UL 2162

STANDARD FOR SAFETY

Commercial Wood-Fired Baking Ovens – Refractory Type

UL Standard for Safety for Commercial Wood-Fired Baking Ovens – Refractory Type, UL 2162

First Edition, Dated May 23, 2014

Summary of Topics

This revision of ANSI/UL 2162 dated August 1, 2019 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

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

The requirements are substantially in accordance with Proposal(s) on this subject dated May 17, 2019.

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UL 2162

Standard for Commercial Wood-Fired Baking Ovens – Refractory Type

Prior to the first edition, the requirements for the products covered by this standard were included in the Outline of Investigation for Commercial Wood-Fired Baking Ovens – Refractory Type, UL 2162.

First Edition

May 23, 2014

This ANSI/UL Standard for Safety consists of the First Edition including revisions through August 1, 2019.

The most recent designation of ANSI/UL 2162 as a Reaffirmed American National Standard (ANS) occurred on July 22, 2019. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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

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INTRODUCTION

1 Scope

1.1 These requirements apply to commercial wood-fired ovens intended for use by commercial establishments for the purpose of cooking or baking food products utilizing solid wood fuel. These ovens utilize as their primary enclosure, refractory materials.

1.2 For the purposes of this standard:

a) It is anticipated the ovens described in 1.1 will be vented by an exhaust hood as covered by the Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, NFPA 96, or an exhaust hood tested for compliance with the requirements in the Standard for Exhaust Hoods for Commercial Cooking Equipment, UL 710.

b) Minimum exhaust hood size including minimum height, depth, and length of the hood as well as minimum hood overhangs, minimum exhaust air flows, and maximum hood height above the oven shall be established as part of the investigation.

c) The seismic stability of the oven and support system is not anticipated in this document.

1.3 The wood-fired baking ovens as covered by these requirements are intended for installation in accordance with the National Electrical Code, NFPA 70, and other codes such as the International Mechanical Code and the Uniform Mechanical Code. The exhaust hoods referenced in these requirements are intended for installation in accordance with the Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, NFPA 96.

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.

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

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

b) Is superseded by a requirement in this standard.

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

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

3 Units of Measurement

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

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

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

5.3 WOOD-FIRED OVEN – A factory- or field-assembled oven intended to cook products utilizing solid wood fuels only.

6 Terminology

6.1 Use of the term "product" in these requirements refers to all wood-fired ovens or any part thereof covered by these requirements unless specifically noted otherwise.

CONSTRUCTION

7 Materials

7.1 An oven part shall be made of noncombustible corrosion-resistant materials. Metals shall not be used in combinations at any location within the assembly that may cause galvanic action.

7.2 The minimum thickness of sheet metal including any coatings and of other materials shall comply with Table 7.1.

Table 7.1
Minimum metal thickness

Material	inch	(mm)
Aluminum-coated steel Type T1-40 regular [0.40 oz per sq ft (0.12 kg/m^2)]	0.018	(0.46)
Aluminum alloys	0.016	(0.41)
Cast iron	0.125	(3.18)
Galvanized steel (G60 coating class)	0.018	(0.46)
Porcelain-enameled steel	0.032	(0.81)
Stainless steel	0.012	(0.30)
Steel (uncoated or painted)	0.042	(1.07)

7.3 Aluminum alloys containing more than 1 percent magnesium shall not be used when the reflectivity of the material is used to reduce the risk of fire.

7.4 The fire chamber of the oven and other parts in contact with flue gases that are visible after installation shall be of material having the durability and resistance to fire and heat equivalent to fire refractories, Series 300 or 400 stainless steel, aluminum-coated steel, cast iron, or 0.042 inch (1.07 mm) thick unprotected or painted steel.

7.5 Cast iron and unprotected and painted sheet steel complying with the requirements of notes (k) and (l) in Table 15.1 comply with the requirements of 7.4.

7.6 Parts that are in contact with flue gases and that are not visible after installation shall be of a material having the durability and resistance to corrosion, fire, and heat equivalent to fireclay tile or Series 300 or 400 stainless steel.

7.7 Thermal insulation material shall be of metal or of a mineral base.

7.8 Thermal insulation shall comply with the following conditions when the oven is tested in accordance with these requirements:

a) The insulation shall not show evidence of softening, melting, or deterioration.

b) Except for binder materials, thermal insulation material shall be noncombustible.

c) Thermal insulation shall not come into contact with the products of combustion.

d) Thermal insulation that is not self-supporting shall be applied to solid surfaces so that the insulation does not sag. An adhesive or cement used to attach such material shall retain its adhesive qualities at any temperature the adhesive may attain when tested in accordance with these requirements and at 0°F (minus 18°C).

e) Adhesives or cements used in the installation of insulating materials shall have a flame spread rating of 25 or less when tested in accordance with the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723.

f) A water-absorbing insulating material shall not be subject to wetting by condensation when installed as intended.

g) Asbestos material shall not be used.

7.9 A device shall be provided to indicate the oven operating temperature. This device shall measure either the oven air temperature or the temperature of the refractory material or both. An electrically operated temperature-indicating device shall comply with the applicable requirements in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873, or it shall be evaluated as an operating control with class A control functions to the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1 in addition to the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls, ANSI/UL 60730-2-9.

8 Assembly

8.1 An oven shall consist of all the essential parts necessary for the intended installation of the complete oven assembly. Each part of the assembly shall be constructed for ready attachment to the other without requiring alteration by the installer, such as cutting, threading, drilling, welding, or similar tasks.

Exception: An assembly or component part intended to be cut to length or to be fitted by the installer may be provided when means are furnished for joining any altered part to a companion part or assembly. All fasteners required to complete the assembly shall be provided with the product by the manufacturer. Drilling is not prohibited when:

a) The drilling operation does not weaken the assembly or penetrate into the flue liner; and

b) The size of the required drill bit is specified and the instructions clearly describe the locations to be drilled, such as by the use of drawings, descriptions, templates, or the like.

8.2 Two or more parts or subassemblies that bear a definite relationship to each other in the intended application shall be:

a) Arranged and constructed to permit them to be incorporated into the complete assembly without need for alteration or alignment and only in the intended relationship with each other; or

b) Assembled and shipped from the factory as one unit.

8.3 Each part, such as an oven flue section or support element, shall be completely assembled by the manufacturer at the factory.

8.4 When an oven flue assembly incorporates elbows, no part of the oven flue shall be at an angle of more than 30 degrees from the vertical at any point in the assembly, and the oven connector shall not include more than one offset (two elbows).

9 Joints

9.1 Parts of an oven shall be joined and secured so that they do not disengage when tested in accordance with these requirements.

9.2 When screws are used to join assemblies during installation, the assemblies to be joined shall provide for the use of screws without being punched or drilled, except as referenced in 8.1. A screw shall not extend into a flue-gas passage.

9.3 A joint shall not retain condensation nor permit condensation or grease to flow from the interior to the exterior of the oven.

9.4 A joint between sections of the oven, fabricated in accordance with the manufacturer's instructions, shall not permit passage of a 1/32 inch (0.81 mm) diameter rod.

10 Support Assembly

10.1 A support assembly shall maintain the minimum required clearance between an oven and combustibles.

10.2 The support assembly shall be able to support the oven assembly.

11 Ventilation Openings

11.1 Openings for air flow may be provided in the oven enclosure, but shall not be located in the passages serving to convey flue gases or oven vapors. Such openings shall not impair the structural integrity of the oven.

11.2 The openings for air flow specified in 11.1 shall be located within the outer assembly of the oven.

11.3 The openings for air flow specified in 11.1 shall be more than 1-1/2 inches (38.1 mm) above the floor and otherwise arranged so that unintentional closure is unlikely.

11.4 When the openings for air flow specified in 11.1 are likely to be blocked in the actual installation or by unintentional means, these openings are to be sealed for the tests in Sections 15 – 19.

PERFORMANCE

12 General

12.1 When an oven is tested in accordance with these requirements, specified temperatures on combustible construction shall be maintained.

12.2 After being subjected to the tests described in Sections 15 – 23 as applicable, an oven shall function as intended for further use.

12.3 Test results indicating compliance with the requirement in 12.2 include the following:

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

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

c) A refractory material shows no evidence of cracking, disintegration, or spalling to the extent that serviceability of any part of an assembly has been impaired.

d) Cracks are not observable in porcelain enamel used as a required protective coating when the surface is examined under a microscope of 60 magnification.

e) The reflectivity of a surface has not been impaired when the reflectivity is utilized to reduce the risk of fire.

f) Burning or scaling of metal parts is not evident upon visual observation.

g) The effectiveness of insulating material has not been reduced.

12.4 During and following tests on the oven, thermal insulation shall comply with the following requirements:

a) The insulating material shall remain in its intended position.

b) The thermal conductivity of the insulating material shall not be increased.

c) The thermal insulation and adhesive shall not show evidence of softening, melting, or other evidence of malfunction of deterioration.

13 Test Installations

13.1 General

13.1.1 Tests are to be conducted as described in Sections 15 – 23 on each type of oven. When the oven is manufactured in more than one size, tests are to be conducted on as many sizes as necessary to determine compliance with the requirements in Sections 15 – 23.

13.1.2 The temperature of the room and the entire test structure within the room is to be between 60 and 90°F (15.6 and 32.2°C) at the beginning of the temperature test.

13.2 Enclosure

13.2.1 The oven is to be placed in a four-sided enclosure consisting of a ceiling, a back wall, and two side walls. The walls and ceiling are to be made of 3/4-inch thick Douglas fir plywood painted flat black.

The ceiling is to be placed 8 feet (2.4 m) from the floor. The side walls are to extend a minimum of 4 feet (1.2 m) in front of the oven door opening. The side walls are to be placed 4 feet (1.2 m) to each side of the door opening unless the manufacturer's installation instructions specify a closer clearance. All joints or seams in the enclosure are to be sealed with pressure-sensitive tape or silicone caulking.

13.2.2 The oven is to be placed at the maximum height on the support frame described in the Installation and Operating Instructions, Section 26. The oven is to then be enclosed with 3/4-inch (19-mm) thick plywood painted flat black facing the oven. The enclosure is to be supported as described in the installation instructions. Any areas specified as non-combustible that would form the enclosure are to be sealed as recommended by the installation instructions or sealed with 3/8-inch (9.5-mm) thick ceramic fiber board.

13.2.3 The test structure is to be erected within a room having ventilation capable of maintaining the buildup of carbon monoxide to less than 50 parts per million throughout the period of any test. The room is to be free of drafts. During any one test the room temperature shall not increase more than 20°F (11°C) above the value recorded at the beginning of the test.

13.3 Exhaust hood

13.3.1 As part of the investigation, the minimum size exhaust hood complying with the requirements in the Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, NFPA 96, is to be installed over the oven in such a manner as to capture all smoke and vapors leaving the confines of the oven.

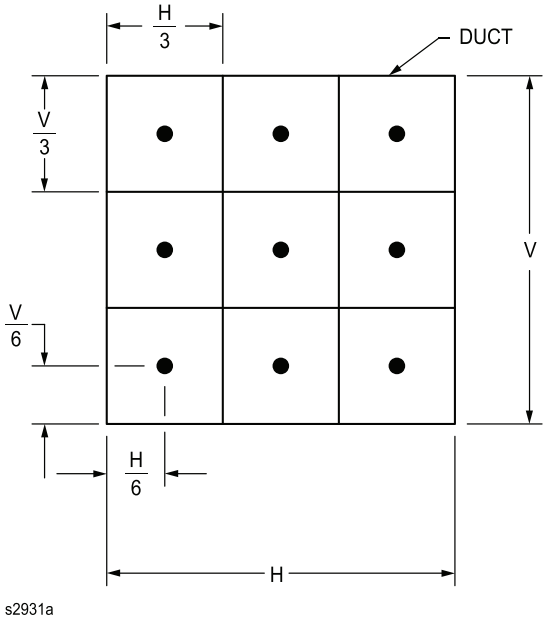
13.3.2 The exhaust hood is to be installed so that the minimum side, front, and when applicable, rear overhangs from the oven are as specified by the oven manufacturer. The hood is to be installed the maximum distance above the oven as specified by the oven manufacturer.

13.3.3 The hood air flow is to be measured while the oven is at room temperature 60 – 90°F (15.6 – 32.2°C).

13.3.4 The exhaust duct used during the test is to be connected to a power ventilator and should be sized so that the velocity through the exhaust collar is at least 1500 feet (457 m) per minute. Either the duct is to be provided with a damper or a suitable ventilator is to be used to permit adjustment of the air velocity.

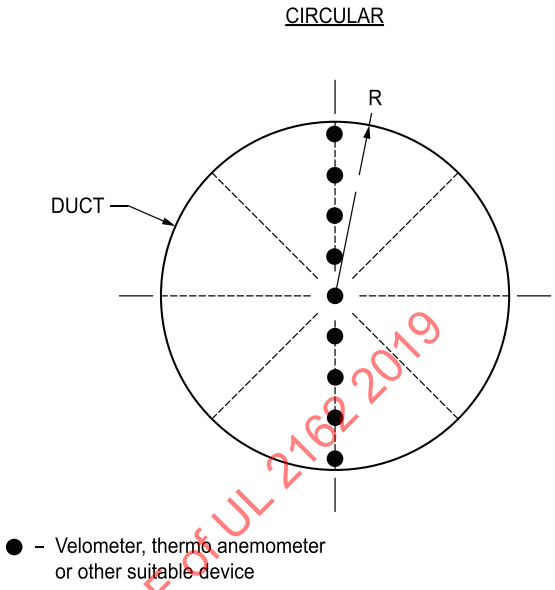
13.3.5 The exhaust air flow is to be adjusted to produce 1500 feet (457 m) per minute air flow through the exhaust duct. The supply air blower (when provided) shall be off. The exhaust air flow is to be measured in the exhaust duct at a distance not less than 3 times the diameter of the duct from the exhaust collar and/or from any elbows or bends within three diameters upstream or downstream. A minimum of nine measurements at one plane in the duct shall be averaged to determine the air flow rate. Measurements shall be made with a calibrated velometer, thermo anemometer, or other suitable device. The measurements are to be made at various locations within the duct, symmetrically located as shown in Figure 13.1. The measurements are to be made with the cooking appliance removed from beneath the exhaust hood or in the unheated state.

Figure 13.1
Air flow measurement location in test duct



Rectangular

Rectangular duct divided into nine equal areas as illustrated with air flow measurement devices located in the center of each of the resulting nine areas.



Circular

Circular duct divided equally into nine locations along the diameter of the duct with air flow measurement devices located as illustrated.

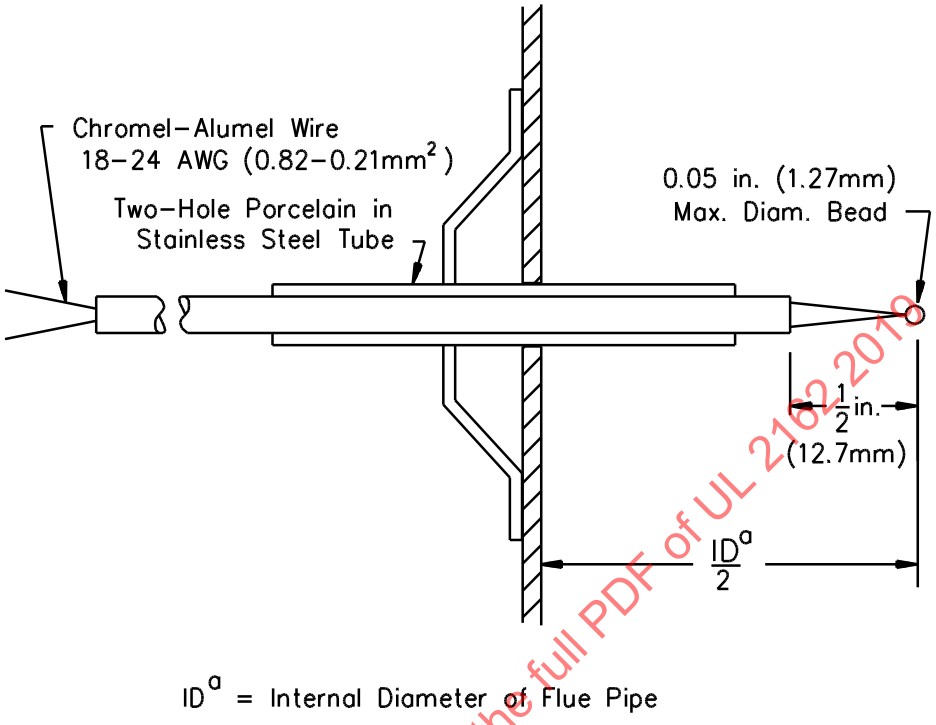
13.4 Wood storage

13.4.1 When the oven is provided with wood storage or the installation instructions provide for wood storage in the vicinity of the oven, temperatures on the wood storage compartment are to be measured. Unless specific details are provided on the material and ventilation to be utilized for the wood storage compartment, the wood storage compartment is to be constructed of 16 gauge steel painted flat black and is to be sealed on all sides during test.

14 Temperature Measurement

14.1 During all tests the outlet flue-gas temperature of the oven and exhaust hood is to be determined by thermocouples as shown in Figure 14.1. The thermocouples are to be Type K (chromel-alumel) of 24 AWG (0.21 mm^2) to 18 AWG (0.82 mm^2) wire with an untwisted, welded bare-lead junction not more than 0.05 inch (1.27 mm) in diameter. The thermocouples are to be positioned in the center line of the oven outlet and exhaust hood outlet.

Figure 14.1
Flue-gas thermocouple and support bracket



14.2 Temperatures of other than flue gases and metal surfaces are to be measured using either Type J (iron-constantan) or Type K (chromel-alumel) thermocouples of wire not larger than 24 AWG (0.21 mm^2).

14.3 Temperatures of metal surfaces other than handles and electrical components are to be measured using Type J (iron-constantan) or Type K (chromel-alumel) thermocouples of wire not larger than 18 AWG (0.82 mm^2).

14.4 The thermocouple wire insulation is to have a temperature use rating higher than the temperatures to which it may be subjected during these tests.

14.5 The ambient temperature is to be determined by using a thermocouple that is shielded by being centrally located within a vertically-oriented, 6-inch (152-mm) length of painted aluminum 2-inch (50.8-mm) steel pipe complying with Welded and Seamless Wrought Steel Pipe, ASME B36.10M, open at both ends.

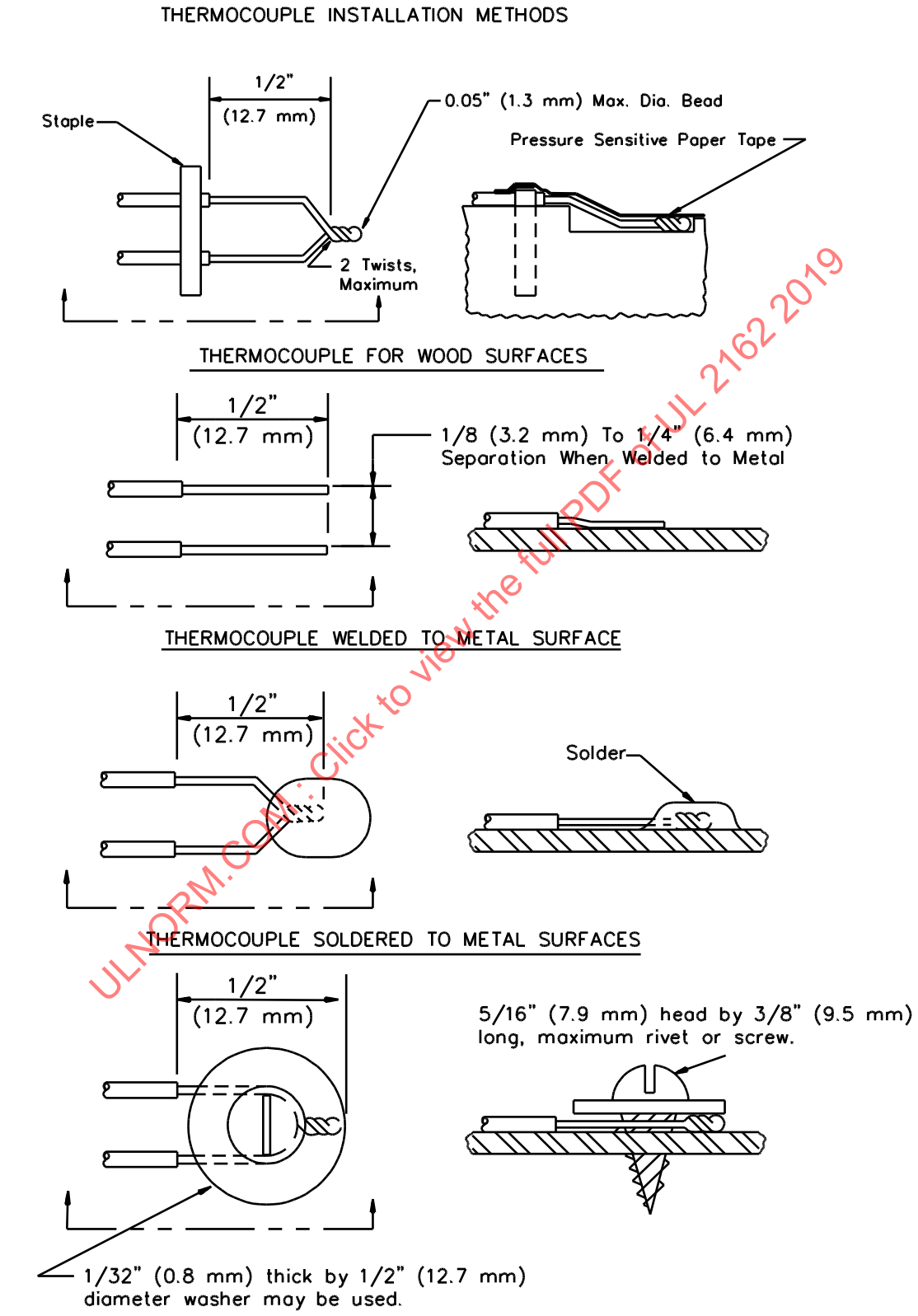
14.6 The shielded thermocouple described in 14.5 is to be located 6 inches (152 mm) from the side wall, 4 feet (1.2 mm) above the floor, and a distance in front of the unit equal to at least the minimum clearance of the unit from the back wall (as specified by the manufacturer) but not less than 7 feet (2.1 m) from the back wall.

14.7 When the oven is intended to take combustion or cooling air from the outside of a building, the ambient temperature of the space outside of the test structure but within the test room, is to be measured by means of a shielded thermocouple located on the same horizontal plane as the opening provided for the admission of outside combustion or cooling air and 3 feet (0.9 m) from the opening.

14.8 The measurement of temperature rises on the oven and oven parts and on the test structure is to be referenced to the recorded ambient temperatures measured as described in 14.5.

14.9 Thermocouples are to be attached to metal surfaces by screws, rivets, or by silver soldering, brazing, or welding of the tip to the metal surface as shown in Figure 14.2.

Figure 14.2
Thermocouple installation methods



14.10 Thermocouples are to be secured to wood surfaces by staples placed over the insulated portion of the wires. The thermocouple tip is to be depressed into the wood so as to be flush with the wood surface at the point of measurement and held in thermal contact with the surface at that point by pressure-sensitive paper tape. See Figure 14.2.

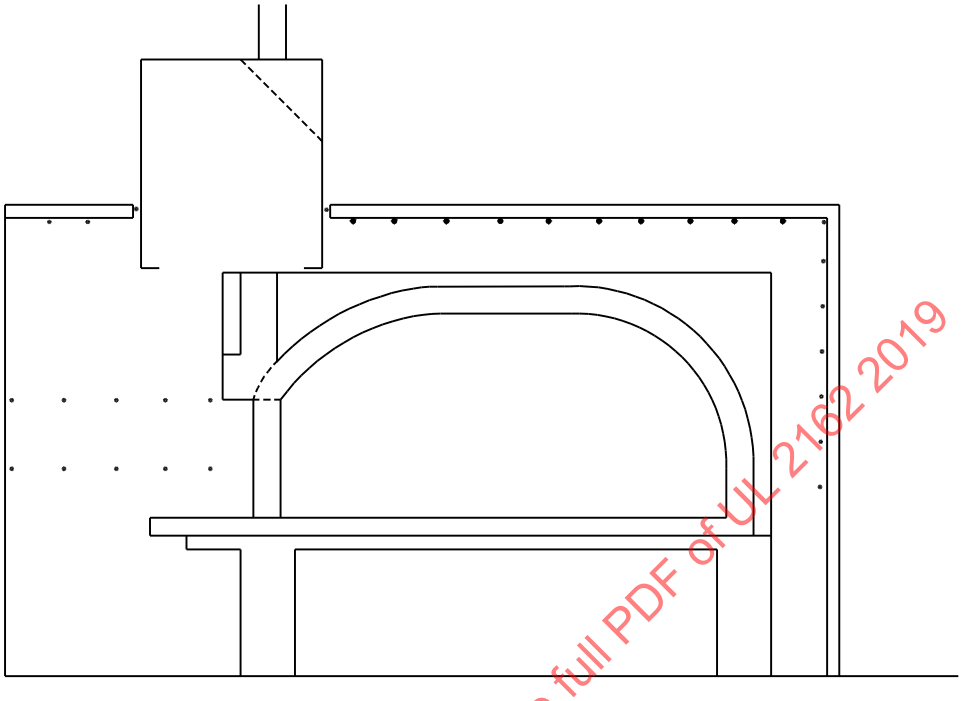
14.11 Thermocouples are to be attached to cement-like material surfaces by having the 1/2 inch (12.7 mm) tip and at least 1 inch (25.4 mm) of the lead wires embedded into the material so as to be flush with the surface of the material. Furnace cement is to be smoothed over such indentations to maintain thermal contact.

14.12 Thermocouples are to be attached to surfaces and electrical components, other than those described in 14.9 – 14.11, by being cemented or taped to the surface in a manner to maintain thermal contact with the surface. Materials and parts whose temperatures are to be measured are included in Table 15.1. Temperatures on electrical conductors are to be measured on the surfaces of the conductor insulation.

14.13 The wiring methods for thermocouples circuitry, including junctions, terminals, switches, plugs, and jacks, are to be constructed to provide independent continuous routing of both thermocouple leads to the recording equipment.

14.14 Thermocouples are to be placed on surfaces of the test structure at various locations as may be required to measure maximum temperatures during tests. A minimum number of typical thermocouple locations are shown in Figure 14.3.

Figure 14.3
Thermocouple locations



SM661

• = Thermocouple location

Thermocouple symmetrically located on the enclosure to the left, right, back, top, and front of the oven. Thermocouples to be 6 inches (152.4 mm) on-center.

14.15 When test enclosure elements are in contact with the oven or oven parts, thermocouples are to be placed on the oven or on oven part surfaces at representative points of contact.

Exception: When a point or line contact of a spacer with an enclosure is not greater than 1/8 inch (3.2 mm) diameter or width, thermocouples are to be placed on the test enclosure at points 1/2 inch (12.7 mm) from the center of the point of line contact.

14.16 Thermocouples are to be attached to the oven and oven enclosure at various locations as may be required to measure maximum temperatures during the tests. A minimum number of locations include the following:

a) Next to each device utilized to monitor oven operating temperatures as required in 7.9.

b) Extending into the oven 1 inch (25.4 mm) below the top of the oven ceiling at the center of the oven.

c) Centered at the terminus to the oven flue gas and cooking vapor outlet.

d) Centered at the terminus of the exhaust hood outlet connection to the grease duct.

e) On all combustible enclosure materials.

f) On any point of contact of any enclosure to the oven assembly.

g) On any surfaces utilized for wood storage.

h) Any handle or knobs used.

15 Fire Tests

15.1 When a wood-fired oven incorporates an integral grate, the grate is to be used during the tests specified in Sections 16 – 19.

15.2 When a wood-fired oven does not incorporate a grate and is intended to be used with wood only, the fire tests are to be conducted with the brands on the hearth and the unit shall bear the visible marking, "DO NOT USE GRATE OR ELEVATE FIRE – BUILD WOOD FIRE DIRECTLY ON HEARTH."

15.3 The surface temperature on the largest amount of material used in a handle or knob for use on a wood-fired oven door shall not exceed the temperature specified in Table 15.1, Column 1, during the Normal Operation Fire Test, Section 17, and the Flame Spillage Fire Test, Section 19.

Exception: The temperature limitation does not apply to knobs used for adjusting combustion air inlets or damper handles that do not require adjustment during operation.

Table 15.1
Maximum temperature rises

Materials and components	Column 1, °C	Column 1, (°F)	Column 2, °C	Column 2, (°F)
A. MOTORS[a,b,c]				
1. Class A insulation on coil windings of an alternating-current motor 7 inches (178 mm) or less in diameter (not including a universal motor):				
a) In an open motor:				
Thermocouple or resistance method	75	(135)	115	(207)
b) In a totally enclosed motor:				
Thermocouple or resistance method	80	(144)	115	(207)
2. Class A insulation on coil windings of an alternating-current motor more than 7 inches (178 mm) in diameter and of direct-current and universal motors:				
a) In an open motor:				
Thermocouple method	65	(117)	115	(207)
Resistance method	75	(135)	115	(207)
b) In a totally enclosed motor:				
Thermocouple method	70	(126)	115	(207)
Resistance method	80	(144)	115	(207)
3. Class B insulation systems on coil windings of an alternating-current motor 7 inches (178 mm) or less in diameter (not including a universal motor):				
a) In an open motor:				
Thermocouple or resistance method	95	(171)	140	(252)
b) In a totally enclosed motor:				
Thermocouple or resistance method	100	(180)	140	(252)
4. Class B insulation systems on coil windings of an alternating-current motor more than 7 inches in diameter and of direct-current and universal motors:				
a) In an open motor:				
Thermocouple method	85	(153)	140	(252)
Resistance method	95	(171)	140	(252)
b) In a totally enclosed motor:				
Thermocouple method	90	(162)	140	(252)
Resistance method	100	(180)	140	(252)
B. COMPONENTS[c]				
1. Capacitors:				
a) Electrolytic types[d]	40	(72)	Not specified	
b) Other types[e]	65	(117)	Not specified	
2. Relay, solenoid, and other coils with:				
a) Class 105 insulation systems:				
Thermocouple method	65	(117)	115	(207)
Resistance method	85	(153)	115	(207)
b) Class 130 insulation systems:				
Thermocouple method	85	(153)	140	(252)
Resistance method	105	(189)	140	(252)

Table 15.1 Continued on Next Page

Table 15.1 Continued

Materials and components	Column 1, °C	Column 1, (°F)	Column 2, °C	Column 2, (°F)
3. Transformer enclosure[b]:				
a) Class 2 transformers	60	(108)	85	(153)
b) Power and ignition transformers	65	(117)	90	(162)
C. INSULATED CONDUCTORS[c,f,g]				
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	(360)
250°C rating	225	(405)	250	(450)
2. Flexible cord – Types HSJ, HSJO, SJO, SJT, SO, ST:				
60°C rating	35	(63)	60	(108)
75°C rating	50	(90)	65	(117)
90°C rating	65	(117)	80	(144)
105°C rating	80	(144)	95	(171)
3. Other types of insulated wires	See note f			
D. ELECTRICAL INSULATION – GENERAL[c,g]				
1. Class C electrical 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 malfunction will result in a risk of fire or electric shock	125	(225)	150	(270)
5. Thermoplastic material	25°C or 77°F less than its temperature rating			
6. Varnished cloth insulation	60	(108)	85	(153)
E. METALS[h]				
1. Aluminum alloys:				
a) 1100	183	(330)	239	(430)
b) 3003	239	(430)	294	(530)
c) 2014, 2017, 2024, 5052[i]	294	(530)	350	(630)
2. Aluminum-coated steel, heat-resistant-type[j]	572	(1030)	708	(1275)
3. Carbon steel – coated with Type A19 ceramic	572	(1030)	628	(1130)
4. Galvanized steel[k]	267	(480)	350	(630)
5. Low-carbon steel, cast iron[l,m]	461	(830)	517	(930)
6. Stainless steel:				
a) Types 302, 303, 304, 321, 347	686	(1235)	767	(1380)
b) Type 316	667	(1200)	748	(1346)
c) Type 309S	867	(1560)	950	(1710)
d) Types 310, 310B	894	(1610)	975	(1755)
e) Type 430	728	(1310)	808	(1455)

Table 15.1 Continued on Next Page

Table 15.1 Continued

Materials and components	Column 1, °C	Column 1, (°F)	Column 2, °C	Column 2, (°F)
f) Type 446	961	(1730)	1042	(1875)
F. GENERAL				
1. Operating knobs, handles, and levers[n]:				
a) Metallic	50	(122)	Not specified	
b) Glass	78	(172)	Not specified	
c) Plastic[o]	85	(185)	Not specified	
d) Wood	150	(302)	Not specified	

[a] The motor diameter is to be measured in the plane of the laminations of the circle circumscribing the stator frame, excluding lugs, boxes, and the like, 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 (for example, a coil immersed in sealing compound) or unless the coil wrap includes thermal insulation or more than 2 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 of 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 by the amount noted below when 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 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 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, 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, open type.

[c] Maximum temperature rises are based on an ambient temperature of 25°C (77°F).

[d] For an electrolytic capacitor that 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).

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

[f] For standard insulating conductors other than those specified, reference should be made to the National Electrical Code, ANSI/NFPA 70. The maximum allowable temperature rise in any case is 25°C or 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. Column 2 temperature rises are 15°C (27°F) higher than Column 1.

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

[h] The specified maximum temperature rises apply to parts whose malfunction may cause the product to be unacceptable for use.

[i] These and other alloys containing more than 1 percent magnesium shall not be used when the reflectivity of the material is used to reduce the risk of fire.

[j] When the reflectivity of aluminum coated steel is used to reduce the risk of fire, the maximum allowable temperature rise is 830°F (461°C).

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

[l] The specified maximum temperature rises shall not apply to parts of 0.152 inch (3.86 mm) thick or heavier steel and 3/16 inch (4.8 mm) thick or heavier cast iron used for the hearth, and to other parts of 0.093 inch (2.36 mm) thick 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. Malfunction of the part will not expose adjacent combustible construction to the fire in the fire chamber.

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

Table 15.1 Continued on Next Page

Table 15.1 Continued

Materials and components	Column 1, °C	Column 1, (°F)	Column 2, °C	Column 2, (°F)
[n] Temperatures are maximum temperatures, based on an ambient temperature of 21°C (70°F).				
[o] Includes plastic with a metal plating not more than 0.005 inch (0.13 mm) thick; and metal with a plastic or vinyl covering not less than 0.005 inch thick.				

15.4 Temperatures of the flue gases and the oven operating temperatures are to be recorded at regular intervals not exceeding 30 minutes for the duration of the fire tests.

15.5 When an oven is provided with an ash drawer, the oven is to be operated during the Rapid Fire, Normal Operation Fire, and Abnormal Operation Fire Tests, Sections 16 – 18, with the ash door in any position including open that develops the maximum temperature.

Exception: The ash door may be closed during these tests when a marking with the word "CAUTION" and the following or equivalent is provided on the ash door: "Risk of Excessive Temperatures, Keep Ash Door Closed During Firing of the Oven."

15.6 During the Rapid Fire, Normal Operation Fire, and Abnormal Operation Fire Tests, Sections 16 – 18, thermostatic controls, adjustable flue-gas dampers, air inlets, and the like are to be adjusted to produce the maximum temperatures.

15.7 When the mechanism of a thermostatic control is accessible, the control is to be bypassed when bypassing produces higher temperatures.

15.8 With reference to the requirements of 15.7, a control is considered accessible if:

a) Access to the control mechanism may be gained by the use of simple hand tools, such as a flat-blade or Phillips head screwdriver, hand pliers, wrenches, and the like, or

b) The control can be modified or its purpose defeated by mechanical means such as by connection of a piece of wire to bypass its operating characteristics.

15.9 Throughout the fire tests, there shall be no evidence of spillage of flame from the oven. Intermittent or sporadic wisps of smoke are not considered spillage.

15.10 Flame spillage is defined as continuous, intermittent, or sporadic flames exiting any oven openings – feed doors, flue, air inlet openings, etc.

15.11 With reference to the requirements in 15.9, the following method is to be used in observing spillage of flame:

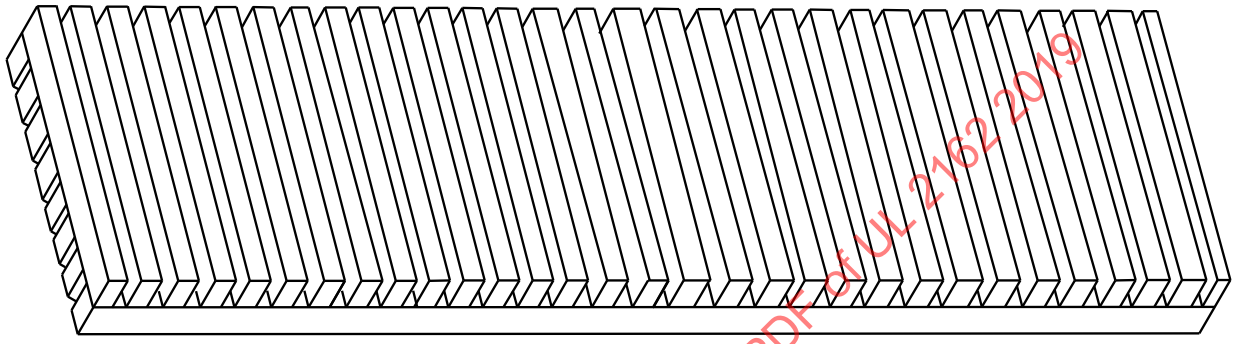
a) Any time the oven is fueled for the Rapid Fire, Normal Operation Fire, and Abnormal Operation Fire Tests, Sections 16 – 18, flame spillage is to be observed.

b) When the maximum temperatures have been attained during the Normal Operation Fire Test, Section 17, the air inlets are to be adjusted to that point of their operating range most likely to create maximum flame spillage. The feed door then is to be opened at a moderate rate. See the Flame Spillage Fire Test, Section 19.

16 Rapid Fire Test

16.1 Firebrands are to be constructed as shown in Figure 16.1, and are to use strips of dry (moisture content of 19 percent or less) Douglas fir finished to 3/4 by 3/4 inch (19.1 by 19.1 mm) weighing 0.020 ±0.002 pounds per cubic inch (554.0 ±55.4 kg/mm^3) and spaced 1 inch (25.4 mm) apart on centers. The brands are to be conditioned in an oven at 105 – 150°F (40.5 – 66°C) for at least 16 hours prior to being burned. Conditioned brands are to be used within 3 hours after their removal from the oven.

Figure 16.1
Brand



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16.2 The brands are to be placed in the fire chamber as described in the oven manufacturer's operation instructions. Each brand is to have an area in the plan view equal to or greater than 3 percent of the total hearth area.

16.3 Wood-fired ovens having fire chambers or fire chamber openings of unconventional design, that is, conical, parabolic, round, and the like, are to use firebrands that comply with the intent of 16.1 and 16.2.

16.4 The oven refractories are to be at room temperature at the start of the test.

16.5 Two brands are to be placed in the fire chamber and ignited using crumpled paper.

16.6 After the ignited brands are well engulfed, one brand is to be added every 7-1/2 minutes, with the long strips placed downwards and parallel to the face of the fire chamber opening.

16.7 The 7-1/2 minute brand feed rate is to be maintained until flame spillage occurs. After 30 minutes, the feed rate may be adjusted to produce a flame spillage condition. Flame spillage is defined as flames exiting any oven openings – feed doors, flue, air inlet openings, etc.

16.8 Once a flame spillage condition exists, the brand feed rate is to be adjusted so that flames do not exit the oven but approach spillage conditions.

16.9 Temperatures at all points of measurement are to be recorded at intervals not exceeding 30 minutes until the oven hearth temperature reaches 700° F (371° C) or reaches the manufacturer's recommended maximum operating temperature as indicated by the oven temperature monitoring equipment required by 7.9 and 14.16.

16.10 When the wood-fired oven described in 16.1 – 16.8 is fired, the maximum temperature rise above ambient temperature shall not exceed 140°F (78°C) on exposed and unexposed combustible surfaces of the test structure.

16.11 The temperature rise of any part of the wood-fired oven provided as part of the oven shall not exceed the maximum temperatures specified in Table 15.1, Column 2, for the material used.

17 Normal Operation Fire Test

17.1 This test is to be conducted as a continuation of the Rapid Fire Test, Section 16. This test may be conducted the following day.

17.2 Fire Brands are to be added to the oven at the feed rate required to maintain the hearth temperature of 700°F (371°C) or the manufacturer's recommended maximum operating temperature as indicated by the oven temperature monitoring equipment described in 7.9 and 14.16.

17.3 Temperatures at all points of measurement are to be recorded at intervals not exceeding 30 minutes until it is apparent that maximum temperatures have been attained. Maximum temperatures are considered to have been attained when three successive readings taken at 30-minute intervals show no change or show a decrease.

17.4 When the wood-fired oven is fired as described in 17.1 and 17.2, the maximum temperature rise above ambient temperature shall not exceed:

a) 117°F (65°C) on exposed combustible surfaces of the test structure and

b) 90°F (50°C) on unexposed combustible surfaces of the test structure.

17.5 The temperature rise of any part of the wood-fired oven provided as part of the oven shall not exceed the maximum temperatures specified in Table 15.1, Column 1, for the material used.

17.6 When the wood-fired oven is fired as specified in 17.1 and 17.2, any doors intended to be provided with the unit are to be adjusted in various positions to determine when flame spillage occurs.

18 Abnormal Operation Fire Test

18.1 The oven is to be at the maximum temperature rise attained during the Normal Operation Fire Test, Section 17, at the beginning of the Abnormal Operation Fire Test, Section 18.

18.2 Brands are to be added one at a time at an increased feed rate until the hearth thermocouple reaches 900°F (482.2°C) or 200°F (93°C) above the manufacturer's recommended operating temperature as determined by the equipment specified in 7.9 and 14.16.

18.3 The brand feed rate is to be adjusted to maintain the 200°F (93°C) above the manufacturer's recommended operating temperature as necessary.

18.4 Temperatures at all points of measurement are to be recorded at intervals not exceeding 30 minutes until it is apparent that the maximum temperatures have been attained. Maximum temperatures are considered to have been attained when three successive readings taken at 30 minute intervals show no change or show a decrease.

18.5 When the wood-fired oven is fired as described in 18.1 – 18.3, the maximum temperature rises shall not exceed 140°F (78°C) above ambient temperature on the following surfaces:

a) Combustible test structure.

b) Wood-fired oven parts at points of zero clearance to the combustible test structure.

18.6 The temperature rise of any part of the product shall not exceed the maximum value specified in Table 15.1, Column 2, for the material used.

19 Flame Spillage Fire Test

19.1 As a continuation of the Normal Operation Fire Test, Section 17, the Flame Spillage Fire Test, Section 19, is to be conducted. A brand is to be added and the door or doors closed for the first brand feed cycle. The doors are to be opened at 1/3 the brand feed rate as established during the Normal Operation Fire Test, Section 17, to determine when flames spill out of the oven.

19.2 At the end of the first brand feed cycle, another brand is to be added and the door or doors closed.

19.3 The doors are to be opened at 2/3 the brand feed rate during the second brand feed cycle to determine when flames spill out the front opening.

19.4 Another brand may be added at the end of the second brand feed cycle and the test may be repeated as necessary. The door or doors may be opened at any time during subsequent brand feed cycles to determine when flame spillage occurs.

19.5 Flame spillage is defined as continuous, intermittent, or sporadic flames exiting any oven openings – feed door or doors, flue, air inlet opening or openings, etc.

20 Glazing Test

20.1 General

20.1.1 Glazing shall not crack, break, or become dislodged when the oven is subjected to the Rapid Fire Test, Section 16; the Normal Operation Fire Test, Section 17; and the Abnormal Operation Fire Test, Section 18.

20.2 Impact test

20.2.1 Glazing shall withstand, without cracking or breaking, the impact described in 20.2.2 prior to the Rapid Fire Test, Section 16, while at room temperature and during:

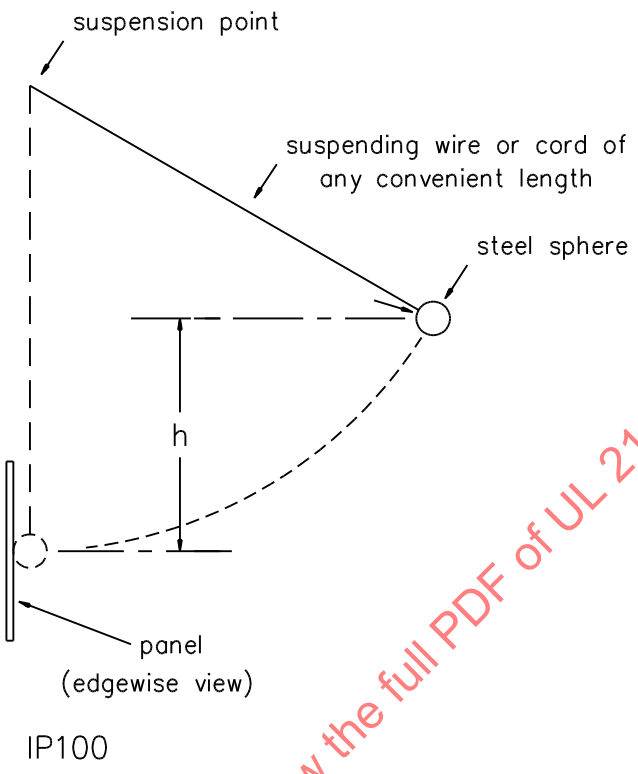
a) The Rapid Fire Test, while at the maximum temperature developed during that test;

b) The Normal Operation Fire Test, Section 17, while at the maximum temperature developed during the test; and

c) The Abnormal Operation Fire Test, Section 18, while at the maximum temperature developed during the test.

20.2.2 An impact is to be applied to the center of the glazing panel by means of a 1.18 pounds-mass (0.54 kg), 2-inch (50.8-mm) diameter steel sphere swung through a pendulum arc from a height (h) of 16.25 inches (413 mm). The at-rest suspension point of the steel sphere is to be 1 inch (25.4 mm) in front of the plane of the panel. See Figure 20.1.

Figure 20.1
Impact test



20.3 Water shock test

20.3.1 While at the maximum temperature developed during the Abnormal Operation Fire Test, Section 18, each glazing panel shall withstand, without cracking or breaking, the application of:

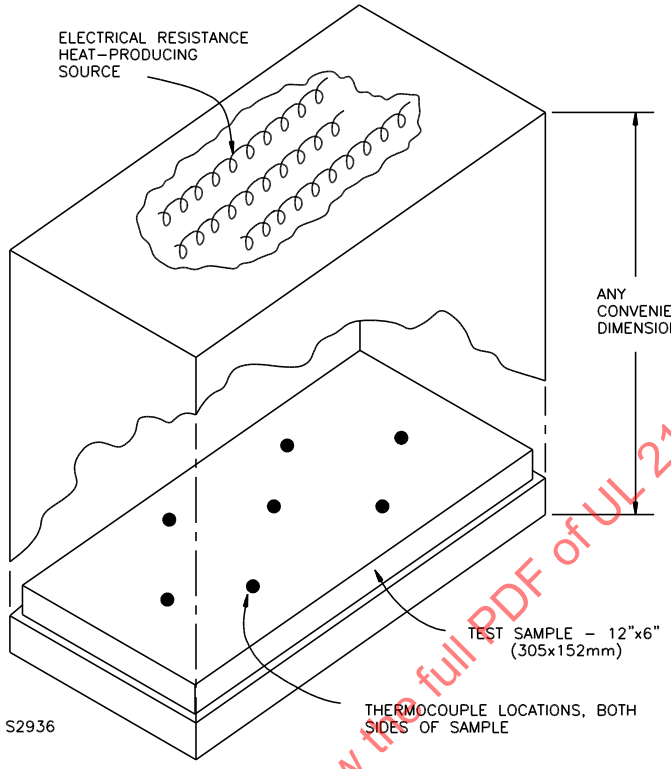
a) A wet cloth, fully saturated with water at room temperature, wiped across the surface of each glazing panel and

b) Three misted water sprays, projected across the surface of each glazing panel from a household cleaning bottle with a gun-type nozzle, applied after the panel has dried and attained the maximum temperature under the heated condition.

21 Thermal Conductivity Test

21.1 The test apparatus to be used for this test is to be constructed as illustrated in Figure 21.1.

Figure 21.1
Test apparatus



21.2 Two samples of each refractory material formulation of the product, each 1 inch (25.4 mm) thick by 6 inches (152.4 mm) wide by 12 inches (304.8 mm) long, are to be subjected to this test.

21.3 The sample is to be positioned in the test apparatus with its exposed surface (as installed) facing the heat-producing source. The joint around the sample is to be sealed with plastic-coated or film-faced, pressure-sensitive tape. The heat-producing source is to be regulated to produce temperatures at the surface of the sample facing the heat-producing source of 400° F (204° C). This temperature is to be maintained until equilibrium temperatures are attained on the unexposed surface of the sample.

21.4 Temperatures are to be measured by placing seven thermocouples on each side of the test sample to form the pattern shown in Figure 21.1.

22 Refractory Material Strength Test

22.1 Three samples of each refractory material formulation are to be subjected to the refractory material strength test as specified in 22.2 – 22.8.

22.2 The test samples are to measure 6 inches wide by 12 inches long by 1 inch thick (152.4 mm by 304.8 mm by 25.4 mm).

22.3 When the manufacturer cures or conditions the refractory materials before shipping the oven, the test samples are to be cured or conditioned prior to the test.

22.4 The test samples are to be conditioned at a temperature of 73 ±5° F (23 ±3° C) and 50 percent relative humidity for a period of 28 days. At the end of the conditioning period, the size and weight for each sample is to be recorded.