b) 1365 Btu/h (400 W) plus one-sixth of the power output of the burner in Btu/h for a burner with a maximum output of more than 4096 Btu/h (1200 W).

41.3.8 Over-the-built-in wall oven

41.3.8.1 A built-in microwave oven intended for use over a conventional built-in gas or electric oven is to be tested with a commercially available 30-in (76.2 cm) wide gas wall oven. A built-in microwave oven intended for use only over a conventional built-in electric oven is to be tested with a commercially available 30-in (76.2 cm) wide electric wall oven. The standard test built-in wall oven to be used is to have an oven capable of maintaining an average temperature of 246°C (475°F) at the center of the oven cavity.

41.3.8.2 The built-in microwave oven is to be installed over the conventional built-in wall oven using the spacings between the appliances as specified by the manufacturer, however, the test enclosure specified in 41.3.5 is to be used. If no spacing between the ovens are specified by the manufacturer, the built-in microwave oven is to be installed in as close proximity as the construction of the appliances will allow.

41.4 Supply voltage

41.4.1 The supply voltage for the temperature test is to be as specified in 40.2.1.

41.5 Cavity load

41.5.1 During the temperature test a heat-resistant glass or plastic electrically nonconductive container is to be placed in the center of the load carrying surface of the cavity containing enough water so that at the conclusion of the final cooking cycle there is as close to 1 L of water remaining as possible, but not less than 1 L. Initially, the water load shall be of such quantity as to enable completion of a complete cooking cycle without necessitating replenishment. At no time during a cooking cycle shall the water load be less than 1 L. If necessary, the water load may be replenished at the completion of a cooking cycle. Microwave appliances employing solid-state controls shall be tested until stabilized temperatures are obtained with a water load of 1 L.

41.6 Operating conditions

41.6.1 Commercial appliances

41.6.1.1 The microwave generating part of a commercial appliance is to be operated for the maximum setting of any timer followed by an off period not to exceed 10 s to simulate removal and replacement of food. The cooking cycle is to be repeated until constant temperatures are attained.

41.6.2 Household appliances

41.6.2.1 The microwave generating part of a household appliance is to be operated continuously for a period of 2 h, if a continuous operating feature is provided. If resetting a timer is necessary, the timer is to be set for the maximum cooking cycle, reset after a timer off period of 30 s, and this cycle repeated until a total cooking time of 2 h has been accumulated on the appliance.

Exception: An appliance relying upon an electronic timing circuit to turn the unit off after a prescribed time period shall be operated continuously until temperatures stabilize, unless the electronic timing circuit has been evaluated. The appliance shall be off only for the time necessary to replenish the water load. The initial water load shall be of such quantity as to enable 1 h of continuous operation without necessitating replenishment.

41.6.2.2 The temperature test for a microwave cooking appliance employing a general-use attachment plug receptacle is to be tested with the receptacle loaded resistively to the maximum current for the receptacle configuration employed. If a provision is made to prevent energizing the receptacle during microwave generation, separate tests are to be conducted in each operating mode.

41.6.3 Over-the-cooktop appliances

41.6.3.1 The test installation for an over-the-cooktop appliance is to be as described in 41.3.7.1.5 and 41.3.7.1.6. The test is to be conducted in each of the applicable conditions specified in 41.6.3.2 (a) – (e). Wall temperatures surrounding the gas or electric range (or cooktop) need not be measured. All tests are to be continued as specified in 41.6.1.1 and 41.6.2.1.

41.6.3.2 The test for an over-the-cooktop appliance is to be conducted in each of the following applicable conditions:

a) Microwave oven, vent hood fan, all range cooktop elements, and the range oven operating. The range oven is to be set in the bake mode with the center of the oven maintained at an average temperature of 246°C (475°F).

b) Only microwave oven and vent-hood fan operating.

c) Microwave oven not operating, range cooktop elements not operating, and vent hood fan operating. The specific range oven operating in the self-clean mode if it is provided with a self-clean feature.

Exception: This condition does not apply to the standard gas range or standard electric range. See 41.3.7.2.1 – 41.3.7.3.6.

d) The conditions specified in (a), (b), and (c), with the vent hood fan not operating. A thermostat that is provided to automatically energize a vent-hood fan shall be allowed to function if the user cannot turn the fan off while the microwave oven is energized because of an interlocking device or an automatic thermostat, the interlocking device or automatic thermostat withstands 100,000 c of intended operation without impaired performance while making and breaking the maximum rated current and rated voltage, and the thermostat complies with the requirements, including calibration verification, applicable to appliance limit controls in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873, or with the requirements of operating type 2 action control in the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, and the Standard for Automatic Electrical Controls – Part 2-9: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9.

e) The conditions specified in (a), (b), and (c) for each intended speed of the vent hood fan.

f) The conditions specified above in the ducted position and ductless position if the appliance is intended for such operation.

41.6.4 Over-the-built-in wall oven

41.6.4.1 The test installation for a built-in microwave oven installed over a conventional built-in wall oven is to be as described in 41.3.8.1 and 41.3.8.2. The test is to be conducted in each of the applicable conditions specified in 41.6.4.2 (a) – (d). Wall temperatures surrounding the gas or electric wall oven need not be measured. All tests are to be continued as specified in 41.6.1.1 and 41.6.2.1.

41.6.4.2 The test for a built-in microwave oven installed over a conventional built-in wall oven is to be conducted in each of the following applicable conditions:

a) Microwave oven and the wall oven operating. The wall oven is to be set in the bake mode with the center of the oven maintained at an average temperature of 246°C (475°F).

b) Only microwave oven.

c) Microwave oven not operating. The specific wall oven operating in the self-clean mode if it is provided with a self clean feature.

d) The conditions specified above in the ducted position and ductless position if the appliance is intended for such operation.

41.6.5 All appliances

41.6.5.1 General

41.6.5.1.1 A microwave cooking appliance with a thermal element in the cavity is to have the thermal element operating at the same time, if simultaneous operation of the microwave generator and thermal element is possible.

41.6.5.1.2 A microwave appliance with an integral thermal element, in which simultaneous operation of the microwave generator and thermal element is not possible, is to be subjected to a separate temperature test with the thermal element energized at maximum heat until thermal equilibrium is attained. The appliance shall be tested with the load described in 41.5.1.

41.6.5.1.3 A combination microwave and thermal cooking appliance other than those described in 41.6.5.1.1 and 41.6.5.1.2 where the microwave and thermal cooking functions are separate and distinct, for example a household microwave oven intended for use over an electric range, is to be operated simultaneously with the range for 2 h, after the electric range has attained thermal equilibrium. The manner of installation of the combination, and the operation of the electric range, shall be in accordance with the Standard for Household Electric Ranges, UL 858.

41.6.5.1.4 For the tests of 41.6.1.1 – 41.6.5.1.3 the sequence of the microwave and thermal cooking operations shall be representative of the most severe condition that may be encountered during intended use, with consideration given to the manufacturer's operating instructions.

41.6.5.1.5 A temperature-regulating thermostat or a temperature-regulating and -limiting thermostat is to be shunted out of the circuit, unless the control has been shown, in accordance with Table 59.1, to be rugged, reliable, and unlikely to be defeated by the user. The control is considered to be unlikely to be defeated if tools are required to gain access to the control, or a positive stop is incorporated in the control.

41.6.5.1.6 An overload, overcurrent-protective or temperature-limiting device shall not open the circuit to interrupt normal operation during the temperature test.

41.6.5.1.7 With reference to the test of 41.6.1.1, 41.6.2.1, and 41.6.5.1.2, thermal equilibrium is considered to exist when three successive readings, taken at intervals of 10 percent of the previously elapsed duration of the test indicate no change. No interval is to be shorter than 5 min.

41.6.5.2 Preheat operation

41.6.5.2.1 An appliance employing a thermal element shall be operated without load under maximum thermal heating conditions for a period of 10 min, or the maximum time for preheat operation specified in the instructions provided with the appliance, whichever is longer. At all times during the test the appliance shall comply with 41.1.1. This test shall be conducted in addition to the tests described in 41.1.1 – 41.6.5.1.7, and may precede the test described in 41.6.5.1.1 – 41.6.5.1.4.

41.7 Motors used with solid-state controls

41.7.1 In addition to the conditions described in 41.1.1 – 41.6.5.2.1, an appliance that includes a motor that is intended for use with a solid-state control is to be operated under each of the following conditions:

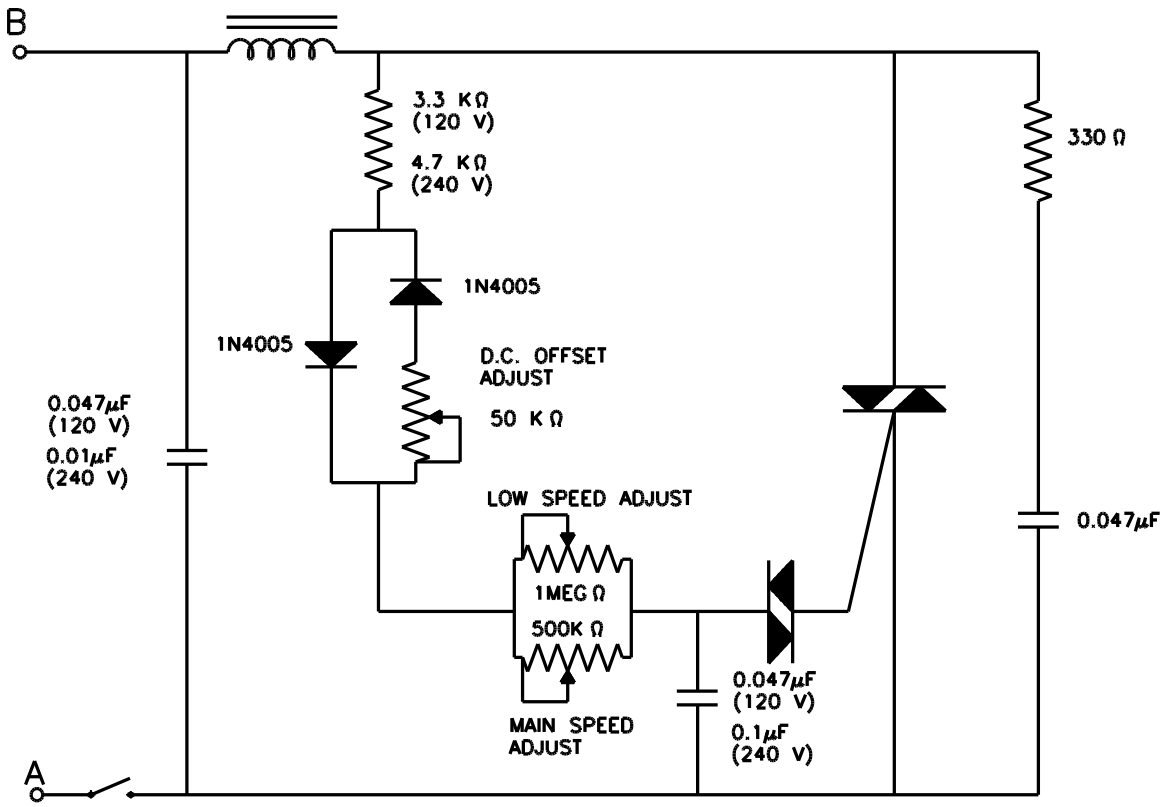
a) At the intended speed resulting in maximum motor winding temperatures. If the control is such that the motor speed may be continuously variable (that is, an infinite number of speeds), during this test the motor is to be connected to the load side of a triac. The triac is to be provided with associated circuitry allowing it to be triggered during each half-cycle of the ac input to the motor. Speed control is to be accomplished by varying the trigger points.

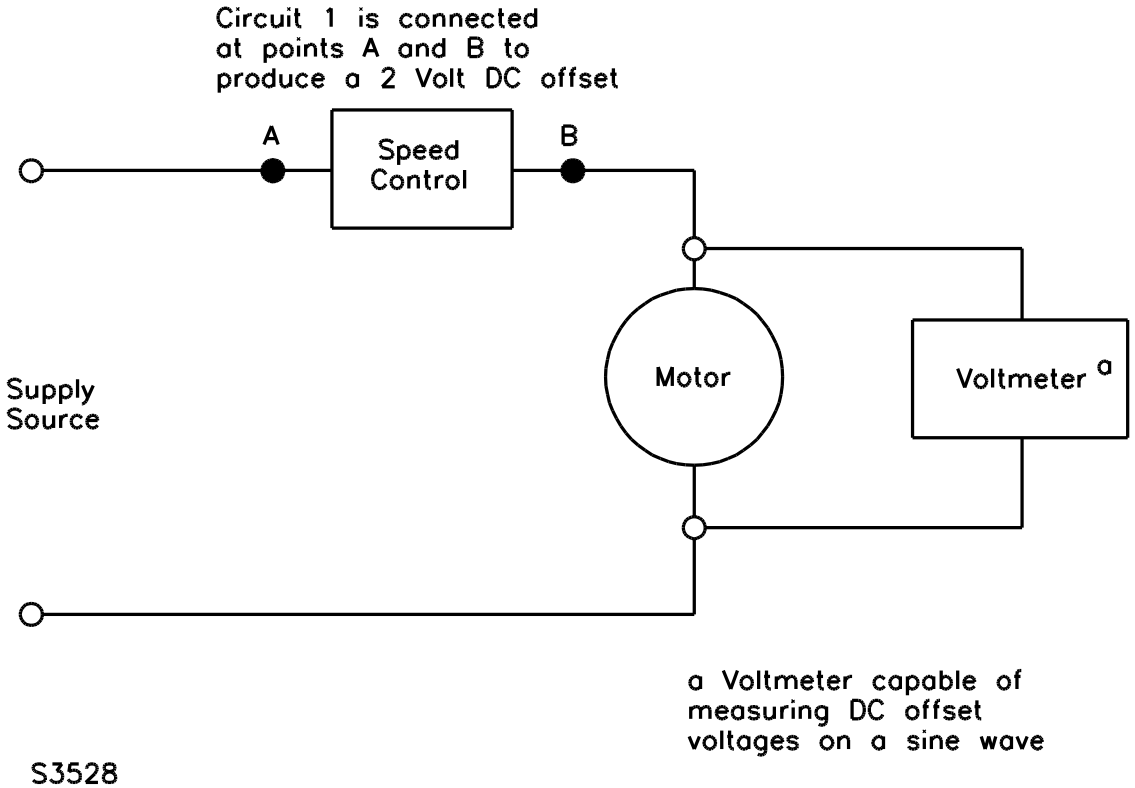
b) Connected and tested as described in (a) with an offset potential of 2 V dc applied to the ac motor input voltage by a suitable method. The offset potential may be obtained by using a modified speed control having routing diodes and dual triggering circuits to allow independent adjustment of the positive and negative half-cycle triac triggering points. See Figure 41.6. The triggering points are to be adjusted so that a bias of 2 V dc is measured on the switched ac output waveform. The dc bias may be measured by a dc voltmeter having a frequency damped response in the range of 0 to 120 Hz. However, if the control has a maximum dc offset potential of less than 2 V, the maximum dc offset potential of the control is to be used.

c) With the motor connected to an ac supply modified to produce half-wave output. The supply is to be switched from sinusoidal to half-wave output after the motor is operating at steady-state speed. This test is to be conducted in the rotating direction, if reversible, and speed control setting resulting in maximum motor winding temperatures. If the motor shaft will not continue to rotate in a manner considered to be a possible normal condition after the supply is switched from sinusoidal to half-wave operation and such malfunction would be obvious to persons operating the appliance, the locked rotor temperature requirements described in 41.7.2 shall be used instead of the maximum temperature rises specified in Table 41.1. Prior to such time that such malfunction becomes obvious to the user, temperature requirements specified in Table 41.1 shall be applicable.

Figure 41.6

Typical solid-state motor speed control with routing diodes for dc offset





S3528

41.7.2 If the motor shaft does not rotate or rotates in a manner not considered to be normal after the supply is switched from sinusoidal to half-wave operation as described in 41.7.1(c), the motor shall comply with the applicable temperature requirements as follows:

a) An impedance-protected motor shall comply with the Locked-Rotor Temperature Test requirements in the Standard for Overheating Protection for Motors, UL 2111 or with the Standard for Impedance Protected Motors, UL 1004-2; or

b) A thermally-protected motor shall comply with the Locked-Rotor Temperature Test requirements in the Standard for Overheating Protection for Motors, UL 2111 or with the Standard for Thermally Protected Motor, UL 1004-3, except that the temperatures measured during the initial cycle of the thermal protector operation shall be disregarded.

41.7.3 During the tests described in 41.7.1 and 41.7.2, the appliance is to be installed and operated as described in 41.1.1 – 41.6.5.2.1, but only motor winding temperatures are to be recorded.

42 Surface Temperature Tests

42.1 General

42.1.1 An appliance employing a thermal element, such as a resistive element, halogen or quartz lamp for browning or convection cooking, shall not attain temperatures at specific points greater than those indicated in Table 42.1 and Table 42.2. The appliance is to be completely assembled for this test, with all handles, knobs, guards, and the like, mounted in place. See 42.1.6.

Exception: The temperature of surfaces of a commercial use appliance that is intended only for use by professional cooks and chefs in a commercial kitchen may exceed the limits specified in Table 42.1, if the appliance is marked in accordance with 71.1.5 and 72.3.

Table 42.1
Maximum acceptable temperatures of surfaces as measured by the probe illustrated in Figure 42.1

	Surfaces 3 ft (914 mm) or less above floor level		Surfaces more than 3 ft above floor level	
	°C	(°F)	°C	(°F)
Bare or painted metal	67	(152)	84	(183)
Porcelain enamel	71	(159)	88	(190)
Glass or ceramic	78	(172)	95	(203)
Plastic[a]	83	(181)	100	(212)

NOTE – An appliance is to be installed in accordance with the manufacturer's instructions to determine which areas will be more than 3 ft (914 mm) above the floor.

[a] Includes plastic with a metal plating not more than 0.005-in (0.13-mm) thick; and metal with a plastic or vinyl covering not less than 0.005-in thick.

Table 42.2
Maximum acceptable temperatures of handles and knobs

Materials	°C	(°F)
Bare or painted metal	55	(131)
Glass	65	(149)
Plastic[a]	75	(167)
NOTE – For a microwave oven employing a self-cleaning feature, the temperature limits shall be in accordance with the Standard for Household Electric Ranges, UL 858, as applicable to self-cleaning ovens.		
[a] Includes plastic with a metal plating not more than 0.005-in (0.13-mm) thick; and metal with a plastic or vinyl covering not less than 0.005-in thick.		

42.1.2 The appliance is to be installed, connected, and loaded as described in 41.3.2.1 – 41.3.6.1, 41.3.7.1.3 – 41.3.7.1.6, and 42.4.1.1 – 42.4.5.4. See 73.14 and 73.16.

42.1.3 The supply voltage for the surface temperature test is to be as specified in 40.2.1.

42.1.4 During the test the cavity of the microwave cooking appliance is to be loaded as specified in 41.5.1.

42.1.5 An appliance employing a resistance-type heating element is to be operated with the temperature regulating control set to maintain the oven temperature at 204 ±3° C (400 ±5° F). If not provided with a temperature regulating control, the appliance is to be operated at full heating-element power. In any case, the surface temperatures are to be measured 1 h after an oven temperature of 204 ±3°C is attained.

42.1.6 The temperature of a surface that may be contacted by the user shall not be more than the applicable value specified in Table 42.1 or Table 42.2, unless otherwise specified. If the test is conducted at a room temperature of other than 25°C (77°F), the results are to be corrected to that temperature. If the appliance employs a thermostat that cycles during the test, each surface temperature is to be measured at the point in the thermostat cycle that results in maximum temperature of the surface.

42.2 Measurement of surfaces

42.2.1 The temperature of any external surface, including the appliance exterior, the bottom surface of the door, and any surface adjacent to or surrounding a handle, knob, grip, or the like, that can be fully contacted by the tip of the probe illustrated in Figure 42.1 shall not exceed the applicable temperature limits in Table 42.1. The test is to be repeated, as necessary, with the alcove walls arranged in the positions resulting in maximum temperatures on all surfaces that may be exposed to contact in any installation configuration recommended by the manufacturer and with the back wall of the alcove removed and the other alcove wall arranged to result in maximum temperatures on the back surface of the appliance (that is, the test is to be conducted with one side alcove wall in place, whichever configuration represents the most severe condition).

Exception No. 1: Temperatures need not be measured on a surface that cannot be contacted after the appliance is installed in accordance with the manufacturer's installation instructions (for example, an external surface of a built-in appliance that is within the building structure).

Exception No. 2: Temperatures need not be measured on a surface protected from unintentional contact (for example, covered) by a knob, guard, or the like, but not a handle.

Exception No. 3: Temperatures need not be measured on a surface within 0.4 in (10.2 mm) of a perforated or louvered oven cavity vent opening.

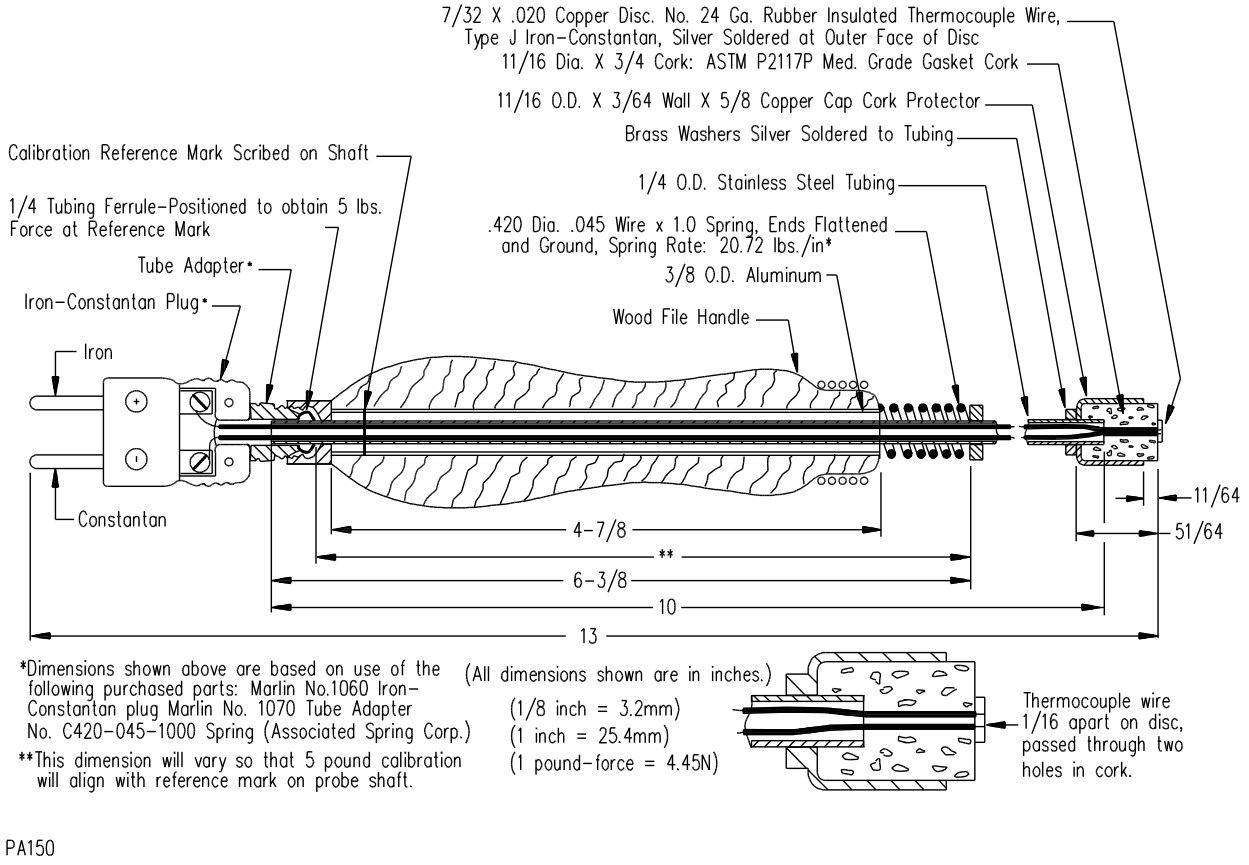
Exception No. 4: For other than an under cabinet-mounted appliance, temperatures need not be measured on the bottom of the appliance exterior.

Exception No. 5: For a built-in or wall-mounted appliance installed at the minimum height specified in the installation instructions, surfaces higher than 5 ft (1.52 m) above the floor are exempt from the limits specified.

Exception No. 6: Temperatures need not be measured on surfaces within 0.4 in (10.2 mm) of the gap between the appliance door and its mating surface.

Figure 42.1

Temperature-measuring and accessibility probe



PA150

42.2.2 The temperature of a rounded corner, decorative trim, or other external surface that cannot be fully contacted by the tip of the probe is to be measured using thermocouples held in intimate contact with the surface and the temperature limits specified in Table 42.1 applied.

42.2.3 With reference to 42.2.1, surfaces that can be fully contacted by the tip include corrugated, dimpled, and similarly finished surfaces.

42.2.4 For each measurement, the probe is to be at the ambient temperature, and then is to be heated for 15 s to approximately the temperature of the surface under consideration. The probe is then to be applied to the surface under consideration with a force of 5 lbf (22 N) for 10 s. The probe is to be moved from the preheat position to the surface as quickly as possible, and is to be applied so that the tip will fully contact the surface. The tip is considered to be the disc and the flat surface of the cork surrounding the disc.

42.2.5 A surface is to be clean when temperatures are measured.

42.3 Measurement of handles and knobs

42.3.1 The temperature of a handle, knob, grip, or the like, shall not exceed the maximum acceptable limits specified in Table 42.2 when measured by thermocouples held in intimate contact with the part in question. Temperatures are to be measured at all points that may be grasped during normal use.

Exception: A handle, knob, grip, and the like, the touching of which is not necessary or likely during the normal functioning and operation of the appliance, shall be considered as an exterior surface and subjected to the requirements in 42.2.1 – 42.2.5 and Table 42.1.

42.4 Over-the-cooktop appliances

42.4.1 General

42.4.1.1 An over-the-cooktop appliance is to be installed and tested over one of the appliances described in 42.4.2.1 – 42.4.5.1. The markings on the appliance determine which appliance is to be chosen for the test as well as the width of the range heat source. If a standard range is chosen, the appliance is to be tested over the widest range recommended.

42.4.2 Standard test gas range

42.4.2.1 The standard test gas range to be used is to have an oven capable of maintaining an average temperature of 204°C (400°F) at the center of the oven. The range is to have surface burners rated 10,000 Btu/h (2930 W) each when supplied with natural gas. The over-the-cooktop microwave oven is to be installed over the widest range specified by the manufacturer. A range 30 in (762 mm) or less in width is to have four surface burners. A range wider than 30 in is to have five surface burners as described in Figure 41.5.

42.4.2.2 A pan of water is to cover each of the surface burners. See 41.3.7.2.4 for description of pans.

42.4.2.3 The control for each surface burner covered with a pan of water is to be adjusted to 3,032 Btu/h (888 W).

42.4.3 Standard test electric range

42.4.3.1 The standard test electric range to be used is to have an oven capable of maintaining an average temperature of 204°C (400°F) at the center of the oven cavity. An over-the-cooktop microwave

oven is to be installed over the widest range specified by the manufacturer. A range less than 36-in (914-mm) wide is to have four surface elements. If a standard test electric range 36 in or wider is to be used, it is to have four surface elements, and a griddle. See 41.3.7.3.2 for a description of the surface elements.

42.4.3.2 A pan of water is to be placed on each of the elements. The pan is to be of aluminum and is to have approximately vertical sides. The diameter of the bottom plane surface of the pan is to be no less than the maximum diameter of the active part of the surface unit on which the pan is used, but no more than 1 in (25.4 mm) larger than that diameter.

42.4.3.3 The control for each element on which a pan of water is placed is to be set so that the average power input is 833 W.

42.4.4 Specific range – electric

42.4.4.1 If an over-the-cooktop microwave oven is intended for use only with a specific electric range or ranges (or cooktops), the specific range or ranges are to be installed and operated as specified in 42.4.3.2 and 42.4.3.3. If the range cooktop surface elements are rated other than as specified in 41.3.7.3.2, or if the cooktop employs a grill, griddle, deep-fat fryer, or the like, the elements are to be loaded and adjusted as specified in the Temperature Test section of the Standard for Household Electric Ranges, UL 858.

42.4.5 Specific range – gas

42.4.5.1 If an over-the-cooktop microwave oven is intended for use only with a specific gas range or ranges (or cooktops), the range or ranges are to be operated using the pans of water noted in 41.3.7.2.4 and positioned as specified in 42.4.2.2. The control for each burner is to be adjusted so that the power input to the burner is not less than:

a) 50 percent of the power output for a burner with a maximum output of 4096 Btu/h (1200 W) or less, or

b) 1365 Btu/h (400 W) plus one-sixth of the power output of the burner in Btu/h for a burner with a maximum output of more than 4096 Btu/h (1200 W).

42.4.5.2 The test installation for an over-the-cooktop appliance is to be as described in 41.3.7.1.5 and 41.3.7.1.6. The test is to be conducted in each of the applicable conditions specified in 42.4.5.3 (a) – (g). Wall temperatures surrounding the gas or electric range (or cooktop) need not be measured. All tests are to be continued as specified in 41.6.1.1 and 41.6.2.1.

42.4.5.3 The test for an over-the-cooktop appliance is to be conducted in each of the following applicable conditions:

a) Microwave oven, vent-hood fan, and the range oven operating. The range oven is to be set in the bake mode with the center of the oven maintained at an average temperature of 204°C (400°F). The range cooktop elements are not to be operating.

b) Microwave oven, vent-hood fan, and all range cooktop elements operating. The range oven is not to be operating.

c) Only microwave oven and vent-hood fan operating.

d) Microwave oven not operating, range cooktop elements not operating, and vent-hood fan operating. The specific range oven operating in the self-clean mode if it is provided with a self-clean feature.

Exception: This condition does not apply to the standard gas range or standard electric range. See 42.4.2.1 – 42.4.3.3.