



Standard Classification for Bank and Mercantile Vault Construction¹

This standard is issued under the fixed designation F1090; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This classification is for the use and guidance of those who purchase, design, construct, install, approve, or modify storage vault enclosures, intended for the protection of assets against loss due to forced entry.

1.2 This classification is a systematic arrangement of constructed products, based on similar intrusion resistance characteristics, as derived from available test data.

1.3 This classification does not address fire resistivity.

1.4 This classification does not address the methods of interfacing vault components. Things such as tamper notification, intrusion detection, response timelines, or other issues, typically forming a complete vault system, should be considered for inclusion.

1.5 Nothing in this classification is intended to prevent the use of systems, methods, or devices that provide a level of intrusion resistance equivalent to that prescribed herein.

1.5.1 Any system, method, or device different from that detailed herein may be examined, in accordance with the intent of this standard, and if found equivalent, may be included.

1.6 Nothing in this classification shall be construed to prohibit better or safer conditions than the requirements specified herein.

1.7 Each standard designation cited shall be meant to be the edition in effect on the date this classification was published.

1.8 A rationale is given in [Appendix X1](#).

NOTE 1—For more information on the construction of bank and mercantile vaults, refer to the following documents: ASTM Specifications [A184/A184M](#), [A615/A615M](#), [A635/A635M](#), [C33](#), [C94/C94M](#), [C150](#), [C494/C494M](#), [C618](#), [C685/C685M](#); American Concrete Institute Building Requirements ACI 318, and American Welding Society Structural Welding Code D 1.4.

1.9 The values stated in inch-pound units are to be regarded as the standard. The values in parentheses are given for information only.

¹ This classification is under the jurisdiction of ASTM Committee F12 on Security Systems and Equipment and is the direct responsibility of Subcommittee F12.10 on Systems Products and Services.

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2. Referenced Documents

2.1 *ASTM Standards*:²

[A184/A184M](#) Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement

[A615/A615M](#) Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

[A635/A635M](#) Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for

[A820/A820M](#) Specification for Steel Fibers for Fiber-Reinforced Concrete

[C33](#) Specification for Concrete Aggregates

[C39/C39M](#) Test Method for Compressive Strength of Cylindrical Concrete Specimens

[C94/C94M](#) Specification for Ready-Mixed Concrete

[C150](#) Specification for Portland Cement

[C494/C494M](#) Specification for Chemical Admixtures for Concrete

[C618](#) Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

[C685/C685M](#) Specification for Concrete Made by Volumetric Batching and Continuous Mixing

[C1116](#) Specification for Fiber-Reinforced Concrete and Shotcrete

2.2 *Underwriters Laboratories Standards*:³

[UL 608](#) Burglary-Resistant Vault Doors and Modular Panels

[UL 680](#) Emergency Vault Ventilators and Vault Ventilating Ports

2.3 *American Concrete Institute Document*:⁴

[ACI 318](#) Building Code Requirements for Reinforced Concrete

2.4 *American Welding Society Document*:⁵

[D 1.4](#) Structural Welding Code Reinforcing Steel

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from Underwriters Laboratories (UL), Corporate Progress, 333 Pfingsten Rd., Northbrook, IL 60062.

⁴ Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333.

⁵ Available from American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126.

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *alternate construction*—a substitute method of fabrication.

3.1.2 *classification*—a systematic rating of products based on testing, according to approved criteria.

3.1.3 *emergency ventilator*—a device constructed of intrusion-resistant materials for the introduction of fresh air.

3.1.4 *equivalent*—a term applied to two or more methods, procedures, materials, devices, etc., expected to give the same average results.

3.1.5 *generic construction*—commonly available construction materials not protected by trademark registration.

3.1.6 *heating, ventilating, and air conditioning (HVAC) port*—a device constructed of intrusion-resistant materials providing an opening for intake or exhaust of air.

3.1.7 *intrusion-resistant*—constructed to prevent a successful penetration by means and techniques as described in UL 608.

3.1.8 *manhole size opening*—a 96-in.² (620-cm²) opening, the smallest dimension of which is not less than 6 in. (15 cm).

3.1.9 *modular panel*—wall, floor, or ceiling components, manufactured of intrusion-resistant material, intended for assembly at the place of use, and capable of being disassembled and relocated.

3.1.10 *vault*—an intrusion-resistant enclosure, intended for the safekeeping of valuables, and sized to allow entry by at least one person.

3.1.11 *vault door*—a movable barrier assembly constructed of intrusion-resistant materials by which a passageway is closed or opened.

4. Significance and Use

4.1 This classification is meant to be a guide for the selection of a vault.

4.2 This classification is intended to assist users in availing themselves of various prefabricated and generically constructed products, while maintaining continuity in the selected intrusion-resistance level.

4.3 This classification is not meant to recommend or prefer the use of any single product or any type level, or its application.

5. Basis of Classification

5.1 The vault shall be rated as a unit and that rating shall be determined by the component having the lowest classification.

5.2 Components of a building shall not be used as part of the vault unless constructed to provide the equivalent intrusion resistance.

5.3 Vaults shall be classified into four (five) types: Type M, Type 1, Type 2, Type 3 (refer to Fig. 1), and Type F.

5.3.1 *Type M Vault*—Type M vault shall be constructed using:

5.3.1.1 Nine-inch (23-cm) reinforced concrete, as specified in 5.4.1 and 5.4.2, or

5.3.1.2 Modular panels bearing the label “Class M” from an independent, third party, accredited testing laboratory, and

5.3.1.3 Vault door(s) bearing the label “Class M” from an independent, third party, accredited testing laboratory,

5.3.2 *Type 1 Vault*—Type 1 vault shall be constructed using:

5.3.2.1 Twelve-inch (30-cm) reinforced concrete, as specified in 5.4.1 and 5.4.2, or

5.3.2.2 Modular panel bearing the label “Class 1” from an independent, third party, accredited testing laboratory, and

5.3.2.3 Vault door(s) bearing the label “Class 1” from an independent, third party, accredited testing laboratory.

5.3.3 *Type 2 Vault*—Type 2 vault shall be constructed using:

5.3.3.1 Eighteen-inch (46-cm) reinforced concrete, as specified in 5.4.1 and 5.4.2, or

5.3.3.2 Modular panel bearing the label “Class 2” from an independent, third party, accredited testing laboratory, and

5.3.3.3 Vault door(s) bearing the label “Class 2” from an independent, third party, accredited testing laboratory.

5.3.4 *Type 3 Vault*—Type 3 vault shall be constructed using:

5.3.4.1 Twenty-seven-inch (68-cm) reinforced concrete, as specified in 5.4.1 and 5.4.2, or

5.3.4.2 Modular panel bearing the label: “Class 3” from an independent, third party, accredited testing laboratory, and

5.3.4.3 Vault door(s) bearing the label: “Class 3” from an independent, third party, accredited testing laboratory.

5.3.5 *Type F Vault*—Type F vault shall be constructed using:

5.3.5.1 9-in. (23-cm) fiber reinforced concrete, as specified in 5.4.3 and 5.4.4, or

5.3.5.2 Modular panel bearing the label “Class F” from an independent, third party, accredited testing laboratory, and

5.3.5.3 Vault door(s) bearing the label “Class F” from an independent, third party, accredited testing laboratory.

NOTE 2—There is no Class F rating established in UL 608. The F Class is expected to meet the requirements of Class M because the volumetric steel contents are similar and modular designs of fibrous concrete are currently marketed for this level of resistance.

5.4 Generic Vault Construction:

5.4.1 Concrete used in vaults Type M, 1, 2, and 3 shall be reinforced using:

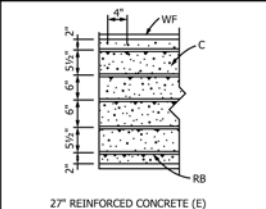
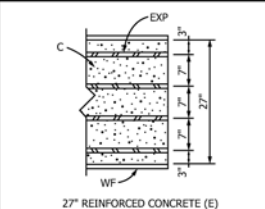
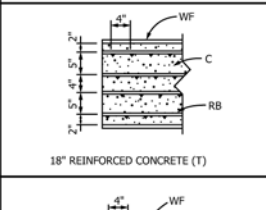
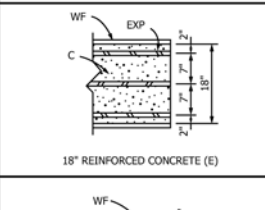
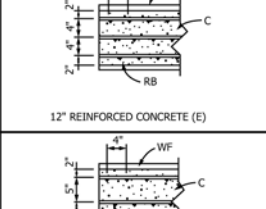
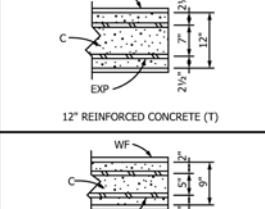
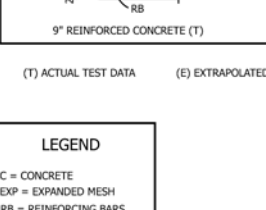
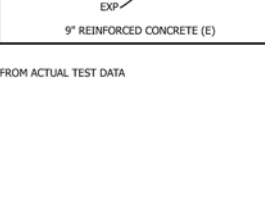
5.4.1.1 Deformed steel bars, Number Five Imperial Type or Number Fifteen Metric type (5/8-in. (16-mm) diameter, a minimum of Grade 40), placed in horizontal and vertical rows, in each direction, to form a grid not more than 4 in. (10 cm) on center, or

5.4.1.2 Expanded steel mesh weighing at least 6 lb/ft² (30 kg/m²) having a diamond pattern not more than 3 by 8 in. (8 by 20 cm), placed parallel to the face of the slab.

5.4.1.3 Grids of either reinforcing material shall be located not less than 4 in. (10 cm) apart, shall be offset in two directions in the same plane (refer to Fig. 2), and shall be placed as stated in Table 1.

5.4.2 Concrete used in vaults Types M, 1, 2, and 3 shall have a minimum 28-day compressive strength of 4000 psi (27.6 MPa), as tested in accordance with the requirements of Test Method C39/C39M.

BANK AND MERCANTILE VAULT CONSTRUCTION CLASSIFICATION

TYPE	GENERIC CONSTRUCTION DEFORMED BARS	ALTERNATE GENERIC CONSTRUCTION EXPANDED MESH	MODULAR PANELS	VAULT DOOR	EMERGENCY VENTILATOR	HVAC PORT
TYPE 3	 27" REINFORCED CONCRETE (E)	 27" REINFORCED CONCRETE (E)	UL LISTED CLASS 3	UL LISTED CLASS 3	UL LISTED CLASS 3	UL LISTED CLASS 3
TYPE 2	 18" REINFORCED CONCRETE (T)	 18" REINFORCED CONCRETE (E)	UL LISTED CLASS 2	UL LISTED CLASS 2	UL LISTED CLASS 2	UL LISTED CLASS 2
TYPE 1	 12" REINFORCED CONCRETE (E)	 12" REINFORCED CONCRETE (T)	UL LISTED CLASS 1	UL LISTED CLASS 1	UL LISTED CLASS 1	UL LISTED CLASS 1
TYPE M	 9" REINFORCED CONCRETE (T)	 9" REINFORCED CONCRETE (E)	UL LISTED CLASS M	UL LISTED CLASS M	UL LISTED CLASS M	UL LISTED CLASS M

NOTATIONS: (T) ACTUAL TEST DATA (E) EXTRAPOLATED FROM ACTUAL TEST DATA

LEGEND

C = CONCRETE
 EXP = EXPANDED MESH
 RB = REINFORCING BARS
 WF = WALL FINISH

FIG. 1 Bank and Mercantile Vault Construction Classification

5.4.3 Concrete used in vaults Type F shall meet the requirements of Specification C1116 and shall have a minimum 28-day compressive strength of 5000 psi (34.5 MPa) as tested in accordance with the requirements of Test Method C39/C39M.

5.4.4 Fiber reinforcement shall meet the requirements of Type I or Type V steel fibers in Specification A820/A820M, and shall be proportioned in the concrete at a minimum of 2 % by volume (265 lb/yd³ or 156 kg/m³).

5.5 Permissible Opening:

5.5.1 Vault shall be invalidated by any opening in the structure, except for:

5.5.1.1 Doors, as specified in 5.3.1.3, 5.3.2.3, 5.3.3.3, 5.3.4.3, or 5.3.5.3.

5.5.1.2 Underwriters Laboratories, Inc. listed emergency ventilators or ventilating (HVAC) ports.

5.5.1.3 Individual conduit when used in generic construction, shall not exceed 1½ in. (38 mm) in diameter. Multiple conduit entries and exits shall not be within 18 in. (46 cm) of each other. Conduit penetrating the vault shall have at least two bends. Entry in the outer face shall be offset from exit in the inner face by a distance in the plane of the vault surface at least equal to the thickness of the component it penetrates.

5.5.2 Vault resistance levels shall be invalidated by the installation of any door, ventilator, or port whose manufacturer’s specified installation instructions have not been followed.

6. Keywords

6.1 asset protection; bank vault; forced entry; intrusion resistance; mercantile vault; steel fibers; storage vault; vault enclosure

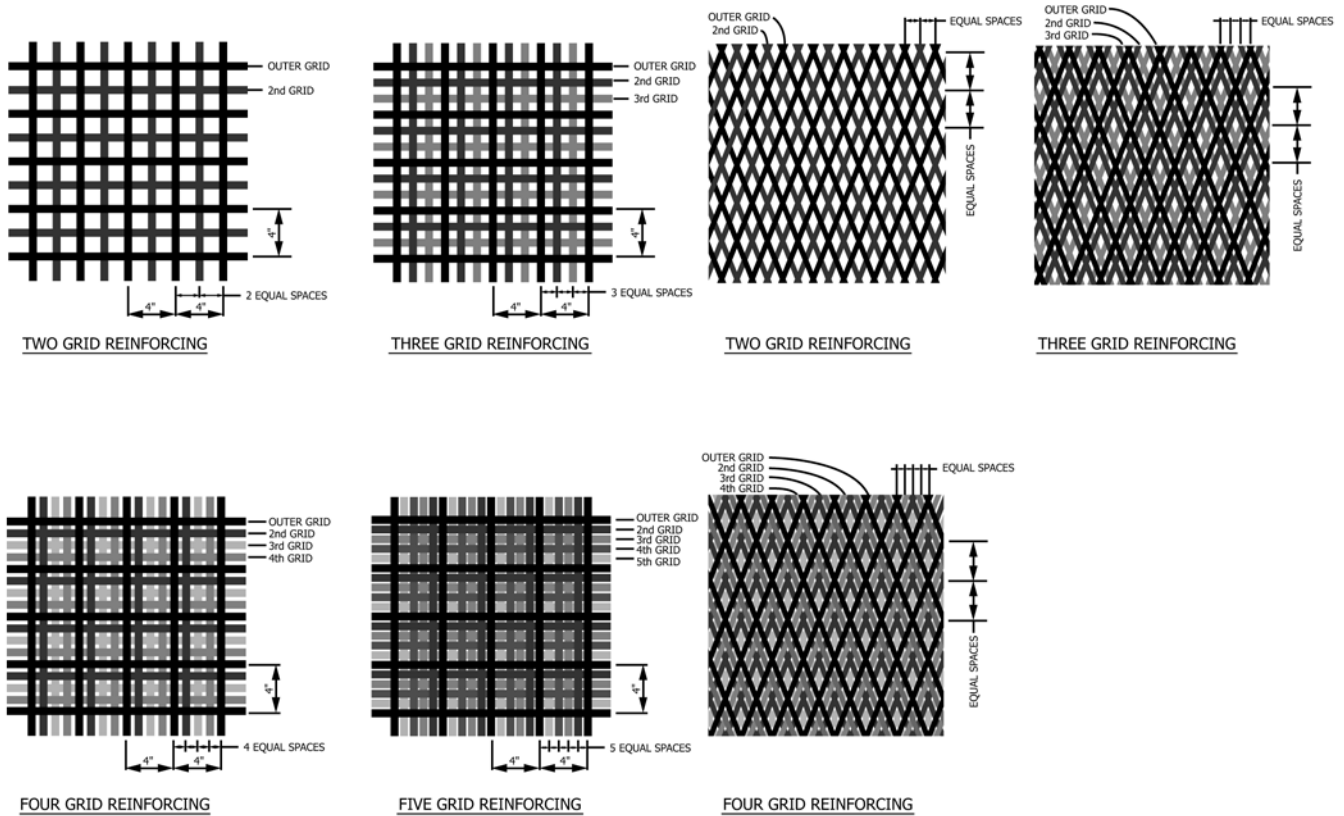


FIG. 2 Grid Patterns

TABLE 1 Placement of Grids

Class Type	Thickness of Concrete	Minimum Number of Grids for Deformed Bars	Minimum Number of Grids for Expanded Steel
M	at least 9 in. (22.9 cm)	2	2
1	at least 12 in. (30.5 cm)	3	2
2	at least 18 in. (45.7 cm)	4	3
3	at least 27 in. (68.6 cm)	5	4
F	not applicable	n/a	n/a

APPENDIX

(Nonmandatory Information)

X1. RATIONALE

X1.1 Determination as to intrusion resistance is based upon the criteria for testing as detailed in UL Standard 608 (Third Edition), and Standard 680.

X1.2 Testing procedures were performed on a representative sample using two basic techniques. First, a portable coring machine equipped with diamond embedded matrix bit core was used to drill a manhole size opening through the sample.

Second, electric hammers, acetylene cutting torch, and various hand tools were used, in combination, to create a manhole size opening through an untouched portion of the sample.

X1.3 Actual testing was restricted to one test team, consisting of two skilled operators and one non-participating assistant.

X1.4 Testing procedures recorded net working time, which is only the time during which the attack is actively in progress.

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