Exception No. 1: A switch that has been investigated and found to be acceptable for the application need not be subjected to the overload test.

Exception No. 2: A switch so interlocked that it will never have to break the locked-rotor motor current need not be subjected to the overload test.

30.2 The ventilator is to be connected to a grounded supply circuit of rated frequency and maximum rated voltage with the rotor of the motor locked in position. During the test, exposed metal parts of the ventilator are to be connected to ground through a 3-ampere plug fuse, and the connection is to be such that any single-pole, current-rupturing switch or control will be located in the ungrounded conductor of the supply circuit. The test is to consist of 50 cycles of operation, making and breaking the locked-rotor current of the controlled motor. The switch or control 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.

31 Permanence of Marking Tests

31.1 General

31.1.1 Unless known to be suitable for the application, a pressure-sensitive label or a label secured by cement or adhesive that is required to be permanent shall be tested as described in 31.1.2.

31.1.2 After being subjected to the conditions described in 31.2.1 – 31.6.1, a pressure-sensitive label or a label secured by cement or adhesive is considered to be permanent if immediately following removal from each test medium and after being exposed to room temperature for 24 hours following removal from each medium:

a) Each sample demonstrates good adhesion and the edges are not curled.

b) The label resists defacement or removal as demonstrated by scraping across the test panel with a flat metal blade 1/32 inch (3.2 mm) thick, held at right angles to the test panel.

c) The printing is legible and is not defaced by rubbing with thumb or finger pressure.

31.2 Oven-aging test

31.2.1 Three samples of the label applied to test surfaces as in the intended application are to be placed in an air oven maintained at the temperature specified in Table 31.1 for 240 hours.

Table 31.1
Oven-aging test temperature

Maximum temperature during normal temperature test of surface to which applied		Oven temperature	
°C	(°F)	°C	(°F)
60 or less	(140 or less)	87	(189)
80 or less	(176 or less)	105	(221)
100 or less	(212 or less)	121	(250)
125 or less	(257 or less)	150	(302)
150 or less	(302 or less)	180	(356)
Over 150	(Over 302)	a	

[a] A label that is applied to a surface attaining a temperature greater than 150°C (302°F), during the normal temperature test, is to be oven-aged at a temperature representative of the temperatures attained by the appliance during normal and abnormal operation.

31.3 Immersion test

31.3.1 Three samples of the label applied to test surfaces as in the intended application are to be placed in a controlled atmosphere maintained at 23 ±2°C (73 ±4°F) with a relative humidity of 50 ±5 percent for 24 hours. The samples are then to be immersed in water at a temperature of 21 ±2°C (70 ±4°F) for 48 hours.

31.4 Standard-atmosphere test

31.4.1 Three samples of the label applied to test surfaces as in the intended application are to be placed in a controlled atmosphere maintained at 23 ±2°C (73 ±4°F) with a relative humidity of 50 ±5 percent for 72 hours.

31.5 Unusual condition exposure test

31.5.1 If a label is exposed to unusual conditions in service, three samples of the label applied to test surfaces as in the intended application are to be placed in a controlled atmosphere maintained at 23 ±2°C (73 ±4°F) with a relative humidity of 50 ±5 percent for 24 hours. The samples are then to be immersed for 48 hours in a solution representative of service use maintained at the temperature the solution would attain in service, but not less than 23 ±2°C (73 ±4°F).

31.6 Outdoor exposure test

31.6.1 If a label is intended to be exposed to the weather, three samples of the label applied to test surfaces as in the intended application are to be subjected to ultraviolet rays and water spray for 720 hours. The test cycle is to consist of exposure to ultraviolet rays for 102 minutes followed by exposure to ultraviolet rays and a fine spray of water for 18 minutes.

32 Bonding Connection Test

32.1 The bonding connection between grounded metal and the motor frame shall not open when carrying for 2 minutes a current equal to twice the rated current of the fuse of largest current rating that can be mounted in the fuseholder of the branch circuit to which the ventilator would normally be connected.

Exception: This test need not be conducted if the minimum bonding conductor is:

a) Sized in accordance with Table 250-95 of the National Electrical Code, NFPA 70; or

b) Not smaller than one of the power supply conductors.

33 Controls – End Product Test Parameters

33.1 General

33.1.1 Spacings of controls shall comply with the electrical spacing, or clearances and clearance distance requirements of the applicable control standard as determined in Controls, Section 16. Where reference is made to declared deviation and drift, this indicates the manufacturer's declaration of the control's tolerance before and after certain conditioning tests.

33.2 Auxiliary controls

33.2.1 Auxiliary controls shall not introduce a risk of electric shock, fire, or personal injury.

33.2.2 Auxiliary controls shall comply with the requirements of this end product standard.

33.3 Operating controls (regulating controls)

33.3.1 The following test parameters shall be among the items considered when judging the acceptability of an operating control investigated using the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1. Appendix A provides more examples of controls intended to be used as operating controls:

a) Control Types 1 or 2;

b) Unless otherwise specified in this standard, manual and automatic controls shall be tested for 6,000 cycles with under maximum normal load conditions, and 50 cycles under overload conditions;

c) Installation Class 2 in accordance with Electromagnetic Compatibility (EMC) – Part 4-5: Testing Measurement Techniques – Surge Immunity Test, IEC 61000-4-5;

d) For the applicable Overvoltage Category, see Table 33.1;

e) For the applicable Material Group, see Table 33.2; and

f) For the applicable Pollution Degree, see Table 33.3.

Table 33.1
Overvoltage categories

Appliance	Overvoltage category
Intended for fixed wiring connection	III
Portable and stationary cord-connected	II
Control located in low-voltage circuit	I
NOTE: Applicable to low-voltage circuits if a short circuit between the parts involved may result in operation of the controlled equipment that would increase the risk of fire or electric shock.	

Table 33.2
Material group

CTI PLC value of insulating materials	Material group
CTI[3] 600 (PLC = 0)	I
CTI[3] 400 < 600 (PLC = 1)	II
CTI[3] 175 < 400 (PLC = 2 or 3)	IIIa
CTI[3] 100 < 175 (PLC = 4)	IIIb
NOTE - PLC stands for Performance Level Category, and CTI stands for Comparative Tracking Index as specified in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.	

Table 33.3
Pollution degree

Appliance control microenvironment	Pollution degree
No pollution or only dry, nonconductive pollution. The pollution has no influence. Typically hermetically sealed or encapsulated controls without contaminating influences, or printed wiring boards with a protective coating can achieve this degree.	1
Normally, only nonconductive pollution. However, a temporary conductivity caused by condensation may be expected. Typically indoor appliances for use in household or commercial clean environments achieve this degree.	2
Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation that is expected. Typically controls located near and may be adversely affected by motors with graphite or graphite composite brushes, or outdoor use appliances achieve this degree.	3

33.4 Protective controls (limiting controls)

33.4.1 An electronic control that performs a protective function shall comply with the requirements in Controls, Section 16, while tested using the parameters in this section. Examples of protective controls are: a control used to sense abnormal temperatures of components within the appliance; temperature protection of the motor due to locked rotor, running overload, loss of phase; or other function intended to reduce the risk of electric shock, fire, or injury to persons. During the evaluation of the protective control/circuit, the protective functions are to be verified under normal and single-fault conditions of the control/circuit.

33.4.2 The following test parameters shall be among the items considered when judging the acceptability of an electronic protective control investigated using the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1. Appendix A provides more examples of controls intended to be used as protective controls:

a) Failure-Mode and Effect Analysis (FMEA) or equivalent Risk Analysis method;

b) Power supply voltage dips, variation and interruptions within a temperature range of 10°C (50°F) and the maximum ambient temperature determined by conducting the Normal temperature test. See Temperature Test, Section 24;

c) Surge immunity test – installation Class 3 shall be used;

d) Electrical fast transient/burst test, a test level 3 shall be used;

e) Electrostatic discharge test;

f) Radio-frequency electromagnetic field immunity:

1) Immunity to conducted disturbances – When applicable, test level 3 shall be used; and

2) Immunity to radiated electromagnetic fields; field strength of 3 V/m shall be used;

g) Thermal cycling test of clause H.17.1.4.2 shall be conducted at ambient temperatures of 10.0 +2°C (50 +4°F) and the maximum ambient temperature determined by conducting the Normal temperature test. The test shall be conducted for 14 days;

h) Overload shall be conducted based on the maximum declared ambient temperature (T_{max}) or as determined by conducting the Temperature Test, Section 24;

i) If software is relied upon as part of the protective electronic control, it shall be evaluated as software Class B.

33.4.3 The test parameters and conditions used in the investigation of the circuit covered by 33.4.1 shall be as specified in the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, using the following test parameters:

a) With regard to electrical supervision of critical components, for attended appliances, a motor operated system becoming permanently inoperative with respect to movement of an exposed portion of the appliance meets the criteria for trouble indication. For unattended appliances, electrical supervision of critical components may not rely on trouble indication;

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

c) The Composite operational and cycling test is to be conducted for 14 days at temperature extremes of 0°C (32°F) and 70°C (158°F);

d) The Humidity Class is to be based on the appliance's intended end use and is to be used for the Humidity test;

e) A vibration level of 5 g is to be used for the Vibration test;

f) When a computational investigation is conducted, Ip shall not be greater than 6 failures/106 hours for the entire system. The Operational test is to be conducted for 14 days;

g) When the Demonstrated method test is conducted, the multiplier for the test acceleration factor is to be 576.30 for intermittent use appliances, or 5763.00 for continuous use appliances. The test acceleration factor equation is to be based on a 25°C (77°F) use ambient;

h) The Endurance test is to be conducted concurrently with the Operational test. The control shall perform its intended function while being conditioned for 14 days in an ambient air temperature of 60°C (140°F), or 10°C (50°F) greater than the operating temperature of the control, whichever is higher. During the test, the control is to be operated in a manner representing normal use;

i) For the Electrical fast transient burst test, test level 1 is to be used;

j) Conduct a failure-mode and effect analysis (FMEA); and

k) If software is relied upon as part of the protective electronic control, it shall be evaluated as software Class 1 in accordance with the Standard for Software in Programmable Components, UL 1998.

33.4.4 Unless otherwise specified in this standard, protective controls shall be evaluated for 100,000 cycles for Type 2 devices, and 6,000 cycles for Type 1 devices, with rated current.

MANUFACTURING AND PRODUCTION TEST

34 Production Dielectric Voltage-Withstand Test

34.1 Each ventilator shall withstand without electrical breakdown as a routine production-line test, the application of a DC potential or an AC potential at a frequency within the range of 40 - 70 hertz:

a) Between the primary winding, including connected components, and accessible dead metal parts that are likely to become energized, and

b) Between primary wiring and accessible low-voltage (42.4 volts peak or less) metal parts, including terminals.

Exception: A ventilator that has no electrical components other than a motor that is acceptable for permanent connection to the power supply, and that has been found to comply with the production

dielectric voltage-withstand requirement in the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1, need not be subjected to this test.

34.2 The production-line test shall be in accordance with either condition A or condition B of Table 34.1.

Table 34.1
Production-line test conditions

Appliance rating, V	Condition A			Condition B		
	Potential, V		Time, s	Potential, V		Time, s
	AC	DC		AC	DC	
250 volts or less with no motor rated more than 1/2 horsepower (370 W)	1000	1400	60	1200	1700	1
More than 250 volts or with a motor rated more than 1/2 horsepower	1000 + 2V	1400 + 2.8V	60	1200 + 2.4V	1700 + 3.4V	1
V = maximum marked voltage						

34.3 The ventilator may be in a heated or unheated condition for the test.

34.4 The test shall be conducted when the ventilator is fully assembled. It is not intended that the ventilator be unwired, modified, or disassembled for the test.

Exception No. 1: A part such as a snap cover or a friction-fit knob that would interfere with performance of the test need not be in place.

Exception No. 2: The test may be conducted before final assembly if the test represents that for the completed ventilator.

34.5 The test equipment shall include a transformer having an essentially sinusoidal output, a means of indicating the test potential, an audible or visual indicator of electrical breakdown, and either a manually reset device to restore the equipment after electrical breakdown or an automatic reject feature of any unacceptable unit.

34.6 If the output of the test equipment transformer is less than 500 volt-amperes, the equipment shall include a voltmeter in the output circuit to directly indicate the test potential.

34.7 If the output of the test-equipment transformer is 500 volt-amperes or larger, the test potential may be indicated:

a) By a voltmeter in the primary circuit or in a tertiary-winding circuit;

b) By a selector switch marked to indicate the test potential; or

c) In the case of equipment having a single test-potential output, by a marking in a visible location to indicate the test potential.

When marking is used without an indicating voltmeter, the equipment shall include a positive means, such as an indicator lamp, to indicate that the manually reset switch has been reset following a dielectric breakdown.

34.8 Test equipment other than that described by 36.6 and 36.7 may be used if found to accomplish the intended factory control.

34.9 During the test, the primary switch is to be in the on position, both sides of the primary circuit of the ventilator are to be connected together and to one terminal of the test equipment, and the second test-equipment terminal is to be connected to the accessible dead metal parts that are likely to become energized.

RATING

35 Details

35.1 A ventilator shall be rated in:

a) Volts.

b) Amperes (motor full-load amperes or service factor full-load amperes).

Exception: The rating may be in watts if the full-load power factor is 0.80 or more.

c) Horsepower, if such rating is 1/8 horsepower or more.

Exception: A ventilator having a shaded pole motor may be rated in watts rather than horsepower.

d) Frequency expressed in one of the following terms: hertz, Hz, cycles-per-second, cps, cycles/second, or c/s.

e) The number of phases, if polyphase.

f) A code letter indicating, in accordance with the National Electrical Code, ANSI/NFPA 70 (see Table 35.1), the locked-rotor motor input for an alternating-current motor rated 1/2 horsepower (373 W output) or more.

Table 35.1
Locked-rotor indicating code letters*

Code letter	Kilovolt-amperes per horsepower with locked rotor
A	0 – 3.14
B	3.15 – 3.54
C	3.55 – 3.99
D	4.0 – 4.49
E	4.5 – 4.99
F	5.0 – 5.59
G	5.6 – 6.29
H	6.3 – 7.09
J	7.1 – 7.99
K	8.0 – 8.99
L	9.0 – 9.99
M	10.0 – 11.19
N	11.2 – 12.49
P	12.5 – 13.99

Table 35.1 Continued on Next Page

Table 35.1 Continued

Code letter	Kilovolt-amperes per horsepower with locked rotor
R	14.0 – 15.99
S	16.0 – 17.99
T	18.0 – 19.99
U	20.0 – 22.39
V	22.4 and up
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MARKING

36 Details

36.1 A ventilator shall be legibly and permanently marked, where visible after installation, with:

a) The manufacturer's name, trade name, trademark, or other descriptive marking by which the organization responsible for the product may be identified;

b) The date or other dating period of manufacture not exceeding any three consecutive months which may be abbreviated or in a nationally accepted conventional code, or in a code affirmed by the manufacturer;

c) A distinctive catalog or model number or the equivalent; and

d) The electrical rating.

36.2 The repetition time cycle of a date code shall not be less than 26 years. The date code shall not require reference to the manufacturer's records to determine when the ventilator was manufactured.

36.3 If the motor is the only electric-energy-consuming component of the ventilator, the electrical rating given on the motor nameplate need not be shown elsewhere on the ventilator if this nameplate is visible on the motor after the ventilator has been installed as intended.

36.4 The markings required by 36.3, 36.5, and 36.6 are visible on a roof- or wall-mounted ventilator if they are plainly visible upon removal of an outer cover or panel that is removable in accordance with the requirements in 9.3.

36.5 A ventilator that incorporates motor-overload protection shall be marked to indicate the presence of such protection.

36.6 A ventilator that does not incorporate motor-overload protection shall be marked:

a) To indicate that the ventilator should be installed with remote motor-overload protection; and

b) To provide such motor-rating data– voltage, frequency, horsepower, and full-load current per phase – so that proper protection may be determined.

36.7 A ventilator that employs a dual-voltage motor that is wired for a particular voltage when shipped from the factory shall be marked to indicate the voltage for which it is connected. In addition, the motor shall be marked with instructions or a wiring diagram for connecting the motor to the other voltages. The

marking need not be permanent. The marking may be in the form of wired-on tags, instruction sheets, decalcomanias, or the like.

36.8 A ventilator having one motor with other loads or more than one motor with or without other loads shall be marked with one of the following:

a) The minimum circuit size and maximum current rating of the overcurrent-protective device unless both are 15 amperes or less; or

b) The rating of the largest motor in volts and amperes, and the rating of any other loads in volts and either amperes or watts.

Exception: The current value of a motor rated 1/8 horsepower (93 W output) or less, or a nonmotor load 1 ampere or less may be omitted unless either load constitutes the principal load.

36.9 A ventilator shall be permanently marked where readily visible during installation to indicate the direction of rotation of the impeller.

36.10 A duct fan intended to move heated air shall be permanently marked "Do not use with heated air in excess of ____°C (____°F)" or with an equivalent statement. The temperature value in the statement shall not exceed that at which the fan was tested. See 24.2 and 24.3.

36.11 A duct fan not intended for outdoor exposure shall be marked "For interior use only" or with an equivalent statement.

36.12 If a manufacturer produces or assembles ventilators at more than one factory, each finished ventilator shall have a distinctive marking to identify it as the product of a particular factory.

36.13 A ventilator that will not start and attain normal running speed when connected to a circuit protected by a fuse of other than the time-delay type as described in the Exception to 22.1 shall be plainly marked, "When connected to a circuit protected by fuses, use time-delay fuses" or with an equivalent statement.

36.14 If during the temperature test, any point within a terminal box or wiring compartment of a ventilator in which field-installed conductors are intended to be connected, including such conductors, attains a temperature rise of more than 30°C (54°F) for a compartment integral with the ventilator or 35°C (63°F) for a remotely mounted compartment, or for a duct fan intended for interior use, the ventilator shall be marked with the following statement or the equivalent, "For supply connections, use wires rated for at least ____°C (____°F)." The temperature value used in the statement shall be in accordance with Table 36.1. The marking shall be located at or near the point where supply connections are to be made, and located so that it will be visible during installation.

Table 36.1
Outlet-box marking

Temperature rise during test in terminal box or compartment				Temperature marking	
Integral		Remotely mounted[a]			
31 – 45°C	(56 – 81°F)	36 – 50°C	(65 – 90°F)	75°C	(167°F)
46 – 60°C	(82 – 108°F)	51 – 65°C	(91 – 117°F)	90°C	(194°F)

[a] Applies to a duct fan intended for interior use.

36.15 Any electrical part of a ventilator not assembled to the remainder of the unit when shipped from the factory shall be plainly marked – such as with the catalog number or model designation of the ventilator –

to indicate clearly the unit with which it is designed for use and shall also be marked with the manufacturer's name. The markings shall be applied directly to the part by a gummed or decalcomania transfer, pressure-sensitive sticker, stenciling or stamping with ink or paint, or by equivalent durable means.

36.16 A ventilator employing other than a totally-enclosed motor that is in the main air stream shall be plainly marked, "For general ventilating use only – do not use to exhaust dirt-, dust-, grease-, or lint-laden air," or with an equivalent statement. See 14.2.1.

36.17 If connections between components of a ventilator are to be made in the field, information shall be provided on a wiring diagram on the ventilator indicating:

a) Which components and connections are factory-installed and which are to be field installed; and

b) Any special requirement for the point of connection of the supply circuit and for field wiring of the interconnections – such as the necessity of moisture-resistant wire insulation, the size of wire necessary, and the like.

36.18 A ventilator that relies on the height of the installation to reduce the likelihood of exposure to moving parts per 6.5.6 shall be marked with the word "CAUTION" and the following or equivalent wording: "MOUNT WITH THE LOWEST MOVING PARTS AT LEAST 2.4 m (8 ft) ABOVE FLOOR OR GRADE LEVEL", or the equivalent.

36.19 A 2-wire, 220 – 240 volt ventilator intended for connection to a circuit operating at 150 volts or less to ground shall be marked with the word "WARNING" and the following or its equivalent: "To Reduce The Risk Of Electric Shock – Do not connect to a circuit operating at more than 150 volts to ground."

36.20 A ventilator that is shipped from the factory without the motor and drive assembly shall be plainly marked as shown in (a) – (e).

a) Identification of all motors suitable for installation on the ventilator. Identification shall include manufacturer's name, model or cat. no., and electrical rating as required by 35.1 (a) – (f).

b) Motors which incorporate motor-overload protection shall be so identified per 36.5.

c) Motors which do not incorporate motor-overload protection (not marked "thermally protected") shall be so identified to indicate that remote motor-overload protection is required per 36.6.

d) The marking shall include:

1) A provision for marking on the unit to indicate which motor has been installed; and

2) The following instruction: "Mark the motor list to indicate which motor has been installed by (include specific method). For dual voltage motors, indicate the voltage for which the motor is connected." (Equivalent wording may be employed).

These markings are for use by the manufacturer's designated organization (such as a distributor) who is responsible for installing the motor and drive assembly.

e) The marking shall include a reference to enclosed installation or operating instructions for identification of the proper drive assembly to be installed.

36.21 A ventilator employing more than one power source shall be provided with a disconnect for each power supply and the following warning; “WARNING: RISK OF ELECTRIC SHOCK. CAN CAUSE INJURY OR DEATH: THIS UNIT SUPPLIED BY MULTIPLE SOURCES, DISCONNECT All REMOTE ELECTRIC

POWER SUPPLIES BEFORE SERVICING", in letters not less than 3.2 mm (1/8 in) high, or the equivalent. This marking shall be located on all panels providing access to hazardous voltage uninsulated live parts.