



# UL 2416

## STANDARD FOR SAFETY

Audio/Video, Information and  
Communication Technology Equipment  
Cabinet, Enclosure and Rack Systems

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UL Standard for Safety for Audio/Video, Information and Communication Technology Equipment Cabinet, Enclosure and Rack Systems, UL 2416

First Edition, Dated March 11, 2015

### **Summary of Topics**

***This revision of ANSI/UL 2416 dated October 2, 2020 includes the following:***

- ***Modified definition of Enclosure; [4.5](#)***
- ***Updated references for spacings; [6.10.1](#)***
- ***Refinement of effectively grounded marking requirement; [7.4.3](#), [7.4.4](#)***
- ***Revision of Functional Earthing (Grounding) marking; Section [7.5](#)***
- ***Clarification on reference to UL 62368-1 for Indoor Locations; [9.1.3.1](#)***
- ***Additional UL 62368-1 alternative for Outdoor Enclosures; [9.1.4.1](#)***
- ***Clarification on condensation and drain holes; [10.2.3.5](#)***
- ***Editorial revision of ITE (Computer) Room application requirement; [12.3.1](#)***
- ***Refinement of Openings in Vertical Surfaces Requirements to promote consistent application; Section [12.5.2](#)***
- ***Clarification on treatment of pryout holes; [12.5.3.4](#)***
- ***Clarification on allowed application of Bottom Opening requirements to promote consistent application; [12.5.4.1](#), [12.5.4.3](#), [12.5.4.4](#), [12.5.4.5](#)***
- ***Clarification on Overcurrent Protection; [13.4.1](#)***
- ***Clarification on application of Temperature Test; [15.3.1](#), [15.3.2](#)***
- ***Clarification on Installation Markings; [16.4.4](#)***
- ***Clarification on Installation Instructions; [16.7.8](#)***
- ***Miscellaneous Updates to UL 2416 to address areas needing further refinement; [3.56](#)***
- ***Additional option for enclosure venting of battery compartments; [13.5.2.1A](#)***
- ***Clarification on Battery Supply Performance; [13.7.2](#), [13.7.3](#)***

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 new and revised requirements are substantially in accordance with Proposal(s) on this subject dated June 12, 2020, July 31, 2020, and August 21, 2020.

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**UL 2416**

**Standard for Audio/Video, Information and Communication Technology  
Equipment Cabinet, Enclosure and Rack Systems**

**First Edition**

**March 11, 2015**

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The most recent designation of ANSI/UL 2416 as an American National Standard (ANSI) occurred on September 28, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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## INTRODUCTION

### 1 Scope

1.1 This Standard covers requirements for Audio/Video, Information and Communication Technology Equipment Cabinet, Enclosure and Rack Systems. For the purpose of this Standard cabinet, enclosure and rack systems are all referred to as “enclosure systems.”

1.2 Enclosure systems are not complete equipment but include components and sub-assemblies that are intended to power, protect, heat, cool or otherwise support information technology (IT), telecommunications, audio/video (A/V) and similar equipment that will be installed at a later time. They usually include mounting hardware, shelves or space for the installation of the additional equipment. These enclosure systems are intended to be used by manufacturers in the construction of complete A/V, IT and communications equipment, or by service providers and other qualified installers for the installation of network infrastructure equipment or communications and multi-media systems equipment.

1.3 This Standard assumes that the final installation of equipment into the enclosure system will be performed by qualified service personnel in accordance with the applicable installation instructions, installation practices and national installation codes. As appropriate, this equipment should be installed in accordance with ANSI/NFPA 70, National Electrical Code (NEC), and/or the applicable sections of ANSI/IEEE C2, National Electrical Safety Code (NESC). Equipment intended for installation in information technology equipment (computer) rooms should be installed in accordance with NFPA 75, Standard for the Protection of Information Technology Equipment.

1.4 Enclosure systems by their very nature are intended to house equipment that is not specified by the enclosure system manufacturer and whose construction and characteristics are largely unknown. As such, in some cases these requirements include additional or supplementary safeguards beyond those normally required by general equipment standards where the final configuration is well defined and risks can be reduced to an acceptable level by a thorough evaluation of the design and testing.

1.5 These requirements do not cover enclosures for modular data centers. Equipment of this type shall be investigated under the requirements in the Outline of Investigation for Modular Data Centers, UL 2755.

1.6 These requirements do not cover exhaust chimneys and other air management systems that connect to environmental air systems in buildings. Equipment of this type shall be investigated under the requirements in the Standard for Heating and Cooling Equipment, UL 1995, and the Outline of Investigation for Drop-Out Ceilings Installed Beneath Automatic Sprinklers, UL 723S.

Note: Environmental air systems include ducts specifically designed for environmental air and other spaces used for environmental air (plenums) that may not be specifically fabricated for environmental air-handling purposes but are used for air-handling purposes as a plenum. The space over a hung ceiling used for environmental air-handling purposes is an example of this type of other space.

1.7 It is the responsibility of the Authority Having Jurisdiction over the final installation to determine if the final configuration meets the necessary criteria for installation and use.

### 2 Units of Measurement

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

### 3 References

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.

- 3.2 The standards specified in [3.3](#) – [3.56](#) contain provisions, which, through referenced in this Standard, constitute provisions of this Standard.
- 3.3 The National Electrical Safety Code, ANSI/IEEE C2. See [6.2.8](#).
- 3.4 Safety glazing materials used in buildings – safety performance specifications and methods of test, ANSI Z97.1. See [9.3.3](#).
- 3.5 The Standard Test Method for Surface Burning Characteristics of Building Materials, ASTM E84. See [12.2.1](#).
- 3.6 The Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings, ASTM A90/A90M. See [B1.4](#) and [B1.5](#).
- 3.7 The Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source, ASTM E162. See [12.2.1](#).
- 3.8 The Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for, ASTM A568/A568M. See [B1.4](#) and [B1.5](#).
- 3.9 Mechanical Structural Issues, ATIS 0600006. See [11.1.7.2](#).
- 3.10 Temperature, Humidity, and Altitude Requirements for Network Telecommunications Equipment Utilized in Outside Plant Environments, ATIS 0600010.01. See [15.3.1](#).
- 3.11 Network Equipment – Earthquake Resistance, ATIS 0600329. See [11.1.7.2](#).
- 3.12 The Code of Federal Regulations (CFR), Title 21. See [16.6.1](#), [16.6.3](#), [16.6.6](#), and [16.6.7](#).
- 3.13 Telcordia Generic Requirements for Electronic Equipment Cabinets, GR-487-CORE. See [10.2.4.1](#) and [10.2.5.3](#).
- 3.14 Generic Requirements for Fiber Optic Splice Closures, GR-771-CORE. See [12.6.1](#).
- 3.15 Telcordia Generic Requirements for Optical Network Unit (ONU) Closures and ONU Systems, GR-950-CORE. See [10.2.5.3](#).
- 3.16 Graphical symbols for use on equipment, IEC 60417. See [7.5.1](#) and [Figure 7.1](#).
- 3.17 Safety of laser products – Part 1: Equipment classification and requirements, IEC 60825-1. See [16.6.3](#), [16.6.4](#), [16.6.6](#), and [16.6.7](#).
- 3.18 The National Electrical Code (NEC), ANSI/NFPA 70. See [6.3.1](#), [6.5.4](#), [6.8.1](#), [6.8.3](#), [6.9.1](#), [7.1.3](#), [7.2.1](#), [8.1.1](#), [8.1.4](#), and [12.4.3.2](#).
- 3.19 The Standard for the Fire Protection of Information Technology Equipment, NFPA 75. See [12.3.1](#) – [12.3.3](#).
- 3.20 The Standard for Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits, UL 5C. See [12.1.8](#).
- 3.21 The Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50. See [6.4.3](#), [9.1.3.1](#), [9.1.3.2](#), [9.1.4.1](#), [9.2.5](#), and [9.3.3](#).

- 3.22 The Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E. See [9.1.4.1](#), [9.2.5](#), and [10.2.4.1](#).
- 3.23 The Standard for Flexible Cords and Cables, UL 62. See [6.6.2](#).
- 3.24 The Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. See [12.5.1.1](#) and [12.6.1](#).
- 3.25 The Standard for Grounding and Bonding Equipment, UL 467. See [7.1.2](#), [7.1.7](#), and [7.2.5](#).
- 3.26 The Standard for Wire Connectors, UL 486A-486B. See [6.5.8](#).
- 3.27 The Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E. See [6.5.7](#) and [6.5.8](#).
- 3.28 The Standard for Attachment Plugs and Receptacles, UL 498. See [6.6.2](#) and [6.7.1](#).
- 3.29 The Standard for Industrial Control Equipment, UL 508. See [6.6.3](#), [6.7.2](#), and [6.10.1](#).
- 3.30 The Standard for Industrial Control Panels, UL 508A. See [6.5.8](#), [9.1.3.1](#), [9.1.3.2](#), and [9.1.4.1](#).
- 3.31 The Standard for Metallic Outlet Boxes, UL 514A. See [6.4.3](#) and [12.5.1.5](#).
- 3.32 The Standard for Conduit, Tubing, and Cable Fittings, UL 514B. See [6.3.2](#) and [12.5.1.5](#).
- 3.33 The Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C. See [6.3.9](#), [6.3.12](#), and [6.4.3](#).
- 3.34 The Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D. See [12.5.1.5](#).
- 3.35 The Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings, UL 651. See [12.5.1.5](#).
- 3.36 The Standard for Test for Surface Burning Characteristics of Building Materials, UL 723 (see [12.2.1](#)), or the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C (see [9.3.4.4](#) and [12.5.1.1](#)).
- 3.37 The Standard for Electrochemical Capacitors, UL 810A. See [13.1.2](#).
- 3.38 The Reference Standard for Service Equipment, UL 869A. See [6.10.6](#).
- 3.39 The Standard for Emergency Lighting and Power Equipment, UL 924. See [13.1.2](#).
- 3.40 The Standard for Marking and Labeling Systems, UL 969. See [16.1.5](#).
- 3.41 The Standard for Terminal Blocks, UL 1059. See [6.5.7](#).
- 3.42 The Standard for Surge Protective Devices, UL 1449. See [6.10.4](#).
- 3.43 The Standard for Fire Tests of Through-Penetration Firestops, UL 1479. See [12.4.3.3](#).
- 3.44 The Standard for Lithium Batteries, UL 1642. See [13.1.2](#).

- 3.45 The Standard for Household, Commercial, and Institutional-Use Carts, Stands and Entertainment Centers for Use with Audio and/or Video Equipment, UL 1678. See [11.4.1](#).
- 3.46 The Standard for Plugs, Receptacles and Cable Connectors of the Pin and Sleeve Type, UL 1682. See [6.6.2](#).
- 3.47 The Standard for Uninterruptible Power Systems, UL 1778. See [13.1.2](#) and [13.7.2](#).
- 3.48 The Standard for Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications, UL 1973. See [13.1.2](#).
- 3.49 The Standard for Standby Batteries, UL 1989. See [13.1.2](#).
- 3.50 The Standard for Cable Routing Assemblies and Communications Raceways, UL 2024. See [12.1.8](#).
- 3.51 The Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces, UL 2043. See [12.4.1](#) and [12.4.3.3](#).
- 3.52 The Standard for Household and Commercial Batteries, UL 2054. See [13.1.2](#).
- 3.53 The Standard for Batteries for Use in Light Electric Vehicle (LEV) Applications, UL 2271. See [13.1.2](#).
- 3.54 The Standard for Batteries for Use in Electric Vehicles, UL 2580. See [13.1.2](#).
- 3.55 The Outline of Investigation for Modular Data Centers, UL 2755. See [9.5.1](#) and [9.5.2](#).
- 3.56 The Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1, or the Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1. See [7.1.4](#), [8.2.3](#), [9.1.3.1](#), [9.1.4.1](#), [9.4](#), [12.1.1](#), [12.1.5](#), [12.3.1](#), [12.5.4.2](#), [13.5.2.1](#), [13.7.3](#), [15.3.1](#), [15.3.2](#), [15.4.1](#), and [15.5.2](#).

## 4 Glossary

4.1 For the purpose of this Standard the following definitions apply. Also reference the National Electrical Code, NFPA 70, Article 100.

Note: Unless otherwise stated, when applying clauses from other referenced standards, such as:

- a) The Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1;
- b) The Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50;
- c) The Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E; and
- d) The Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

the terms and definitions in those standards are applicable.

4.2 **ACCESORY** – A part or combination of parts intended for installation in or connection to an enclosure system for the purpose of modifying or supplementing the functions of the product. It may be factory installed or intended for installation by the user or service personnel. Examples of accessories include:

- a) Shelves;
- b) Brackets,
- c) Fan trays;
- d) Temperature sensors,
- e) Monitoring equipment;
- f) Cable management;
- g) Extensions;
- h) Power distribution equipment,

and the like.

4.3 BREAKOUT – A portion of a wall of a cast or molded enclosure so fashioned, usually by the use of one or more rings of reduced thickness of the wall material, that the material within the outer perimeter of the ring to be removed may be readily broken away at the time of installation in order to provide an opening similar to that provided by a knockout

4.4 ELECTRIC SHOCK, RISK OF – The risk that a person encounters when exposed to live uninsulated parts of a product which have a voltage and current sufficient to cause an electric shock. Generally, parts operating at voltages over 42.4 volts peak or 60 volts dc where wet contact is not likely to occur, and 21.2 volts peak or 30 volts dc where wet contact is likely to occur, are considered to pose a risk of electric shock.

4.5 ENCLOSURE (ALL CAPITAL LETTERS) – An enclosure system with doors, top, side and bottom panels constructed to provide a degree of protection to personnel against accidental contact with parts involving a risk of electric shock or personal injury, to minimize the risk of fire due to spread of fire or flames from within, and to provide a degree of protection to the enclosed equipment against physical damage or specified environmental conditions.

4.6 ENCLOSURE (NORMAL CASE LETTERS) – A general term referring to the overall structure and outer housing (panels, doors, etc.) of an enclosure system.

4.7 ENCLOSURE SYSTEM – A simplified term used in this Standard for audio/video, information and communication technology equipment cabinet, enclosure and rack systems.

4.8 EQUIPMENT CABINET (ALL CAPITAL LETTERS) – A closed storage system with a surrounding case or housing that does not provide the degrees of protection of an enclosure. An EQUIPMENT CABINET is used to store or mount equipment that is provided with its own enclosure or may be used in place of an enclosure in a restricted access location that is limited to access by service personnel only. EQUIPMENT CABINETS are intended for indoor installation only.

4.9 EQUIPMENT FRAME (ALL CAPITAL LETTERS) – Same as RACK. See [4.15](#) for definition.

4.10 HAZARDOUS ENERGY LEVEL – Available power level of 240 volt-amperes or more, having a duration of 60 s or more, or a stored energy level of 20 J or more (for example, from one or more capacitors), at a potential of 2 volts or more

4.11 INDOOR LOCATIONS – Areas that are protected from exposure to the weather.

4.12 IN-WALL MOUNTED ENCLOSURE SYSTEM – An EQUIPMENT CABINET or ENCLOSURE that is intended for mounting in a wall (behind the finished wall), has provisions for mounting ears or flanges to facilitate mounting between wall studs, is provided with instructions for mounting in an unfinished wall cavity or by its appearance or design would otherwise lead a person to mount the system in a wall. The enclosure system is placed inside an unfinished wall cavity with at least some part of the enclosure system located behind the plane of the front wall of the wall cavity and in front of the plane of the rear wall of the wall cavity.

4.13 KNOCKOUTS – A portion of a wall of an enclosure system so fashioned that it may be removed readily by a hammer, screwdriver, and pliers at the time of installation in order to provide a hole for the attachment of an auxiliary device, railway, cable or fitting.

4.14 OUTDOOR LOCATIONS – Areas which are exposed to the weather.

4.15 RACK (ALL CAPITAL LETTERS) – An open frame mounting system, usually either in a two-post or four-post frame design that does not provide the degrees of protection of an enclosure. A RACK is used to store or mount equipment that is provided with its own enclosure or is intended for use only in restricted access locations limited to service personnel only. RACKS are intended for indoor installations only or in outdoor environments when installed in a suitably rated ENCLOSURE.

4.16 SERVICE EQUIPMENT – Equipment, usually consisting of a circuit breaker, switch, or fuses, and related accessories, located near the point of entrance of supply conductors to a building or other structure and intended to constitute the main control and means of cutoff of the supply.

4.17 USER INSTALLED EQUIPMENT – Equipment that is not included as part of the enclosure system but that may be installed by the user or final customer at a later date.

## CONSTRUCTION

### 5 Components and Subassemblies

5.1 In addition to complying with the requirements in this Standard, and other than as indicated in [5.2](#), a component or subassembly used in a product covered by this shall comply with the requirements for that component or subassembly. See Appendix for a list of standards covering components and subassemblies used in the products covered by this .

5.2 A component is not required to comply with a specific component 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.

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

5.4 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.

## 6 Power Circuits

### 6.1 General

6.1.1 The cross-sectional area of wires shall be adequate for the current they are intended to carry when the equipment is operating under maximum rated load such that the maximum permitted temperature of conductor insulation is not exceeded. All wiring (including busbars) used in the distribution of power shall be protected against overcurrent and short-circuit by suitably rated protective devices. Wiring not directly involved in the distribution path does not require protection if it can be shown that creation of hazards is unlikely (for example, indicating circuits).

6.1.2 Wireways shall be smooth and free from sharp edges. Wires shall be protected so that they do not come into contact with burrs, cooling fins, moving parts, etc., which could cause damage to the insulation of conductors. Holes in metal, through which insulated wires pass, shall have smooth well-rounded surfaces or shall be provided with bushings.

6.1.3 Internal wiring shall be routed, supported, clamped or secured in a manner that reduces the likelihood of:

- a) Excessive strain on wire and on terminal connections;
- b) Loosening of terminal connections; and
- c) Damage of conductor insulation.

6.1.4 Conductors shall be provided with a means (for example, barriers or fixing), or be so terminated, that they and their terminators (for example, ring terminals and flat quick-connect terminals) cannot, in normal use, become so displaced that spacings are reduced to less than the values specified in Spacings, [6.10](#). It is permitted to use soldered, welded, crimped, screwless (push-in) and similar terminations for the connection of conductors. For soldered terminations, the conductor shall be positioned or fixed so that reliance is not placed upon the soldering alone to maintain the conductor in position.

### 6.2 Branch circuit connection

6.2.1 Enclosure systems intended for fixed installation or permanent connection to the building structure that require a branch-circuit supply shall be provided with a means for permanent connection to the branch-circuit supply. See Connections for wiring systems, [6.3](#), Field wiring compartments, [6.4](#) and Wiring terminals and leads, [6.5](#).

*Exception: Products may be cord-connected under the conditions specified in [6.2.4](#).*

6.2.2 Stationary enclosure systems (systems that are not fixed but are not easily moved) that require a branch-circuit supply shall be provided with a means for permanent connection to the branch-circuit supply. See Connections for wiring systems, [6.3](#), Field wiring compartments, [6.4](#) and Wiring terminals and leads, [6.5](#).

*Exception: Products may be cord-connected under the conditions specified in [6.2.4](#).*

6.2.3 Enclosure systems that are portable, easily moved or intended to be moved on a regular basis that requires a branch-circuit supply shall be provided with a length of flexible cord and an attachment plug for connection to the supply circuit. See Power supply cords, [6.6](#).

6.2.4 In determining whether or not it is acceptable to the compliance of cord and plug connection for stationary equipment, the decision should include consideration of whether:

- a) The cord connection of the equipment facilitates frequent interchange;
- b) The fastening means or mechanical connections are intended to permit removal for maintenance and repair; or
- c) All external connections to the equipment are by means of cord and attachment plug.

6.2.5 An in-wall mounted enclosure system intended for connection to a branch circuit shall have a means for permanent connection to the branch-circuit supply.

### 6.2.6 Connection to an AC mains supply

6.2.6.1 The connection of an enclosure system intended to be connected to the AC mains supply shall be made by means of one the following:

- a) Terminals for permanent connection to a building mains supply. See Connections for wiring systems, [6.3](#), Field wiring compartments, [6.4](#) and Wiring terminals and leads, [6.5](#).
- b) A hard-service non-detachable power supply cord that terminates in an attachment plug that is rated for the voltage and current involved. See Power supply cords, [6.6](#).
- c) A receptacle for the connection of a detachable power supply cord (appliance inlet). The arrangement shall be such that live parts shall not be exposed under any intended condition of use.

### 6.2.7 Connection to a DC mains supply

6.2.7.1 The connection of an enclosure system intended to be connected to a dc mains supply shall be made by means of one the following:

- a) Terminals for permanent connection to a building DC mains supply. See Connections for wiring systems, [6.3](#), Field wiring compartments, [6.4](#) and Wiring terminals and leads, [6.5](#).
- b) A non-detachable power supply cord that terminates in an attachment plug that is rated for the dc voltage and current involved. The plug shall not be of a configuration commonly used for ac systems. The plug shall be designed as to prevent reverse polarity connections if a hazard can be created by such a connection. See Power supply cords, [6.6](#).
- c) A receptacle for the connection of a flexible cord or cord set suitable for dc applications. The receptacle shall not be of a configuration commonly used for ac systems. The receptacle shall be designed as to prevent reverse polarity connections if a hazard can be created by such a connection. The arrangement shall be such that live parts shall not be exposed under any intended condition of use.

6.2.8 Enclosure systems intended for installation on the network side of the subscriber demarcation point and intended to be installed and maintained by telecommunications companies, CATV companies, and similar network communications companies shall be permitted to be provided with a wiring system conforming to generally-accepted utility installation practices for the type of equipment and service involved. This equipment is intended to be installed in accordance with the applicable sections of ANSI C2, National Electrical Safety Code.

## 6.3 Connections for wiring systems

6.3.1 A unit intended for permanently-connected branch circuit power shall have a provision for the connection of one of the applicable wiring systems in accordance with ANSI/NFPA 70, National Electrical Code. The equipment shall be provided with cable entries, conduit entries, knock-outs, or glands that allow connection of the appropriate types of cables or conduits.

6.3.2 Openings in an enclosure for conduit or threaded connectors shall be of such sizes and so located that the conduit can be readily inserted and shall permit the proper seating of a conduit bushing or locknut (see Appendix [D](#) for knockout dimension information). All openings provided for conduit connections in the field shall be of standard dimensions. When provided, conduit fittings shall comply with the Standard for Conduit, Tubing, and Cable Fittings, UL 514B.

6.3.3 Openings in an enclosure for the connection of a wiring system that in some cases will not be used shall be closed by a knockout, cover, or plug. The closure shall be formed of metal not less than 1.35 mm (0.053 in) thick or of a non-metallic material acceptable for the purpose. The closure shall be such that it may be readily removed, but will not drop out in ordinary handling.

6.3.4 Knockouts shall be so formed that they are capable of being readily removed but will not drop out during ordinary handling. Multiple ring knockouts shall have sufficient strength to meet the test requirements of [6.3.6](#).

6.3.5 Breakouts shall be so formed that:

- a) The material can be readily removed, using ordinary care, to provide an opening of the required size without damaging the remainder of the enclosure or any outer rings and
- b) The strength of any remaining rings will withstand the loading test specified in [6.3.6.3](#)(b).

### **6.3.6 Multiple knockouts test**

6.3.6.1 This clause provides test requirements to determine that a combination consisting of an inner knockout surrounded by additional rings has been manufactured such that when one or more of its elements are removed there will be no change to the remaining rings, if any, or to the enclosure in which the combination is located, either during the removal or when conduit has been properly secured in place.

6.3.6.2 Samples for testing shall be in the form of either complete enclosures or sample plates that fulfill the requirements of [Figure 6.1](#).

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