both), the protective device is to be defeated and the measurement is to be made five seconds after the unit is connected to the source of supply.

Table 30.1
Maximum output current for inherently limited units

Circuit voltage (V_{max})[a,b] ac or dc Volts	Maximum nameplate ratings		Maximum output current (I_{max})[c], Amperes
	Volt-Amperes	Amperes	
0 – 20	5.0 X V_{max}	5.0	8.0
Over 20 to 30	100	$100/V_{max}$	8.0
Over 30 to 60, dc only	100	$100/V_{max}$	$150/V_{max}$

[a] V_{max} : Maximum output voltage regardless of load with rated input voltage applied.

[b] Voltage ranges shown are for sinusoidal alternating current and continuous direct current. For nonsinusoidal alternating current, maximum voltage shall not be greater than 42.4 volts peak. For direct current interrupted at a rate of 10 – 200 hertz, maximum voltage shall not be greater than 24.8 volts.

[c] I_{max} is maximum output current regardless of load.

30.2.2 If the value of current and power cannot be obtained due to operation of a protective device, damage to the transformer, or the like:

a) The values are to be extrapolated, if feasible, from the values measured earlier in the time period; or

b) A protective device may be shunted to obtain the required data.

30.2.3 The current between output terminations of a multi-output unit is not required to comply with 30.2.1 when output terminations are interconnected if the following conditions are met:

a) The output current between any two terminations is not more than the limit specified in 30.2.1 when no connections are made between output terminations of separate outputs;

b) The unit is marked in accordance with 52.10; and

c) There is no emission of flame or molten metal from the unit enclosure and no other evidence of a risk of fire or electric shock.

30.3 Not inherently limited

30.3.1 When the unit includes means to automatically de-energize the output circuit (see 11.11), the values of the output current and volt-amperes specified in 30.2.1 shall not exceed those specified in Table 30.2.

30.3.2 To determine if a unit complies with the requirement in 30.3.1, the unit is to be allowed to deliver the test current to a resistance load, with the primary connected to a source of supply. The unit is to be draped with a double layer of cheesecloth conforming to the device outline. Charring, glowing, or flaming of the cheesecloth is unacceptable.

Table 30.2
Maximum output current and volt-amperes for not inherently limited units

Circuit voltage (V_{max})[a,b] ac or dc, volts	Maximum nameplate ratings		Maximum output (I_{max})[c], amperes	Maximum output volt-amperes, (VA_{max})[d]	Maximum overcurrent protection rating, amperes
	Volt-amperes	Amperes			
0 – 20	5.0 X V_{max}	5.0	$1000/V_{max}$	250[e]	5.0
Over 20 to 30	100	$100/V_{max}$	$1000/V_{max}$	250	$100/V_{max}$
Over 30 to 60, dc only	100	$100/V_{max}$	$1000/V_{max}$	250	$100/V_{max}$

[a] V_{max} is the maximum output voltage regardless of load with rated input voltage applied.

[b] Voltage ranges shown are for sinusoidal alternating current and continuous direct current. For nonsinusoidal alternating current, maximum voltage shall not be greater than 42.4 volts peak. For direct current interrupted at a rate of 10 – 200 hertz, maximum voltage shall not be greater than 24.8 volts.

[c] I_{max} is maximum ampere output regardless of load after operation as specified in 30.2.1.

[d] VA_{max} is maximum volt-ampere output regardless of load after operation as specified in 30.2.1.

[e] Maximum volt-amperes is 350 if maximum circuit voltage is 15 or less.

31 Calibration of Overcurrent Protection Devices Test

31.1 A protective device provided as a part of a not inherently limited unit shall operate in not more than the time indicated in Table 31.1 when the unit is delivering the specified secondary current. There shall be no emission of flame or molten metal from the enclosure, and no evidence of a risk of fire or electric shock as described in 39.1.2. The unit shall withstand the dielectric voltage withstand test as specified in 34.1.1(a), applied between the primary winding and secondary windings, and between the primary and exposed dead metal parts.

Exception: This test need not be conducted if a suitably rated (see Table 30.2) and calibrated fuse is provided in the output circuit.

31.2 During the test, the grounding means is to be connected to ground through a 3-ampere nontime-delay fuse and the unit is to be draped with a double layer of cheesecloth conforming to the outline of the unit.

Table 31.1
Maximum acceptable time for protection device operation

Rated secondary potential, volts	Secondary test current, amperes	Maximum time for protective device to operate, minutes
20 or less	10[a]	2
20 or less	6.75[b]	60
Over 20 to 30	$200/V_{max}$[a,c]	2
Over 20 to 30	$135/V_{max}$[b,c]	60
Over 30 to 60, dc only	$200/V_{max}$[a,c]	2
Over 30 to 60, dc only	$135/V_{max}$[b,c]	60

[a] The load is to be adjusted continuously to maintain the test current value shown.

[b] After 15 minutes of operation, the load is to be readjusted to return the output current value shown.

[c] V_{max} is the maximum output voltage regardless of load with rated input.

32 Full-Load Output Current Test

32.1 A unit shall deliver its rated full-load secondary current continuously.

Exception: The test of 32.2 is not required for a battery charger that is marked for a specific battery load per the Exception to 50.1 and is not marked with the output ratings.

32.2 To determine compliance with the requirement in 32.1, one sample is to be tested as follows. With a variable load as specified in Table 25.3 and an ammeter connected to the output, the primary is to be connected to the supply circuit. The load is to be adjusted to draw rated output current. After 15 minutes of operation, the resistance is to be readjusted, if necessary, to return the current to that value. The test is then to be continued for 1 hour without further adjustment. At the end of 1 hour, the output current shall not be less than 90 percent of the rated load current. An overtemperature- or overcurrent-protective device shall not function during this test.

32.3 If a unit has its output rated in volt-amperes or watts, the rated output current is to be determined by dividing the rated output voltage into the rated output volt-amperes or watts.

33 Normal Temperature Test

33.1 The temperature rises on various materials and parts shall not exceed the limits specified in Table 33.1 when the unit is operated as specified in 33.2 – 33.5. Upon completion of this test, the unit shall comply with the Dielectric Voltage Withstand Test, Section 34.

Table 33.1
Maximum acceptable temperature rises

Materials and components	°C	(°F)
A. COMPONENTS		
1. Rubber- or thermoplastic-insulated conductors[a]	35	(63)
2. Silicon components[b]	75	(135)
B. ELECTRICAL INSULATION – GENERAL		
1. Class 105 insulation systems:		
Resistance method	75	(135)
Thermocouple method	65	(117)
2. Class 120 insulation systems:		
Resistance method	85	(153)
Thermocouple method	75	(135)
3. Class 130 insulation systems:		
Resistance method	95	(171)
Thermocouple method	85	(153)
4. Class 155 insulation systems:		
Resistance method	115	(207)
Thermocouple method	110	(198)
5. Class 180 insulation systems:		
Resistance method	135	(243)
Thermocouple method	125	(225)

Table 33.1 Continued on Next Page

Table 33.1 Continued

Materials and components			°C	(°F)
	6.	Class 200 insulation systems:		
		Resistance method	150	(270)
		Thermocouple method	140	(252)
	7.	Class 220 insulation systems:		
		Resistance method	165	(297)
		Thermocouple method	155	(279)
	8.	Fiber employed as electrical insulation	65	(117)
	9.	Phenolic composition[a]	125	(225)
	10.	Varnish-cloth insulation	60	(108)
C.	SURFACES			
	1.	Surface temperature, metal[c,d]	30	(54)
	2.	Surface temperature, nonmetallic[c,e]	50	(90)
	3.	Wood or similar material	65	(117)

[a] The limitation on phenolic composition, rubber and thermoplastic insulation does not apply to compounds that have been investigated and found to be acceptable for use at a higher temperature. The maximum acceptable temperature rise in any case is 25°C (77°F) less than the acceptable temperature limit in question.

[b] Does not apply to a material that has been investigated and found acceptable for a higher temperature.

[c] A material having a coefficient of thermal conductivity greater than 2.419 Btu per hour per square foot per foot per degree Fahrenheit (0.01 c/s/cm^2 /cm/°C) is considered to be metal. See 33.7.

[d] 45°C (81°F) rise for semipermanent mounted and permanently connected units marked as required by 52.5 and 71.2 respectively.

[e] 65°C (117°F) rise for semipermanent mounted and permanently connected units marked as required by 52.5 and 71.2 respectively.

33.2 For a direct plug-in unit, this test is to be conducted in both the horizontal and vertical positions. For a cord-connected unit, this test is to be conducted in all likely mounting positions. A sample is to be operated with the primary energized from a circuit as specified in 25.3 and 25.4. Each output is to be loaded as specified in 25.8. A battery charger which is likely to be used for consecutive charging of batteries is to be tested as specified in 33.5 and 33.6.

33.3 If the load mentioned in 33.2 and specified in 25.8 includes a variable resistance, the load is to be adjusted after 15 minutes of operation, if necessary, to return the output to the original value. If the load consists of a battery, the battery shall be discharged as specified in 25.10, 25.11, or 25.12, as applicable.

33.4 If a battery charger which is not likely to be used for consecutive charging of batteries is tested with a battery load, the test is to be continued until temperatures peak. The load is to be replaced by a second discharged battery. The test is terminated when temperatures peak during the second load condition.

33.5 A battery charger which is likely to be used for consecutive charging of batteries is to be tested with the intended battery load. The test is to be conducted in accordance with 33.6.

33.6 With respect to 33.5, a charger is to be tested in accordance with the following:

a) For a charger with no charge status indicator, the test is to be continued until temperatures peak. The load is to be replaced with another discharged battery. This sequence is to be repeated until maximum temperatures are obtained.

b) For a charger with a visual charge status indicator, the test is to be continued until the visual indicator indicates that the charge cycle is complete. The load is to be replaced with another discharged battery. This sequence is to be repeated until maximum temperatures are obtained.

c) For a charger with a charge time marking or instruction, the test is to be continued until the specified charge time has elapsed. The load is to be replaced with another discharged battery. This sequence is to be repeated until maximum temperatures are obtained.

d) For a charger with both a visual charge status indicator and a charge time marking or instruction, the test is to be continued until the specified charge time has elapsed or until the visual indicator indicates that the charge cycle is complete, whichever occurs first. The load is to be replaced with another discharged battery. This sequence is to be repeated until maximum temperatures are obtained.

33.7 With reference to footnote c to Table 33.1, the thermal conductivity of a material can be obtained by comparison with materials that have known thermal conductivities. Samples of materials with known values of the constant and a sample of the material for which the value is unknown are to be fixed to a heated metal plate. All samples are to be of the size used in the unit. The temperatures of the faces of the reference samples opposite the heated metal plate are to be plotted as a function of the constant. The constant of the material for which the value is unknown is derived from the curve by reading off the value corresponding to the temperature attained by the sample under investigation.

33.8 All values in Table 33.1 are based on an assumed ambient temperature of 25°C (77°F), but a test may be conducted at any ambient temperature within the range specified in 25.7.

33.9 A temperature is considered to be constant when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 15 minutes, indicate no further increase.

33.10 Except when it is specifically stated that the temperature determinations are to be made by the resistance method, temperatures are to be measured by means of thermocouples. The junction of the thermocouple is to be secured in intimate contact with the point of the surface at which the temperature is to be measured.

33.11 Thermocouples are to consist of wires not larger than 24 AWG (0.21 mm^2) and not smaller than 30 AWG (0.05 mm^2). When thermocouples are used in determining temperatures in electrical equipment, it is common practice to employ thermocouples consisting of 30 AWG iron and constantan wire and a potentiometer-type instrument; and such equipment is to be used whenever referee temperature measurements by thermocouples are necessary. The thermocouples and related instruments are to be accurate and calibrated in accordance with accepted laboratory practice. The thermocouple wire is to comply with the requirements listed in the Tolerances on Initial Values of EMF versus Temperature tables in the Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples, ASTM E230/E230M.

33.12 Coil and winding temperatures are to be measured by thermocouples located on exposed surfaces, except the resistance method is to be used for a coil that is inaccessible for mounting of these devices such as a coil:

a) Immersed in sealing compound;

b) Wrapped with thermal insulation; or

c) Wrapped with a material, such as cotton, paper, or rayon more than 1/32 inch (0.8 mm) thick.

33.13 The temperature rise of a copper winding is determined by the resistance method by comparing the resistance of the winding at a temperature to be determined with the resistance at a known temperature according to the formula:

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

in which:

Δt is the temperature rise;

R is the resistance of the coil at the end of the test in ohms (see 33.14);

r is the resistance of the coil at the beginning of the test in ohms;

k is 234.5 for copper;

t_1 is the room temperature in degrees C at the beginning of the tests; and

t_2 is the room temperature in degrees C at the end of the test.

The winding is to be at room temperature at the start of the test.

33.14 Because it is generally necessary to de-energize the winding before measuring R, the value of R at shutdown may be determined by taking several resistance measurements at short intervals, beginning as quickly as possible after the instant of shutdown. A curve of the resistance values against time may be plotted and extrapolated to give the value of R at shutdown. Instrumentation by which R can be measured while the coil is energized may be used.

33.15 For manufacturers who choose to declare an operating ambient above 25° C, the following formulas can be used to determine compliance when testing in a normal room temperature environment:

if T_{MAX} is specified: $(T - T_{AMB}) \leq (T_{MAX} - T_{MRA})$

if ΔT is specified: $(T - T_{AMB}) \leq (\Delta T_{MAX} + 25 - T_{MRA})$

where:

T = the temperature of the given part measured under prescribed test conditions; and

T_{MRA} = the maximum room ambient temperature permitted by the manufacturer's specification or 25°C, whichever is greater.

34 Dielectric Voltage Withstand Test

34.1 General

34.1.1 One minute after the applicable test, the unit shall withstand for 1 minute without breakdown the application of a potential. The test potential shall be:

a) One thousand volts ac plus twice the maximum rated voltage between:

1) The primary circuit and accessible dead metal parts; and

2) The primary and secondary circuit or circuits.

b) One thousand volts ac plus two times the sum of secondary voltages between secondary windings for units described in 28.3 or 30.2.3.

c) Five hundred volts ac between a secondary circuit and dead metal parts.

d) A dc potential of 1.414 times (2 V + 1000), where V is the rms supply voltage, between the terminals of a capacitor used for radio-interference elimination or arc suppression.

Exception: If an ac potential results in excessive leakage through capacitors during the test specified in (a), (b), and (c), the capacitors are to be removed from the circuit for the ac potential. With the capacitors connected in the circuit, the unit shall withstand a dc potential of 1.414 times the ac rms potential between the points specified.

34.1.2 To determine if a unit complies with the requirements in 34.1.1, it is to be tested by means of a transformer of 500-volt-ampere capacity or larger, having an output voltage that is essentially sinusoidal or continuous direct current, as applicable, and can be varied. The applied potential is to be increased from zero until the required test level is reached, and is to be held at that level for 1 minute. The increase in applied potential is to be at a substantially uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter.

Exception: A 500 volt-ampere or larger capacity transformer need not be used if the transformer is provided with a voltmeter to measure directly the applied output potential.

34.1.3 With respect to the electrical stress level mentioned in 12.2, each capacitor shall be subjected to a test potential as specified in 34.1.1(d).

34.2 Induced potential

34.2.1 One sample of a transformer as described in Exception No. 1 to 13.2.8 and 13.2.9 is to be subjected to this test. While in a heated condition from operation as described in Normal Temperature, Section 33, the primary winding shall withstand without breakdown an alternating potential of twice the rated voltage of the winding. The potential is to be:

a) Applied for 7200 cycles if the frequency is 120 hertz or more; or

b) 60 seconds if the frequency is less than 120 hertz.

A higher test frequency may be necessary so the core is not saturated.

34.2.2 The test voltage is to be started at one-quarter or less of the full value and increased to full value in not more than 15 seconds. After being held for the time specified, the voltage is to be reduced within 5 seconds to one-quarter or less of the maximum value and the circuit is to be opened.

34.2.3 With reference to 34.2.1, a transformer may be conditioned in an oven to obtain the temperature reached in the Normal Temperature Test, Section 33, before conducting the induced potential test.

35 Endurance Test on Overcurrent- and Overtemperature-Protective Devices

35.1 One sample of a unit employing a manually reset overcurrent- or overtemperature-protective device shall be operated under the condition of maximum obtainable output current, including short circuit, and the protector shall be cycled for 50 operations as quickly as the protector can be reset. During this test the grounding means, if provided, is to be connected to ground through a 3-ampere nontime delay fuse. A risk of fire or electric shock as described in 39.1.2 shall not result and the temperature rise at any point on the enclosure shall not exceed 65°C (117°F). The protector device shall be operational upon completion of the test.

35.2 One sample of a unit employing an automatically reset protective device or a protector that stays open as long as the overload is connected is to be connected and operated under the conditions described in 35.1 for 15 days but not less than 2000 cycles. A risk of fire or electric shock – see 39.1.2 – shall not result and the temperature rise at any point on the enclosure shall not exceed 65°C (117°F). Temperatures are to be measured at the end of the test. The protective device shall be operational upon completion of the test.

35.3 The test described in 35.2 shall be conducted for 24 hours for units incorporating thermostats, the acceptability of which has been determined by the requirements in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873. Compliance with the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, and/or the applicable Part 2 standard from the UL 60730 series fulfills these requirements.

35.4 Following the Endurance Test, the unit is to be subjected to a repeat Dielectric Voltage Withstand Test as described in Section 34.

36 Overload and Endurance Tests on Switches and Controls

36.1 A switch or other control that has not been shown to be acceptable for the purpose in accordance with 10.6 shall perform acceptably when subjected to an overload test consisting of 50 cycles of operation making and breaking the applicable load, and to an endurance test consisting of 6000 cycles of operation at rated load. There shall be no electrical or mechanical breakdown of the device, undue burning or pitting of the contacts as a result of the overload or endurance test, or opening of the fuse in the grounding connection.

36.2 For the test specified in 36.1, the output of the unit is to be connected to its intended load based on its input and output ratings and to a supply having a frequency specified in 25.4. For the overload test, the supply voltage is to be increased to 110 percent of the maximum test voltage specified in 25.1. For the endurance test, the test voltage specified in 25.1 is to be used. During these tests, exposed dead metal parts of the unit are to be connected to ground through a 3-ampere nontime-delay fuse. The device is to be operated at a rate of not more than 10 cycles per minute, except that a faster rate of operation may be employed if agreeable to those concerned.

37 Overload Test on Secondary Switches

37.1 If tests are required in accordance with 10.7, a switch or other control device shall be tested as described in 37.2. The performance is unacceptable if:

a) The fuse in the grounding connection opens during the test;

b) There is welding of contacts or mechanism breakdown; or

c) The device is otherwise incapable of completing the tests.

37.2 To determine if a secondary circuit switch or other control device is capable of performing acceptably in the overload test mentioned in 10.7, the unit is to be connected to a circuit supplying the maximum test voltage as specified in 25.1 and the rated frequency in accordance with 25.4. The switch is to be caused to make and break 150 percent of the rated secondary load current or maximum obtainable, whichever is less. During the test, exposed dead-metal parts of the unit are to be connected to the polarity opposite to the switching device through a 3-ampere fuse. The device is to be operated for 50 cycles at a rate of not more than 10 cycles per minute, except that a faster rate of operation may be employed if agreeable to those concerned.

38 Operation Test

38.1 A switch or other controller required to be tested in accordance with 10.8 is to be subjected to 1000 operations through all positions. The operations are to be with no electrical load. There shall be no mechanical breakdown of the switching mechanism or loosening of parts.

38.2 After the 1000 operations, the switch shall be capable of making and breaking the circuit for 50 cycles of operation as indicated in the Overload and Endurance Tests on Switches and Controls, Section 36. For a voltage selector switch, the test voltage is to be based on the highest rated voltage.

39 Abnormal Tests

39.1 General

39.1.1 A unit shall not emit flame or molten metal or become a risk of fire or electric shock when subjected to the following tests: output loading, reverse polarity, switch position, component breakdown, and when required, the printed wiring board abnormal operation test. Each abnormal test shall be followed by a dielectric voltage withstand test as required by 34.1.1(a).

39.1.2 A risk of fire or electric shock is considered to exist if any of the following occur:

a) Opening of the grounding fuse;

b) Charring of cheesecloth;

c) Emission of flame or molten material from the unit enclosure and output cord, if provided;

d) Any condition that exposes live parts which pose a risk of electric shock as specified in Accessibility of Live Parts, Section 16;

e) Indication of dielectric breakdown;

f) For a direct plug-in unit, loss of structural integrity to a degree where the unit cannot be removed from a receptacle immediately after the test without deformation or a risk of electric shock; or

g) Opening of the branch-circuit overcurrent protective device.

39.1.3 Each test is to be conducted on a separate sample unless the manufacturer requests that more than one test be conducted on the same sample.

39.1.4 During each test, the grounding means, if provided, is to be connected to ground through a 3-ampere nontime-delay fuse.

39.1.5 A polarity-protection circuit provided to reduce the likelihood of output-current flow until a battery is connected as intended to the output is to be made inoperative so that the required output current will flow.

39.1.6 During all abnormal tests, the unit is to be draped with a double layer of cheesecloth conforming to the outline of the unit.

Exception: The cheesecloth is not required to be used during the short-circuit condition of the output loading test.

39.1.7 The temperature rises specified are based on an assumed ambient temperature of 25°C (77°F), but a test may be conducted at any ambient temperature of 21 – 30°C (70 – 86°F). However, if the operation of an automatic thermal control during the test limits the temperatures under observation, no temperature higher than 25°C (77°F) plus the specified maximum rise is acceptable.

39.2 Output loading

39.2.1 During the tests of 39.2.2 and 39.2.3, a fuse or circuit breaker provided as part of the unit is to remain in the circuit, and a user replaceable fuse is to be replaced by the largest fuse the fuseholder will accept. A manually reset protector is to be operated for 10 cycles and the protector contacts shall be operative upon completion of the test. If an automatic reset protector is provided, or the input current is a value other than zero, the test is to be continued for:

a) 7 hours; or

b) 15 days in accordance with 13.2.4.

For units with more than one output, the remaining outputs are to be open circuited or loaded to rated conditions in accordance with Table 25.2, whichever results in a more severe operating condition.

39.2.2 Each output is to be short-circuited in turn. The temperature rise on the enclosure of a direct plug-in unit shall not exceed 65°C (117°F).

Exception: A temperature rise of 125°C (225°F) is acceptable if the unit permanently opens within 1 hour after initiation of the test.

39.2.3 Each output is to be overloaded in turn. Each overload condition is to be conducted with the output loaded to a current (I_L) equal to the rated current (I_R) plus X percent of the difference between the maximum current (I_{max}) in accordance with Table 39.1 and the rated output current (I_R). In the tests, the values of X are to be 100, 75, 50, 25, 20, 15, 10, and 5, in that order. If a load current results in continuous operation, further tests need not be conducted. For each test, a variable resistance load is to be adjusted to the required value and readjusted, if necessary, one minute after application of the source of supply.

Exception: The alternate test method of 39.3 may be used for units that employ a:

a) Thermal link complying with the Standard for Thermal-Links – Requirements and Application Guide, UL 60691; or

b) Fuse complying with the Standard for Low-Voltage Fuses – Part 14: Supplemental Fuses, UL 248-14.

Table 39.1
Maximum current for output loading

Unit type	I_{max}
Inherently limited	As determined per 30.1.1
Not inherently limited	$200/V_{max}$ [a]

[a] V_{max} per 28.1

39.3 Output loading – alternate method

39.3.1 With reference to the Exception to 39.2.3, if the output short circuit test of 39.2.2 results in opening of a thermal link or fuse, the alternate method of 39.3.2 or 39.3.3 may be performed in lieu of 39.2.3.

39.3.2 If short circuiting causes opening of a thermal link, the device is to be shunted and a thermocouple attached to its body. The load current is to be raised slowly until a temperature equal to the rated trip temperature of the device plus 5°C (9°F) is reached. Without further readjustment of the load, the unit is to be operated for the remainder of the specified time length (7 hours or 15 days, as applicable).

39.3.3 If short circuiting causes opening of a fuse, the unit is to be tested with a load current that causes the maximum current to flow in the fused circuit without opening the fuse. The maximum current to be delivered through the fuse is to be determined by the following formula:

$$I_{FC} = 1.1\ (I_{FR})\ [1 + n(0.02)]$$

in which:

I_{FC} is the fuse overload current;

I_{FR} is the fuse current rating; and

n is an integer that causes the unit to run such that I_{FC} is able to be maintained at its continuous maximum current (7 hours or 15 days, as applicable).

When conducting this test, at least two load conditions are to be used; one load condition where I_{FC} (n=c) results in continuous operation, and one load condition where I_{FC} (n=c+1) results in opening of the fuse prior to the specified time length (7 hours or 15 days, as applicable). Prior to each test, the sample is to be at room temperature.

39.4 Transformer burnout

39.4.1 A unit having components in the output circuit shall not emit flame or molten metal or result in a risk of fire or electric shock as described in 39.1.2 while first operating as described in the temperature test, followed by operation under the loading conditions described in 39.4.3 for linear designs, 39.4.4 for switch mode designs. Each test is to be followed by a dielectric voltage withstand test described in 34.1.1 (a) with the potential applied between primary and secondary windings. During this test the grounding means, if provided, is to be connected directly to ground. The unit is to be operated continuously:

a) Until ultimate conditions are observed, including opening of a thermal cutoff or a similar device;

b) For 7 hours if temperatures stabilize or cycling of an automatically reset protector occurs; or

c) For 50 cycles of resetting a manually reset protector.

39.4.2 If a transformer has more than one secondary winding or a tapped secondary winding, separate tests are to be conducted for each winding, or each section of a tapped winding, with the other windings loaded or unloaded as may occur in service unless it can be determined that one condition will produce the most unfavorable results.

39.4.3 For linear designs, a resistive load that will draw three times the normal input alternating current or maximum obtainable output current, whichever is less, is to be connected directly to the transformer secondary winding with the unit connected to the maximum test voltage.

39.4.4 For switch mode designs, a resistive load is to be connected at a point in the secondary circuit where energy limiting circuitry (see 5.8) is not affected. The load is to be adjusted to result in three times the normal input current to the transformer or maximum obtainable output current, whichever is less.