UL 497B

STANDARD FOR SAFETY

Protectors for Data Communications and Fire-Alarm Circuits

UL Standard for Safety for Protectors for Data Communications and Fire-Alarm Circuits, UL 497B

Fourth Edition, Dated June 14, 2004

Summary of Topics

This revision of ANSI/UL 497B dated February 7, 2022 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

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

The requirements are substantially in accordance with Proposal(s) on this subject dated December 17, 2021.

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UL 497B

Standard for Protectors for Data Communications and Fire-Alarm Circuits

Prior to the first edition, the requirements for the products covered by this standard were included in the Standard for Protectors for Communications Circuits, UL 497.

First Edition – January, 1987
Second Edition – December, 1993
Third Edition – February, 1999

Fourth Edition

June 14, 2004

This ANSI/UL Standard for Safety consists of the Fourth Edition including revisions through February 7, 2022.

The most recent designation of ANSI/UL 497B as a Reaffirmed American National Standard (ANS) occurred on February 7, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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

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INTRODUCTION

1 Scope

1.1 These requirements cover protectors for data communications and fire-alarm circuits.

1.2 As covered by these requirements, data communications circuit protectors and fire-alarm circuit protectors consist of single- and multiple-pair air-gap arresters, gas-tube arresters, or solid-state arresters, with or without fuses or other voltage-limiting devices. Data communications circuit protectors and fire-alarm circuit protectors are intended to protect equipment, wiring, and personnel against the effects of excessive potentials and currents caused by lightning in communications alarm-initiating or alarm-indicating loop circuits.

1.3 This standard does not cover the following:

a) Lightning protective devices for the protection of primary distribution wiring systems and equipment such as AC branch circuit protection.

b) Antenna discharge units for radio- and television-receiving appliances.

c) Lightning conductor and air terminals for connection of lightning rods for building protection.

d) Protective devices to be used on telephone lines or telephone lines connecting to the telecommunication networks.

1.4 A product that contains features, characteristics, components, materials, or systems new or different from those in use when the standard was developed, 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 as determined necessary to maintain the level of safety for the user of the product as originally anticipated by the intent of this Standard.

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component.

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

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

b) Is superseded by a requirement in this standard.

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

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

2.2 Units of measurement

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

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

2.3 Undated references

2.3.1 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.

3 Glossary

3.1 For the purpose of this standard the following definitions apply.

3.2 APPLIQUE' UNIT – An arrester assembly provided with leads for connection across field terminals.

3.3 ARRESTER – A device intended to limit voltage by use of two or more electrodes in an enclosed medium or a solid-state conductor. It may also contain elements that prevent overheating when carrying fault currents.

3.4 BREAKDOWN – The abrupt transition of the gap resistance from a practically infinite value to a relatively low value. In the case of a gap, this is sometimes referred to as sparkover or ignition.

3.5 DIRECT CURRENT (DC) BREAKDOWN VOLTAGE – The voltage at which a protector changes from nonconduction to conduction when the DC potential is increased at a rate of 100 volts per second.

3.6 PROTECTOR – A device intended to provide transient protection for low voltage DC or AC circuits. The protector uses a base assembly and an arrester that may be a solid-state device, a gas tube, an air gap unit such as a carbon arrester, or similar device. AC circuits are defined as audio or alternating-current circuits that are isolated from AC branch circuits by a transformer.

CONSTRUCTION

4 General

4.1 A circuit protector shall be constructed to withstand, without damage, its intended installation and use and shall comply with the performance requirements specified in Sections 11 – 24.

4.2 A protector mounted or soldered directly to a printed-wiring board shall comply with the spacing requirements in 9.1. When an insulating barrier or enclosure is used, the material shall be acceptable for the purpose.

4.3 An arrester shall not have provision for adjustment of the electrode gap.

5 Enclosures

5.1 General

5.1.1 An enclosure for protectors shall have the strength and rigidity to resist total or partial collapse with attendant reduction of spacings, loosening or displacement of parts, or other conditions that could impair the operation of the product or result in a risk of fire, electric shock, or injury to persons.

5.1.2 Enclosures for individual components, outer enclosures, and combinations of the two are considered in determining compliance with 5.1.1.

5.1.3 A protector enclosure shall have provision for mounting.

5.2 Sheet metal

5.2.1 The thickness of sheet metal used for an enclosure of a protector shall not be less than the applicable value specified in Table 5.1 or Table 5.2.

Exception: Sheet metal of lesser thickness is not prohibited from being used when, considering the shape, size, and function of the enclosure, it provides equivalent mechanical strength to an enclosure of the thickness specified.

5.3 Nonmetallic

5.3.1 An enclosure of nonmetallic material for a protector shall have the mechanical strength and durability acceptable for the application and be formed so as to cover all current-carrying parts. See the Polymeric Materials Tests, Section 23.

Table 5.1
Minimum thickness of sheet metal for electrical enclosures of carbon steel or stainless steel

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness uncoated,		Minimum thickness metal coated,	
Maximum width,[b]		Maximum length,[c]		Maximum width,[b]		Maximum length,[c]					
inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)	inch	(mm)	inch	(mm)
4.0	(10.2)	Not limited		6.25	(15.9)	Not limited		0.020	(0.51)	0.023	(0.58)
4.75	(12.1)	5.75	(14.6)	6.75	(17.1)	8.25	(21.0)				
6.0	(15.2)	Not limited		9.5	(24.1)	Not limited		0.026	(0.66)	0.029	(0.74)
7.0	(17.8)	8.75	(22.2)	10.0	(25.4)	12.5	(31.8)				
8.0	(20.3)	Not limited		12.0	(30.5)	Not limited		0.032	(0.81)	0.034	(0.86)
9.0	(22.9)	11.5	(29.2)	13.0	(33.0)	16.0	(40.6)				
12.5	(31.8)	Not limited		19.5	(49.5)	Not limited		0.042	(1.07)	0.045	(1.14)
14.0	(35.6)	18.0	(45.7)	21.0	(53.3)	25.0	(63.5)				

NOTE – Sheet steel for an enclosure intended for outdoor use (watertight) shall be at least 0.036 inch (0.91 mm) thick if zinc-coated and at least 0.032 inch (0.81 mm) thick if uncoated.

[a] A supporting frame is a structure of angle or channel or a folded, rigid section of sheet metal that is rigidly attached to - and has essentially the same outside dimensions as - the enclosure surface and that has sufficient torsional rigidity to resist the bending moments that may be applied via the enclosure surface when it is deflected. A structure that is as rigid as one built with a frame of angles or channels is considered to have equivalent reinforcing. Constructions considered to be without supporting frames include:

Table 5.1 Continued on Next Page

Table 5.1 Continued

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness uncoated,		Minimum thickness metal coated,	
Maximum width,[b]		Maximum length,[c]		Maximum width,[b]		Maximum length,[c]					
inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)	inch	(mm)	inch	(mm)
1) A single sheet with single formed flanges (formed edges),											
2) A single sheet that is corrugated or ribbed, and											
3) An enclosure surface loosely attached to a frame, such as by spring clips.											
[b] The width is the smaller dimension of a rectangular sheet-metal piece that is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.											
[c] For panels that are not supported along one side (for example, side panels of boxes) the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a continuous flange at least 1/2 inch (12.7 mm) wide.											

Table 5.2
Minimum thickness of sheet metal for electrical enclosures of aluminum, copper, and brass

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness,	
Maximum width,[b]		Maximum length,[c]		Maximum width,[b]		Maximum length,[c]			
inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)	inches	(mm)
3.0	(7.6)	Not limited		7.0	(17.8)	Not limited		0.023	(0.58)
3.5	(8.9)	4.0	(10.2)	8.5	(21.6)	9.5	(24.1)		
4.0	(10.2)	Not limited		10.0	(25.4)	Not limited		0.029	(0.74)
5.0	(12.7)	6.0	(15.2)	10.5	(26.7)	13.5	(34.3)		
6.0	(15.2)	Not limited		14.0	(35.6)	Not limited		0.036	(0.91)
6.5	(16.5)	8.0	(20.3)	15.0	(38.1)	18.0	(45.7)		
8.0	(20.3)	Not limited		19.0	(48.3)	Not limited		0.045	(1.14)
9.5	(24.1)	11.5	(29.2)	21.0	(53.3)	25.0	(63.5)		
12.0	(30.5)	Not limited		28.0	(71.1)	Not limited		0.058	(1.47)
14.0	(35.6)	16.0	(40.6)	30.0	(76.2)	37.0	(94.0)		
NOTE – Sheet copper, brass, or aluminum for an enclosure intended for outdoor use (watertight) shall not be less than 0.029 inch (0.74 mm) thick.									
[a] A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal that is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and that has sufficient torsional rigidity to resist the bending moments that may be applied via the enclosure surface when it is deflected. A structure that is as rigid as one built with a frame of angles or channels is considered to have equivalent reinforcing. Constructions considered to be without supporting frames include:									
1) A single sheet with single formed flanges (formed edges),									
2) A single sheet that is corrugated or ribbed, and									
3) An enclosure surface loosely attached to a frame, such as by spring clips.									
[b] The width is the smaller dimension of a rectangular sheet metal piece that is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.									
[c] For panels that are not supported along one side (for example, side panels of boxes) the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a continuous flange at least 1/2 inch (12.7 mm) wide.									

6 Corrosion Protection

6.1 An iron or steel part shall be protected against corrosion by enameling, galvanizing, sherardizing, plating, or other equivalent means.

Exception No. 1: This requirement does not apply to a part, such as a washer, screw, bolt, or the like, when corrosion of the unprotected part is not likely to result in a risk of fire or electric shock, or in unintentional contact with moving parts that involve a risk of injury to persons, or impair the operation of the protector.

Exception No. 2: A part made of stainless steel, polished or treated, if necessary, does not require additional protection against corrosion.

6.2 The requirement in 6.1 applies to all enclosures whether of sheet steel or cast iron, and to all springs and other parts upon which mechanical operation depends.

6.3 Bearing surfaces shall be of such materials as to resist binding due to corrosion.

6.4 Metals shall be used in combinations that are galvanically compatible.

6.5 Nonferrous cabinets and enclosures are not prohibited from being used without corrosion protection.

7 Field-Wiring Connections

7.1 General

7.1.1 A protector shall be provided with wiring terminals or leads for the connection to equipment that it is intended to protect.

7.2 Field-wiring terminals

7.2.1 A line terminal on a protector shall be constructed to terminate the size or sizes of conductors that will be used. When a protector is constructed so that wiring is intended to terminate on the line terminals, the terminals shall be constructed to accept any conductor in the range of Nos. 14 to 22 AWG (2.1 to 0.32 mm^2).

7.2.2 Any one of the following terminal configurations or the equivalent is capable of being used for the connection of field wiring:

a) Stud-type nonferrous terminal post with securing nut – the post shall not be smaller than No. 6 (3.5 mm).

b) Wire-binding nonferrous screw or stud not smaller than No. 8 (4.2 mm), with not more than 36 threads per inch.

c) Telephone Type Terminal – Nonferrous terminal plate using a narrow V-shaped slot for securing a conductor. Requires a specific tool for wire connection.

d) Wire-Wrapped Terminal – Hardened copper or brass, having at least two sharp edges, and requiring a specific connection.

7.2.3 A field-wiring terminal shall be prevented from turning and shall not use a setscrew form of contact that could shear a conductor during installation. Prevention of turning is capable of being accomplished by means such as:

a) Two screws or rivets;

b) Square shoulders or mortises;

c) A dowel pin, lug, or offset; or

d) A connecting strap or clip fitted into an adjacent part.

Friction between surfaces is not to be used for preventing movement of the terminals.

7.2.4 A wire-binding screw shall not thread into material other than metal, and shall engage at least two full threads.

7.2.5 A terminal plate tapped for a wire-binding screw may be extruded at the tapped hole so as to give the thickness necessary for at least two full threads.

7.3 Applique' units

7.3.1 An applique' unit shall be constructed so that it is capable of being connected as intended in the field. Either solid or stranded conductors may be used. The ends of stranded conductors shall be soldered to prevent flaring of strands. The leads for connection to the line terminal shall not be smaller than No. 18 AWG (0.82 mm^2) and the ground leads shall not be smaller than No. 16 AWG (1.3 mm^2). All leads shall be provided with strain relief. When terminal lugs are provided at the lead ends, they shall be of the closed-loop type, hook type, or be provided with upturned ears unless the rigidity of the leads is such that they will be retained under the terminal with the securing nut loosened.

8 Components

8.1 General

8.1.1 An uninsulated live part shall be secured to the base or mounting surface so that it is prevented from turning or shifting in position, when such motion results in a reduction of spacings below the required minimum values. See Spacings, Section 9.

8.1.2 Electrode-type devices shall be protected against fouling by dust or other material that affects intended operation.

8.1.3 A current-carrying part shall be silver, copper or copper-alloy, or the equivalent.

8.2 Arrester assemblies

8.2.1 An arrester assembly, provided with a protector box assembly or intended for field replacement use, shall be constructed so that it is compatible with the protector base or bases with which it is intended to be used.

8.3 Electrical insulation material

8.3.1 A base for the support of a current-carrying part shall be formed of a combustion- and moisture-resistant insulating material, such as porcelain, phenolic, or a cold-molded composition.

8.3.2 A polymeric material is not prohibited from being used for the sole support of an uninsulated live part when determined to be equivalent to the materials indicated in 8.3.1.

9 Spacings

9.1 A protector shall provide reliably maintained spacings between uninsulated live parts and dead metal parts, and uinsulated live parts of opposite polarity. The spacing shall not be less than the applicable values specified in Table 9.1.

Table 9.1
Minimum spacings

Point of application	Minimum spacings, inch (mm)			
	Through air		Over surface	
To walls of enclosure:				
Cast metal enclosures	0.25	(6.4)	0.25	(6.4)
Sheet metal enclosures	0.50	(12.7)	0.50	(12.7)
Installation wiring terminals:				
With barriers	0.125	(3.2)	0.25	(6.4)
Without barriers	0.25	(6.4)	0.25	(6.4)
Rigidly clamped assemblies	0.0625	(1.6)	0.0625	(1.6)
Other parts	0.0625	(1.6)		

NOTE – An insulating liner or barrier of vulcanized fiber, varnished cloth, mica, phenolic composition, or similar material used where spacings would otherwise be insufficient, shall not be less than 0.028 inch (0.71 mm) thick; except that a liner or barrier not less than 0.013 inch (0.33 mm) thick may be used in conjunction with an air spacing of not less than one-half of the through air spacing required. The liner shall be located so that it will not be affected by arcing. Insulating material having a thickness less than that specified may be used if it is acceptable for the particular application.

10 Fuses

10.1 When specific fuses are to be used with a protector, such fuses shall be supplied with the protector and shall not be interchangeable with standard cartridge-enclosed fuses for use on ordinary light and power circuits.

10.2 When provision is made for standard cartridge-enclosed fuses, such fuses are not required to be supplied with the protector.

10.3 When provision is made for instrument fuses, such provision shall be on the equipment side of the arrester in series with the arrester line and equipment terminals.

PERFORMANCE

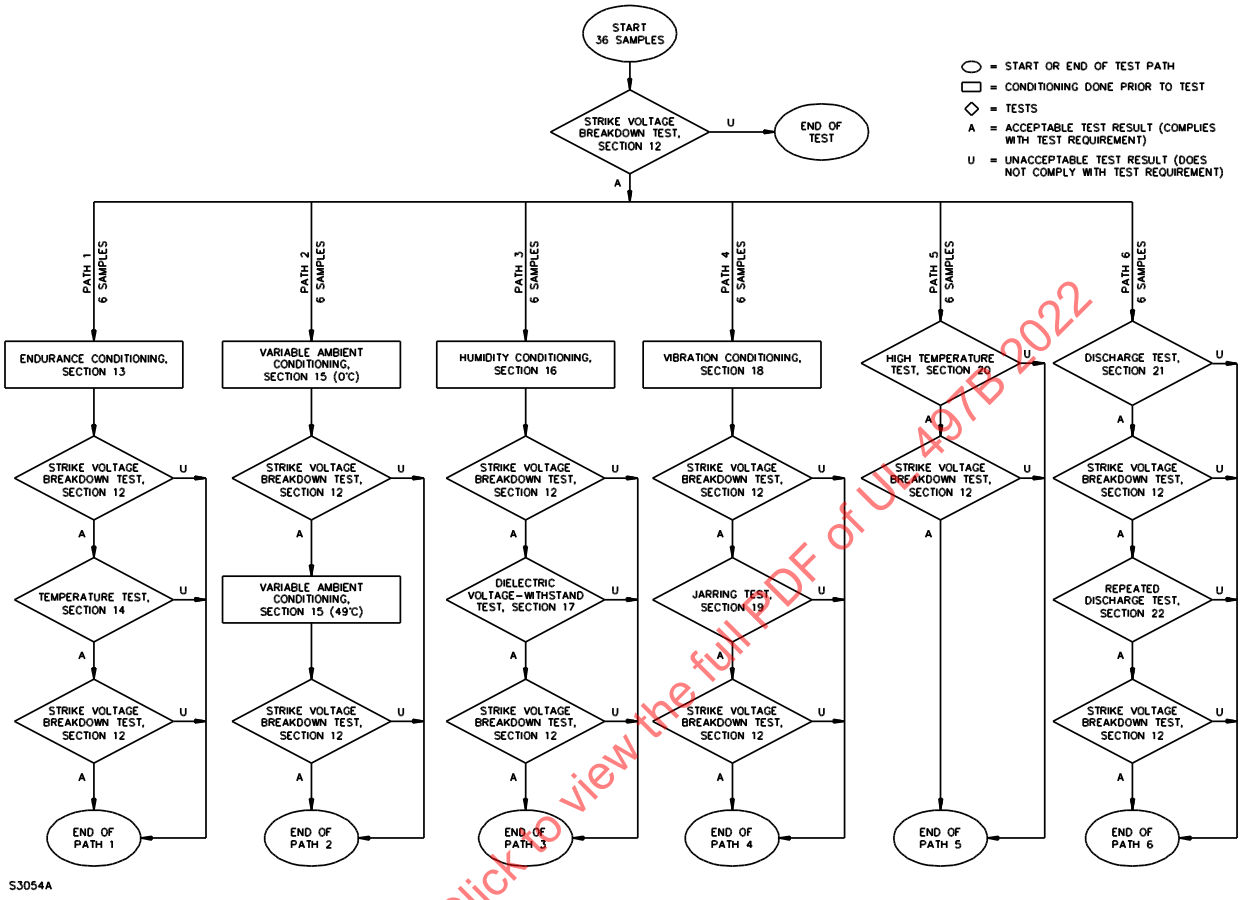
11 General

11.1 Samples that are fully representative of production are to be used for each of the following tests unless otherwise specified.

11.2 Figure 11.1 specifies the sample requirements and shows a test flow chart for the electrical performance investigation of protectors.

Figure 11.1

Test flow chart



12 Strike Voltage Breakdown Test

12.1 A protector shall break down within the manufacturer's specified rated breakdown voltage range or within 10 percent of a nominal single breakdown voltage rating before and after being subjected to the tests described in Sections 13 – 22.

12.2 Each sample in the test lot of 36 (initially) or six (subsequently) is to be subjected in turn to a voltage rise of 100 volts per second and 100 volts per microsecond, using a maximum current of 10 amperes. A 50 megahertz or higher frequency oscilloscope is to be used to display the breakdown voltage and is to use a 10 megahertz probe. The oscilloscope is to be capable of waveform storage and measurements of 1000 volts maximum and 1 volt minimum. The breakdown voltage of each sample is to be recorded.

13 Endurance Conditioning

13.1 A protector shall comply with the requirements in the Strike Voltage Breakdown Test, Section 12, after being subjected to 100 pulses as described in 13.2.

13.2 Six protector samples are to be mounted, each in a position of intended use, and subjected to 50 cycles of a 10-ampere by 1000-volt pulse, each pulse consisting of a 10 × 1000 waveform applied at a rate of one pulse every 10 seconds. The 50 pulses are then to be repeated, except in the opposite polarity.

14 Temperature Test

14.1 The temperature rise of a protector shall not exceed 65°C (117°F) above ambient temperature when subjected to voltage equal to the specified maximum circuit rating. Upon completion of the temperature test described in 14.2, the protector shall comply with the requirements in the Strike Voltage Breakdown Test, Section 12.

14.2 Six protector samples are each to be connected across a voltage potential equal to the normal operating circuit voltage maximum rating at which the protector is intended to be used. The test is to be conducted with the ambient air within the range of 18 to 32°C (64 to 90°F). Temperatures are to be monitored using thermocouples placed directly on the body of the component under test. Temperature measurements are to be recorded at 1 hour and at 7 hours after the protector is energized. If the protector body is metallic and a current-carrying or live voltage part, the thermocouple is to be placed on an insulating part of the protector as close to the current-conducting part as possible without direct contact with the current-carrying or live part.

15 Variable Ambient Conditioning

15.1 Six protector samples shall comply with the requirements in the Strike Voltage Breakdown Test, Section 12, after being subjected to a 0°C (32°F) ambient temperature for 4 hours and, again, after being subjected to a 49°C (120°F) ambient temperature for an additional 4 hours as described in 15.2.

15.2 The samples are each to be tested for compliance with the requirements in the Strike Voltage Breakdown Test, Section 12, while still in either the 0 or 49°C (32 or 120°F) ambient.

16 Humidity Conditioning

16.1 Each of six protector samples shall comply with the Strike Voltage Breakdown Test, Section 12, after being subjected to 85 percent relative humidity at 30°C (86°F) for 24 hours and while still in the specified humidity environment. The samples are then to be subjected to the Dielectric Voltage-Withstand Test, Section 17, followed by a repeat of the Strike Voltage Breakdown Test, Section 12.

17 Dielectric Voltage-Withstand Test

17.1 A protector shall withstand for 1 minute, without breakdown, the application of an essentially sinusoidal AC potential of a frequency within the range of 40 – 70 hertz, or a DC potential, between live parts and the enclosure, between live parts and exposed dead-metal parts, and between live parts of circuits operating at different potentials or frequencies. The test potential for a circuit at a potential as follows is to be (also, see 17.2):

a) 30 volts AC rms (42.4 volts DC or AC peak) or less – 500 volts (707 volts, when a DC potential is used).

b) Between 31 and 250 volts AC rms– 1000 volts (1414 volts, when a DC potential is used).

c) Greater than 250 volts AC rms – 1000 volts plus twice the highest rated value of the breakdown voltage range of the arrester element (1414 volts plus twice the highest rated value when a DC potential is used).

17.2 For the application of a potential between live parts of circuits operating at different potentials or frequencies, the voltage is to be the applicable value specified in 17.1 (a) – (c), based on the highest voltage of the circuits under test. Electrical connections between the circuits are to be disconnected before the test potential is applied.

17.3 Exposed dead-metal parts referred to in 17.1 are noncurrent-carrying metal parts that are likely to become energized and that are accessible from outside the enclosure.

17.4 The test potential may be obtained from any convenient source having sufficient capacity to maintain the specified voltage. The output voltage of the test apparatus is to be monitored. Starting at zero, the potential is to be increased at a rate of approximately 200 volts per minute until the required test value is reached and is to be held at that value for 1 minute.

17.5 When a protector block or base is constructed of a polymeric or nonmetallic material, the arrester is to be removed from the block or protector base. The block or base is to be wrapped in aluminum foil and the foil is to be separated from all live parts. The potential is then to be applied between the foil and live parts.

18 Vibration Conditioning

18.1 A protector that uses point-to-point arc type electrodes, spring assemblies, clip assemblies, or other mechanical parts that are subject to being loosened or repositioned due to vibration shall comply with the requirements in the Strike Voltage Breakdown Test, Section 12, after being subjected to vibration as described in 18.2 and 18.3.

18.2 Six protector samples are each to be secured in the intended mounting position on a mounting board and the board, in turn, securely fastened to a variable speed vibration machine having an amplitude of 0.01 inch (0.25 mm). The frequency of vibration is to be varied from 10 to 35 cycles per second in increments of 5 cycles per second until a resonant frequency is obtained. The samples then are to be vibrated at the maximum resonant frequency for a period of 1/4 hour. If no resonant frequency is obtained, the samples are to be vibrated at 35 cycles per second for a period of 4 hours.

18.3 For this test, amplitude is defined as the maximum displacement of sinusoidal motion from a position of rest or one-half of the total table displacement. Resonance is defined as the maximum magnification of the applied vibration.