

UL 752

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Bullet-Resisting Equipment

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UL Standard for Safety for Bullet-Resisting Equipment, UL 752

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Revisions: This Standard contains revisions through and including December 21, 2006.

Summary of Topics

These revisions add bullet resisting requirements to resist .50 Caliber and 7.62 mm Armor Piercing Rounds.

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The revisions dated December 21, 2006 include a reprinted title page (page1) for this Standard.

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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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INTRODUCTION

1 Scope

1.1 These requirements cover materials, devices, and fixtures used to form bullet-resisting barriers which protect against robbery, holdup, or armed attack such as those by snipers.

1.1 revised December 21, 2006

1.1.1 This standard can also be used to determine the bullet resistance of building components that do not fit the definition of equipment, such as windows, walls, or barriers made out of bullet resistant materials.

1.1.1 added December 21, 2006

1.2 As used in these requirements, the term "bullet-resisting" signifies that protection is provided against complete penetration, passage of fragments of projectiles, or spalling (fragmentation) of the protective material to the degree that injury would be caused to a person standing directly behind the bullet-resisting barrier.

1.3 These requirements also cover electrically-operated equipment, such as teller's fixtures using electrically-driven deal trays or package passers, and intercommunication or other electrical equipment that is an integral part of the bullet-resisting product.

1.4 The term "product" as used in this standard refers to all bullet-resisting equipment or any part thereof covered by this standard unless specifically noted otherwise.

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. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

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.

2.3 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 Specifications and Ammunition

3.1 For the purposes of rating assignment, the ammunition specifications given in Table 3.1 shall apply.

Table 3.1
Ratings of bullet-resisting materials

Table 3.1 revised December 21, 2006

Rating	Ammunition	Grain	(g)	Minimum velocity,		Number of shots	Paragraph
				fps	(m/s)		
Level 1	9 mm full metal copper jacket with lead core	124	8.0	1,175	358	3	4.3
Level 2	.357 Magnum jacketed lead soft point	158	10.2	1,250	381	3	4.4
Level 3	.44 Magnum lead semi-wadcutter gas checked	240	15.6	1,350	411	3	4.5
Level 4	.30 caliber rifle lead core soft point	180	11.7	2,540	774	1	4.6
Level 5	7.62 mm Rifle lead core full metal copper jacket, military ball	150	9.7	2,750	838	1	4.7
Level 6	9 mm full metal copper jacket with lead core	124	8.0	1,400	427	5	4.8
Level 7	5.56 mm Rifle full metal copper jacket with lead core	55	3.56	3,080	939	5	4.9
Level 8	7.62 mm Rifle lead core full metal copper jacket, military ball	150	9.7	2,750	838	5	4.10
Level 9	Armor piercing .30 caliber Rifle steel core lead point filler full metal jacket	166	10.8	2715	828	1	4.11
Level 10	.50 caliber rifle lead core full metal copper jacket military ball	709.5	45.9	2810	856	1	4.12
Supplementary shotgun	12-Gauge rifled lead slug and	437	28.3	1,585	483	3	4.11
	12-Gauge 00 lead buckshot (12 pellets)	650	42	1,200	366		
NOTE – Maximum velocity is 110 percent of the minimum velocity.							

4 Glossary

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

4.2 ELECTRICAL CIRCUITS:

a) High-Voltage (Class 1) – A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage, power-limited circuit.

b) Low-Voltage – A circuit involving a potential of not more than 30 volts AC, rms, 42.4 volts DC or AC peak.

c) Power-Limited – A circuit whose output is limited as specified in Power-Limited Circuits, Section 34.

d) Class 2 – A circuit in which the voltage and power limitations are in accordance with the requirements of Table 34.1 for AC circuits and Table 34.2 for DC circuits.

e) Class 3 – A circuit in which the voltage and power limitations are in accordance with the requirements of Table 34.1 for AC circuits and Table 34.2 for DC circuits.

4.3 LEVEL 1 – Protection against hand guns of medium power, such as the 9 mm, Super 38 Automatic, and the like, with muzzle energy of 380 – 460 foot-pounds (515 – 624 J).

4.4 LEVEL 2 – Protection against hand guns of high power, such as the .357 Magnum, and the like, with muzzle energy of 548 – 663 foot-pounds (743 – 899 J).

4.5 LEVEL 3 – Protection against hand guns of super power, such as the .44 Magnum, and the like, with muzzle energy of 971 – 1175 foot-pounds (1317 – 1593 J).

4.6 LEVEL 4 – Protection against high-power hunting and sporting rifles, such as the 30-06, and the like, with muzzle energy of 2580 – 3120 foot-pounds (3498 – 4929 J).

4.7 LEVEL 5 – Protection against military ball full metal copper jacket ammunition fired from a hunting rifle such as the 308 Winchester or a military rifle with muzzle energy of 2519 – 3048 foot-pounds (3416 – 4133 J).

4.8 LEVEL 6 – Protection against multiple shots from a submachine-gun, such as a 9 mm Uzi, and the like, with muzzle energy of 540 – 653 foot-pounds (732 – 885 J).

4.9 LEVEL 7 – Protection against multiple shots from a military assault rifle, such as an M-16, and the like, with muzzle energy of 1158 – 1402 foot-pounds (1570 – 1901 J).

4.10 LEVEL 8 – Protection against multiple shots from a military assault rifle, such as an M-14, and the like, with muzzle energy of 2519 – 3048 foot-pounds (3416 – 4133 J).

4.11 LEVEL 9 – Protection against armor piercing rounds fired from an M1 Garand rifle or the like, or high-power hunting and sporting rifles with muzzle energy of 2717 to 2777 foot-pounds (3683 – 4457 J). The bullet will be a .30-06 armor piercing round such as the US Military APM2.

4.11 revised December 21, 2006

4.12 LEVEL 10 – Protect against one shot from a military sniper rifle, such as the Barrett M82 A1 (XM 107), with a muzzle energy of 12,439 – 12,706 foot-pounds (16,863 – 20,404 J). The bullet will be a .50 caliber round such as the US Military M2.

4.12 added December 21, 2006

4.13 SUPPLEMENTARY SHOTGUN – A supplementary test using a rifled lead slug with a muzzle energy of 2438 – 2950 foot-pounds (3306 – 4000 J) and 00 lead buckshot with a muzzle energy of 2078 – 2415 foot-pounds (2818 – 3275 J), fired from a 12-gauge shotgun. Products shall be tested with both loads. Products complying with this test may have the suffix “-SG” added to the rating designation.

4.13 added December 21, 2006

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5 Installation and Operating Instructions

5.1 Each unit shall be provided with installation instructions and drawings which shall include the following information:

- a) Typical installation drawing layouts and complete representative installation wiring diagrams for the product(s) indicating recommended locations and wiring methods that shall be in accordance with applicable installation wiring codes.
- b) A concise description of the operation, testing, and proper maintenance procedures for the product(s).
- c) Replacement parts, such as lamps or batteries, shall be identified in the instructions by a part number, manufacturer's model number, or the equivalent.
- d) A description of the conditions that might be expected to result in impaired operation of the product.
- e) A description of the protective features and a warning against bypassing such features.

5.2 The instructions may be incorporated on the inside of the product, on a separate sheet, or as part of a manual. If not included directly on the product, the instructions or manual shall be referenced in the marking information on the product.

6 Protection of Service Personnel

6.1 Uninsulated parts that operate at high voltage and that are made accessible by opening or removing a cover, door, panel, or other closure on or within the unit shall be provided with guards over the parts to reduce the risk of service personnel unintentionally contacting them during any servicing of the product. See also 6.2 and 6.3.

6.2 If parts that are in motion during servicing operations and that present a pinching, snagging, cutting, or other mechanical motion are made accessible by opening or removing a cover, door, panel, or other closure on the unit for the purpose of affording access to the interior of the product, guards shall be provided over the moving parts that can cause risk of injury to persons to reduce the risk of unintentional contact by service personnel. See 6.3 for further specifications.

6.3 If the guards mentioned in 6.1 and 6.2 must be removed during servicing of the parts mentioned in 6.1 and 6.2, the guards shall be constructed and arranged so they can be removed and replaced with a minimum of effort.

6.4 Internal components (especially those that are likely to involve frequent replacement or adjustment) shall be isolated from the power-supply-connection areas and other locations in which parts are likely to be live during servicing.

6.5 Each power-supply switch for which there is an "OFF" position marked on a unit shall disconnect all ungrounded conductors of the power-supply circuit when placed in the "OFF" position.

CONSTRUCTION – BULLET-RESISTING EQUIPMENT AND MATERIALS

7 Gunports

7.1 Gunports shall be constructed for operation from behind the barrier only. The gun door or shutter shall close automatically, and shall be guarded against being opened from the exposed side with a rubber suction cup or similar means.

7.2 Gunports shall be constructed so that a rod 5/8-inch (15.9 mm) in diameter will have a horizontal traverse of at least 90 degrees and a vertical traverse of at least 30 degrees below horizontal.

7.3 For Levels 1 – 3, a gunport shall not be rendered inoperative after being struck with one projectile. For Levels 4 – 10, and supplementary shotgun, a gunport may be rendered inoperative after being struck with one projectile, but shall remain closed (see Assemblies, Section 15).

7.3 revised December 21, 2006

8 Speaking Apertures

8.1 Speaking apertures shall:

- a) Fulfill their intended purpose;
- b) Be bullet-resisting in accordance with 1.2; and
- c) Prevent the insertion of the muzzle of any firearm including weapons as small as a 0.25 caliber handgun, in such a manner as to command direct aim on persons behind the protection.

9 Deal Trays and Package Passers

9.1 Deal trays and package passer devices shall not have openings or joints which will permit spray of projectile fragments to the interior as a result of firearm tests.

9.2 Deal trays and package passers shall be guarded against forcible entry from the exposed side using any of the methods specified for gunports.

9.3 Package passers shall be constructed such that money bags and the like can be passed without providing any opening through which the muzzle of any firearm, including weapons as small as a 0.25 caliber handgun, might be inserted to command the work space.

9.4 Deal trays shall be constructed so that when installed as intended they permit no direct line of fire toward the teller's position nor the insertion of the muzzle of any firearm, including weapons as small as a 0.25 caliber handgun, in such a manner as to command direct aim on persons behind the protection.

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	Nonmetallic material	Tested at high, room, and low temperatures	5 ^c
Levels 1 – 5 ^b and Levels 9 and 10	Metallic material	Tested at room temperature	3 ^c
Levels 6 – 10 ^b	Material	Tested at room temperature	1
Levels 1 – 10 ^b	Assemblies	Tested at room temperature	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.

17.4.1 revised December 21, 2006

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.

17.6 Indoor use material

17.6.1 Two samples of Levels 1 – 5, Level 9, and supplementary shotgun (for Levels 1 – 5) nonmetallic bullet-resisting material intended for indoor use only are to be subjected to the tests described in 17.2.1 or 17.3.1. One sample is to be cooled to a temperature of 13°C (55°F) for 3 hours and the second sample is to be tested after it has been subjected to a temperature of 35°C (95°F) for 3 hours.

17.6.1 revised December 21, 2006

17.7 Outdoor use material

17.7.1 Two samples of Levels 1 – 5, Levels 9 and 10, and supplementary shotgun (for Levels 1 – 5) nonmetallic bullet-resisting material intended for outdoor use, such as in armored cars, windows for tellers' fixtures, and the like, are to be subjected to the tests described in 17.2.1 or 17.3.1. One sample is to be tested immediately after exposure for 3 hours of the attack side at minus 32 ±3°C (minus 26 ±5°F) and the other side at 22 ±3°C (72 ±5°F). The second sample is to be tested immediately after exposure of the entire sample for 3 hours to a temperature of 49 ±3°C (120 ±5°F).

17.7.1 revised December 21, 2006

CONSTRUCTION – GENERAL

18 Enclosures

18.1 General

18.1.1 The frame and enclosure of a product shall be sufficiently strong and rigid to resist total or partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and development of other conditions that impair operation of the product or increase the risk of fire, electric shock, or injury to persons. See Mechanical Strength Tests for Enclosures, Section 52.

18.1.2 Electrical parts of a product shall be located or enclosed to provide protection against unintentional contact with uninsulated high-voltage live parts.

18.1.3 An operating part, such as a gear mechanism, light-duty relay, or similar device, shall be enclosed to protect against malfunction from dust or other foreign material that may impair its intended operation.

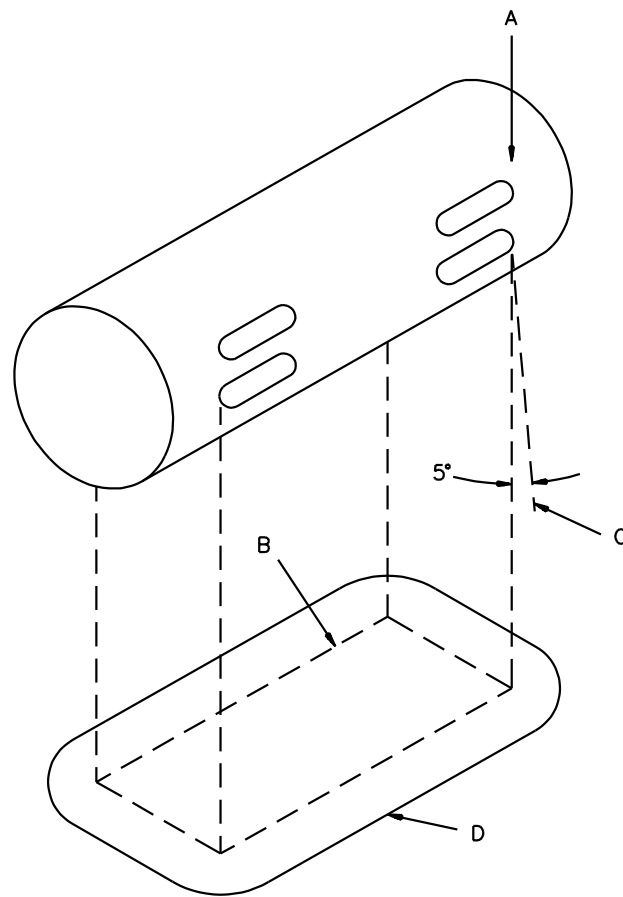
18.1.4 The mounting means of an enclosure shall be accessible without disassembly of any operating part of the product. Removal of a completely assembled panel to mount the enclosure is not considered to be disassembly of an operating part.

18.1.5 An enclosure shall be constructed to reduce the risk of fire from emission of flame, molten metal, flaming or glowing particles, or flaming drops. See Abnormal Operation Test, Section 46; Solenoid Burnout Test, Section 47; and Ignition Through Bottom-Panel Openings Tests, Section 51.

18.1.6 A nonflammable bottom in accordance with 18.2.4, or a protective barrier as described in Figure 18.1, shall be used under all areas containing flammable materials.

Exception: A nonflammable bottom or protective barrier need not be provided under a material or assembly classified V-1 or less flammable in accordance with the Standard for Test for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

Figure 18.1
Protective pan



EB115

A. The entire component under which a barrier (flat or dish with or without a lip or other raised edge) of noncombustible material is required to be provided. The sketch above is of a metal enclosed component with ventilating openings to show that the protective barrier is required only for those openings from which flaming parts might come. If the component or assembly does not have its own noncombustible enclosure, the area to be protected would be the entire area occupied by the component or assembly.

B. Outline of the area of the component (A) for which a bottom barrier is required, projected vertically downward onto the horizontal plane of the lowest point on the outer edge (D) of the barrier.

C. Inclined line that traces out an area (D) on the horizontal plane of the barrier. Moving around the perimeter of the area for which a bottom barrier is required (B), this line projects at a 5 degree angle from the line extending vertically at every point around the perimeter of (A) and oriented to trace out the largest area, except that the angle may be less than 5 degrees if the barrier or portion of the bottom cover contacts a vertical barrier or side panel of noncombustible material, or if the horizontal extension of the barrier (B) to (D) would exceed 6 inches (150 mm).

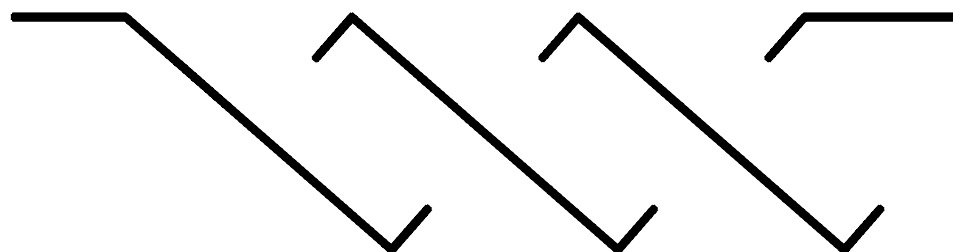
D. Minimum outline of the barrier, except that the extension B – D need not exceed 6 inches (150 mm) (flat or dished with or without lip or other raised edge). The bottom of the barrier may be flat or formed in any manner if every point of area (D) is at or below the lowest point on the outer edge of the barrier.

18.1.7 A construction employing individual barriers under components, groups of components or assemblies, as specified in Figure 18.1, is considered to comply with the requirement in 18.1.6.

18.2 Openings

18.2.1 An opening directly over uninsulated high-voltage live parts shall not exceed 0.187 inch (4.75 mm) in any dimension unless the configuration is such that direct entry to uninsulated high-voltage live parts is prevented. See Figure 18.2 for examples of top cover designs and Figure 18.3 for side openings that are considered to prevent direct entry. See also 18.2.2.

Figure 18.2
Cross sections of top cover designs

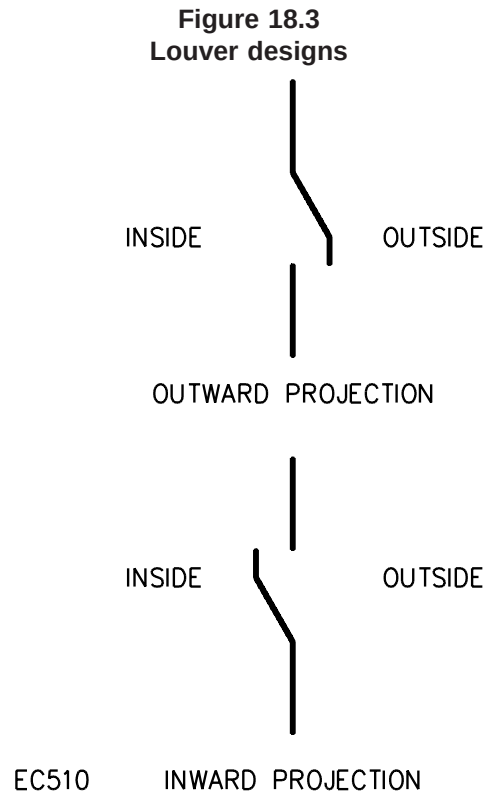


SLANTED OPENINGS



EC500

VERTICAL OPENINGS



18.2.2 An opening shall not permit entrance of a 1-inch (25.4-mm) diameter rod and shall be sized and arranged so that a probe, as illustrated in Figure 18.4, cannot be made to contact any uninsulated live electrical part (other than low-voltage) when inserted through the opening in a straight or articulated position. The probe may also be inserted into any opening that is created during the normal operating cycle of the product.

Exception: An opening may permit entrance of a 1-inch diameter rod under the conditions specified in 18.2.3.