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Standard for Bullet-Resisting Equipment

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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. 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 <http://csds.ul.com>.

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10 Intercommunication System

10.1 An electronic intercommunication system unit shall comply with the Standard for Audio-Video Products and Accessories, UL 1492.

11 Barriers and Building Components

11.1 Barrier devices and building components that are intended to provide protection on their own or as part of an overall protective assembly between the public and the protected side may be fixed or moved into place when required.

11.1 revised December 21, 2006

11.2 Protection against a specified level of attack shall extend to a minimum of 78 inches (2 m) above the floor level on the public side.

11.3 In order to prevent an attacker from climbing or vaulting the barrier, throwing objects over the barrier, or aiming and firing a firearm directly or indirectly into the protected side, the construction described in 11.4 shall be provided from the minimum 78-inch (2-m) height to the ceiling.

11.4 The area from the 78-inch (2-m) height to a height of 10 feet (3.08 m) is to be provided with a minimum construction of wire mesh screening constructed of at least 0.053 inch (1.35 mm) minimum thickness expanded sheet steel or No. 10 AWG (0.102 inch diameter) (5.3 mm²) steel wire with openings not greater than 2 inches (51 mm).

Exception: The construction described need not be provided to a height of 10 feet if the installation instructions specify that the top of the barrier is to be flush with part of the building structure.

PERFORMANCE – BULLET-RESISTING MATERIALS

12 General

12.1 During these tests the velocity of the projectile is to be recorded and is to be not more than 110 percent of the minimum velocity rating of the ammunition used. See Table 3.1 for the minimum velocity ratings of each type of ammunition used for test purposes. If a test shot has a velocity less than the minimum velocity rating of the ammunition, the results for that particular test sample are to be rejected. If the velocity rating for the ammunition used exceeds more than 110 percent of the minimum rating, and the sample complies with the requirements in 17.2.1, 17.2.2, 17.3.1, 17.4.1, or 17.5.1, the data are acceptable.

12.2 A laboratory weapons system with interchangeable test barrels or a commercially available weapon shall be used to fire the ammunition specified in Table 3.1.

12.3 Shooting at bullet-resisting material and assemblies from a distance of 15 feet (4.6 m) will create hazardous conditions caused by the ricocheting bullet and bullet parts, and the fly back of parts of the bullet-resisting material and assemblies. Therefore, the testing party shall be protected by a barrier. The laboratory weapons system or commercially available weapon shall be:

- a) Mounted on a fixed stand capable of being aimed at the sample and fired from behind the barrier or

b) Fired by hand through an opening in the barrier large enough to accommodate the barrel of the weapon and to aim it at the sample.

If method (b) is used, the person firing the weapon shall wear full face and head protection and gloves.

13 Bullet-Resisting Material

13.1 Solid open-hearth steel not less than 3/16 inch (4.8 mm) thick, having an ultimate tensile strength of 50,000 psi (345 MPa), is acceptable for Level 1 rating. The bullet-resisting ratings of other materials and composites of materials shall be determined by ballistics tests. See Table 3.1.

13.2 Test sample, fully representative of production products shall be submitted for tests.

13.3 Each test sample of a material is to be 12 by 12 inches (305 by 305 mm). If test results indicate that a more severe condition would involve the testing of a larger size test sample, then the larger size sample up to the maximum overall size commercially produced is to be tested.

13.4 Each assembly of bullet-resisting material tested shall be finished to the degree that there are no visible imperfections in the material.

14 Bullet-Resisting Glazing Material

14.1 Test samples submitted for tests shall be fully representative of production products and shall be in assemblies (including frames and glazing) that are representative of how those products are commonly built or applied.

14.1 revised December 21, 2006

14.2 A sample of each type of bullet-resisting glazing material is to be subjected to each test. Each assembly of bullet-resisting glazing material tested is to be finished to the degree that there are no visible imperfections in the materials, such as delaminations, air bubbles, and the like.

14.3 Each test sample is to be 12 by 12 inches (305 by 305 mm). If bullet-resisting glass, plastic, or any combination thereof is produced with any lateral dimension smaller than test sample size, then the smallest section sample is also to be tested. If test results indicate that a more severe condition would involve the testing of a larger size test sample, then the larger size sample up to the maximum overall size commercially produced is to be tested.

15 Assemblies

15.1 Samples of assemblies, such as gunports, deal trays, package passers, voice panels, door operating mechanisms, and the like, are to be subjected to the Ballistics Test, Section 17, using the ammunition designated for its rating. See Table 3.1.

15.2 Using the designated ammunition, shots are to be placed at various locations on the assembly that are considered most likely to allow penetration of the projectile, fragments of the projectile, or fragments of the assembly with sufficient force to embed into or damage the cardboard indicators specified in 17.1.2.

15.3 Each shot is to be fired singly for each test. For each shot, the weapon is to be aimed, loaded with a single round, the aim checked, and then fired.

15.4 For Levels 1–5, each shot is not to be closer than $4 \pm 1/2$ inch (102 ± 12.7 mm) from any other shot.

15.5 Assemblies that are opened and closed as part of their intended operation are to have the test shots fired with the assembly fully closed and fully opened. If a partially opened condition will create a greater possibility of penetration, the assembly is to be tested with a partial open position.

Exception: A gunport is not to be subjected to a ballistics test while in its open position.

15.6 Assemblies rated Levels 1–5 and for Levels 9 and 10 are to have single shots placed in the area of locking cylinders, door-operating mechanisms, and the like.

15.6 revised December 21, 2006

15.7 Assemblies rated Levels 6–8 are to have two shots placed in the area of locking cylinders, door-operating mechanisms, and the like.

15.8 Shots, as specified in 15.6 and 15.7, are to be placed at seams in the assembly.

15.9 For Levels 6–8, five shots are to be placed in a $4\text{-}1/2$ by $4\text{-}1/2$ inch (114 by 114 mm) square as specified in 17.5.1. The square is to be at the location on the assembly determined to be the weakest area. More than one location may be subjected to this test.

16 Shotgun Tests

16.1 All fixed or movable assemblies used to pass material between persons on either side of the assembly, speaking apertures, and similar devices, are to be tested as described in 16.2. The shotgun pellets shall not penetrate the assembly so as to embed into or damage the cardboard indicators specified in 17.1.2.

16.2 The assembly is to be mounted as described in 17.1.2 and a single shot from a No. 20 gauge shotgun using No. 7-1/2 or No. 8 lead shot is to be fired into the assembly from a distance of approximately 15 feet (4.6 m) at a location determined most likely to allow passage of the shotgun pellets through the assembly.

17 Ballistics Test

17.1 Levels 1–10 and supplementary shotgun

17.1.1 For the following tests, there shall be no penetration of the projectile through the test sample, and there shall also be no spalling of material on the protected side of the test sample to the extent that fragments embed into or damage the cardboard indicators. There shall be no opening of sufficient size to permit insertion of the muzzle of a standard weapon designed to use the ammunition used for the test completely through the sample.

17.1.2 Each test sample of material is to be mounted in a rigidly fixed frame. A sample of an assembly is to be mounted and rigidly held in place. The tests are to be conducted at a range of 15 feet (4.6 m) using a test barrel or weapon and the ammunition specified in Table 3.1. Corrugated cardboard indicators, approximately 1/8 inch (3.2 mm) thick, are to be placed a distance of approximately 18 inches (457 mm) behind the protected side of the test sample.

17.1.3 Each type of bullet-resisting material and assembly shall be tested in accordance with the bullet-resisting rating assigned to it by the manufacturer. See Table 3.1.

17.1.4 For Levels 1 – 10, these tests are to be conducted at room temperature, $22 \pm 3^\circ\text{C}$ ($72 \pm 5^\circ\text{F}$). For Levels 1–5 and for Levels 9 and 10 rating, and supplementary shotgun for Levels 1–5, materials and assemblies that are not constructed of metal are to be tested at the temperatures specified in 17.6.1 or 17.7.1.

17.1.4 revised December 21, 2006

17.1.5 The number of samples required to be tested is indicated in Table 17.1.

Table 17.1 Samples required for tests

Table 17.1 revised December 21, 2006

Rating	Type of product	Ambient temperature	Number of samples ^a
Levels 1–5 ^b and Levels 9 and 10 Levels 1–5 ^b and Levels 9 and 10 Levels 6–10 ^b Levels 1–10 ^b	Nonmetallic material Metallic material Material Assemblies	Tested at high, room, and low temperatures Tested at room temperature Tested at room temperature Tested at room temperature	5 ^c 3 ^c 1 1
^a Because there may be inconclusive results, additional samples may be required. If tested for supplementary shotgun, the number of samples is doubled. ^b Includes supplementary shotgun as applicable. ^c If the Exception to 17.4.1 applies, the number of samples is reduced by one.			

17.2 Levels 1–3 and supplementary shotgun

17.2.1 Bullet-resisting material with a Level 1, 2, or 3 rating, or supplementary shotgun rating (for Levels 1 – 5), shall resist three shots spaced $4 \pm 1/2$ inch (102 ± 12.7 mm) apart in a triangular pattern in the approximate center of the test sample. The measurement between each shot is to be made from the center of the impact of each shot on the test sample.

17.2.2 A separate sample of each type of bullet-resisting material that is intended to have a Level 1, 2, or 3, or supplementary shotgun rating for Levels 1–3, is to be subjected to a test in which two shots are fired at the approximate center of the test sample with the shots spaced $1-1/4$ to $1-3/4$ inches (32 to 45 mm) apart. Spalling of bullet-resisting material from the protected side of the test sample is acceptable under this test condition.

17.3 Levels 4, 5, 9 or 10

17.3.1 Bullet-resisting material with a Level 4, 5, 9 or 10 rating shall resist one shot in the approximate center of the test sample. Level 4 or 5 rated material tested for supplementary shotgun rating shall resist three shots as required in 17.2.1.

17.3.1 revised December 21, 2006

17.4 Levels 1–5, Level 9, and supplementary shotgun

17.4.1 A separate sample of each type of bullet-resisting material that is intended for a Levels 1–5 rating, Level 9 rating, and supplementary shotgun rating for Levels 1–5 is to be subjected to an unsupported edge test. The sample is to be mounted in a frame with the lower edge unsupported and struck with a single shot placed midway between the vertical supports and 1 to $1-1/2$ inches (25 to 38 mm) from the free edge. Spalling of bullet-resisting material is acceptable under this test condition.

Exception: Bullet-resisting material that is to be used in a fully-supported manner need not be subjected to this test.

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17.5 Levels 6–8

17.5.1 For Levels 6–8, five shots shall be placed in a square pattern that is $4-1/2$ by $4-1/2$ inches (114 by 114 mm) located in the center of the sample. The first of the five shots is to be placed in the upper left hand corner, the second in the upper right hand corner, the third in the lower right hand corner, and the fourth in the lower left hand corner. The fifth shot is to be placed at the center of the square. A plus or minus $1/2$ inch (12.7 mm) tolerance is allowed.

30.4 The spacings in a motor shall comply with the spacing requirements in the Standard for Electric Motors, UL 1004.

30.5 Film-coated wire is considered an uninsulated live part in determining compliance of a product with the spacing requirements, but film coating may be used as turn-to-turn insulation in coils.

30.6 The spacings within snap switches, lampholders, and similar wiring devices supplied as part of a device shall comply with the requirements for that component but need not comply with the requirements of Table 30.1.

30.7 To allow for the possible physical expansion of a capacitor with an internal interrupter, 1/2 inch (12.7 mm) shall be added to each of the spacing requirements of Table 30.1 for spacings between the terminals of the capacitor. The spacing shall be in line with the direction in which the terminals will expand when the interrupter operates.

PERFORMANCE – ELECTRICAL AND MECHANICAL EQUIPMENT

31 General

31.1 Unless otherwise specified, the performance of bullet-resisting equipment shall be investigated by subjecting a representative sample to the following tests.

32 Test Samples and Miscellaneous Data

32.1 Samples

32.1.1 The following samples are to be provided for testing: a) One or more assembled products of each type. b) Unassembled sample of any encapsulated or otherwise permanently assembled portions

which otherwise could not be disassembled for examination and photographs.

c) Installation and operating instructions for each sample.

32.2 Test voltages

32.2.1 Unless otherwise specified, each test is to be conducted at the applicable potential indicated in Table 32.1.

Table 32.1 Test voltages

Rated voltage	Normal test voltage	Input test voltage	Overvoltage	Undervoltage
110 – 120 200 – 208 220 – 240 Other	120 208 240 Rated	Rated Rated Rated Rated	132 229 264 110 percent rated	102 177 204 85 percent rated

33 Input Test

33.1 The input to a product shall not be more than 110 percent of the rated current, power, or volt-ampere value when the product is operated under the condition of maximum intended load and when connected to a test voltage in accordance with the requirements in 33.2.

33.2 The test voltage for this test is to be the maximum rated voltage for the product. For a product having a single voltage, such as 115 volts, maximum rated voltage is to be that single voltage. If the voltage is given in terms of a range of voltages, such as 110 – 120 volts, the maximum rated voltage is the highest value of the range.

34 Power-Limited Circuits

34.1 General

34.1.1 All field-wiring circuits shall be classified as a power-limited or nonpower-limited circuit. A circuit shall be considered nonpower-limited unless otherwise identified in the installation documentation and marking on the product.

34.1.2 The power source (or sources) supplying a power-limited circuit shall be either:

- a) Inherently limited requiring no overcurrent protection or
- b) Limited by a combination of a power source and overcurrent protection devices such that a power-limited circuit has electrical characteristics described in Table 34.1 for AC circuits or Table 34.2 for DC circuits.

Table 34.1 Power source limitations for alternating current Class 2 and Class 3 circuits

	Circuit voltage V_{max} a (volts)	Power source maximum nameplate ratings		Current limitations I_{max} b (amps)	Power limitations $(VA)_{max}$ c (volt-amperes)	Maximum overcurrent protection (amps)	Current (amps)
		VA (volt-amperes)					
Inherently limited power source (overcurrent protection not required)							
Class 2	0 to 20	$5.0 \times V_{max}$	5.0	8.0	—	—	
	over 20 to 30	100	$100/V_{max}$	8.0	—	—	
	over 30 to 150	$0.005 \times V_{max}$	0.005	0.005	—	—	
Class 3	over 30 to 100	100	$100/V_{max}$	$150/V_{max}$	—	—	
Not inherently limited power source (overcurrent protection required)							
Class 2	0 to 20	$5.0 \times V_{max}$	5.0	$1000/V_{max}$	250d	5.0	
Class 3	over 20 to 30	100	$100/V_{max}$	$1000/V_{max}$	250	$100/V_{max}$	
	over 30 to 100	100	$100/V_{max}$	$1000/V_{max}$	250	$100/V_{max}$	
	over 100 to 150	100	$100/V_{max}$	1.0	NA	1.0	
NOTES 1 Adapted from the National Electrical Code, ANSI/NFPA 70, copyright National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. 2 For nonsinusoidal AC, V_{max} shall not be greater than 42.4 volts peak. Where wet contact (immersion not included) is likely to occur, Class 3 wiring methods shall be used, or V_{max} shall not be greater than 15 volts for sinusoidal AC and 21.2 volts peak for nonsinusoidal AC. a V_{max} : Maximum output voltage regardless of load with rated input applied. b I_{max} : Maximum output current under any noncapacitive load, including short circuit, and with overcurrent protection bypassed, when used. When a transformer limits the output current, I_{max} limits apply after 1 minute of operation. Where a current limiting impedance is used in combination with a nonpower-limited transformer or a stored energy source, such as a storage battery, in order to limit the output current, I_{max} limits apply after 5 seconds. c $(VA)_{max}$: Maximum volt-ampere output after 1 minute of operation regardless of load, and with overcurrent protection bypassed, when used. d When the power source is a transformer, $(VA)_{max}$ is 350 volt-amperes or less where V_{max} is 15 volts or less.							

Table 34.2 Power source limitations for direct current Class 2 and Class 3 circuits

	Circuit voltage V_{max} a (volts)	Power source maximum nameplate ratings		Current limitations I_{max} b (amps)	Power limitations (VA) $_{max}$ c (volt-amperes)	Maximum overcurrent protection (amps)	Current (amps)
		VA (volt-amperes)					
Inherently limited power source (overcurrent protection not required)							
Class 2	0 to 20	$5.0 \times V_{max}$	5.0	8.0	—	—	
	over 20 to 30	100	$100/V_{max}$	8.0	—	—	
	over 30 to 60	100	$100/V_{max}$	$150/V_{max}$	—	—	
	over 60 to 150	$0.005 \times V_{max}$	0.005	0.005	—	—	
Class 3	over 60 to 100	100	$100/V_{max}$	$150/V_{max}$	—	—	
Not inherently limited power source (overcurrent protection required)							
Class 2	0 to 20	$5.0 \times V_{max}$	5.0	$1000/V_{max}$	250d	5.0	
Class 3	over 20 to 60	100	$100/V_{max}$	$1000/V_{max}$	250	$100/V_{max}$	
	over 60 to 100	100	$100/V_{max}$	$1000/V_{max}$	250	$100/V_{max}$	
	over 100 to 150	100	$100/V_{max}$	1.0	N/A	1.0	
1 Adapted from the National Electrical Code, ANSI/NFPA 70, copyright National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. 2 A dry cell battery shall be considered an inherently limited power source, when the voltage is 30 volts or less and the capacity is equal to or less than that available from series connected No. 6 carbon zinc cells. 3 For DC interrupted at a rate of 10 to 200 hertz, V_{max} shall not be greater than 24.8 volts. Where wet contact (immersion not included) is likely to occur, Class 3 wiring methods shall be used, or V_{max} shall not be greater than 30 volts for continuous DC and 12.4 volts for DC that is interrupted at a rate of 10 to 200 hertz. a V_{max} : Maximum output voltage regardless of load with rated input applied. b I_{max} : Maximum output current under any noncapacitive load, including short circuit, and with overcurrent protection bypassed, when used. When a transformer limits the output current, I_{max} limits apply after 1 minute of operation. Where a current limiting impedance is used in combination with a nonpower-limited transformer or a stored energy source, such as a storage battery, in order to limit the output current, I_{max} limits apply after 5 seconds. c (VA)$_{max}$: Maximum volt-ampere output after 1 minute of operation regardless of load, and with overcurrent protection bypassed, when used. d When the power source is a transformer, (VA)$_{max}$ is 350 volt-amperes or less where V_{max} is 15 volts or less.							

34.1.3 With regard to 34.1.2, acceptable means for current limiting include: a) Transformer winding impedance; b) A thermal link embedded within the winding overwrap of a transformer; c) Circuit components (resistors, regulators, transistors, and similar components) that comply with the Temperature Test, Section 45, under I_{max} condition; and d) Current limiting impedances determined to be suitable for the application (positive temperature coefficient varistor or similar component). Circuit component burnout, permanent (by soldered means or similar method) or replaceable fuses, opening of conductors on printed-wiring boards, or opening of internal wiring conductors shall not be used as a means of current limiting.

34.1.4 The overcurrent protection device specified in 34.1.2 shall be of the noninterchangeable type such that it is incapable of being renewed in the field with an overcurrent device having a higher current rating.

34.1.5 When measuring the I_{max} and VA_{max} , all overcurrent protection devices of the control unit shall be short-circuited. However, current limiting devices shall not be bypassed and shall remain functional.

34.2 Maximum voltage

34.2.1 With the circuit energized only from its rated primary power source, the output voltage of the circuit under test is to be measured while the circuit is connected to full rated load and under open circuit conditions. The maximum voltage under these two conditions shall be considered V_{max} .

34.3 Maximum current

34.3.1 In order to determine compliance with the I_{max} limitation, a variable load resistor is to be connected across the circuit. While monitoring the current through the load resistor, the load resistor shall be adjusted from open circuit to short circuit as quickly as possible and the highest current noted. The load resistor is then to be readjusted to produce the highest current obtained and the current through the load resistor is to be measured after 1 minute or after 5 seconds as determined by Table 34.1 or 34.2.

34.3.2 When the maximum current through the load resistor is unable to be maintained for 5 seconds due to current-limiting devices (opening of thermal link, power supply foldback, PTC varistor effect, and similar methods), the circuit load resistor is to be adjusted to a value that produces a current just above the I_{max} value indicated in Table 34.1 or Table 34.2. The results are in compliance when the I_{max} value stated in Table 34.1 or Table 34.2 is unable to be maintained for more than 5 seconds.

34.3.3 When a transformer limits the value of I_{max} , and when I_{max} is unable to be maintained for 1 minute due to transformer burnout, a plot of current versus time is to be generated and the graph extrapolated to 1 minute. The results are in compliance when the extrapolated value of I_{max} at 1 minute does not exceed the I_{max} limitations as indicated in Table 34.1 or Table 34.2.

34.4 VA_{max} (Not inherently limited circuits only)

34.4.1 The circuit is to be energized from a rated source of supply and then the circuit under test is to be open-circuited. A variable load resistor, initially set to draw rated circuit current, is then to be connected across the circuit. The circuit voltage and current are to be recorded and the load is to be removed. The resistance of the load shall then be decreased, momentarily reconnected across the circuit while recording the voltage and current, and then removed. This procedure is to be repeated until the load resistance has been reduced to a short circuit. Using the recorded voltage and current, the maximum volt-ampere, VA_{max} , output under each load condition is to be calculated. The load resistor is then to be adjusted to that value which produced the maximum volt-ampere, VA_{max} ; calculated; and then connected to the circuit. After 1 minute, the voltage and current are again to be measured. The results of this test are in compliance when the calculated volt-ampere, VA, output of the circuit does not exceed the values specified in Table 34.1 or Table 34.2, after 1 minute.