-circuit loads, other than a fixed control-circuit load, such as a pilot lamp, are within the same enclosure, or

b) Extractor-type fuses each with its own enclosure, or

c) Fuses in low-voltage circuits.

9.2.7 Hinged covers, where required, shall not depend solely upon screws or other similar means requiring the use of tools to hold them closed, but shall be provided with a catch or spring latch.

9.2.8 A spring latch, a magnetic latch, a dimple, or any other mechanical arrangement that will hold the door in place and would require some effort on the user's part to open it is considered to be a means for holding the door in place as required in 9.2.7.

9.2.9 A door or cover giving direct access to fuses in other than low-voltage circuits shall shut closely against a 1/4-inch (6.4-mm) rabbet or the equivalent, or shall have either turned flanges for the full length of four edges or angle strips fastened to it. Flanges or angle strips shall fit closely with the outside of the wall of the box proper and shall overlap the edges of the box not less than 1/2 inch (12.7 mm). A construction which provides equivalent protection, such as a fuse enclosure within an outer enclosure or a combination of flange and rabbet may be used.

9.2.10 Strips used to provide rabbets, or angle strips fastened to the edges of a door, shall be secured at not less than two points, not more than 1-1/2 inches (38.1 mm) from each end of each strip and at points between these end fastenings not more than 6 inches (152 mm) apart.

9.3 Openings

9.3.1 During the examination for conformance with the requirements of 9.3.3, 9.3.4, and 9.3.5, a part of the enclosure, including air filters, which may be removed without the use of tools, is to be removed.

9.3.2 The acceptability of openings in an enclosure shall be determined on the basis of possible emission of flame, burning particles and molten metal and accessibility of bare live parts and film-coated wire in accordance with 9.3.4 – 9.3.13.

9.3.3 An opening in an enclosure to provide clearance around a dial, knob, lever, or handle shall not allow the entrance of a rod having a diameter of 9/64 inch (3.6 mm) at any setting or position of the dial, knob, or the like. The probe illustrated by Figure 9.1 shall not contact uninsulated live part or film-coated wire through such opening.

9.3.4 Except as permitted in 9.3.3 and 9.3.6 – 9.3.9, the enclosure shall have no openings other than:

a) Not more than four unused holes intended for mounting various components inside the enclosure. The largest dimension of each such opening shall not be greater than 5/32 inch (4.0 mm) (No. 8 screw diameter).

b) Not more than four holes 1/8 inch (3.2 mm) or less in diameter for the escape of air or drainage of paint during the painting process if they are located as close to the corners of the enclosure as possible.

9.3.5 Ventilating openings in an enclosure shall be judged on the basis of the necessity for their existence and their size and location in accordance with the following:

a) A ventilating opening shall be necessary to prevent the attainment of excessive temperatures on parts of the heat reclaimer, as demonstrated by a heating test with such opening(s) blocked.

b) Openings shall not be located in the bottom of the enclosure.

c) The location of the ventilating openings shall conform with the requirements of 14.2.6.

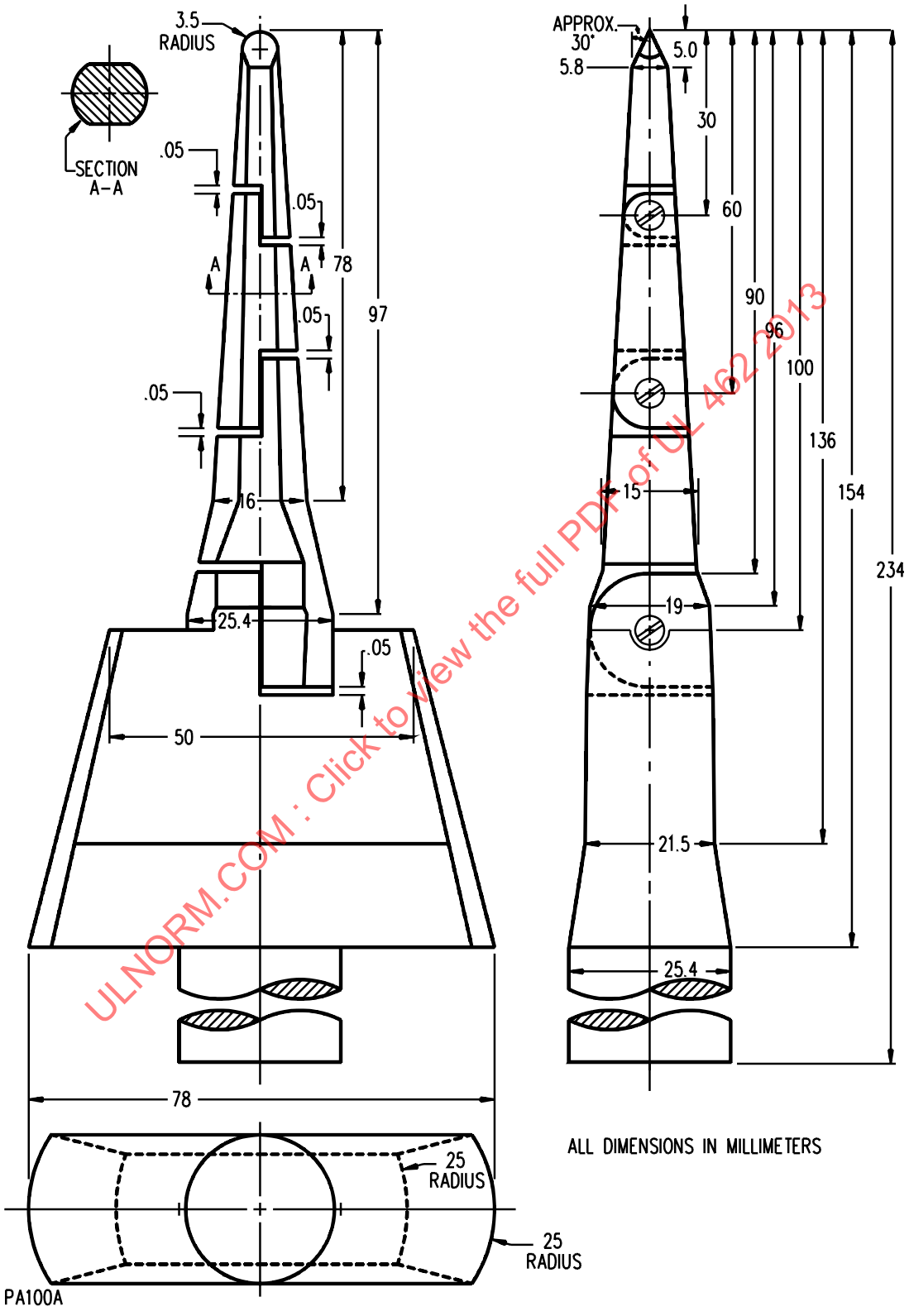
d) If an enclosure houses fuses, or any portion of a circuit breaker other than the operating handle, ventilating openings shall not be provided unless the construction affords containment of electrical fault disturbances equivalent to that provided by the requirements in 9.3.1 and 9.3.2.

e) The compartment or that part of an enclosure which contains field-wiring splices in the high-voltage circuit shall not be provided with ventilating openings.

f) There shall be no emission of flame or molten material, or other risk of fire, during all tests, such as transformer burnout and burnout of relays with blocked armature.

g) An opening shall not permit entrance of a 3/4-inch (19.1-mm) diameter rod.

Figure 9.1
Articulate probe with web stop



9.3.6 To reduce the likelihood of unintentional contact that may involve a risk of electric shock from an uninsulated live part or film-coated wire, an opening in an enclosure shall comply with either item a or b.

a) For an opening that has a minor dimension (see 9.3.10) less than 1 inch (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in Figure 9.1.

b) For an opening that has a minor dimension of 1 inch or more, such a part or wire shall be spaced from the opening as specified in Table 9.3.

Exception: An opening in an integral enclosure of a motor need not comply with these requirements if it complies with the requirements in 9.3.7.

Table 9.3
Minimum acceptable distance from an opening to a part that may involve a risk of electric shock

Minor dimensions of opening[a]		Minimum distance from opening to live part or file-coated wire	
Inches	**(mm)[b]**	**Inches**	**(mm)**
3/4	(19.1)[c]	4-1/2	(114)
1[c]	(25.4)[c]	6-1/2	(165)
1-1/4	(31.8)	7-1/2	(190)
1-1/2	(38.1)	12-1/2	(318)
1-7/8	(47.6)	15-1/2	(394)
2-1/8	(54.0)	17-1/2	(444)
d		30	(762)

[a] See 9.3.10.

[b] Between 3/4 and 2-1/8 inches, interpolation is to be used to determine a value between values specified in the table.

[c] Any dimensions less than 1 inch applies to a motor only.

[d] More than 2-1/8 inches, but not more than 6 inches (152.0 mm).

9.3.7 With respect to a part or wire as mentioned in 9.3.6, in an integral enclosure of a motor as mentioned in the exception to 9.3.6:

a) An opening that has a minor dimension (see 9.3.10) less than 3/4 inch (19.1 mm) is acceptable if:

1) Film-coated wire cannot be contacted by the probe illustrated in Figure 9.3;

2) In a directly accessible motor (see 9.3.11), an uninsulated live part cannot be contacted by the probe illustrated in Figure 9.2; or

3) In an indirectly accessible motor (see 9.3.11), an uninsulated live part cannot be contacted by the probe illustrated in Figure 9.2.

b) An opening that has a minor dimension of 3/4 inch or more is acceptable if a part or wire is spaced from the opening as specified in Table 9.3.

Figure 9.2
Probe for uninsulated live parts

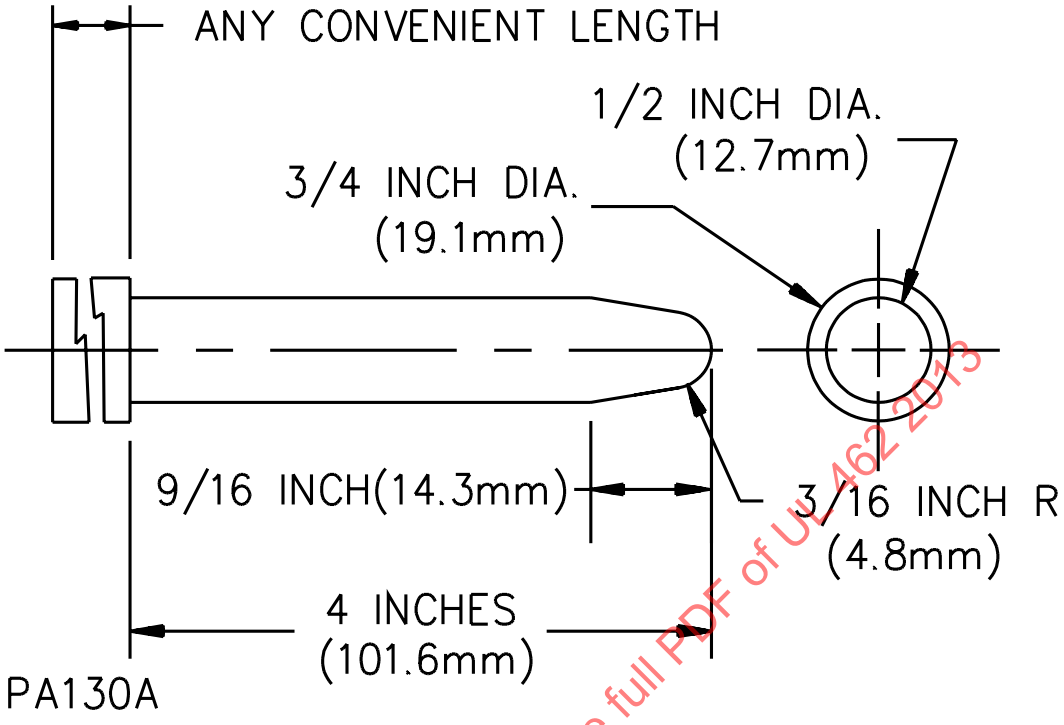
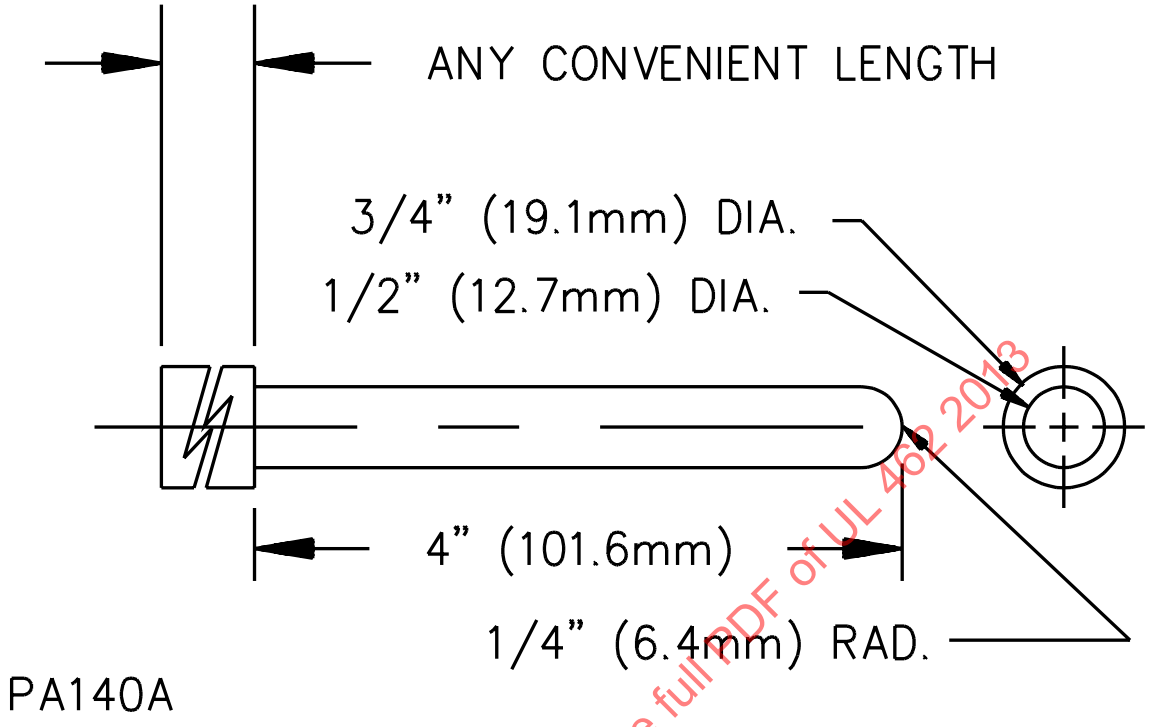
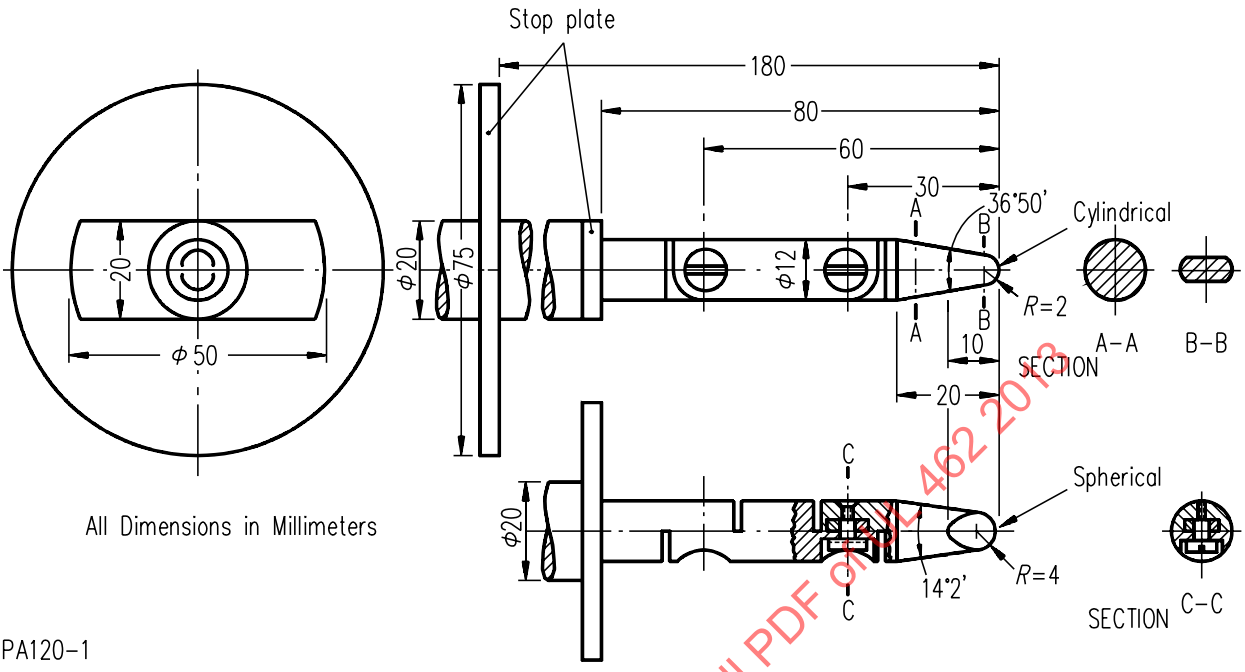


Figure 9.3
Probe for film-coated wire



9.3.8 The probes mentioned in 9.3.6, 9.3.7, and 9.3.9 and illustrated in Figures 9.1, 9.2, 9.3, and 9.4, shall be applied to any depth that the opening will permit; and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probes illustrated in Figures 9.1 and 9.4 shall be applied in any possible configuration; and, if necessary, the configuration shall be changed after insertion through the opening.

Figure 9.4
IEC articulate probe



9.3.9 The probes mentioned in 9.3.6, 9.3.7, and 9.3.8 shall be used as measuring instruments to judge the accessibility provided by an opening, and not as instruments to judge the strength of a material; they are to be applied with the minimum force necessary to determine accessibility.

9.3.10 With reference to the requirements in 9.3.6 and 9.3.7, the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

9.3.11 With reference to the requirements in 9.3.7, an indirectly accessible motor is a motor:

a) That is accessible only by opening or removing a part of the outer enclosure, such as a guard or panel, that can be opened or removed without using a tool, or

b) That is located at such a height or is otherwise guarded or enclosed so that it is unlikely to be contacted.

A directly accessible motor is a motor:

a) That can be contacted without opening or removing any part or

b) That is located so as to be accessible to contact.

9.3.12 During the examination of a product to determine whether it complies with the requirements in 9.3.7 or 9.3.8, a part of the enclosure that may be opened or removed by the user without using a tool (to attach an accessory, to make an operating adjustment, or for other reasons) is to be opened or removed.

9.3.13 With reference to the requirements in 9.3.7 and 9.3.8, insulating brush caps are not required to be additionally enclosed.

10 Supply Connections

10.1 General

10.1.1 In the following and particularly where wiring terminals or leads are mentioned, wiring connections are considered to be those which are made to the heat reclaimer when it is installed.

10.1.2 A heat reclaimer shall have provision for connection of one of the wiring systems that, in accordance with the National Electrical Code, NFPA 70, would be suitable for the heat reclaimer.

10.1.3 A heat reclaimer which is for use only with fittings of one type of wiring system shall be supplied with such a fitting and the heat reclaimer shall be marked to indicate that it must be installed with the applicable wiring system. The marking shall be located so that it is visible at the time the installation connections are made.

10.1.4 A heat reclaimer shall be provided with wiring terminals or leads for the connection of conductors of at least the size required by the National Electrical Code, NFPA 70, corresponding to the rating of the heat reclaimer.

10.1.5 A terminal box or wiring compartment shall be so located that wire connections therein will be accessible for inspection, without disturbing either high-voltage or safety-circuit wiring, after the heat reclaimer is installed in the intended manner.

10.2 Leads

10.2.1 The electrical and mechanical properties of the insulation on a lead wire intended for field-wired connections shall be equivalent to that of 1/32 inch (0.79 mm) thick thermoplastic, rated 600 volts. Such leads shall not be smaller than 18 AWG (0.82 mm^2) and shall have a free length of at least 6 inches (152 mm).

10.2.2 Leads for field connections shall be provided with strain relief to prevent mechanical stress from being transmitted to terminals, splices, or interior wiring. Each lead shall be capable of withstanding for 1 minute a pull of 10 pounds-force (4.5 N).

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

10.2.4 A lead intended for connection of a grounded supply conductor shall be finished to show a white or gray color and shall be distinguishable from all other leads, and no other conductor visible to the installer shall be so identified.

10.2.5 A power supply cord set may be shipped with the heat reclaimer for installation in the field. See 10.5.1 – 10.5.6.

10.3 Terminals

10.3.1 A wiring terminal shall consist of a pressure terminal connector fastened in place, such as by a bolt or screw, except that a wire-binding screw may be employed for a wiring terminal intended to accommodate a 10 AWG (5.3 mm^2) or smaller conductor if upturned lugs, corners, or the equivalent are provided to hold the wire in place.

10.3.2 A wire-binding screw shall be not smaller than No. 8 (4.2 mm diameter) except that a No. 6 (3.5 mm diameter) screw may be used for the connection of a conductor not larger than 14 AWG (2.1 mm^2).

10.3.3 A terminal plate tapped for a wire-binding screw shall be of metal not less than 0.030 inch (0.76 mm) in thickness for a 14 AWG (2.1 mm^2) wire and not less than 0.050 inch (1.27 mm) in thickness for a wire larger than 14 AWG (2.1 mm^2); and in either case, there shall be not less than two full threads in the metal.

10.3.4 Except for low-voltage ″nonsafety″ circuits, terminals shall be so constructed that the conductor will make metal-to-metal contact with the terminal plate as well as with any wire-binding screw when the conductor is secured to the terminal.

10.3.5 A terminal intended for connection of a grounded supply conductor shall be of or plated with metal that is substantially white in color and shall be readily distinguishable from other terminals, or identification of that terminal shall be shown in some other manner, such as on an attached wiring diagram.

10.3.6 A terminal solely for connection of an equipment-grounding conductor shall be capable of securing a conductor of the size intended for the particular application, in accordance with the National Electrical Code, NFPA 70.

10.3.7 A wire-binding screw intended for the connection of an equipment grounding conductor shall have a slotted, or hexagonal green-colored head. A pressure wire connector intended for connection of such a conductor shall be identified by being marked G, GR, GROUND, GROUNDING, or by a marking on a wiring diagram provided on the heat reclaimer. The wire-binding screw or pressure wire connector shall be so located that it is unlikely to be removed during intended servicing of the heat reclaimer.

10.3.8 If a heat reclaimer includes a lampholder of the Edison screw shell type, the identified grounded terminal or lead shall be electrically connected to the screw shell of the lampholder.

10.4 Wiring space

10.4.1 Space shall be provided within the enclosure of a heat reclaimer to allow room for the distribution and stowing of wires and cables required for the wiring of the heat reclaimer.

10.5 Power supply cords

10.5.1 If a power supply cord is shipped with the heat reclaimer for attachment by the installer, it shall be Type SJ or equivalent, or Type HSJ or equivalent if the need of a heat resistant cord is demonstrated by the Heating Test, Section 25, and Abnormal Heating Test, Section 26. The length of the cord shall be such that its free length will be more than 7 feet (2.1 m) but less than 8 feet (2.4 m) when attached.

10.5.2 The installation instructions furnished with the heat reclaimer shall include information in regard to use and connection of the power supply cord.

10.5.3 The power supply cord shall include an equipment grounding conductor and attachment-plug of the proper grounding type. The equipment grounding conductor shall show a continuous green color or a continuous green color with one or more yellow stripes.

10.5.4 A strain-relief bushing or a cord grip to prevent transmitting strain to the terminals to which the cord is to be connected shall be shipped with the cord. The strain-relief means shall prevent the cord from being pushed inward if such movement may result in exposure to excessive temperatures, reduction of spacings, or damage to the cord by moving parts.

10.5.5 The strain-relief means provided with the cord shall protect the cord from exposure to sharp edges which may be present at the entry hole.

10.5.6 When tested in accordance with 10.5.7, the strain-relief means provided on the flexible cord shall withstand for 1 minute, without displacement, a direct pull of 35 pounds-force (15.9 N) applied to the cord, with the connections within the heat reclaimer disconnected.

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

11 Current-Carrying Parts

11.1 Current-carrying parts shall be silver, copper, copper alloys, or other metal recognized for such use.

12 Switches and Controllers

12.1 A switch or other control device shall have a current and voltage rating no less than that of the circuit (load) it controls.

12.2 A switching device that interrupts the main power supply circuit to a heat reclaimer and includes a marked off position shall be of such construction that, when in the off position, it will disconnect all ungrounded conductors of the power supply circuit.

13 Mounting of Electrical Components

13.1 A switch, fuseholder, lampholder, or similar electrical component shall be mounted to prevent it from turning, except as noted in 13.2 – 13.5.

13.2 The requirement that a switch be prevented from turning may be waived if all of the following conditions are met:

a) The switch is of a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to turn the switch during intended operation of the switch.

b) The means for mounting the switch makes it unlikely that operation of the switch will loosen it.

c) The electrical spacings are not reduced below the required values if the switch rotates. See Section 20, Electrical Spacings.

d) The intended operation of the switch is by mechanical means rather than by direct contact by persons.

13.3 A lampholder of the type in which the lamp cannot be replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel, need not be prevented from turning if rotation cannot reduce spacings below the required values.

13.4 The means for preventing turning is to consist of more than friction between surfaces. A toothed lock washer which provides both spring take-up and an interference lock is acceptable as the means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

13.5 Uninsulated live parts shall be so secured to the base or mounting surface that they will be prevented from turning or shifting in position if such motion may result in a reduction of spacings below the values specified in Electrical Spacings, Section 19.

14 Internal Wiring

14.1 General

14.1.1 The wiring of high-voltage and safety-control circuits shall conform to the requirements in this section. The wiring of all circuits included in the heat reclaimer assembly shall be furnished as part of the heat reclaimer assembly.

14.1.2 Wiring shall be done with insulated conductors having current carrying capacity, voltage, and temperature ratings consistent with their use. A conductor, other than an integral part of a component, shall be not smaller than 18 AWG (0.8 mm^2).

14.1.3 Flexible metal conduit, if used, shall be not smaller than 3/8 inch (9.5 mm) electrical trade size. This does not apply to parts of components considered under other standards.

14.1.4 If flexible metal conduit is used it shall be mechanically secured within 12 inches (305 mm) on each side of every junction box except for lengths not over 36 inches (914 mm) where flexibility is necessary.

14.2 Wiring methods

14.2.1 Electrical wiring to a part which must be moved for intended servicing shall be arranged so that the part may be moved without breaking soldered connections or disconnecting conduit. Conductors to be disconnected from terminals of such parts shall terminate in eyelets or connectors. When the wiring to such a part is not readily detachable, the assembly shall include provision for support of that part by means other than the wiring when the part is moved for servicing. Any allowable movement of such part shall not unduly twist, bend, or pull the wiring.

14.2.2 Conductors shall be enclosed within conduit, electrical metallic tubing, metal raceways or electrical enclosures, or metal-clad cable, except as permitted by 14.2.5 – 14.2.7. Acceptable fittings shall be used.

14.2.3 Splices in wiring shall be located only in accessible junction boxes. Splices shall be made mechanically secure, soldered, and insulated with tape; or fixture-type splicing connectors may be employed.

14.2.4 The design of a wireway shall be such that the interconnection of sections and fittings will provide a rigid mechanical assembly and electrical conductivity. The interior of the wireway shall be free from burrs, sharp corners, or edges which might cause injury to the insulation on wires. Screws and bolts shall not project into the wireway unless sharp ends and threaded sections, other than the threaded sections of machine screws or bolts which do not project into the wireway more than 1/32 inch (0.8 mm), are covered or otherwise protected from contacting the wires.

14.2.5 Wiring within an enclosed compartment may be Type SJO or SJT cord or appliance wiring material having neoprene or thermoplastic insulation of equivalent thickness when supported and arranged to avoid being injured or disturbed during intended use of the heat reclaimer, and provided with strain relief.

14.2.6 An enclosed compartment is one having no opening in the bottom nor in a top located less than 24 inches (610 mm) above the wiring. Sides of the compartment may contain openings located at least 2 inches (50.8 mm) above the bottom and at least 2 inches from the wiring, provided such openings located less than 18 inches (457 mm) above the wiring are louvered and will not permit the passage in any direction of a rod having a diameter of 1/2 inch (12.7 mm).

14.2.7 Holes in metal walls, through which insulated wires not enclosed in conduit pass, shall be provided with smoothly rounded bushings, or shall have smooth, rounded surfaces, to prevent abrasion of the insulation.

14.2.8 A hole in porcelain, phenolic composition, or other nonconducting material and having a smoothly rounded surface is considered to be the equivalent of a bushing.

14.2.9 Bushings shall be phenolic, porcelain, or hard fiber. Ceramic materials and some molded composition are acceptable generally for insulating bushings; but bushings of wood or hot-molded shellac and tar compositions are not acceptable.

14.2.10 A fiber bushing shall be not less than 1/16 inch (1.6 mm) in thickness, with a minus tolerance of 1/64 inch (0.4 mm) for manufacturing variations, and shall not be employed where it will be subjected to a temperature higher than 90°C (149°F) under intended operating conditions.

14.2.11 To provide an unbushed opening in sheet metal the metal around the opening shall be rolled or extruded or both.

15 Separation of Circuits

15.1 Unless provided with insulation for the highest voltage involved, insulated conductors of different circuits (internal wiring) shall be separated by barriers or shall be segregated and shall, in any case, be separated or segregated from uninsulated live parts connected to different circuits or opposite-polarity parts of the same circuit.

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

15.3 A metal barrier shall have a thickness at least as great as that required by Table 9.1 or 9.2 based on the size of the barrier. A barrier of insulating material shall be not less than 0.028 inch (0.71 mm) in thickness and shall be of greater thickness if its deformation may be readily accomplished so as to defeat its purpose. Any clearance at the edges of a barrier shall be not more than 1/16 inch (1.6 mm) wide.

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

16 Bonding for Grounding

16.1 A heat reclaimer shall be provided with an equipment grounding terminal or lead.

16.2 Exposed or accessible noncurrent-carrying metal parts which are likely to become energized and which can be contacted by the user or by service personnel during service operations that may be performed when the equipment is energized shall be electrically connected to the point of connection of an equipment ground.

16.3 Except as indicated in 16.4, uninsulated metal parts of cabinets, electrical enclosures, motor frames and mounting brackets, controller mounting brackets, capacitors and other electrical components, or the like, are to be bonded for grounding if they may be contacted by the user or serviceman.

16.4 Metal parts as described below need not be grounded:

a) Adhesive-attached metal-foil markings, screws, handles, or the like, which are located on the outside of enclosures or cabinets and isolated from electrical components or wiring by grounded metal parts.

b) Isolated metal parts, such as magnet frames and armatures, small assembly screws, or the like, which are separated from wiring and uninsulated live parts.

c) Panels and covers which do not enclose uninsulated live parts if insulated parts and wiring are separated from the panel or cover.

d) Panels and covers which are insulated from electrical components and wiring by an attached insulating barrier of vulcanized fiber, varnished cloth, phenolic composition, or similar material not less than 1/32 inch (0.8 mm) thick.

16.5 If a component, such as a switch, is likely to become separated from its intended grounding means for purposes of testing or adjustment while the equipment is energized, it is to be provided with a grounding conductor not requiring removal for such service.

16.6 Splices shall not be employed in wire conductors used for bonding.

16.7 Metal-to-metal hinge bearing members may be considered as a means for bonding a door for grounding.

16.8 A separate bonding conductor shall be of material rated for use as an electrical conductor. Ferrous metal parts in the grounding path shall be protected against corrosion by enameling, galvanizing, plating, or equivalent means. A separate bonding conductor or strap shall:

a) Be protected from mechanical damage, such as by being located within the confines of the outer enclosure or frame, and

b) Not be secured by a removable fastener used for any purpose other than bonding for grounding, unless the bonding conductor is unlikely to be omitted after removal and replacement of the fastener.

16.9 The bonding shall be by a positive means, such as by clamping, riveting, bolted or screwed connection, or by welding, soldering, or brazing with materials having a softening or melting point greater than 454°C (850°F). The bonding connection shall penetrate nonconductive coatings such as paint or vitreous enamel.

16.10 A connection that depends upon the clamping action exerted by rubber or similar materials is acceptable if it complies with 16.12 under any degree of compression permitted by a variable clamping device, and if the results are still acceptable after exposure to the effects of oil, grease, moisture, and thermal degradation which are likely to occur in service. The effect of assembling and disassembling for maintenance purposes such a clamping device is to be considered with respect to the likelihood of the clamping device being reassembled in its intended position.

16.11 If bonding depends on screw threads, two or more screws or two full threads of a single screw shall engage the metal.

16.12 If the adequacy of a bonding connection cannot be determined by examination, or if a bonding conductor is smaller than required by 16.13 and 16.14, it shall be considered acceptable if the connecting means does not open when carrying for 2 minutes twice the current equal to the rating of the branch circuit overcurrent device required to protect the equipment.

16.13 The size of a conductor or strap employed to bond an electrical enclosure or motor frame shall be based on the rating of the branch circuit overcurrent device in which the equipment will be connected. Except as indicated in 16.12, the size of the conductor or strap shall be in accordance with Table 16.1.

16.14 A bonding conductor to a component or electrical enclosure is not required to be larger than the size of the conductors supplying power to the component or components within the enclosure.

Table 16.1
Bonding wire conductor size

Rating of overcurrent device, amperes	Size of bonding conductor[a]			
	Copper wire		Aluminum wire	
	AWG	$(mm)^2$	AWG	(mm^2)
15	14	(2.1)	12	(3.3)
20	12	(3.3)	10	(5.3)
30	10	(5.3)	8	(8.4)

[a] Or equivalent cross-sectional area

17 Motors and Motor Overcurrent (Overload) Protection

17.1 All motors shall be protected by an integral thermal protector, impedance protection, or by overcurrent protective devices, or combinations thereof.

17.2 Overcurrent protective devices as referred to in 17.1 mean overcurrent protective devices conforming to the requirements of the National Electrical Code, NFPA 70, as follows:

a) A separate overcurrent device which is responsive to motor current. This device shall be rated or selected to trip at no more than the percent of the motor full-load current rating indicated in column A of Table 17.1. Each winding of a multispeed motor is to be considered separately and the motor is to be protected at all speeds.

b) If the values specified for motor-running overcurrent-protection do not correspond to the standard sizes or rating of fuses or magnetic or thermal overload-protective devices, the next higher size or rating may be used, but not higher than the percent of motor full-load current rating indicated in column B of Table 17.1.

Table 17.1
Rating of overcurrent protective devices

Type of motor	Maximum rating of overcurrent device	
	A[a]	B[b]
Motors with a marked service factor not less than 1.5	125 percent	140 percent
Motors with a marked temperature rise not over 40°C (104°F)	125 percent	140 percent
All other motors	115 percent	130 percent

[a] See 17.2(a).
[b] See 17.2(b).

17.3 An integral thermal protective device shall comply with the requirements of the Standard for Overheating Protection for Motors, UL 2111 or the Standard for Thermally Protected Motors, UL 1004–3.

UL 1004-3 will replace Part III of UL 2111 effective September 15, 2014

17.4 Separate overcurrent-devices, except when included as part of a magnetic motor controller, are to be assembled as part of the assembly, and be readily identifiable as such after assembly to the heat reclaimer.

17.5 Motors, such as direct-drive fan motors, which are not normally subjected to overloads and which are determined to be protected against overheating due to locked-rotor current by a thermal or overcurrent-protective device, may be accepted under this requirement, provided it is determined that the motor will not overheat under actual conditions of use.

17.6 Impedance protected motors shall comply with the requirements of the Standard for Overheating Protection for Motors, UL 2111 or the Standard for Impedance Protected Motors, UL 1004–2, under the ambient temperature conditions to which the motor may be subjected in the normal use. See Stalled Blower Motor Test, Section 32.

UL 1004-2 will replace Part II of UL 2111 effective September 16, 2013

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

17.8 Motors having openings in the enclosure or frame shall be installed or shielded to prevent particles from falling out of the motor onto combustible material located within or under the assembly.

17.9 The requirement in 17.8 will necessitate the use of a barrier of noncombustible material under an open type motor unless:

a) The structural parts of the motor or the heat reclaimer, such as the bottom closure, provide the equivalent of such a barrier, or

b) The motor overload-protection device provided with a single-phase motor is such that no burning insulation or molten material falls to the surface that supports the heat reclaimer when the motor is energized under each of the following fault conditions, as applicable to the particular type of motor:

1) Open main winding,

2) Open starting winding,

3) Starting switch short-circuited, and

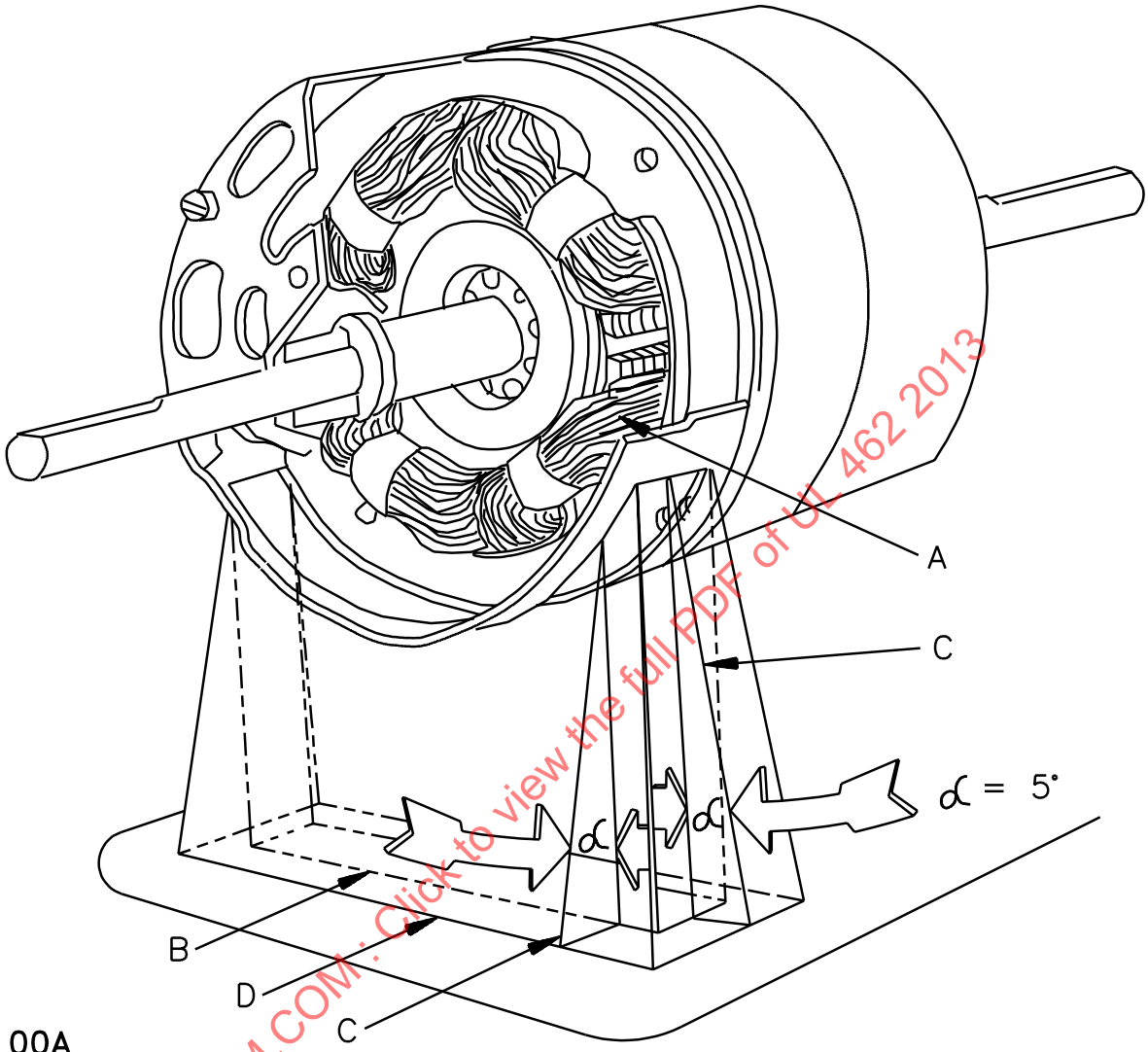
4) Capacitor shorted, permanent split capacitor type, or

c) The motor is provided with a thermal motor protector (a protective device that is sensitive to temperature and current) that will prevent the temperature of the motor windings from becoming more than 125°C (257°F) under the maximum load under which the motor will run without causing the protector to cycle and from becoming more than 150°C (302°F) with the rotor of the motor locked, (see Stalled Blower Motor Test, Section 32), or

d) The motor complies with the requirements for impedance-protected motors, and the temperature of the motor windings will not exceed 150°C (302°F) during the first 72 hours of operation with the rotor of the motor locked. See Stalled Blower Motor Test, Section 32.

17.10 The barrier mentioned in 17.9 shall be horizontal, shall be located as indicated in Figure 17.1, and shall have an area not less than that described in that illustration. Openings for drainage, ventilation, and the like, may be employed in the barrier, provided that such openings would not permit molten metal, burning insulation, or the like, to fall on combustible material.

Figure 17.1
Location and extent of barrier



a – Motor winding to be shielded by barrier. This is to consist of the entire motor winding if it is not otherwise shielded, and is to consist of the unshielded portion of a motor winding which is partially shielded by the motor enclosure or equivalent.

b – Projection of outline of motor winding on horizontal plane.

c – Inclined line which traces out minimum area of the barrier. When moving, the line is to be always (1) tangent in the motor winding, (2) 5 degrees from the vertical, and (3) so oriented that the area traced out on a horizontal plane is maximum.

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

18 Capacitors

18.1 A motor starting or running capacitor shall be housed within an enclosure or container which will protect the plates against mechanical damage and which will prevent the emission of flame or molten material resulting from impaired operation of the capacitor. Except as noted in 18.2 and 18.3, the container shall be of metal providing strength and protection not less than that of uncoated steel having a thickness of 0.020 inch (0.51 mm).

18.2 The individual container of a capacitor may be of material other than metal if the capacitor is mounted in an enclosure which houses other parts of the heat reclaimer and provided that such box, case, and the like, is acceptable for the enclosure of current-carrying parts.

18.3 If the container of an electrolytic capacitor is constructed of metal, it shall be insulated from dead metal parts by moisture resistant insulation not less than 0.028 inch (0.71 mm) thick, or it shall be separated from dead metal parts in accordance with the requirements specified in Electrical Spacings, Section 20.

19 Insulating Material

19.1 Material for the mounting of current-carrying parts shall be porcelain, phenolic composition, cold-molded composition, or equivalent material.

19.2 Ordinary vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not as the sole support of uninsulated live parts where shrinkage, current leakage, or warpage may introduce a risk of electric shock. Plastic materials may be accepted for the sole support of uninsulated live parts if found to have mechanical strength and rigidity, resistance to heat, resistance to flame propagation, dielectric withstand, and other properties as needed for the application.

20 Electrical Spacings

20.1 General

20.1.1 All uninsulated electrically live parts connected to different circuits shall be spaced from one another as though they were parts of opposite polarity, in accordance with the requirement of 20.2.1 and shall be judged on the basis of the highest voltage involved.

20.1.2 The spacing at wiring terminals is to be measured with appropriate wires in place and connected to the terminals as in actual service.

20.1.3 For the purpose of determining conformance with the minimum spacing requirements specified in 20.2.1 – 20.3.5 and Table 20.1 film coated wire is considered to be an uninsulated live part.

20.2 High-voltage circuits

20.2.1 Except as noted in 20.2.5, spacings in a heat reclaimer shall be not less than those indicated in Table 20.1. Greater spacings may be required if the enclosure, because of its size, shape, or the material used, is not considered to be sufficiently rigid to warrant the minimum spacings.

20.2.2 The determination as to whether a heat reclaimer is within the volt-ampere limitation with respect to the spacing requirements of Table 20.1 is to be made by power input measurement in accordance with 24.2.

20.2.3 If more than one load controlling component such as a switch or a relay is included in one enclosure, the spacing from one such component to another, and from any one component to the enclosure or other uninsulated dead metal part excluding its mounting surface, is based on the maximum voltage and total volt-ampere rating of the heat reclaimer and not on the individual component rating. The inherent spacings within an individual component (including spacings from a live part to the mounting surface other than the enclosure) are judged on the basis of the volt-ampere consumed and controlled by the individual component.

Table 20.1
Minimum spacing for high-voltage circuits at points other than fuseholders or inside motors

Item	Voltage range	Between any uninsulated live part and an uninsulated live part of opposite polarity, uninsulated grounded part other than the enclosure, or exposed metal parts				Between any uninsulated live part and walls of a metal enclosure including fittings for conduit of metal-clad cable[c]	
		Through air or oil		Over surface		Shortest distance	
		Inch	(mm)	Inch	(mm)	Inch	(mm)
A. General	0 – 150	1/8[a,b]	(3.2)	1/4[b]	(6.4)	1/2	(12.7)
	151 – 240	1/4[b]	(6.4)	3/8[b]	(9.5)	1/2	(12.7)
B. Maximum rating of 2000volt-amperes							
1. Safety circuits	0 – 240	1/8[b]	(3.2)	1/4[b]	(6.4)	1/4	(6.4)
2. Other than safety circuits	0 – 240	1/16[a]	(1.6)	1/16[a]	(1.6)	1/4	(6.4)

[a] The spacing between wiring terminals by which connections are to be made to the control, regardless of polarity, and between a wiring terminal and a dead metal part (including the enclosure) which may be grounded when the device is installed, shall be not less than 1/4 inch (6.4 mm).

[b] For safety circuits the spacings between uninsulated live parts of the same polarity, except at contacts, required to be not less than 1/32 inch (0.8 mm) through air and not less than 1/16 inch (1.6 mm) over the surface of insulating material, and the construction of the parts is required to be such that these spacings will be maintained permanently. For other than safety circuits the same polarity spacings are not specified and the minimum permissible spacings are based on acceptable performance during the tests.

[c] For the purpose of this requirement, a metal piece attached to the enclosure is considered to be a part of the enclosure if deformation of the enclosure is liable to reduce spacings between the metal piece and uninsulated live parts.

20.2.4 The inherent spacings within a component device such as a snap switch or lampholder, in other than a safety circuit, and the inherent spacings within a motor or clock motor, are judged under the requirements for the component. The spacings from such a component to another component and to the enclosure, and the spacings at wiring terminals are to be judged under the requirements in 20.2.1 and Table 20.1.

20.2.5 An insulating lining or barrier of vulcanized fiber or similar materials employed where spacings would otherwise be insufficient shall be not less than 0.028 inch (0.71 mm) thick and shall be so located or of such material that it will not be impaired by arcing.

Exception No. 1: Vulcanized fiber not less than 0.013 inch (0.33 mm) thick may be used in conjunction with an air spacing of not less than 50 percent of the spacing required for air alone.

Exception No. 2: Insulating material having a thickness less than 0.028 inch may be used if it has equivalent mechanical and electrical properties.

20.2.6 Unless of a material conforming to 19.1, a barrier or liner shall be used in conjunction with at least 1/32 inch (0.8 mm) air space.

20.2.7 Mica not less than 0.013 inch (0.33 mm) in thickness may be used in lieu of the through air spacing required in Table 20.1, provided the mica is tightly held in a fixed position by the parts between which the spacing is required.

20.2.8 If required in place of spacings between a magnet-coil winding and other uninsulated live parts or grounded dead metal parts, the type of insulation may differ from that specified in 20.2.5, and the type and thickness of crossover-lead insulation and insulation under coil terminals secured to the coil winding may be less than that specified in 20.2.6, provided that the coil is capable of withstanding the Dielectric Voltage-Withstand Test, Section 30, between coil-end leads after breaking the inner coil lead where it enters the layer, or an equivalent opposite polarity test. The application of the test potential is to be in accordance with 30.1 – 30.3.

20.3 Low-voltage circuits

20.3.1 Spacings shall be as indicated in 20.3.3 – 20.3.5 if a short circuit between the parts involved may result in impaired operation of the controlled equipment.

20.3.2 The spacing between an uninsulated live part and the wall of a metal enclosure, including fittings for the connection of conduit or metal-clad cable, shall be not less than 1/8 inch (3.2 mm).

20.3.3 The spacing between wiring terminals, regardless of polarity, and between a wiring terminal and a dead metal part (including the enclosure) which may be grounded when the device is installed shall be not less than 1/4 inch (6.4 mm).

20.3.4 The spacing between uninsulated live parts, regardless of polarity, and between an uninsulated live part and a dead metal part, other than the enclosure, which may be grounded when the device is installed, shall be not less than 1/32 inch (0.8 mm), provided that the construction of the parts is such that spacings will be maintained.

20.3.5 For low-voltage circuits where a short circuit between the parts involved does not result in impaired operation of the controlled equipment, the spacings between the uninsulated live parts are not specified and the minimum spacings required between such parts is based on acceptable performance during all tests.

PERFORMANCE

21 General

21.1 When a heat reclaimer is tested in accordance with these requirements, temperatures shall be maintained as specified in Table 25.3 on combustible construction adjoining the heat reclaimer and the chimney or vent connector, and on the various materials and components of the heat reclaimer.

21.2 After being tested in accordance with these requirements, the equipment shall be acceptable for further use.

21.3 Results indicating conformance with 21.2 include the following:

a) No part has become damaged or permanently distorted to an extent that it will not continue to function as intended.

b) The effectiveness of any required protected coating or finish on metal parts has not been impaired.

c) The reflectivity of a surface has not been impaired when the reflectivity of such surface is employed to reduce a risk of fire or excessive temperatures on parts of the heat reclaimer.

22 Mounting Positions

22.1 A heat reclaimer is to be tested in the position in which it is intended to be installed as specified in the installation instructions. A heat reclaimer that may be installed in several different mounting positions is to be tested in the position that is judged to be the most adverse for the particular test, as specified in 22.2 and 22.3.

22.2 The most adverse mounting position for a particular test is considered to be the one that is likely to influence the test results in the most unfavorable manner, such as causing higher temperatures on materials and components or influencing the operation of a temperature-operated control which is intended to provide compliance with the requirements in this standard, such as Operation Test, Section 26.

22.3 If the most adverse mounting position for a heat reclaimer is not definable or if different adverse conditions are introduced by different mounting positions, the tests shall be conducted in as many different positions as necessary to cover each adverse condition.

23 Test Voltages

23.1 Unless otherwise specified, the product is to be tested at the following potentials specified in Table 23.1, maintained at the supply connections provided.

Table 23.1
Test voltages

Nameplate voltage rating	Test voltage at 60 hertz[a]	
	Input test	All other tests
110 to 120	115	120
208	208	208
220 to 240	230	240

[a] Products rated at frequencies other than 60 hertz are to be tested at their rated voltages and frequencies.

24 Input Test

24.1 The power input to a heat reclaimer shall be not more than 110 percent of its marked rating.

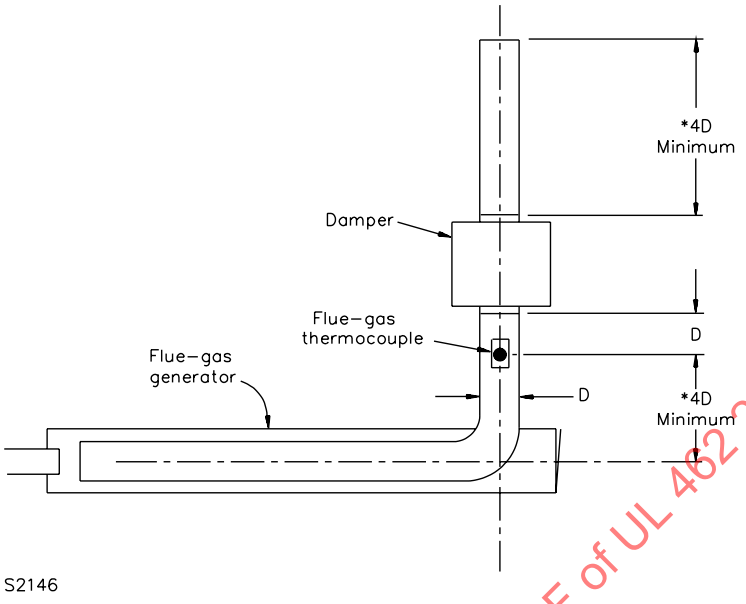
24.2 To determine if a heat reclaimer complies with the requirement in 24.1, the power input is to be measured with the heat reclaimer connected to a supply circuit of input test voltage in accordance with 23.1.

25 Heating Test

25.1 Test installation

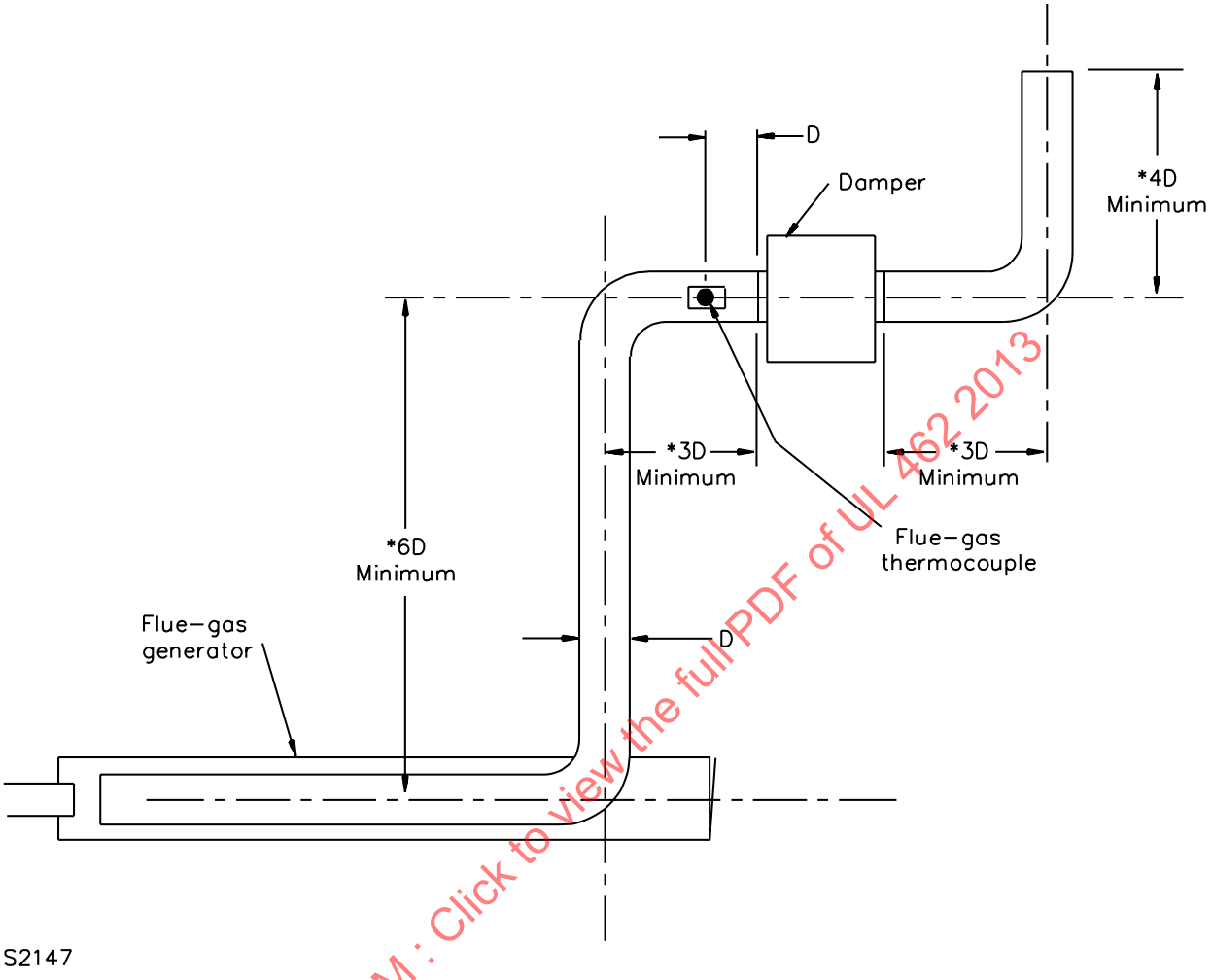
25.1.1 The heat reclaimer is to be installed in accordance with the manufacturer's instructions as part of a vertical or horizontal flue pipe assembly (see also 22.1) as shown in Figures 25.1 and 25.2, respectively. The diameter of the flue pipe is to be consistent with the size of the flue-pipe connections of the heat reclaimer.

Figure 25.1
Installation for heating test on vertical flue pipe assembly



*Greater dimensions may be used.

Figure 25.2
Installation for heating test on horizontal flue pipe assembly



*Greater dimensions may be used.

25.1.2 The flue gas generator illustrated in Figures 25.1 and 25.2 is to be used to supply flue gases to the vertical or horizontal flue-pipe assembly in which the heat reclaimers is installed. The flue gas generator is to be capable of producing flue gases at the specified test temperatures when fired at least at the inputs specified in Table 25.1.

Table 25.1
Flue-gas generator inputs

Equivalent nominal diameter of chimney or vent connector,		Input to flue-gas generator btu per hour (kW)			
Inches	(mm)	Column 1		Column 2	
6	(152)	48,500	14.2	59,200	17.4
7	(178)	65,800	19.3	80,500	23.6
8	(203)	86,200	25.3	106,000	31.1
9	(229)	109,000	31.9	133,000	39.0
10	(254)	135,000	39.6	165,000	48.4
12	(305)	195,000	57.2	238,000	69.8
14	(356)	264,000	77.4	323,000	94.7
16	(406)	345,000	101	421,000	123
18	(457)	436,000	128	533,000	156
20	(508)	539,000	158	658,000	193
22	(559)	662,000	191	808,000	237
24	(610)	776,000	227	947,000	278

25.1.3 The flue pipe assemblies, connected to the flue gas generator in which the heat reclaimer is to be installed, are to consist of standard stove pipe sections.

25.1.4 A partial enclosure, consisting of two adjoining walls forming a corner, is to be placed adjacent to the vent or chimney connector damper under test, and installed in a vertical flue pipe assembly shown in Figure 25.1. A wall and adjoining ceiling are to be placed on one side and above the heat reclaimer installed in a horizontal flue pipe assembly as shown in Figure 25.2. The enclosure parts simulating the walls and ceiling are to be placed at clearances from the heat reclaimer to combustibles as specified by the manufacturer, but not at a greater clearance than 18 inches (0.46 m) as measured from the side of the flue pipe inlet connector of the heat reclaimer.

25.1.5 The walls and ceiling of the partial enclosure are to extend at least 3 feet (0.9 m) beyond the extreme section(s) of the heat reclaimer. The partial enclosure is to be constructed of 1-inch trade size wood boards [3/4-inch (19 mm) thick], or 3/4 inch thick plywood, and finished flat black at the side facing the test sample.

25.2 Temperature measurements on other than electrical parts

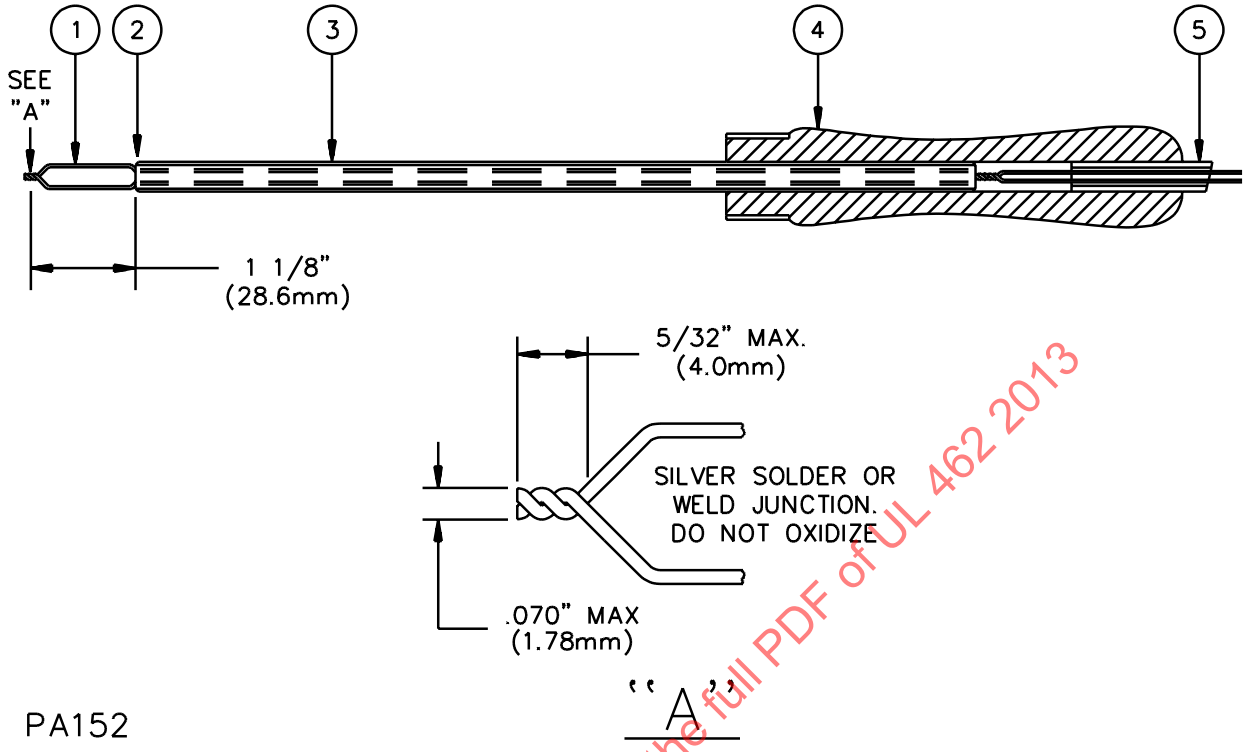
25.2.1 The flue-gas temperature is to be measured by a thermocouple, such as illustrated in Figure 25.3, inserted into the vertical or horizontal section of flue pipe as shown in Figures 25.1, 25.2, and 25.4 at a level one flue-pipe diameter below or upstream from the connection to the heat reclaimer.

25.2.2 A temperature other than the flue-gas temperature is to be measured by a thermocouple not heavier than 24 AWG (0.21 mm^2). The temperature attained by a part of the heat reclaimer is to be obtained by means of a thermocouple applied to assure positive thermal contact with the part. Such a thermocouple is to be located at a point attaining maximum temperatures. Additional thermocouples may be placed at other locations as deemed necessary.

25.2.3 The ambient temperature is to be determined by the use of a shielded thermocouple located at the elevation of the horizontal axis of the flue-gas generator and is to be on a vertical line located 24 inches (610 mm) horizontally from one wall of the test structure.

25.2.4 The measurements of temperature rises on the heat reclaimer parts and on the test structure are to be referenced to the recorded ambient temperatures as determined by 25.2.3.

Figure 25.3
Thermocouple for flue-gas temperature



1. 20 AWG (0.51 mm^2) iron-constantan, or woven-glass-covered thermocouples wires extending from hot junction to potentiometer or reference junction.

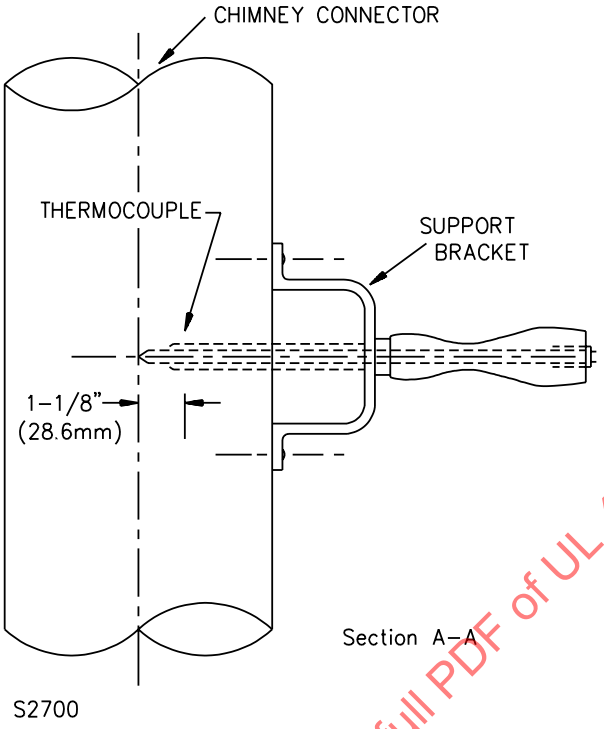
2. 1 – Leeds & Northrup Standard 714B, or equal, 1/4 inch (6.4 mm) outside diameter of two-hole porcelain insulator cut to length and ends beveled on two sides.

3. 1 – 5/16 inch (7.9 mm) outside diameter by 0.032 inch (0.81 mm) wall tubing. Ream, if necessary, to fit over insulator; then crimp ends over beveled ends of insulator.

4. 1 – Small wooden handle.

5. 1 – Piece of rubber tubing, approximately 5/16 by 3/32 by 2 inches long (7.9 by 2.4 by 50.8 mm).

Figure 25.4
Test setup for a stack-mounted control



25.2.5 A thermocouple is to be attached to a metal surface by silver soldering, brazing, or welding of the tip (junction) to the metal surface.

25.2.6 A thermocouple is to be secured to a wood surface by staples placed over the insulated portion of the wires. The 1/2 inch (12.7 mm) length of thermocouple tip is to be depressed flush with the wood surface at the point of measurement and held in thermal contact with the surface at that point by pressure-sensitive tape.

25.2.7 The wiring methods for thermocouple circuitry including junctions, terminals, switches, plugs, and jacks shall be such as to provide independent continuous routing of both thermocouple leads to the recording equipment.

25.3 Temperature measurement on electrical components

25.3.1 Thermocouple method

25.3.1.1 Temperatures of electrical components are to be measured by thermocouples, except that the change-in-resistance method may be used to measure the temperature of motor windings or of coils. The thermocouples are to consist of 24 – 30 AWG (0.21 – 0.05 mm^2) wires. The thermocouple wire is to conform to the requirements specified in the Tolerances on Initial Values of EMF versus Temperature tables in the Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples, ANSI/ASTM E230/E230M.

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

25.3.1.3 If thermocouples are used in the determination of temperatures in connection with the heating of electrical equipment, it is common practice to employ thermocouples consisting of 30 AWG (0.05 mm^2) iron and constantan wires and a potentiometer type of indicating instrument whenever referee temperature measurements by means of thermocouples are necessary.

25.3.2 Resistance method

25.3.2.1 If the temperature of a motor winding or coil is to be determined by the resistance method, the following formula is to be used:

$$T = (R_2/R_1) \times (k + t_1) - (k + t_2)$$

in which:

T = temperature rise in degrees C,

R_1 = resistance of the coil in ohms at the start of the test,

R_2 = resistance of the coil in ohms at the end of the test,

t_1 = room temperature in degrees C at the start of the test,

t_2 = room temperature in degrees C at the end of the test, and

k = 234.5 for copper and 225.0 for electrical conductor grade (EC) aluminum. Values of the constant for other grades must be determined.

25.3.2.2 If it is necessary to de-energize the winding before measuring R, the value of R at shutdown is to be determined by taking several resistance measurements at short intervals, beginning as quickly as possible after the instant of shutdown. A curve of the resistance values and the time is to be plotted and extrapolated to give the value of R at shutdown. The motor or coil winding is to be at room temperature at the start of the test.

25.4 Test method I (with air or water circulation)

25.4.1 The temperature rises shall not exceed the maximum rises specified in Table 25.2, Column 1 when tested as described in 25.4.2 – 25.4.5.

25.4.2 The test is to be started with the heat reclaimer and test enclosure at room temperature. The flue-gas generator is to be fired at least at the input specified in Table 25.1, Column 1 and regulated to produce flue gases entering the heat reclaimer at a temperature specified in Table 25.3, as appropriate. The temperature of the flue gases is to be measured at the location specified in 25.1.5.

25.4.3 A heat reclaimer that includes electrical circuits and components shall be connected to an electrical supply and energized at the corresponding test voltage specified in 23.1. If the heat reclaimer includes a manual ″on-off″ switch, the switch shall be in the ″on″ position at the start of the test. If the heat reclaimer includes an automatic temperature-operated control for the blower or water circulating pump, the control shall be permitted to operate as intended.

Table 25.2
Maximum temperature rises

Materials and components				Column 1 Degrees		Column 2 Degrees	
				C	(F)	C	(F)
A.	Motors[a,b]						
	1. Class A insulation systems on coil windings of alternating-current motors 7 inches (178 mm) or less in diameter (not including universal motors):						
		a. In open motors:					
			thermocouple or resistance method	75	(135)	115	(207)
		b. In totally enclosed motors:					
			thermocouple or resistance method	80	(144)	115	(207)
	2. Class A insulation systems on coil windings of alternating-current motors more than 7 inches (178 mm) in diameter and of direct-current and universal motors:						
		a. In open motors:					
			thermocouple method	65	(117)	115	(207)
			resistance method	75	(135)	115	(207)
		b. In totally enclosed motors:					
			thermocouple method	70	(126)	115	(207)
			resistance method	80	(144)	115	(207)
	3. Class B insulation systems on coil windings of alternating-current motors 7 inches (178 mm) or less in diameter (not including universal motors):						
		a. In open motors:					
			thermocouple or resistance method	95	(171)	140	(252)
		b. In totally enclosed motors:					
			thermocouple or resistance method	100	(180)	140	(252)
	3. Class B insulation systems on coil windings of alternating-current motors more than 7 inches (178 mm) in diameter and of direct-current and universal motors:						
		a. In open motors:					
			thermocouple method	85	(153)	140	(252)
			resistance method	95	(171)	140	(252)
		b. In totally enclosed motors:					
			thermocouple method	90	(162)	140	(252)
			resistance method	100	(180)	140	(252)

Table 25.2 Continued on Next Page

Table 25.2 Continued

Materials and components				Column 1		Column 2	
				Degrees		Degrees	
				C	(F)	C	(F)
B.	Components						
	1. Field-wiring terminals[m]			50	(90)	65	(117)
	2. Points on or within terminal box which may be in contact with field wiring[a]			35	(63)	60	(108)
	3. Capacitors:						
		a. electrolytic types[c]		40	(72)	(Not specified)	
		b. other types[d]		65	(117)	(Not specified)	
	4. Relay, solenoid, and other coils with:						
		a. Class 105 insulation system:					
			thermocouple method	65	(117)	115	(207)
			resistance method	85	(153)	115	(207)
		b. Class 130 insulation system:					
			thermocouple method	85	(153)	140	(252)
			resistance method	105	(189)	140	(252)
	5. Transformer enclosure with:						
		a. Class 2 transformers		60	(108)	85	(153)
		b. Power transformers		65	(117)	90	(162)
C.	Insulated conductors[e,f]						
	1. Appliance wiring material						
		75°C rating		50	(90)	65	(117)
		80°C rating		55	(99)	70	(126)
		90°C rating		65	(117)	80	(144)
		105°C rating		80	(144)	95	(171)
		200°C rating		175	(315)	200	(300)
		250°C rating		225	(405)	250	(450)
	2. Flexible cord – Types SO, ST, SJO, SJT			35	(63)	60	(108)
	3. Other types of insulated wires				See note c		
D.	Electrical insulation – general[f]						
	1. Class C electric insulation material				(Not specified)		
	2. Class (180) electrical insulation material			As determined by test			
	3. Fiber used as electrical insulation or cord bushings			65	(117)	90	(162)
	4. Phenolic composition used as electrical insulation or as parts where failure will result in a hazardous condition			125	(225)	150	(270)
	5. Thermoplastic material			25°C (77°F) less than its temperature rating			
	6. Varnished cloth insulation			60	(108)	85	(153)
E.	Metals[g]						
	1. Aluminum alloys:						
		a. 1100 (2S)		183	(330)	239	(430)
		b. 3003 (3S)		239	(430)	294	(530)
		c. 2014, 2107, 2024, 5052[h]		294	(530)	350	(630)
	2. Aluminum-coated steel, heat-resistance type[j]			572	(1030)	708	(1275)
	3. Carbon steel – coated with Type A19 ceramic			572	(1030)	628	(1130)
	4. Galvanized steel[j]			267	(480)	350	(630)
	5. Low-carbon steel, cast iron[k,1]			461	(830)	517	(930)
	6. Stainless steel:						
		a. Types 302, 303, 304, 321, 347		686	(1235)	767	(1380)
		b. Type 316		667	(1200)	748	(1345)
		c. Type 309S		867	(1560)	950	(1705)

Table 25.2 Continued on Next Page

Table 25.2 Continued

Materials and components			Column 1		Column 2	
			Degrees		Degrees	
			C	(F)	C	(F)
		d. Types 310, 310B	894	(1610)	975	(1755)
		e. Type 430	728	(1310)	808	(1455)
		f. Type 446	961	(1730)	1042	(1875)
F.	Adjacent combustibles					
	1. Test enclosure		65	(117)	97	(175)

[a] The motor diameter is to be measured in the plane of the laminations of the circle circumscribing the stator frame, excluding lugs, boxes, etc., used solely for motor cooling, mounting, assembly, or connection.

[b] Ordinarily, coil or winding temperatures are to be measured by thermocouples unless the coil is inaccessible for mounting of these devices (e.g., a coil immersed in sealing compound) or unless the coil wrap includes thermal insulation such as asbestos or more than two layers, 1/32 inch (0.8 mm) maximum, of cotton, paper, rayon, or the like. For a thermocouple measured temperature of a coil of an alternating-current motor having a diameter of 7 inches (178 mm) or less, the thermocouple is to be mounted on the integrally applied insulation on the conductor. At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature rise measured by a thermocouple may exceed the indicated maximum, provided that the temperature rise of the coil, as measured by the resistance method, is not more than that specified in the table.

1. 5°C (9°F) for Class A insulation on coil windings of alternating-current motors having a diameter of 7 inches (178 mm) or less, open type.

2. 10°C (18°F) for Class B insulation on coil windings of alternating-current motors having a diameter of 7 inches (178 mm) or less, open type.

3. 15°C (27°F) for Class A insulation on coil windings of alternating-current motors having a diameter of more than 7 inches (178 mm), open type.

4. 20°C (36°F) for Class B insulation on coil windings of alternating-current motors having a diameter of more than 7 inches (178 mm), open type.

[c] For an electrolytic capacitor which is physically integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure may be not more than 65°C (117°F).

[d] A capacitor which operates at a temperature higher than a 65°C (117°F) rise may be judged on the basis of its marked temperature rating.

[e] For standard insulated conductors other than those mentioned, reference should be made to the National Electrical Code; the maximum allowable temperature rise in any case is 25°C (77°F) less than the temperature rating of the insulation in question where Column 1 temperature rises are specified and the maximum allowable temperature rise where Column 2 rises are specified is to be based on the heat-resistant properties of the insulation.

[f] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds which have been investigated and found to have special heat-resistant properties.

[g] The specified maximum temperature rises apply to parts whose failure may cause the product to be unsuitable for use.

[h] See 8.5.

[i] When the reflectivity of aluminum coated steel is employed to reduce a fire hazard the maximum allowable temperature rise is 830°F (461°C).

[j] The specified maximum temperature rises apply when the galvanizing is required as a protective coating or the reflectivity of the surface is employed to reduce the risk of fire.

[k] The specified maximum temperature rises do not apply to parts of No. 8 gage (3.86 mm) or heavier steel and 3/16 inch (4.8 mm) thick or heavier cast iron employed for the hearth and to other parts of No. 12 gage (2.36 mm) or heavier steel, and 1/8 inch (3.2 mm) thick or heavier cast iron when: (1) the part is not the only enclosure, and (2) failure of the part will not expose adjacent combustible construction to the fire in the fire chamber.

[l] The specified maximum temperature rises do not apply to parts of 1/4 inch (6.4 mm) or heavier steel and 5/16 inch 7.9 mm) thick or heavier cast iron.

[m] The temperature rise observed on the terminals and at points within a terminal box may exceed the values specified, provided the heat reclaimer is marked in accordance with 31.2 and 31.3. The wiring may not attain a temperature rise higher than 65°C (117°F).

Table 25.3
Maximum flue gas temperatures for heating test

Type of heating appliance on which the heat reclaimer is intended to be installed	Minimum flue gas temperature above room ambient	
	Degrees F	Degrees C
Residential[a] gas burning appliances	500	278
Residential[b] oil burning appliances	930[c]	517[c]
Solid fuel burning appliances	930	517
Commercial and industrial gas or oil burning appliances	930[c]	517[c]

[a] A residential type gas burning appliance is considered one having the flue collar size not exceeding 6 inches (152 mm).

[b] A residential type oil burning appliance is considered one having the flue collar size not exceeding 8 inches (203 mm).

[c] A manufacturer may specify lower temperatures but not lower than 500°F (278°C) above room ambient, in which case the maximum flue gas temperature of the appliance with which the heat reclaimer may be installed shall be marked on the heat reclaimer and shall also be specified in the installation instructions.

25.4.4 A heat reclaimer that is intended to reclaim heat by heating water is to be connected to a water circulating system in which the temperature of water shall be maintained at 180 ±5°F (82 ±3°C). The flow of the water through the heat reclaimer shall be as specified by the manufacturer. If the heat reclaimer includes a temperature-operated control that limits the water temperature exiting the heat reclaimer to 210°F (99°C), the control is to be allowed to operate as intended. If the control operates to cut off the water circulation, the test is to be continued without the water circulation. See also 27.2.1.

25.4.5 The test is to be continued until equilibrium temperatures are attained on surfaces and parts of the heat reclaimer and the test enclosure.

25.5 Test method II (without air or water circulation)

25.5.1 The temperature rises shall not exceed the maximum rises specified in Table 25.2, Column 1, when tested as described in 25.5.2.

25.5.2 The test is to be conducted in the same manner as described in 25.4.2 – 25.4.5 except the electrical supply to the heat reclaimer is to be disconnected and no water is to be circulated through the heat reclaimer which is intended to heat water.