UL 1414

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Capacitors and Suppressors for Radio- and Television-Type Appliances

Underwriters Laboratories Inc. (UL)
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UL Standard for Safety for Capacitors and Suppressors for Radio- and Television-Type Appliances, UL 1414

Sixth Edition, Dated February 18, 2000

The new and revised requirements are substantially in accordance with UL's Bulletin(s) on this subject dated April 16, 1999. The bulletin(s) is now obsolete and may be discarded.

The entire edition of this Standard is effective May 1, 2007. Do not discard the Fifth Edition of this Standard until that date.

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Recognition and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

This Standard consists of pages dated as shown in the following checklist:

FEBRUARY 18, 2000

1

UL 1414

Standard for Capacitors and Suppressors for Radio- and Television-Type Appliances

The First and Second Editions were titled Standard for Across-the-Line Capacitors, Antenna-Coupling and Line-By-Pass Components for Radio- and Television-Type Appliances, UL 1414.

The Third, Fourth, and Fifth Editions were titled Standard for Across-the-Line, Antenna-Coupling and Line-By-Pass Capacitors for Radio- and Television-Type Appliances, UL 1414.

First Edition – January, 1975
Second Edition – December, 1978
Third Edition – April, 1982
Fourth Edition – May, 1989
Fifth Edition – June, 1994

Sixth Edition

February 18, 2000

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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MARKING

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

Section 1 effective May 1, 2007

1.1 These requirements cover capacitors rated not more than 1.0 microfarad, 85°C, 250 V, and 60 Hz that are employed in radio, television receiving, and similar appliance circuits where breakdown of the capacitor results in a risk of fire, electric shock, or injury to persons.

1.2 These requirements also cover gas-tube voltage surge suppressors for use in products rated not more than 250 V, and 60 Hz that are employed in radio, television receiving, and similar appliance circuits where breakdown of the voltage surge suppressor results in a risk of fire, electric shock, or injury to persons.

1.3 These requirements cover capacitors and suppressors intended for use in radio- and television-type appliances which conform with the requirements applicable to such equipment.

1.4 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements to determine that the level of safety as originally anticipated by the intent of this Standard is maintained. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard shall not be judged to comply with this Standard. Where appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

2 Terminology

Section 2 effective May 1, 2007

2.1 For the purpose of these requirements:

a) The term capacitor also refers to combinations of capacitors and resistors;

b) The term suppressor refers to a gas-tube voltage surge suppressor; and

c) The term component refers to a capacitor or a gas-tube voltage surge suppressor.

3 Glossary

Section 3 effective May 1, 2007

3.1 ANTENNA-COUPLING SUPPRESSOR – A suppressor that is connected from an accessible metal part to a nominal 125 V or 250 V line circuit within an appliance.

3.2 CLASS X1 COMPONENT – A capacitor or suppressor that is connected across a line circuit.

3.3 CLASS Y1 CAPACITOR – A capacitor that is connected from an accessible metal part to a nominal 250 V line circuit within an appliance.

3.4 CLASS Y2 CAPACITOR – A capacitor that is connected from an accessible metal part to a nominal 125 V line circuit within a double insulated appliance, or a capacitor that is connected from an accessible metal part to a nominal 250 V line circuit within a grounded appliance.

4 References

Section 4 effective May 1, 2007

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 Units of Measurement

Section 5 effective May 1, 2007

5.1 When a value for measurement is followed by a value in other units in parentheses, the second value is only approximate. The first stated value is the requirement.

CONSTRUCTION

6 Enclosure

Section 6 effective May 1, 2007

6.1 A polymeric material used as all or part of the enclosure of a component shall:

a) Be classified at least V-0 as determined in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, or

b) Comply with the Flammability Test, Section 9.

6.2 A material classified at least V-0 at a thickness of 1/16 in (1.6 mm) shall be accepted at lesser thicknesses.

7 Sleeving, Tape, Tubing, and Wire Insulation

Section 7 effective May 1, 2007

7.1 Sleeving, tape, tubing, and wire insulation shall be rated for the voltage involved and the temperature attained under any condition of actual use. Tape shall be flame-retardant. Sleeving, tubing, and wire insulation shall have a VW-1 flame retardant rating.

8 Spacings

Section 8 effective May 1, 2007

8.1 The spacing between uninsulated live parts of opposite polarity, and between an uninsulated live part and a dead metal part, shall not be less than the applicable value specified in Table 8.1.

Table 8.1
Spacings

Capacitor class	Minimum spacing through air and over surface, mm
Y1	6.0
Y2	3.0

PERFORMANCE

ALL COMPONENTS

9 Flammability Test

Section 9 effective May 1, 2007

9.1 For a polymeric enclosure material that does not comply with 6.1(a), three samples of the component are to be subjected to three 15 s applications of a test flame, the period between applications of the flame being 15 s. The material shall not continue to flame for more than 15 s after the first and second applications, and not more than 60 s after the third application.

9.2 For the test, a supply of gas having a heating value of approximately 1000 Btu/ft^3 (37.6 MJ/m^3) at normal pressure and a 3/8-in (9.5-mm) diameter Tirrill burner are to be used. The test flame is to be 3/4 in (19 mm) high with the air ports of the burner closed.

9.3 Each component is to be mounted in a position that is most conducive to the ignition of the component and that is permitted by the physical construction of the component. The tip of the test flame is to be applied at any location on the body of each component.

10 Dielectric Voltage-Withstand Test

Section 10 effective May 1, 2007

10.1 As-received samples

10.1.1 Ten components shall withstand without indication of unacceptable results at the sensitivity setting specified in 10.3.2 for 1 min a sinusoidal potential, having a frequency of 60 Hz, applied from lead to lead. The potential is to be 4 kV rms for Class Y1 capacitors, and 2 kV rms for all other components.

10.2 Tested samples

10.2.1 Where specified, components subjected to tests in other sections of this Standard shall withstand without indication of unacceptable results at the sensitivity setting specified in 10.3.2 for not less than 1 min a sinusoidal potential, having a frequency of 60 Hz, applied, unless specified otherwise, between leads and between both leads of the component connected together and metal foil wrapped closely around the enclosure. The potential is to be 4 kV rms for Class Y1 capacitors, and 2 kV rms for all other components.

10.3 Test method

10.3.1 The test potential is to be obtained from a transformer that provides a variable output voltage. The applied potential is to be increased at a uniform rate, by manual or automatic means, from zero to the specified test value within 5 s.

10.3.2 The sensitivity of the test equipment is to be adjusted so that when a resistor having a value as specified in (a) and (b) is connected across the output, the test equipment indicates acceptable results for any output voltage less than the specified test voltage, and indicates unacceptable results for any output voltage equal to or greater than the specified test voltage. The minimum resistance of the resistor is to be as follows:

a) For potentials applied from lead to lead – 200,000 Ω or 1000/C Ω, whichever is less, where C is the capacitance of the capacitor expressed in μF; and

b) For potentials applied from metal foil covering the enclosure to all leads of the component connected together – 120,000 Ω.

10.3.3 When applying the dielectric voltage-withstand potential from metal foil covering the enclosure to all leads, the metal foil is to be wrapped closely around the body of the capacitor. The metal foil is to be kept at least 1/16 in (1.6 mm) from the leads and from an uninsulated protective spark gap.

10.3.4 When the component under test contains a resistor that dissipates more than the resistor's rated power when the test potential is applied from lead to lead, the component is to be cooled by artificial means, and 10 additional as-received components are to be subjected to the test described in 10.3.5.

10.3.5 The resistance of a component with a shunt resistor that dissipates more than the resistor's rated power during the test shall not change more than ±10 percent after being subjected to a 1300 Vac potential for 4 s with no artificial cooling. The resistance is to be measured before, and 1 h after the application of the 1300 Vac potential.

10.4 Production-line dielectric potential suitability test

10.4.1 When a manufacturer conducts the production-line Dielectric Voltage-Withstand Test at a potential, duration, or both, greater than specified in curve A of Figure 21.1, three samples of the capacitor are to be subjected to the continuous application of the potential that the manufacturer intends to use. The time duration is to be 100 times the factory test time. During the test, there shall not be indication of unacceptable results as defined in 21.2(c).

ANTENNA-COUPLING SUPPRESSORS

11 General

Section 11 effective May 1, 2007

11.1 An antenna-coupling suppressor rated 125 V shall comply with the applicable requirements in Sections 12 – 14; 16.1 – 16.3, 16.6, 17.1.1, 17.1.2, 17.3.1, and 17.3.2.

11.2 An antenna-coupling suppressor rated 250 V shall comply with the applicable requirements in Sections 12 – 14; 16.1 – 16.3, 16.5, 17.1.1, 17.1.2, 17.3.1, and 17.3.2.

12 Spark-Over Voltage Determination Test

Section 12 effective May 1, 2007

12.1 When tested in accordance with 12.2 and 12.3, a suppressor shall not spark-over at a potential less than 1000 Vac, and the average spark-over voltage following the tests described in Sections 13, 14, 16, and 17 shall not change by more than 50 percent from the average spark-over voltage before tests.

12.2 The test potential is to be obtained from a transformer that provides a variable output voltage. The applied potential is to be increased at a uniform rate from zero to the voltage resulting in spark-over. The spark-over current is to be limited to 5.0 mA.

12.3 The spark-over voltage of each suppressor is to be measured four times and an average spark-over voltage is to be calculated for each suppressor tested.

13 Discharge Test

Section 13 effective May 1, 2007

13.1 Ten samples of a suppressor are to be tested as described in 13.2 and 13.3. As a result of this test:

a) There shall not be visible evidence of damage to the suppressor. Discoloration or other minor changes in the physical appearance of a suppressor are not evidence of damage.

b) The suppressor shall comply with 10.2.1.

13.2 Each suppressor is to be subjected to 50 discharges from a 0.001 µF capacitor that has been charged to a potential of 10 kVdc. The interval between successive discharges is to be 5 s.

13.3 The circuit to be used in performing the discharge test is illustrated in Figure 13.1.

14 Suppressor Endurance Test

Section 14 effective May 1, 2007

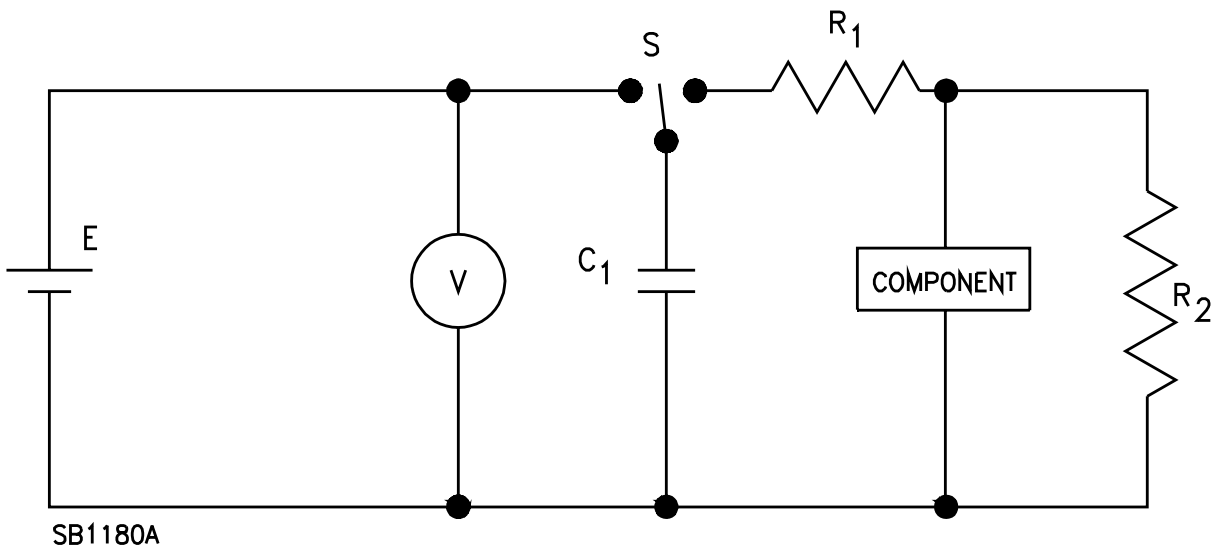
14.1 Ten samples of a suppressor rated 125 V are to subject to the tests described in 17.1.1 and 17.1.2 and the test for Class Y2 capacitors described in 17.3.2. Ten samples of a suppressor rated 250 V are to be subjected to the tests described in 17.1.1 and 17.1.2 and the test for Class Y1 capacitors described in 17.3.2. After the tests, the samples shall comply with the following:

a) The insulation resistance of the dielectric material of the suppressor, measured at 500 Vdc, with a 2 m electrification time, shall not be less than 500 MΩ;

b) The suppressor shall comply with 10.2.1 for the leads-to-foil test; and

c) The 1-A fuse shall not rupture.

Figure 13.1
Circuit for discharge test



NOTES –

Component – Sample under test

C_1 – 0.001 µF capacitor

R_1 – 1000 Ω resistor

R_2 – 100 MΩ resistor

E – 10 kVdc source of supply

S – Switch

V – Dc voltmeter

CLASS X AND CLASS Y CAPACITORS

15 General

Section 15 effective May 1, 2007

15.1 A Class X1 capacitor shall comply with 16.1 – 16.4, 16.7, and 17.1.1 – 17.2.2.

15.2 A Class Y1 capacitor shall comply with 16.1 – 16.3, 16.5, 16.7, 17.1.1, 17.1.2, 17.3.1, and 17.3.2.

15.3 A Class Y2 capacitor shall comply with 16.1 – 16.3, 16.6, 16.7, 17.1.1, 17.1.2, 17.3.1, and 17.3.2.

15.4 A Class Y1 capacitors with shunt resistor shall comply with 16.1 – 16.3, 16.5, 16.7, 17.1.1, 17.1.2, 17.3.1, 17.3.2, Sections 18, 19, and 20.

15.5 A Class Y2 capacitor with shunt resistor shall comply with 16.1 – 16.3, 16.6, 16.7, 17.1.1, 17.1.2, 17.3.1, 17.3.2, Sections 18, 19, and 20.

16 Impulse Voltage Test

Section 16 effective May 1, 2007

16.1 Twelve samples of a capacitor are to be tested as described in 16.2 and 16.3. As a result of the tests, there shall not be permanent breakdown or flashover.

16.2 Each capacitor is to be mounted by the leads in a fixed position with the capacitors randomly oriented in any end-use configuration not prohibited by the physical construction of the capacitor. The free length of the leads is to be at least 1 in (25.4 mm) unless the samples are provided with shorter leads.

16.3 Each individual capacitor is to be subjected to a maximum of 24 impulses of the same polarity. The time between impulses shall not be less than 10 s.

16.4 The peak value of the impulse voltage (Vp) is to be 4 kVdc for Class X1 capacitors.

16.5 The peak value of the impulse voltage (Vp) is to be 8 kVdc for Class Y1 capacitors.

16.6 The peak value of the impulse voltage (Vp) is to be 5 kVdc for Class Y2 capacitors.

16.7 When any three successive impulses are shown by the oscilloscope to have a waveform indicating that no self-healing breakdowns or flashovers have taken place in the capacitor, no further impulses are to be applied, and the capacitor complies with the requirement. When all 24 impulses have been applied to the capacitor, and three or more of the waveforms indicate that no self-healing or flashovers have occurred, the capacitor complies with the requirement. When less than three waveforms are of the required waveform, the capacitor does not comply with the requirement.

Exception: When the waveform has a dampened oscillation, the peak-to-peak voltage (V_{PP}) of the oscillation shall not be greater than 10 percent of the peak voltage (V_P) of the impulse. See Figure 16.1.

16.8 The waveform is to be determined by the circuit components in the test circuit. Figure 16.2 illustrates the circuit to be used in performing this test. The parameters of the components in the test circuit are to be in accordance with Table 16.1.

Figure 16.1
Impulse waveform

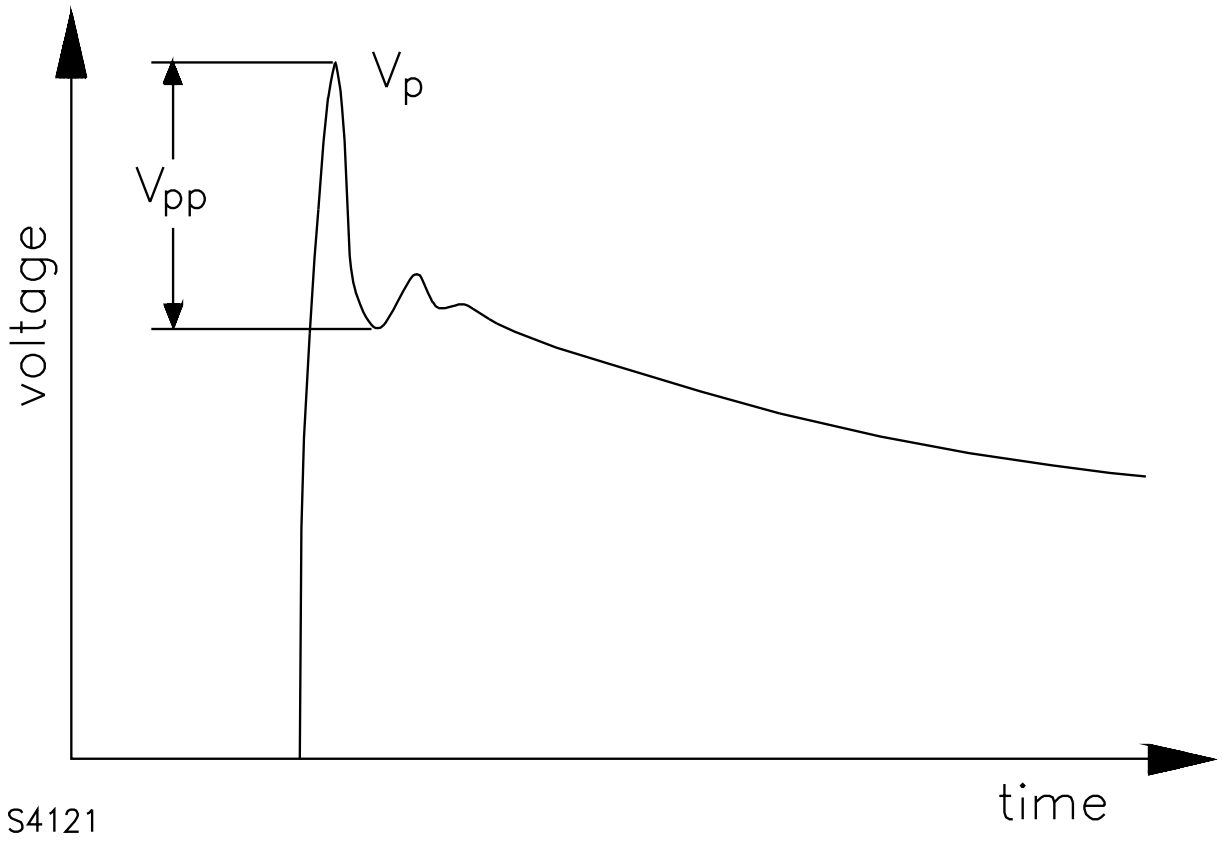
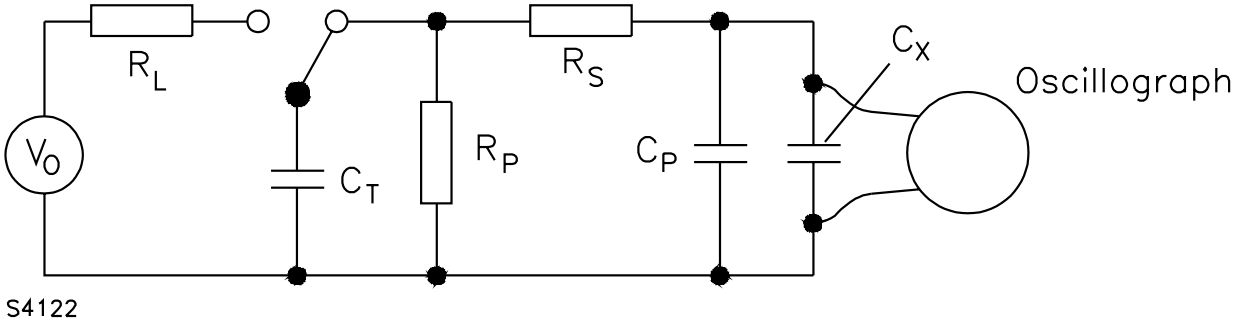


Figure 16.2
Impulse voltage test circuit



NOTES –

C_T = Charging (or tank) capacitor

C_P = Parallel capacitor

C_X = Capacitor under test

R_L = Loading resistor

R_S = Series resistor, or charging resistor

R_P = Parallel resistor, or discharging resistor

V_O = Dc source

Table 16.1
Test circuit component parameters

Nominal value of C_X (µF)			C_T (µF)	R_P (Ω)	R_S (Ω)	C_P (pF)
	C_X	≤0.0039	0.25	234	62	7 800
0.0039	<C_X	≤0.012	0.25	234	45	7 800
0.012	<C_X	≤0.018	0.25	234	27	7 800
0.018	<C_X	≤0.027	0.25	234	27	–
0.027	<C_X	≤0.039	20	3	25	3 300
0.039	<C_X	≤0.056	20	3	13	3 300
0.056	<C_X	≤0.082	20	3	9	3 300
0.082	<C_X	≤0.12	20	3	7	3 300
0.12	<C_X	≤0.18	20	3	5	3 300
0.18	<C_X	≤1.0	20	3	3	3 300

16.9 Before use, the functioning of the circuit is to be checked using C_X values of 0.01 µF and 0.1 µF, and the corresponding values for the other circuit elements as given in Table 16.1. The values for rise time t_r and decay time t_d shall be within 100 and 150 percent of the values specified in Table 16.2.

Table 16.2
Circuit calibration rise and decay time

C_X (µF)	t_r (µs)	t_d (µs)
0.01	1.2	46
0.1	1.5	47

17 Endurance Test

Section 17 effective May 1, 2007

17.1 General

17.1.1 Within one week after the completion of the Impulse Voltage Test, the samples used in the Impulse Voltage Test are to be subjected to the test described in 17.1.2 – 17.3.2. As a result of the tests, there shall not be visible damage to the capacitors such as detached leads or expulsion of parts from the enclosure, and the 1-A fuse in the supply circuit shall not rupture. After the tests, each capacitor shall comply with Dielectric Voltage-Withstand Test, Section 10.2.

17.1.2 Each capacitor is to be placed in an air-circulating oven so that no capacitor is within 1 in (25.4 mm) of any other capacitor. Each capacitor is to be conditioned at 85 ±3°C (185 ±5.4 °F) at any point capacitors are placed. A 1-A fuse is to be connected in the supply circuit of each capacitor.

Exception: When the width or the diameter of the capacitor is less than 1 in, the distance between the capacitors is to be reduced to the value of this width or diameter, unless this results in extra heating of the capacitors. In case of doubt a 1 in spacing is to be used.

17.2 Endurance Test for Class X1 Capacitors

17.2.1 For a multi-section capacitor, all X-sections are to be tested in parallel, when required, by shorting out any Y-sections.

17.2.2 The capacitors are to be subjected to an endurance test of 1008 h at 85 ±3 °C (185 ±5.4 °F) at a voltage of 313 V rms, and once every hour the voltage is to be increased to 1000 V rms for 0.1 s. Each of these voltages is to be applied to each capacitor individually through a 47 ± 2.4 Ω resistor.

17.3 Endurance Test for Class Y Capacitors

17.3.1 For a multi-section capacitor, all Y-sections are to be tested in parallel, when required, by shorting out any X-sections.

17.3.2 The capacitors are to be subjected to an endurance test of 1008 h at 85 ±3°C (185 ±5.4 °F) at a voltage of 213 V rms for Class Y2 capacitors and 425 V rms for Class Y1 capacitors, and once every hour the voltage is to be increased to 1000 V rms for 0.1 s. Each of these voltages is to be applied to each capacitors individually through a 47 ±2.4 Ω resistor.

18 Class Y Capacitor with Shunt Resistor

Section 18 effective May 1, 2007

18.1 For a Class Y capacitor with a shunt resistor, twenty additional samples are to be subjected to the Discharge Test described in 19.1 – 19.5 and ten additional samples are to be subjected to the Discharge Test described in 20.1.

19 Discharge Test

Section 19 effective May 1, 2007

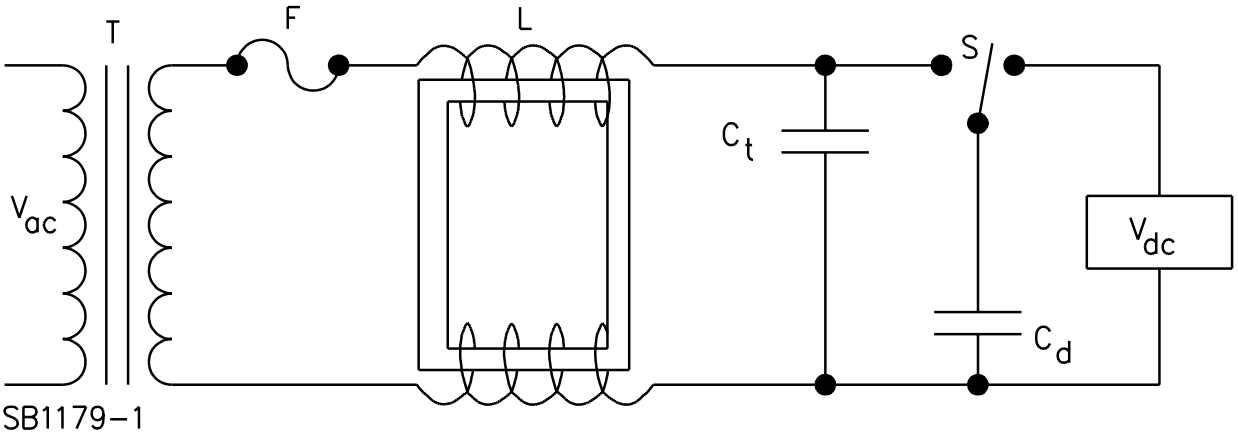
19.1 The initial resistance of 20 samples of a capacitor with a shunt resistor is to be measured. The initial resistance shall comply with 19.2. The samples are then to be subjected to the conditions described in 19.3 – 19.5. The resistance of each sample when measured after each of the conditions shall be from 80 to 120 percent of the value initially measured, and not more than 12 MΩ. The resistance is to be measured within 5 min after the conditioning described in 19.3, and within 15 – 60 min after the conditioning described in 19.4 and 19.5.

19.2 The initial resistance of each sample shall not be less than 480,000 Ω for a Class Y2 capacitor, not less than 960,000 Ω for a Class Y1 capacitor, and not more than 12 MΩ.

19.3 The samples are to be conditioned for 21 d in a chamber maintained at a temperature of 40 ±2°C (104 ±3.6°F) and a relative humidity of 95 ±2 percent. The chamber is to be constructed so that condensed water is continuously drained from the chamber and not used again until it has been repurified and no condensed water from the walls and roof of the chamber fall on the samples.

19.4 After removal from the chamber, each sample is to be subjected to ten discharges from a 0.01 µF capacitor (C_d) that has been charged to a potential of 10 kVdc. The potential is to be applied between the capacitor leads. The interval between successive discharges is to be 5 s. Figure 19.1 illustrates the circuit to be used in performing this test.

Figure 19.1
Circuit for discharge test for capacitors with shunt resistor



NOTES –

C_d – Dump capacitor having a capacitance value of 0.01 µF.

C_t – Capacitor with shunt resistor under test.

F – Cartrige fuse (branch-circuit type) rated 30 A, 250 V.

L – Choke – 3 mH with a maximum impedance of 0.03 Ω.

S – High-voltage switch.

T – Optional isolation transformer for pulse blocking, having a 1:1 turns ratio and an output capability of at least 25 A.

V_{ac} – Supply source – 240 V for Class Y1 capacitors, 120 V for Class Y2 capacitors.

V_{dc} – 10 kVdc supply.

19.5 Each capacitor shall withstand without indication of unacceptable results in accordance with 10.3.2 a 1000 V rms sinusoidal potential having a frequency of 60 Hz for 1 min applied across the capacitor leads.

20 Capacitor (with shunt resistor) Endurance Test

Section 20 effective May 1, 2007

20.1 Ten samples are to be subjected to the test described in 17.1.1, 17.1.2, and 17.3.2. The initial resistance of a capacitor with a shunt resistor is to be measured before the tests and shall comply with 19.2. After the tests, the samples shall comply with the following:

a) The resistance between the terminals of a capacitor with a shunt resistor shall not have changed more than 20 percent from the value measured before the test, and the resistance shall not be less than the applicable value specified in 19.2;

b) The capacitor shall withstand without indication of unacceptable results the leads-to-foil Dielectric Voltage-Withstand Test; and

c) The 1-A fuse shall not rupture.

MANUFACTURING AND PRODUCTION TESTS

21 Dielectric Voltage-Withstand Test

Section 21 effective May 1, 2007

21.1 Each component shall withstand, as a routine production-line test, the application of a 40 – 70 Hz ac potential or dc potential for the associated test duration above curve B of Figure 21.1 without indication of unacceptable results as defined in 21.2(c). When a dc test potential is used, it is to be equal to twice the ac values for the durations specified in Figure 21.1 for ceramic disc capacitors and 2000 V applied for 1 s for wound capacitors.

21.2 When adjusted for production-line testing, an ac tester is to have the following features and characteristics:

a) The test equipment is to produce an output voltage that has:

1) A sinusoidal waveform;

2) A frequency that is within the range of 40 – 70 Hz; and

3) A peak value not less than 1.3 times and not more than 1.5 times the rms value.

b) For a selected factory-test duration, the test equipment is to produce an output voltage that is not less than that specified by curve B of Figure 21.1 when the tester is used in each of the following conditions:

1) When the factory-test duration is less than 4 s, the output voltage is to remain above curve B of Figure 21.1 when:

i) Only a voltmeter having an input impedance of at least 2 MΩ and, when desired by the manufacturer, a sample of the product being tested is connected to the output terminals; and

ii) A resistance of not less than 2 MΩ is connected in parallel with the voltmeter and, when desired by the manufacturer, the product being tested, and the value of the resistance is reduced in increments that are not greater than 25 percent of the preceding value to the point at which an indication of unacceptable results just occurs.

2) When the test duration is 4 s or more, the output voltage is to be increased from zero at a uniform rate so as to attain the factory-test potential in approximately 5 s. The output voltage is to be maintained above curve B, by manual or automatic means, throughout the remainder of the test or until there is an indication of unacceptable results.

c) When the test equipment is adjusted to produce the factory-test voltage, and a resistance in ohms equal to the quotient of 1000/C where C is the capacitance being tested, expressed in μF, is connected across the output, the test equipment is to indicate unacceptable results within 0.5 s. Use of higher resistance to produce higher sensitivity as an indication of unacceptable results meets the intent for the sensitivity setting.

21.3 It is acceptable for the component to be in a heated or unheated condition for the test.

21.4 The test equipment is to include:

a) A means for indicating the test voltage that is being applied to the product being tested. The indicating means is to be connected directly to the test leads or provide the equivalent voltage indication.

b) A means for effectively indicating unacceptable results. The indicating means is to be one or more of the following:

1) An auditory means with a sound level greater than the background noise level;

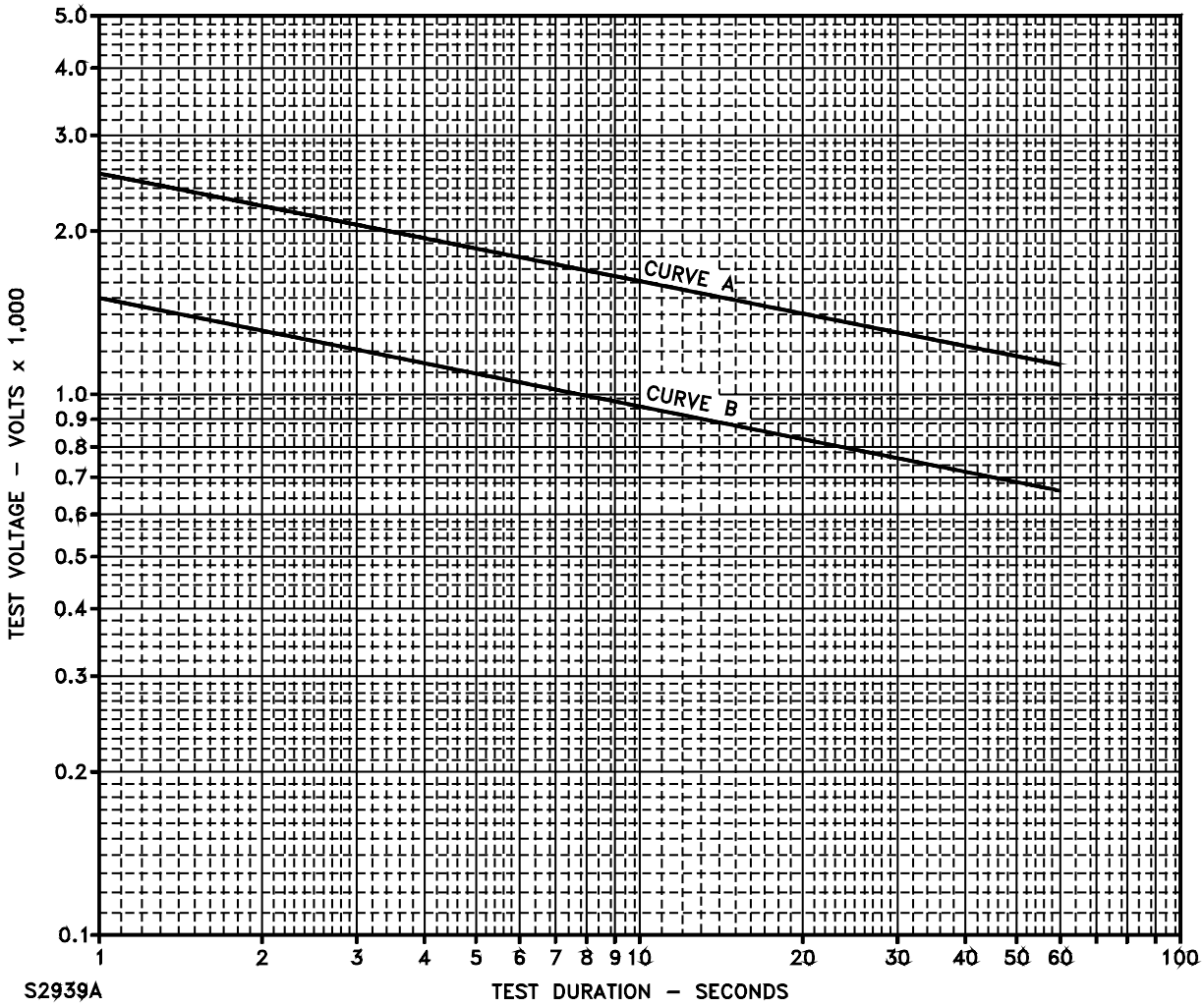
2) A visual means that commands the attention of the operator; or

3) A device that automatically rejects an unacceptable product.

When the indication of unacceptable results is auditory or visual, the indication is to remain active and conspicuous until the test equipment is reset manually.

21.5 For a selected test duration, there is not to be any transient voltage applied to the product being tested that results in an instantaneous voltage to the product exceeding 120 percent of the peak value of the test voltage that the manufacturer selects for this test. This requirement applies for the entire duration of the test, including the time that the voltage is first applied to the product and the time when the voltage is removed from the product.

Figure 21.1
Test duration



MARKING

22 Details

Section 22 effective May 1, 2007

22.1 A component shall be marked with the manufacturer's name or trademark and the catalog, type, or similar designation, and Class designation for the capacitor. For a component that is unable to be marked because it is surface mounted or it does not have a coating or an enclosure, the marking placed on the smallest unit shipping container for the component complies.

22.2 The voltage rating or a code indicating the voltage rating is not required to be marked on a component. For a component that is marked with a voltage rating on the component, the voltage rating shall be equal to or less than that for which it has been investigated.

22.3 A capacitor provided with a shunt resistor shall be marked with the resistance value or range of resistance values.

22.4 When a manufacturer produces a component at more than one factory, each finished component shall have a distinctive marking identifying it as the product of a particular factory.