NSF International Standard / American National Standard

NSF/ANSI 7 - 2016
Commercial Refrigerators and Freezers
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Chair, Joint Committee on Food Equipment
c/o NSF International
789 North Dixboro Road, P.O. Box 130140
Ann Arbor, Michigan 48113-0140 USA
Phone: (734) 769-8010 Telex: 753215 NSF INTL
FAX: (734) 769-0109 E-mail: info@nsf.org
Web: http://www.nsf.org
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**Foreword**

The purpose of this Standard is to establish minimum food protection and sanitation requirements for the materials, design, construction, and performance of commercial refrigerators and freezers.

This version of NSF/ANSI 7 – 2016 includes the following revisions:

**Issue 9:**

Sections 9.13.2 and 9.14.1 were revised establishing performance testing and labeling requirements for multi-zone refrigerated equipment.

**Issue 10:**

This revision made changes to subsections of section 9 covering Closed Display Units with Automatic Door Locks.

**Issue 13:**

A normative reference in section 2 was updated.

**Issue 15:**

Restrictions on the use of galvanized and zinc-alloy-coated materials in walk-in and roll-in refrigerators and freezers were added to section 8.

This Standard was developed by the NSF Joint Committee on Food Equipment using the consensus process described by the American National Standards Institute.

Suggestions for improvement of this Standard are welcome. This Standard is maintained on a Continuous Maintenance schedule and can be opened for comment at any time. Comments should be sent to Chair, Joint Committee on Food Equipment, c/o NSF International, Standards Department, P.O. Box 130140, Ann Arbor, Michigan, 48113-0140, USA.

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NSF maintains laboratories in Michigan, as well as offices in Ann Arbor, MI, and Brussels, Belgium.

Commercial Refrigerator Manufacturers Division/Air Conditioning Refrigeration Institute

The Commercial Refrigerator Manufacturers Association (CRMA) was founded in 1933 as a national trade association dedicated to advancing the common interests of the commercial refrigeration industry. In April 2000, CRMA merged with the Air Conditioning Refrigeration Institute (ARI) to form the Commercial Refrigerator Manufacturers Division/Air Conditioning Refrigeration Institute. CRMD/ARI continues to target three primary objectives:

— to showcase technical and business information to help solve common problems and promote growth in industry.

— to represent the collective voice of the industry with any government organization addressing policies or issues affecting the industry.

— to support high voluntary standards for quality in equipment design and performance.

CRMD/ARI is a not-for-profit corporation of leading businesses meeting international demands for increasingly specialized and efficient refrigeration equipment. CRMD/ARI members serve a wide range of markets, including supermarkets, food stores, convenience stores, restaurants, hotels, motels, food processing establishments, and hospitals.
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NSF/ANSI International Standard
for Food Equipment —

Commercial refrigerators
and freezers

1 General

1.1 Purpose

This Standard establishes minimum food protection and sanitation requirements for the materials, design, manufacture, construction, and performance of commercial refrigerators and freezers and their related components.

1.2 Scope

This Standard contains requirements for refrigerators and freezers used to store and/or display cold food. The types of refrigerators and freezers covered by this Standard include, but are not limited to: storage refrigerators (e.g., reach-in, under counter, walk-in, roll-in); storage freezers (e.g., reach-in, under counter, walk-in, roll-in); rapid pull-down refrigerators and freezers; refrigerated food transport cabinets; refrigerated buffet units; refrigerated food preparation units; display refrigerators; beverage coolers; and ice cream cabinets.

This Standard does not establish equipment installation requirements. While the requirements of this Standard are intended to ensure that equipment may be installed in a sanitary manner, proper installation of equipment shall be governed by the applicable codes.

Refrigerator and freezer components and materials covered under other NSF or NSF/ANSI Standards or Criteria shall also conform to the requirements therein. This Standard is not intended to restrict new unit design, provided that such design meets the minimum specifications described herein.

1.3 Alternate materials, design, and construction

While specific materials, design, and construction may be stipulated in this Standard, equipment that incorporates alternate materials, design, or construction may be acceptable when such equipment meets the applicable requirements herein.

1.4 Measurement

Decimal and SI conversions provided parenthetically shall be considered equivalent. Metric conversions have been made according to IEEE/ASTM SI 10.

2 Normative references

The following documents contain provisions that, through reference, constitute provisions of this NSF/ANSI Standard. At the time this standard was balloted, the editions listed below were valid. All documents are subject to revision, and parties are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below.

ANSI/ASHRAE 72 - 2014, Method of Testing Open and Closed Commercial Refrigerators and Freezers

ANSI/UL 471-2006, Standard for Commercial Refrigerators and Freezers


ASHRAE Refrigeration Handbook

ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process, Vol. 01.06

ASTM A924/A924M, Specification for General Requirements Steel Sheet, Metallic-Coated by the Hot Dip Process, Vol. 01.06


NSF/ANSI 2. Food equipment

NSF/ANSI 51. Food equipment materials

NSF/ANSI 170. Glossary of food equipment terminology

3 Definitions

Terms used in this Standard that have special technical meaning are defined in NSF/ANSI 170.

4 Materials

This section contains general requirements that apply to all equipment covered under the scope of this Standard.

The requirements contained in this section are intended to protect food from contamination and ensure that the materials used in the manufacture of refrigerators and freezers resist wear; penetration by vermin; and the effects of foods, cleaning compounds, sanitizers, refrigerants, and other substances that may contact the materials in the intended use environment.
4.1 Conformance to NSF/ANSI 51

Materials shall conform to the requirements in NSF/ANSI 51 applicable to the zone in which the material is used.

4.2 Zinc-coated materials

4.2.1 Galvanized and other zinc-alloy-coated materials shall not be used inside refrigerated food storage compartments, except compartments intended exclusively for the storage and/or display of packaged foods only or the material is protected by an additional coating conforming to NSF/ANSI 51.

4.2.2 Zinc-coated fasteners may be used in food zones but shall not be used in areas having direct food contact.

4.3 Solder

Solder containing lead as an intentional ingredient shall not be used in a food zone or splash zone.

4.4 Gaskets

Gaskets shall be made of resilient rubber, rubber-like materials, plastics, or a combination thereof.

4.5 Canopies and awnings

Canopies, awnings, and similar overhead decorative items located at least 36 in (90 cm) above all working surfaces shall be exempt from the material smoothness and cleanability requirements of this Standard. These items shall conform to applicable design and construction requirements of this Standard.

4.6 Storage shelving

Storage shelving that is manufactured, in whole or in part, of metallic materials and is intended for use in refrigerator or freezer interiors shall meet the corrosion resistance requirements in NSF/ANSI 51 section 8.

4.6.1 Shelving manufactured of stainless steel in the AISI 200 or 300 series, or of aluminum of the alloy series/designations listed in NSF/ANSI 51 section 4.2.2.1 and 4.2.2.2, is exempt from corrosion resistance requirements.

4.6.2 The coating requirements in section 6 of NSF/ANSI 51 shall also apply to storage shelving.

5 Design and construction

This section contains general requirements that apply to all equipment covered within the scope of this Standard.

5.1 General sanitation

5.1.1 Equipment shall be designed and manufactured to prevent the harborage of vermin and the accumulation of dirt, debris, and moisture, and to permit the inspection, maintenance, servicing, and cleaning of the equipment and its components.

5.1.2 Food zones and surfaces in direct contact with packaged foods shall be readily accessible and easily cleanable.

5.1.3 Splash zone surfaces shall be accessible and easily cleanable.
5.1.4 Non-food zone surfaces shall be accessible and cleanable.

5.1.5 Unexposed non-food zone surfaces shall be accessible or closed.

5.2 External angles and corners

Exposed external angles and corners in a food zone shall be sealed and smooth (See figure 1).

5.3 Fasteners

5.3.1 Fasteners shall not be used in areas having direct food contact.

5.3.2 Fasteners used in food storage compartments shall be removable. Rivets and other non-removable fasteners may be used:

— on electrical components and their housings; and
— in refrigerators intended solely for the storage or display of packaged foods (e.g., beverage coolers, self-service display refrigerators).

5.3.3 Fasteners shall be easily cleanable. Fasteners meeting this requirement include, but are not limited to, slot-head and Phillips-head screws, hex-head fasteners, and flush-break pop rivets. Hex-key screws and nonflush-break pop rivets may be used in a splash zone or non-food zone provided that the heads are capped or filled.

5.3.4 Fasteners shall be tight-fitting to the surface except as permitted in 5.3.5.

5.3.5 No more than one locking washer and one flat washer shall be used per fastener head. The diameter of the washer adjacent to the fastening surface shall not be less than the diameter of the washer under the fastener head. External-tooth lock washers shall not be used.

5.3.6 There shall be no exposed threads, projecting screws, or studs in a food or splash zone. There shall be no more than 2.5 exposed threads or ¼ in (0.25 in, 6.4 mm) of exposed threads, whichever is less, in a non-food zone. Exposed threads on electrical cord strain relief devices in a nonfood zone shall be exempt.

5.3.7 The sharp point of a fastener shall not be exposed.

5.4 Joints and seams

5.4.1 Permanent joints and seams in a food or splash zone shall be sealed and smooth. Seams formed by the attachment of breaker strips shall be exempt from this requirement.

5.4.2 In addition to conforming to 5.4.1, permanent seams located below the liquid overflow level of a food storage compartment shall be filled and made flush with the adjoining surfaces.

5.4.3 Joints formed by overlapping sheets of material shall not create upwardly facing horizontal ledges.

5.4.4 Permanent joints and seams in a non-food zone shall be closed. Welded joints and seams in a non-food zone shall be deburred.

5.4.5 Sealants shall only be used to seal joints and seams that are structurally sound and are less than ¼ in (0.13 in, 3.2 mm) wide before sealing. Sealants may be used to fill spaces around collars, grommets, and service connections. Sealants shall not be used in place of grommets or gaskets.
5.4.6 Solder
Solder and other fillet material shall be smooth and securely bonded to its substrate so that it will not crack or chip. All flux and catalytic material shall be removed.

5.5 Edges and nosings
If a shelf or unit top is reinforced by forming its edge into a structural shape (nosing), and there is an adjoining vertical surface (i.e., cabinet body), the following requirements shall apply:

— the nosing shall be integral with the shelf or unit top; and
— the edge shall be deburred; and
— the nosing and adjoining vertical surface shall be closed or shall have a clearance of at least \( \frac{3}{4} \) in \((0.75 \text{ in}, 19 \text{ mm})\) or \( \frac{1}{3} \) of the nosing’s vertical dimension, whichever is greater.

If the profile edge is turned in to form a channel-like configuration, the return (horizontal) shall not exceed \( \frac{1}{2} \) in \((0.50 \text{ in}, 13 \text{ mm})\) and shall be angled downward at least 5° from the horizontal plane. This requirement does not apply to readily removable shelves or knockdown shelves.

5.6 Reinforcing and framing
5.6.1 Exposed reinforcing and framing members and gussets shall be easily cleanable. Reinforcing and framing members shall be designed and manufactured to prevent the harborage of vermin (See figure 2).

5.6.2 Horizontal surfaces of reinforcing and framing members and gussets shall not be located where debris may accumulate.

5.6.3 Vertical channels that form hollow sections shall be closed at each end, open at each end, or readily accessible along the entire channel. All other hollow sections shall be closed at each end.

5.7 Inspection and maintenance panels
When necessary for equipment inspection and maintenance, removable panels of adequate size shall be provided. Each panel shall be sized to permit removal and replacement by one person.

5.8 Veneers
When provided, veneers shall be permanently affixed to equipment surfaces. Air pockets between veneer materials and equipment surfaces shall be eliminated.

5.9 Doors
5.9.1 Doors shall be sized to fit their openings and shall close properly.

5.9.2 Sliding doors shall slide freely and shall be readily removable.

5.9.3 Exposed channel sections on single panel doors shall be inverted or easily cleanable. Clean-outs shall be provided if channels are not inverted (see figure 3).

5.9.4 Exposed edges of glass doors shall be protected by tight-fitting channels, stripping materials, or other means such as rounding the edges of tempered glass to protect against chipping. The glass shall conform to the requirements in 5.30.3 (See figure 4).
5.10  **Hinges**

5.10.1  Hinges located in a food zone shall be easily cleanable while in place or shall be designed to be disassembled, without the use of tools, for routine cleaning. Hinges located in a splash zone shall be easily cleanable while in place or shall be designed to be disassembled (with or without the use of tools) for routine cleaning.

5.10.2  Continuous hinges shall not be used in a food zone.

5.10.3  Hinges on splash zone doors and covers weighing 80 lb (36 kg) or more shall have no more than five knuckles in total per hinge set and shall have sealed joints and seams on the hinge body (except for seams at the pivot joint).

5.10.4  Hinges on splash zone doors and covers weighing less than 80 lb (36 kg) shall conform to the requirements in 5.10.3 or each of the following:

- the hinge pin shall be lift-off style or have a removable pin; and
- the diameter of the hinge pin shall be greater than or equal to \(\frac{3}{16}\) in (0.19 in, 5.0 mm); and
- mating surfaces of the hinge (such as the joint between a knuckle and leaf) shall be closed or be separated by at least \(\frac{1}{8}\) in (0.13 in, 3.2 mm).

5.11  **Door gaskets**

5.11.1  Door gaskets shall be easily cleanable and shall be removable for replacement.

5.11.2  Retaining grooves and other devices for holding readily removable gaskets shall be easily cleanable.

5.12  **Door tracks and guides**

5.12.1  Door tracks and guides shall be easily cleanable. Channel tracks shall not have a depth greater than the width of the channel top.

5.12.2  Tracks and guides shall:

- have clear open slots continuously or at intervals along their entire length; or
- have clean-out holes at each end; or
- terminate at least \(\frac{1}{2}\) in (0.50 in, 13 mm) short of framing at each end; or
- be integral with the equipment surface and have no square corners.

This shall not apply to lower guides for overhead door suspensions that are integral with the equipment surface and channel-type bottom tracks equipped with readily removable strips.

5.13  **Covers**

5.13.1  Covers protecting a food zone shall overlap the opening.

5.13.2  Covers shall be designed with sufficient clearance to prevent contact with food.

5.13.3  Port openings through a food zone cover shall be flanged upward at least \(\frac{3}{16}\) in (0.19 in, 5.0 mm) and shall have a cover overlapping the flange.

5.13.4  Hinges and pivots shall conform to 5.10.
5.13.5 Covers shall be readily removable and easily cleanable.

5.13.6 Covers shall be designed and manufactured to prevent accumulation of liquid or debris on the covers and contamination of the food zone during opening and closing.

5.13.7 Covers shall be free of cracks, crevices, and exposed horizontal ledges.

5.13.8 Handles and knobs on covers shall be easily cleanable.

5.14 Openings into food zones

5.14.1 Openings into food zones shall be equipped with covers, doors, or other means effective in protecting stored food from contamination.

5.14.2 In areas where liquids may accumulate, top openings into food zones shall be protected by a raised rim that extends at least $\frac{3}{16}$ in (0.19 in, 5.0 mm) above the flood level (See figure 5).

5.15 Entry ports

Entry ports through which piping, thermometers, equipment, rotary shafts, and other functional parts enter into a food zone shall be closed and sealed at the point of entry and exit.

5.16 Drains

There shall be no drains other than those from a condensate evaporator in a food zone. Drains utilized for condensate shall be fabricated or located to prevent their use as a general drain for a food zone.

5.17 Hardware

Hardware shall be smooth, easily cleanable, and corrosion resistant. Hardware shall not have open seams, recesses, or unnecessary projections.

5.18 Handles and pulls

5.18.1 Exposed surfaces of handles and pulls shall meet the materials requirements of the applicable zone.

5.18.2 Handles and pulls shall be easily cleanable as installed on equipment.

5.18.3 If locking features are furnished, the keyway and lock areas of the handle are exempt from cleanability requirements.

5.19 Latches and catches

Latches and catches shall be easily cleanable while in place or shall be designed to be removable for cleaning. Openings that are functionally necessary are exempt from cleanability requirements.
5.20 Breaker strips

5.20.1 Breaker strips shall:

— be securely fastened around the entire perimeter; and
— be designed and manufactured to minimize accumulations of spillage, condensation, and foreign matter; and
— have smooth, easily cleanable surfaces without sharp or rough edges.

5.20.2 Seams between the breaker strip and capping shall be closed.

5.21 Shelving

5.21.1 Shelving and shelf support systems shall be easily cleanable and shall not provide harborage for vermin.

5.21.2 Shelving shall be readily removable.

5.21.3 Readily removable shelves shall be sized to permit handling by one person. Shelves used as readily removable false bottoms shall have flanged corners that are closed or are sufficiently notched to permit cleaning (See figure 6).

5.22 Ventilation openings

Areas housing compressors or other electrical equipment that may be subject to spills, splashes, or overhead drips shall be protected by louvers or other drip deflecting devices.

5.23 Louvers

5.23.1 Louvers that may be subject to overhead splashes, spills, and drips shall be of a deflecting design, or they shall be readily removable and the space immediately behind the louver easily cleanable.

5.23.2 If electrical safety requirements prohibit the use of readily removable louvers on compressor compartments, then such louvers need only be removable.

5.23.3 Louvers shall be deburred and shall have spaces large enough to allow for easy cleaning.

5.23.4 Screening on louvered openings, if provided, shall be 16 mesh (minimum 16 strands per 1.0 in [25mm]) or greater and removable.

5.24 Equipment mounting

5.24.1 Floor-mounted units shall be designed and manufactured to be:

— portable; or
— mobile; or
— sealed to the floor; or
— elevated on legs that provide a minimum unobstructed clearance of 6.0 in (150 mm) beneath the unit; or
— elevated on legs that provide a minimum unobstructed clearance beneath the unit of 4.0 in (100 mm) provided that no part of the floor under the equipment is more than 6.0 in (150 mm) from the point of cleaning access.

5.24.2 Counter-mounted equipment shall be designed and manufactured to be:

— portable; or

— sealed to the counter; or

— elevated on legs that provide a minimum unobstructed clearance of 4.0 in (100 mm) beneath the unit; or

— elevated on legs that provide a minimum unobstructed clearance beneath the unit of 3.0 in (76 mm) provided that no part of the counter top under the footprint of the equipment is more than 16 in (41 cm) from the point of cleaning access; or

— elevated on legs that provide a minimum unobstructed clearance beneath the unit of 2.0 in (50 mm) provided that no part of the counter top under the footprint of the equipment is more than 3.0 in (76 mm) from the point of cleaning access.

5.24.2.3 Portable equipment shall not weigh more than 80 lb (36 kg) and shall not exceed 36 in (90 cm) in any plane.

5.24.2.4 Utility connections on portable equipment and mobile equipment shall be designed to be disconnected without the use of tools or shall be of sufficient length to permit the equipment to be moved for cleaning.

5.24.2.5 Equipment intended to be sealed to the floor or counter shall not create inaccessible cavities or areas that may be subject to soiling or vermin harborage.

5.24.2.6 Kick plates on floor-mounted equipment shall be removable.

5.25 Legs and feet

5.25.1 Legs and feet shall be fastened to the body of the machine and shaped at their floor or counter contacts to minimize the accumulation of dirt and the harborage of vermin.

5.25.2 Legs and feet shall be sufficiently rigid to support the machine with a minimum of cross bracing.

5.25.3 If the outer dimension of a leg exceeds the outer dimension of its foot by ½ in (0.50 in, 13 mm) or more in the same plane, then the foot shall extend at least 1.0 in (25 mm) below the leg at the minimum adjustment (See figure 7a).

5.25.4 Hollow sections between a leg and a foot shall be closed. Legs and feet shall have no exposed threads at the maximum adjustment.

5.25.5 Gussets shall be assembled to the equipment and shall be easily cleanable and designed to prevent vermin harborage. The resultant assembly shall have no recessed areas (See figure 7b).

5.26 Casters, rollers, and gliders

If used, casters, rollers, and gliders shall be easily cleanable and conform to NSF/ANSI 2.
5.27 Insulation

5.27.1 Insulation shall be installed so as to prevent it from separating, settling, or becoming compacted under use conditions.

5.27.2 Insulated space shall be closed and sealed to protect it from condensation, spills, and seepage. Tight-fitting, readily removable plugs conforming to the zone-specific material requirements may be used to seal off openings to insulated spaces.

5.28 Cutting boards

Cutting boards shall be readily removable for cleaning and shall conform to the cutting board requirements in NSF/ANSI 2.

5.29 Temperature controls

Self-contained refrigerators and freezers shall have automatic controls capable of maintaining temperatures in accordance with the applicable performance requirements of this Standard.

5.30 Breakable glass components

5.30.1 Fixtures and devices that, if impacted, may break and contaminate food shall be protected by guards. This requirement shall not apply to view ports and windows constructed of heat tempered glass.

5.30.2 Light bulbs that have been plastic-coated or otherwise treated to resist shattering shall have a permanent label affixed near the bulb indicating that the lamp has been treated to resist shattering and must be replaced with a similarly treated lamp.

5.30.3 Glass, other than light fixtures, that may be subject to contact during use and routine maintenance and cleaning shall conform to the impact test in ANSI Z97.1 or to the impact test within ANSI/UL 197, or to the impact test within BS857:1967.

5.31 Food drawers

Refrigerated food drawers and drawer pan assemblies shall be readily removable for cleaning. Drawer slides and tracks need not be readily removable, provided that they are easily cleanable as installed. Joints and seams between drawer pan assemblies and drawer slides shall be closed, and recessed areas shall be minimized.

5.32 Food shields

Food shields shall conform to the food shield requirements in NSF/ANSI 2.

6 Storage refrigerators and freezers and refrigerated food transport cabinets

This section contains requirements for storage refrigerators and freezers and for refrigerated food transport cabinets, which shall also meet the requirements of 4 and 5. The food storage compartments of refrigerators and freezers shall conform to the food zone material requirements of 4 and the food zone design and construction requirements of 5 and 6. The food storage compartments of refrigerators and freezers that are intended solely for the storage of packaged foods, and are appropriately labeled as such, shall conform to the splash zone material requirements of 4 and 6 and the splash zone design and construction requirements of 5 and 6.
6.1 Zinc-coated materials

In addition to the requirements specified in 4.2:

6.1.1 Galvanized and other zinc-alloy-coated materials may be used inside refrigerated food storage compartments intended exclusively for the storage and/or display of packaged foods only. Unless protected by an additional coating conforming to NSF/ANSI 51, galvanized and other zinc-alloy-coated materials used in this application shall be at least as corrosion resistant as G60 galvanized steel per ASTM A653/A653M and ASTM A924/A924M.

6.2 Internal angles and corners

6.2.1 Internal angles or corners of less than 135° in a food zone shall be smooth and shall have minimum continuous radii of \( \frac{1}{4} \) in (0.25 in, 6.4 mm). The following internal angles are exempt from this requirement:

- angles formed by the ceiling and side walls of the interior liner of refrigerators and freezers; and
- angles formed where an evaporator is mounted to the interior liner of refrigerators and freezers.

Internal angles of less than 135° formed on the underside of roll-type covers, tilt-type covers, and similar-type covers for a food zone shall be smooth. The radius shall not be less than \( \frac{1}{8} \) in (0.13 in, 3.2 mm).

6.2.2 Solder and other fillet material shall not be used to effect the required minimum radius of an internal angle except at the intersection of the door mullion and the interior liner of refrigerated cabinets and on the underside of roll-type covers.

6.3 Joints and seams

In addition to the requirements specified in 5.4:

6.3.1 Seams within 3.0 in (75 mm) of the interior bottoms of dry, chest-type refrigerators and freezers shall be filled and made flush with the adjoining surfaces.

6.3.2 The joints and seams of a refrigerated food transport cabinet need not be sealed if:

- the unit is intended to be cleaned using high pressure cleaning methods as described in written cleaning instructions provided by the manufacturer; or
- the joints and seams are readily accessible for high-pressure cleaning methods; or
- the unit is capable of being completely drained in an upright position.

6.4 Hinges

Continuous hinges may be used on the exterior front corners and exterior side panels of refrigerated food transport cabinets. When used in this way, continuous hinges are exempt from the requirements of 5.10.

6.5 Casters, rollers, and gliders

In addition to the applicable requirements specified in 5.26, tread surfaces on pneumatic, semi-pneumatic, and conductive wheels on refrigerated food transport cabinets need not be smooth. Wheels on motorized food transport cabinets need not be smooth.

6.6 Refrigeration and cooling components

In addition to the applicable requirements specified in 5.26,
6.6.1 Shelf-type evaporators (evaporator shelving) shall not be used except in storage freezers. When used in storage freezers, shelf-type evaporators shall be exempt from the joint and seam requirements in 5.4.

6.6.2 Plate evaporators in under-counter refrigerator interiors shall be exempt from the food zone design and construction requirements provided that they are not intended for direct food contact and are protected from food splash and spillage. They shall conform to non-food zone design and construction requirements and to food zone materials requirements.

6.6.3 Refrigeration components shall be accessible for necessary cleaning and maintenance.

6.6.4 Evaporator coils and refrigerant tubing shall not be in direct contact with food contact surfaces and shall be installed so that condensate will not contact food or insulation.

6.6.5 If exposed to potential food splash or spillage, refrigeration coils shall be of finless design or shall be enclosed in a housing to protect them from being soiled. Their design shall provide for the drainage of condensate.

6.6.6 Air recirculation ducts outside the food zone shall be totally enclosed and protected from splash, spillage, and other contamination. Materials shall conform to splash zone materials requirements. Air ducts in the food zone shall conform to food zone requirements.

6.6.7 Evaporator drain pans shall be at least ½ in (0.50 in, 13 mm) deep and shall be accessible for cleaning. Drain connections to the evaporator drain pan shall not prevent the pan from being accessible for cleaning.

6.6.8 Upon installation, evaporator housings shall be sealed to the interior liner of the equipment or shall be located so that the space between the evaporator and the liner is readily accessible for cleaning.

6.6.8.1 Coil sections shall be either:

— accessible for cleaning; or

— designed to permit cleaning manually, or by flushing with water or other appropriate liquid in accordance with the manufacturer’s cleaning instructions.

6.6.9 Evaporator grills and interior panels having air discharge and return openings shall be removable. To permit cleaning upon removal, egg crate-type grills and honeycomb-type materials used in a food zone shall not exceed 24 in (61 cm) in any dimension.

6.7 Temperature-indicating devices (thermometers)

6.7.1 Each refrigerated storage compartment and cabinet shall have at least one securely mounted temperature-indicating device that clearly displays the air temperature in the compartment. A temperature-indicating device shall not be required in units intended solely for the storage of ice cream and other frozen desserts.

6.7.2 The temperature display of a temperature-indicating device shall be visible immediately upon opening a door to each refrigerated compartment, or shall be visible from the equipment exterior without opening a door to each compartment. The sensing element of the device shall be easily cleanable and located to reflect the temperature in the warmest part of the food storage compartment.

6.7.3 Temperature-indicating devices shall be removable.

6.7.4 Temperature-indicating devices shall be accurate to ± 2 °F (± 1 °C) and shall be graduated in increments no greater than 2 °F (1 °C) in the intended range of compartment temperatures.
6.8 Drains

In addition to the requirements specified in 5.16, dry chest-type refrigerators and freezers and equipment specifically designed for holding food products on ice shall have a drain. The drain shall have minimum internal diameter of 1.0 in (25 mm).

6.9 Equipment labeling and literature requirements

6.9.1 Equipment intended solely for the storage and display of packaged food products shall have a permanently attached label that states: “This equipment is intended for the storage and display of packaged products only.” The label shall be clearly visible to the user after installation of the equipment. This label is not required on self-service display refrigerators or units intended solely for the storage and display of ice cream and other frozen desserts.

6.9.2 The manufacturer of a remote refrigerator shall specify the load requirements BTU/hr (kW/hr) and the applicable evaporator temperature for each unit at its test condition.

6.10 Performance – storage refrigerators and refrigerated food transport cabinets

6.10.1 Performance requirement

Storage refrigerators and refrigerated food transport cabinets shall be capable of maintaining an air temperature of 40 °F (4 °C) or lower in all refrigerated compartment interiors.

6.10.2 Test method

A “no-load” test shall be conducted to evaluate the ability of a refrigerator to maintain an air temperature of 40 °F (4 °C) or lower in all refrigerated compartment interiors. Prior to the start of the test, the equipment shall be allowed to establish thermal equilibrium according to the manufacturer’s instructions, or cycle on and off at least two full cycles at an ambient temperature of 73 ± 3 °F (22 ± 2 °C). The test shall be conducted within a test chamber maintained under the following conditions for the duration of the test:

— ambient temperature of 100 ± 3 °F (38 ± 2 °C); and
— no vertical temperature gradient exceeding 1.5 °F/ft (2.5 °C/m).

NOTE — If this test method is used to evaluate a display refrigerator, the ambient temperature shall be 86 ± 2 °F (30 ± 1 °C).

Air temperatures within each empty refrigerated compartment shall be monitored using remote temperature-sensing devices (thermocouples) accurate to ± 1 °F (0.5 °C). The thermocouples shall be positioned as close as possible to the following locations:

**Thermocouple #1:** (when facing the front of the unit) 5.0 ± 0.25 in (130 ± 6.4 mm) from the left interior wall, 2.0 ± 0.25 in (50 mm ± 6.4 mm) above the bottom horizontal plane of the overhead cooling unit, (for units in which the evaporator is not suspended from the ceiling, the thermocouple shall be placed 5.0 ± 0.25 in [130 ± 6.4 mm] down from the ceiling) and centered front-to-back.

**Thermocouple #2:** centered front-to-back, centered top-to-bottom, centered left-to-right.

**Thermocouple #3:** (when facing the unit) 5.0 ± 0.25 in (130 ± 6.4 mm) from the right interior wall, 5.0 ± 0.25 in (130 ± 6.4 mm) above the internal floor of the unit, and centered front-to-back.

This test is not required for prefabricated walk-in and roll-in refrigerators or remote refrigerators not supplied with refrigeration. Adequate performance of these units, in accordance with 6.10, shall be ensured through the proper determination of refrigeration equipment demands.
The thermocouples shall be in thermal contact with the center of a 1.6-oz (45-g) cylindrical brass slug with a diameter and height of ¾ in (0.75 in, 19 mm). The brass slugs shall be placed at least ½ in (0.50 in, 13 mm) from any heat-conducting surface.

Before the air temperatures are recorded, the unit shall be operated for two complete refrigeration cycles at the test chamber ambient conditions. The temperature at each thermocouple location shall then be recorded at 5-min intervals over a period of 4 h.

The time during which the unit’s compressor(s) is operating shall be monitored over the complete test duration, continuing until reaching the same point in the cycle at which the test was started. The compressor percentage run time shall be calculated for each compressor using the formula below (monitoring the compressor run time is not required for refrigerated food transport cabinets).

NOTE — Variable capacity compressors shall be operated at maximum speed only using the test in 6.10.2.

\[ R = \frac{d}{D} \times 100, \]

where:

- d is the elapsed time that the compressor is operating during a whole number of cycles; and
- D is the total elapsed time during a whole number of cycles.

6.10.3 Acceptance criteria

The temperature at each thermocouple location within each refrigerated compartment shall not exceed 40 °F (4 °C) for the duration of the test.

The compressor percentage run time shall not exceed 70%. This criterion does not apply to refrigerated food transport cabinets.

6.11 Performance – storage freezers

6.11.1 Performance requirement

Storage freezers shall be capable of maintaining an air temperature of 0 °F (-18 °C) or lower in all freezer compartment interiors.

NOTE — This requirement does not apply to freezers designed and intended exclusively for the storage of ice cream and other frozen desserts. Adequate performance in such freezers is ensured by the desired condition of the product in the unit.

6.11.2 Test method

A “no-load” test shall be conducted to evaluate the ability of a freezer to maintain an air temperature of 0 °F (-18 °C) or lower in all freezer compartment interiors. Prior to the start of the test, the equipment shall be allowed to establish thermal equilibrium according to the manufacturer's instructions or cycle on and off at least two full cycles at an ambient temperature of 73 ± 3 °F (22 ± 2 °C). The test shall be conducted within a test chamber maintained under the following conditions for the duration of the test:

- ambient temperature of 100 ± 3 °F (38 ± 2 °C); and

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9 This test is not required for prefabricated walk-in and roll-in storage freezers or remote refrigerators not supplied with refrigeration. Adequate performance of these units, in accordance with 6.11, shall be ensured through the proper determination of refrigeration equipment demands.
no vertical temperature gradient exceeding 1.5 °F/ft (2.5 °C/m).

Air temperatures within each empty freezer compartment shall be monitored using remote sensing devices (thermocouples) accurate to ± 1 °F (± 0.5 °C). The thermocouples shall be positioned as close as possible to the following locations:

**Thermocouple #1:** (when facing the front of the unit) 5.0 ± 0.25 in (130 ± 6.4 mm) from the left interior wall, 2 ± 0.25 in (51 ± 6 mm) above the bottom horizontal plane of the overhead cooling unit, (for units in which the evaporator is not suspended from the ceiling, the thermocouple shall be placed 5.0 ± 0.25 in [130 ± 6.4 mm] down from the ceiling) and centered front-to-back.

**Thermocouple #2:** centered front-to-back, centered top-to-bottom, centered left-to-right.

**Thermocouple #3:** (when facing the unit) 5.0 ± 0.25 in (130 ± 6.4 mm) from the right interior wall, 5.0 ± 0.25 in (130 ± 6.4 mm) above the internal floor of the unit, and centered front-to-back.

The thermocouples shall be in thermal contact with the center of a 1.6-oz (45-g) cylindrical brass slug with a diameter and height of ¾ in (0.75 in, 19 mm). The brass slugs shall be placed at least ½ in (0.50 in, 13 mm) from any heat-conducting surface.

Before the air temperatures are recorded, the unit shall be operated for two complete refrigeration cycles at the test chamber ambient conditions. The temperature at each thermocouple location shall then be recorded at 5-min intervals over a period of 4 h.

The time during which the unit’s compressor(s) is operating shall be monitored over the complete test duration, and the compressor percentage run time shall be calculated for each compressor using the formula below:

NOTE — Variable capacity compressors shall be operated at maximum speed only using the test in 6.11.2.

\[ R = \frac{d}{D} \times 100, \]

where:

- d is the elapsed time that the compressor is operating during a whole number of cycles; and
- D is the total elapsed time during a whole number of cycles.

### 6.11.3 Acceptance criteria

The temperature at each thermocouple location within each freezer compartment shall not exceed 0 °F (-18 °C) during the 4-h test period.

The compressor percentage run time shall not exceed 80%.

### 7 Refrigerated buffet units and refrigerated food preparation units

This section contains requirements for refrigerated buffet units and refrigerated food preparation units, which shall also meet the requirements of 4 and 5.
7.1 Internal angles and corners

In addition to the requirements in 5:

7.1.1 Internal angles or corners of less than 135° in a food zone shall be smooth and shall have minimum continuous radii of ¼ in (0.25 in, 6.4 mm). The following internal angles are exempt from this requirement:

— angles formed by the ceiling and side walls of the interior liner of refrigerators; and
— angles formed where an evaporator is mounted to the interior liner of refrigerators and freezers.

Internal angles of less than 135° formed on the underside of roll-type covers, tilt-type covers, and similar-type covers for a food zone shall be smooth. The radius shall not be less than ⅛ in (0.13 in, 3.2 mm).

Internal angles of less than 135° formed on preparation surface and raised rails for a food zone shall be smooth. The radius shall not be less than ⅛ in (0.13 in, 3.2 mm).

7.1.2 Solder and other fillet material shall not be used to effect the required minimum radius of an internal angle except at the intersection of the door mullion and the interior liner of refrigerated cabinets and on the underside of roll-type covers.

7.2 Equipment labeling and literature requirements

7.2.1 Refrigerated buffet units, refrigerated food preparation units, and similar open-top refrigeration equipment shall have a permanent label indicating that the equipment is intended for use in rooms having an ambient temperature of 86 °F (30 °C) or lower. The label shall be clearly visible to the user after installation of the equipment.

7.2.2 The manufacturer of a remote refrigerator shall specify the load requirements BTU/hr (kW/hr) and the applicable evaporator temperature for each unit at its test condition.

7.2.3 If ice is used as the cooling medium for buffet units, even if there is a mechanical system used to slow the ice melting, performance testing to this Standard shall not be required. Ice-cooled buffet units shall have a permanent label indicating that the unit has not been performance tested for the holding of potentially hazardous foods. The label shall be clearly visible to the user after installation of the equipment.

7.2.4 Frost top units shall not require performance testing to this Standard. Frost top units shall have a permanent label indicating that the unit has not been performance tested for the holding of potentially hazardous foods. The label shall be clearly visible to the user after installation of the equipment.

7.3 Refrigeration and cooling components

7.3.1 Refrigeration components shall be accessible for necessary cleaning and maintenance.

7.3.2 Evaporator coils and refrigerant tubing shall not be in direct contact with food contact surfaces and shall be installed so that condensate will not contact food or insulation.

7.3.3 If exposed to potential food splash or spillage, refrigeration coils shall be of finless design or shall be enclosed in a housing to protect them from being soiled. Their design shall provide for the drainage of condensate.

7.3.4 Air recirculation ducts outside the food zone shall be totally enclosed and protected from splash, spillage, and other contamination. Materials shall conform to splash zone materials requirements. Air ducts in the food zone shall conform to food zone requirements.
7.3.5 Evaporator drain pans shall be at least ½ in (0.50 in, 13 mm) deep and shall be accessible for cleaning. Drain connections to the evaporator drain pan shall not prevent the pan from being accessible for cleaning.

7.3.6 Upon installation, evaporator housings shall be sealed to the interior liner of the equipment or shall be located so that the space between the evaporator and the liner is readily accessible for cleaning.

7.3.6.1 Coil sections shall be either:

— accessible for cleaning; or

— designed to permit cleaning manually, or by flushing with water or other appropriate liquid in accordance with the manufacturer's cleaning instructions.

7.3.7 Evaporator grills and interior panels having air discharge and return openings shall be removable. To permit cleaning upon removal, egg crate-type grills and honeycomb-type materials used in a food zone shall not exceed 24 in (61 cm) in any dimension.

7.4 Temperature-indicating devices (thermometers)

7.4.1 Each refrigerated storage compartment and cabinet shall have at least one securely mounted temperature-indicating device that clearly displays the air temperature in the compartment.

7.4.2 The temperature display of a temperature-indicating device shall be visible immediately upon opening a door to each refrigerated compartment, or shall be visible from the equipment exterior without opening a door to each compartment. The sensing element of the device shall be easily cleanable and located to reflect the temperature in the warmest part of the food storage compartment.

7.4.3 Temperature-indicating devices shall be removable.

7.4.4 Temperature-indicating devices shall be accurate to ± 2 °F (± 1 °C) and shall be graduated in increments no greater than 2 °F (1 °C) in the intended range of compartment temperatures.

7.5 Performance

7.5.1 Performance requirements

Refrigerated buffet units and refrigerated food preparation units shall be capable of maintaining product in the open display area (rail) at temperatures not greater than 41 °F (5 °C) and not less than 33 °F (1 °C). They shall also be capable of maintaining air temperatures in enclosed refrigerated compartments (if provided) of no lower than 33 °F (1 °C) and no higher than 40 °F (4 °C).

NOTE — This test is not required for remote refrigerators not supplied with refrigeration.

7.5.2 Test method

A test shall be conducted to evaluate the ability of refrigerated buffet units and refrigerated food preparation units to maintain the temperature of a food-simulating test medium between 41 °F (5 °C) and 33 °F (1 °C) in the open rail. Prior to the start of the test, the entire rail shall be loaded with 4.0 in (100 mm) deep hotel pans that are at least half-filled with cold water. If rail covers are provided, the covers shall be closed. The equipment shall then be allowed to cycle on and off at least two full cycles at an ambient temperature of 73 ± 3 °F (22 ± 2 °C).

The test shall be conducted within a test chamber maintained under the following conditions for the duration of the test:
— ambient temperature of 86 ± 2 °F (30 ± 1 °C);
— no vertical temperature gradient exceeding 1.5 °F/ft (2.5 °C/m);
— maximum relative humidity of 50%; and
— maximum air current velocity of 50 ft/min (0.25 m/s) across the surfaces of the test pans.

After the required test chamber conditions are established, the unit shall be loaded with pans of test medium (Annex A, section A.1) so that media temperature can be monitored at the four outermost corners of the rail and as close to the center of the rail as possible. At each of these locations, the media temperature shall be monitored using thermocouples positioned approximately 1.0 in (25 mm) below the media surface and approximately ⅛ in (0.13 in, 3.2 mm) above the bottom of the pans. The thermocouples at the corner locations shall not touch the side walls or end walls of the pans, nor shall they be more than ½ in (0.50 in, 13 mm) from the side walls or end walls. At the center location, the thermocouples shall be positioned in the center of a pan of media. The thermocouples used shall be accurate to ± 1 °F (± 0.5 °C).

The test shall be started upon verification that the temperature of the test medium is 35 ± 2 °F (2 ± 1 °C) at each of the 5 thermocouples located 1.0 in (25 mm) below the surface. If a rail cover(s) is provided, the cover(s) shall be closed until the start of the test.

The temperature at each of the 10 thermocouple locations shall be recorded at 5-min intervals over a period of 4 h.

For each of the 10 thermocouple locations located in the rail area of the unit, a separate 1-h, moving box car average calculation shall be applied to the collected data points. Specifically, at each thermocouple location, the first 12 collected data points (data points 1 through 12) shall be averaged together to obtain box car average #1; then data points 2 through 13 shall be averaged together to obtain box car average #2; then data points 3 through 14 shall be averaged together to obtain box car average #3. This data manipulation shall continue throughout the 4-h evaluation until box car average #37 (data points 37-48) is calculated. A total of 37 box car averages shall be calculated for each of the 10 thermocouple locations.

If a unit has one or more integral refrigerated compartments, a “no-load” test shall be conducted to evaluate the ability of the unit to maintain an air temperature between 33 °F (1 °C) and 40 °F (4 °C) or lower in all refrigerated compartment interiors. The test shall be conducted in accordance with the test method in 6.10.2 except that the ambient test chamber conditions prescribed in this section shall apply. The 4-h “no-load” test shall be conducted simultaneously with the 4-h evaluation of the open-top refrigeration.

The time during which the unit’s compressor(s) is operating shall be monitored over the complete test duration, and the compressor percentage run time shall be calculated for each compressor using the formula below.

\[ R = \frac{d}{D} \times 100, \]

where:

- \( d \) is the elapsed time that the compressor is operating during a whole number of cycles; and
- \( D \) is the total elapsed time during a whole number of cycles.

### 7.5.3 Acceptance criteria

For each of the 10 thermocouple locations, all 37 calculated box car averages shall not exceed 41 °F (5 °C) nor be lower than 33 °F (1 °C).

The temperature at each thermocouple location within each refrigerated compartment shall not exceed 40 °F (4 °C) nor be lower than 33 °F (1 °C) during the 4-h test period.
The compressor percentage run time shall not exceed 90%.

8 Prefabricated walk-in and roll-in refrigerators and freezers

This section contains requirements for walk-in and roll-in refrigerators and freezers, which shall also meet the requirements of 4 and 5. The food storage compartments shall meet splash zone material requirements of 4 and 8 and food zone design and construction requirements of 5 and 8.

8.1 Prefabricated walk-in and roll-in refrigerators and freezers

8.1.1 Zinc-coated materials

In addition to the requirements specified in 4.2:

8.1.1.1 Galvanized and other zinc-alloy-coated materials may only be used on the walls, ceilings, and attached hardware and components of walk-in and roll-in refrigerators and freezers. Unless protected by an additional coating conforming to NSF/ANSI 51, galvanized and other zinc-alloy-coated materials used in this application shall be at least as corrosion resistant as G90 galvanized steel per ASTM A653/A653M and ASTM A924/A924M. Coated materials, including galvanized materials, shall not be used on the floor of a walk-in or roll-in refrigerator or freezer unless it is to be covered with a masonry floor at the time of installation, or as permitted in 8.2.3 for walk-in or roll-in refrigerators and freezers used only for the storage of food in the original sealed package.

8.1.1.2 PVC laminated steel or aluminum

PVC laminated steel or aluminum may be used as the finished floor of walk-in and roll-in refrigerators and freezers provided that the substrate is at least as corrosion resistant as G90 galvanized steel. The PVC film shall consist of one or more layers that are obtained through a continuous calendaring or extrusion process and continuously laminated to the substrate. The PVC laminated material shall comply with the performance criteria in 8.4.

NOTE — Calendaring is a process of smoothing and compressing a material during production by passing a single continuous sheet through a number of pairs of heated rolls.

8.1.2 Design and construction

The design and construction requirements in this section apply to prefabricated walk-in and roll-in refrigerators and storage freezers.

8.1.2.1 To facilitate the sealing of joints between interior liner panels, gaskets shall be applied to panel perimeters at the time of manufacture. The gaskets shall conform to requirements in 4.4 and shall be permanently attached. Caulking and sealants shall not be used to seal joints and seams between panels, except to effect minor repairs. All other interior permanent seams (floors, walls, ceilings, door sections, etc.) shall be sealed.

8.1.2.2 If a unit has a prefabricated floor, the angles formed at the floor-wall juncture shall conform to the minimum radius requirement in 8.1.3. The minimum radius shall be effected by forming the edges of the floor into the same vertical plane as the wall at the floor-wall juncture. This requirement shall not apply if a masonry floor (e.g., concrete, tile) is to be installed on top of the prefabricated floor after installation. If a masonry floor is to be installed in a prefabricated walk-in or roll-in, the required radius shall be effected upon installation of the floor using masonry materials or coved bases made available by the manufacturer.

8.1.2.3 Units without prefabricated floors shall be manufactured so that seams formed between the walls and floor or base may be closed and sealed upon assembly of the equipment. The minimum required radius
at the floor-wall juncture shall be effected using masonry materials or coved bases made available by the manufacturer.

8.1.2.4 Doors shall be of a non-sweeping design. Door sills shall be designed to facilitate the cleaning of the interior floor. Doors shall be capable of being opened from the inside, even when locked. Sliding doors on walk-in refrigerators and freezers shall be readily removable, or shall be removable and easily cleanable as installed.

8.1.2.5 Tracks and guides of roll-in units shall be easily cleanable or readily removable.

8.1.2.6 Anti-skid adhesive strips shall be exempt from the requirement that materials be smooth and easily cleanable.

8.1.2.7 Walk-in units with pre-fabricated floors shall not have floor drains.

8.1.2.8 Manufacturers of walk-in units not supplied with refrigeration components, or of units that are intended for remote refrigeration, shall recommend minimum BTU ratings for ambient temperatures of 75°F (24°C), 80°F (27°C), or 100°F (38°C), as determined by calculations contained in the ASHRAE Refrigeration Handbook. If the same unit may be used as either a refrigerator or a freezer, the manufacturer shall provide minimum BTU/hr (kW/hr) ratings for each application. If a unit may be used only as a refrigerator or as a freezer, the manufacturer shall provide the minimum BTU/hr (kW/hr) ratings for the application for which the unit is designed.

If a manufacturer supplies only components for construction of a walk-in or roll-in refrigerator or freezer, the manufacturer shall specify the "U" value of the panels in its literature.

8.1.3 Internal angles and corners

8.1.3.1 Internal angles or corners of less than 135° in a food zone shall be smooth and shall have minimum continuous radii of ¼ in (0.25 in, 6.4 mm). The following internal angles are exempt from this requirement:

— angles formed by the ceiling and side walls of the interior liner of refrigerators and freezers; and
— angles formed where an evaporator is mounted to the interior liner of refrigerators and freezers.

8.1.3.2 Solder and other fillet material shall not be used to effect the required minimum radius of an internal angle.

8.1.4 Refrigeration and cooling components

8.1.4.1 Refrigeration components shall be accessible for necessary cleaning and maintenance.

8.1.4.2 Evaporator coils and refrigerant tubing shall not be in direct contact with food contact surfaces and shall be installed so that condensate will not contact food or insulation.

8.1.4.3 If exposed to potential food splash or spillage, refrigeration coils shall be of finless design or shall be enclosed in a housing to protect them from being soiled. Their design shall provide for the drainage of condensate.

8.1.4.4 Air recirculation ducts outside the food zone shall be totally enclosed and protected from splash, spillage, and other contamination. Materials shall conform to splash zone materials requirements. Air ducts in the food zone shall conform to food zone requirements.

8.1.4.5 Evaporator drain pans shall be at least ½ in (0.50 in, 13 mm) deep and shall be accessible for cleaning. Drain connections to the evaporator drain pan shall not prevent the pan from being accessible for cleaning.
8.1.4.6 Upon installation, evaporator housings shall be sealed to the interior liner of the equipment or shall be located so that the space between the evaporator and the liner is readily accessible for cleaning.

8.1.4.6.1 Coil sections shall be either:
   — accessible for cleaning; or
   — designed to facilitate cleaning manually, or by flushing with water or other appropriate liquid in accordance with the manufacturer's cleaning instructions.

8.1.4.7 Evaporator grills and interior panels having air discharge and return openings shall be removable. To permit cleaning upon removal, egg crate-type grills and honeycomb-type materials used in a food zone shall not exceed 24 in (61 cm) in any dimension.

8.1.5 Temperature-indicating devices (thermometers)

8.1.5.1 Each refrigerated compartment shall have at least one securely mounted temperature-indicating device that clearly displays the air temperature in the compartment.

8.1.5.2 The temperature display of a temperature-indicating device shall be visible immediately upon opening a door to each refrigerated compartment, or shall be visible from the equipment exterior without opening a door to each compartment. The sensing element of the device shall be easily cleanable and located to reflect the temperature in the warmest part of the refrigerated compartment.

8.1.5.3 Temperature-indicating devices shall be removable.

8.1.5.4 Temperature-indicating devices shall be accurate to ± 2 °F (± 1 °C) and shall be graduated in increments no greater than 2 °F (1 °C) in the intended range of compartment temperatures.

8.2 Prefabricated walk-in and roll-in refrigerators and freezers used for the storage of food in the original sealed package

The materials, design, and construction requirements in this section apply to prefabricated walk-in and roll-in refrigerators and freezers used to store food in the original sealed package. The interiors of these units shall meet the splash zone requirements of this Standard except as noted in this section. Therefore, minimum radius requirements that apply to other prefabricated walk-in and roll-in refrigerators and storage freezers are not applicable to this equipment.

8.2.1 Joints between liner panels shall be sealed per the manufacturer's instructions. If gaskets are used, the gaskets shall conform to requirements in 4.4 and shall be permanently attached.

Joints and seams resulting from the application of wainscoting shall be smooth, but are not required to be factory sealed. Wainscoting that has been fastened to the walls shall be sealed along the top edge to prevent accumulation of dirt, debris, and moisture. When fiberglass reinforced polyester (FRP) is used as wainscoting, seams shall be joined using moldings provided by the FRP manufacturer. All other interior permanent seams (floors, walls, ceilings, door sections, etc.) shall be sealed.

8.2.2 Units without prefabricated floors shall be manufactured so that seams formed between the walls and floor or base may be closed and sealed upon assembly of the equipment.

8.2.3 Prefabricated floors may be constructed of galvanized and other zinc-alloy-coated materials at least as corrosion resistant as G90 galvanized steel per ASTM A653/A653M and ASTM A924/A924M. If tread plate flooring is to be applied over galvanized floors, it shall be fastened and sealed per the manufacturer's instructions.
8.2.4 Doors shall be of a non-sweeping design. Door sills shall be designed to facilitate the cleaning of the interior floor. Doors shall be capable of being opened from the inside, even when locked.

8.2.5 Tracks and guides of roll-in units shall be easily cleanable or readily removable.

8.2.6 Anti-skid adhesive strips shall be exempt from the requirement that materials be smooth and cleanable.

8.2.7 Manufacturers of walk-in units not supplied with refrigeration components, or of units that are intended for remote refrigeration, shall recommend minimum BTU ratings for ambient temperatures of 75 °F (24 °C), 80 °F (27 °C), or 100 °F (38 °C), as determined by calculations contained in the ASHRAE Refrigeration Handbook. If the same unit may be used as either a refrigerator or a freezer, the manufacturer shall provide minimum BTU/hr (kW/hr) ratings for each application. If a unit may be used only as a refrigerator or as a freezer, the manufacturer shall provide the minimum BTU/hr (kW/hr) ratings for the application for which the unit is designed.

If a manufacturer supplies only components for construction of a walk-in or roll-in refrigerator or freezer, the manufacturer shall specify the “U” value of the panels in their literature.

8.2.8 Prefabricated walk-in and roll-in refrigerators and freezers used to store food in the original sealed package are exempt from the requirements of 5.6 and 5.27.

8.2.9 Doors shall meet the requirements of 5.9 except that sliding doors are not required to be readily removable.

8.2.10 Fasteners used for prefabricated panels shall meet the requirements of 5.3. All other fasteners are exempt from the requirements of 5.3.

8.2.11 Pallet racks, shelf standards, and equipment designed to hold one or more loads of palletized product, are not required to meet the requirements of 5.18.

8.2.12 Temperature-indicating devices

8.2.12.1 Each refrigerated compartment shall have at least one securely mounted temperature-indicating device that clearly displays the air temperature in the compartment.

8.2.12.2 The temperature display of a temperature-indicating device shall be visible immediately upon opening a door to the refrigerated compartment or shall be visible from the equipment exterior without opening a door to each compartment. The sensing element of the device shall be easily cleanable and located to reflect the temperature in the warmest part of the refrigerated compartment.

8.2.12.3 Temperature-indicating devices shall be removable.

8.2.12.4 Temperature-indicating devices shall be accurate to ± 2 °F (± 1 °C) and shall be graduated in increments no greater than 2 °F (1 °C) in the intended range of compartment temperatures.

8.3 Equipment labeling and literature requirements

Prefabricated walk-in and roll-in refrigerators and freezers used for the storage of food in the original sealed package shall have a permanently attached label that states: “This equipment is intended for the storage of food in the original sealed package only.” The statement shall also appear in applicable product literature, on the product drawings, and in the installation manual.
When a factory-supplied door is included in the unit, the label shall be attached to the frame adjacent to the door. When the door location(s) is not known to the manufacturer, the label shall be attached in the field in another conspicuous location per the manufacturer’s instructions.

NOTE — The location of the label is intended to be near the door, inside or outside the unit.

8.4 Performance for PVC laminated steel or aluminum

8.4.1 Performance requirement

PVC laminated steel or aluminum flooring material shall be capable of withstanding abrasion, impact, and adhesion resistance as outlined in 8.4.2, 8.4.3, and 8.4.4.

8.4.2 Abrasion resistance test method

Abrasion resistance shall be evaluated using three laminated test plaques that represent the finished product. The laminated test plaques shall be conditioned for at least 24 h at 73 ± 3 °F (23 ± 2 °C) and 50 ± 5% relative humidity. Each laminated test plaques shall be weighed to the nearest milligram. The samples shall be mounted on a Taber® Abraser, or equivalent apparatus, with No. S-35 standardized abrasion test wheels and a total applied load of 4.4 lb (2.0 kg). Samples shall undergo 200 wear cycles. The final mass of each sample shall be recorded and subtracted from its initial weight. Each sample shall be inspected for substrate exposure.

8.4.2.1 Acceptance criteria

The mass of laminate lost from each test sample shall be less than 200 milligrams, and the substrate shall not be exposed on any of the samples.

8.4.3 Impact resistance test method

Impact resistance shall be evaluated per ASTM D 2794 using three laminated test plaques that represent the finished product. The laminated test plaques shall be conditioned for at least 24 h at -10 ± 3 °F (-23 ± 2 °C). Each of the samples shall be subjected to a single impact force of 160 in-lbs (1.8 kg-m) delivered with a 4.0-lb (1.8 kg) weight and a 1/2 in (0.500 in, 12.7 mm) diameter hemispherical-head steel punch. Samples shall be supported by a platform consisting of a 1/4 in (0.25 in, 6.4 mm) thick neoprene rubber pad with a durometer hardness value of 60 ± 5 that is secured to an anvil (a die shall not be used). The samples shall be secured to the platform; the neoprene pad shall not be compressed by the securing mechanism (i.e., clamping).

8.4.3.1 Acceptance criteria

The samples shall not exhibit any cracking, chipping, or peeling at the impact site.

8.4.4 Adhesion resistance test method

Adhesion ability shall be evaluated using three laminated test plaques that represent the finished product. The laminated test plaques shall be conditioned for at least 24 h at 73 ± 3 °F (23 ± 2 °C) and 50 ± 5% relative humidity. The plaques shall be evaluated using Method B of ASTM D3359. One evaluation shall be performed per sample plaque.

8.4.4.1 Acceptance criteria

For each sample plaque, the grid area shall be classified as 5B per ASTM D3359, or the edges of the cuts shall be completely smooth and none of the squares of the lattice shall be detached.

9 Display refrigerators and freezers

This section contains requirements for display refrigerators and freezers, which shall also meet the requirements of 4 and 5.

9.1 Materials

In addition to the applicable requirements in 4.2:

9.1.1 Galvanized and other zinc-alloy-coated materials may be used inside refrigerated food storage compartments intended exclusively for the storage and/or display of packaged foods only. Unless protected by an additional coating conforming to NSF/ANSI 51, galvanized and other zinc-alloy-coated materials used in this application shall be at least as corrosion resistant as G60 galvanized steel per ASTM A653/A653M and ASTM A924/A924M.

9.1.2 Packaged food storage compartments shall conform to material requirements for splash zones.

9.1.3 Unpackaged food compartments or cabinets shall conform to material requirements for food zones.

9.1.4 Night curtains, when installed on open refrigerated display cases that are intended for the storage of packaged foods only and that do not have misting or rehumidification systems, shall be exempt from the material smoothness and cleanability requirements of this Standard. This exemption shall apply to the curtain materials only, and shall apply only to night curtains that are removable or readily removable. Night curtains and their assemblies shall conform to applicable design and construction requirements of this Standard.

9.2 Design and construction

The food storage compartments of display refrigerators shall conform to the splash zone design and construction requirements of this Standard.

9.3 General sanitation

Display refrigerators shall be designed to facilitate cleaning of food storage compartments manually, or by flushing them with water or other appropriate liquid in accordance with the manufacturer’s cleaning instructions.

9.4 Fasteners

In addition to the requirements specified in 5.3, hex-key screws may be used on clamp hinge assemblies for glass doors on display refrigerators.

9.5 Joints and seams

In addition to the requirements specified in 5.4, for display refrigerators, the gap between the end frame and end may be up to \( \frac{5}{16} \text{ in} \) (0.31 in, 7.9 mm) when filled with a compressible gasket and sealed with a sealant conforming to NSF/ANSI 51.
9.6 Reinforcing and framing

Reinforcing and framing members shall comply with 5.6. Hollow sections located inside display refrigerators are exempt from 5.6 if each of the following conditions is met:

- the sections serve as shelf standards for removable shelves or as air circulation ducts; and
- the sections are not exposed to routine splash or spillage; and
- the sections are capable of being readily inspected.

9.7 Doors

9.7.1 In addition to the requirements specified in 5.9, sliding doors on display refrigerators shall be readily removable, or shall be removable and easily cleanable as installed.

9.7.2 Display refrigerators with automatic lockout shall be equipped with:

- an automatic door lock; and
- self-closing door(s); and
- a feature that would allow the door to be unlocked only by an operator/employee or service person.

NOTE — The self-closing feature of a self-closing door is not required to function when the door is opened to a position beyond a 90-degree arc.

9.8 Drains

In addition to the applicable requirements specified in 5.16:

9.8.1 A drain or waste outlet may be provided for the draining of a display refrigerator. If display refrigerator drains are provided for flushing, they shall have a minimum internal diameter of 1.0 in (25 mm).

9.8.2 Display refrigerators equipped with automatic or off-time defrost systems shall have a drain located at the lowest level of the compartment to which water will drain.

9.9 Shelving

In addition to the applicable requirements specified in 5.21:

9.9.1 Shelving in self-service display refrigerators shall be removable or readily removable.

9.9.2 Shelving for self-service display refrigerators shall be exempt from the requirements of NSF/ANSI 51, section 5.2.2, if made with a minimum G60 galvanized steel. Galvanized steel shelves may be coated for appearance.

9.9.3 Shelving and shelf support systems shall be easily cleanable and shall not provide harborage for vermin.

NOTE — This requirement shall not preclude the use of hollow shelf standards in display refrigerators as permitted in 9.6.

9.10 Equipment mounting

In addition to the applicable requirements in 5.24:

9.10.1 Self-service display refrigerators shall be exempt from 5.24.1 if the unit is elevated on an open channel base or other support that provides a minimum clearance of 6 in (15 cm) beneath the unit.
9.10.2 Self-service display refrigerators shall be exempt from 5.24.1 if the unit:

— is designed so that the unit is elevated on an open channel base or other support that provides a minimum clearance of at least 3.0 in (75 mm) beneath the unit; and

— is provided with installation instructions that provide for sufficient access for inspection, maintenance, and cleaning under the unit, as installed; and

— is provided with instructions for cleaning under the unit including the recommended equipment to be used.

9.10.3 Self-service display refrigerators shall be exempt from 5.24.1 if the unit:

— is designed such the unit is elevated on an open channel base or other support that provides a minimum clearance of at least 2.0 in (50 mm) beneath the unit; and

— is equipped with barriers that prevent spills of liquids and solids from passing under the unit; and

— is provided with installation instructions that provide for sufficient access for inspection, maintenance, and cleaning under the unit, as installed; and

— is provided with instructions for cleaning under the unit including the recommended equipment to be used.

9.10.4 Sufficient access shall mean that at least 90% of the floor and any horizontal ledges or channel sections under the unit are accessible by hand or by means of a 1.5 in (38 mm) diameter rod. The space beneath the unit may contain piping, wiring, junction boxes, structural support members, and similar items provided that sufficient access, as defined here, is maintained when the unit is installed in accordance with the manufacturer's instructions.

9.10.5 If a base or kick plate on a display refrigerator has louvers, slots, perforations, or other openings to allow air circulation under the unit, those openings shall terminate at least 1.0 in (25 mm) above the floor.

9.11 Refrigeration and cooling components

9.11.1 Refrigeration components shall be accessible for necessary cleaning and maintenance.

9.11.2 Evaporator coils and refrigerant tubing shall not be in direct contact with food contact surfaces, and shall be installed so that condensate will not contact food or insulation. Top-mounted coils in service display refrigerators shall have a drain pan (drip pan) that prevents condensate from dripping onto food and drains condensate away from the food storage areas.

9.11.3 If exposed to potential food splash or spillage, refrigeration coils shall be of finless design or shall be enclosed in a housing to protect them from being soiled. Their design shall provide for the drainage of condensate.

9.11.4 Air recirculation ducts outside the food zone shall be totally enclosed and protected from splash, spillage, and other contamination. Materials shall conform to splash zone materials requirements. Air ducts in the food zone shall conform to food zone requirements.

9.11.5 Evaporator drain pans shall be at least ½ in (0.50 in, 13 mm) deep and shall be accessible for cleaning. Drain connections to the evaporator drain pan shall not prevent the pan from being accessible for cleaning.

9.11.6 Upon installation, evaporator housings shall be sealed to the interior liner of the equipment or shall be located so that the space between the evaporator and the liner is readily accessible for cleaning.
9.11.6.1 Coil sections shall be either:

— accessible for cleaning; or

— designed to facilitate cleaning manually, or by flushing with water or other appropriate liquid in accordance with the manufacturer's cleaning instructions.

9.11.7 Evaporator grills and interior panels having air discharge and return openings shall be removable. To permit cleaning upon removal, egg crate-type grills and honeycomb-type materials used in a food zone shall not exceed 48 in (122 cm) in any dimension.

9.12 Temperature-indicating devices (thermometers)

9.12.1 Each refrigerated storage compartment and cabinet shall have at least one securely mounted temperature-indicating device that clearly displays the air temperature in the compartment. A temperature-indicating device shall not be required in beverage coolers or units intended solely for the storage and/or display of ice cream and other frozen desserts.

9.12.2 The temperature display of a temperature-indicating device shall be visible immediately upon opening a door to each refrigerated compartment, or shall be visible from the equipment exterior without opening a door to each compartment. The sensing element of the device shall be easily cleanable and located to reflect the temperature in the warmest part of the food storage compartment.

Open display refrigerators shall have a temperature-indicating device that is easily cleanable and located to reflect the air temperature in the warmest part of the food storage compartment. Open display refrigerators shall include a thermometer and instructions for installing the thermometer in the warmest part of the food storage compartment, as determined by the manufacturer.

9.12.3 Temperature-indicating devices shall be removable.

9.12.4 Temperature-indicating devices shall be accurate to ± 2 °F (± 1 °C) and shall be graduated in increments no greater than 2 °F (1 °C) in the intended range of compartment temperatures.

9.13 Equipment labeling and literature requirements

9.13.1 Beverage coolers shall have a permanently attached label that states: "This equipment is intended for the storage and display of non-potentially-hazardous bottled or canned products only." The label shall be clearly visible to the user after installation of the equipment. This statement shall also appear in the product literature and the product manual.

9.13.2 Type I display refrigerators shall have a permanent label indicating that the equipment is intended for use in an area where the environmental conditions are controlled and maintained so that the ambient temperature typically does not exceed 75 °F (24 °C).

Type II display refrigerators shall have a permanent label indicating that the equipment is intended for use in an area where the environmental conditions are controlled and maintained so that the ambient temperature typically does not exceed 80 °F (27 °C).

Display refrigerators tested in accordance with 6.10.2 shall have a label indicating that the equipment is for use in ambient temperatures not exceeding 86 °F (30 °C).

Display refrigerators that contain a refrigerated buffet section or refrigerated food preparation section shall be exempt from 7.2.1.
9.13.3 Display refrigerators intended solely for the display of foods that are not potentially hazardous shall have a permanently attached label that states: “This display refrigerator is not for the display of potentially hazardous foods.” The label shall be clearly visible to the user after installation of the equipment.

9.13.4 Display refrigerators with automatic lockout shall have a permanently attached label that states “Evaluated and tested for automatic lockout per NSF/ANSI Standard 7”. The label shall be clearly visible to the user after installation of the equipment.

9.13.5 Display refrigerators shall have the maximum load level clearly marked on the unit or indicated in the operating instructions.

9.13.6 The manufacturer of a display refrigerator shall provide written instructions that include the following:
   — electrical requirements;
   — installation procedures that address setting, pull-up, trimming, assembly, wiring, and special procedures such as properly ventilating the backs of units under special conditions;
   — operational data such as control settings, checking methods, and typical temperatures; and
   — maintenance procedures.

9.13.7 The manufacturer of a remote refrigerator shall specify the load requirements BTU/hr (kW/hr) and the applicable evaporator temperature for each unit at its test condition.

9.14 Performance

9.14.1 Performance requirement

Display refrigerators shall be capable of maintaining a product temperature of 41 °F (5 °C) or lower when tested in accordance with 9.14.2. This requirement shall not apply to display refrigerators that are not intended for the display of potentially hazardous foods and that are labeled in accordance with 9.13.3. This requirement shall not apply to display freezers.

Display refrigerators that conform to the performance requirements for storage refrigerators in 6.10 shall be considered acceptable in meeting this requirement.

A storage compartment in a Type I or Type II display refrigerator shall be tested in accordance with 6.10 with the ambient conditions described in 9.14.2. Compressor run time requirements shall not apply.

A refrigerated buffet section or refrigerated food preparation section in a Type I or Type II display refrigerator shall be tested in accordance with 7.5 with the ambient conditions described in 9.14.2. Compressor run time requirements shall not apply.

NOTE — This test is not required for remote refrigerators not supplied with refrigeration or beverage coolers labeled in accordance with 9.13.1.

9.14.2 Test method

The temperature performance of display refrigerators shall be evaluated in accordance with ANSI/ASHRAE 72 except that the temperature at each thermocouple location shall be recorded at 5-min intervals over a period of 24 h, and the ambient test conditions shall be maintained as described below.

Display refrigerators shall be classified and tested according to the environmental conditions under which they are intended to be used. The classification shall be as follows:
— Type I display refrigerator: A display refrigerator intended for use in an area where the environmental conditions are controlled and maintained so that the ambient temperature typically does not exceed 75 °F (24 °C).

— Type II display refrigerator: A display refrigerator intended for use in an area where the environmental conditions are controlled and maintained so that the ambient temperature typically does not exceed 80 °F (27 °C).

Type I display refrigerators shall be tested under the ambient conditions described in Section 4 of ASHRAE 72. Type II display refrigerators shall be tested under the ambient conditions described in Section 4 of ASHRAE 72 except that the test-room dry-bulb temperature shall be 80 ± 2 °F (27 ± 1 °C) and the test-room wet-bulb temperature shall be 68 ± 2 °F (20 ± 1 °C).

The average temperature and the maximum test package temperature shall be determined for each test package.

9.14.3 Acceptance criteria

The average temperature of each test package shall not exceed 41 °F (5 °C).

At no point during the test shall any test package temperature exceed 43 °F (6 °C).

9.15 Performance - temperature recovery test

The performance requirements in this section apply only to display refrigerators with automatic lockout.

9.15.1 Performance requirement

Display refrigerators with automatic lockout shall require no more than 30 min to restore the air temperature in its food storage compartment to 41 °F (5 °C) or below after having its door open for 15 min.

9.15.2 Test method

An "open door" test shall be conducted to evaluate the ability of display refrigerators with automatic lockout to restore the food storage compartment air temperature to 41 °F (5 °C) or below within 30 min after having its door open for 15 min. The test shall be conducted under no-load conditions. The test shall be conducted in a test chamber in which the following conditions are maintained at the start of the test:

— ambient air temperature of 73 ± 4 °F (23 ± 2 °C); and
— no vertical temperature gradient exceeding 1.5 °F per ft (2.5 °C per m).

Air temperatures within each empty refrigerated compartment shall be monitored using remote temperature-sensing devices (thermocouples) accurate to ± 1 °F (0.5 °C). The thermocouples shall be positioned as close as possible to the following locations:

**Thermocouple #1:** (when facing the front of the unit) 5.0 ± 0.25 in (130 ± 6.4 mm) from the left interior wall, 2.0 ± 0.25 in (50 mm ± 6.4 mm) above the bottom horizontal plane of the overhead cooling unit, (for units in which the evaporator is not suspended from the ceiling, the thermocouple shall be placed 5.0 ± 0.25 in [130 ± 6.4 mm] down from the ceiling) and centered front-to-back.

**Thermocouple #2:** centered front-to-back, centered top-to-bottom, centered left-to-right.

**Thermocouple #3:** (when facing the unit) 5.0 ± 0.25 in (130 ± 6.4 mm) from the right interior wall, 5.0 ± 0.25 in (130 ± 6.4 mm) above the internal floor of the unit, and centered front-to-back.
The thermocouples shall be in thermal contact with the center of a 1.6-oz (45-g) cylindrical brass slug with a diameter and height of ¾ in (0.75 in, 19 mm). The brass slugs shall be placed at least ½ in (0.50 in, 13 mm) from any heat-conducting surface.

The air temperature in the food storage compartment shall be allowed to stabilize at 41 °F (5 °C) or below before the test is started.

The door to the food storage compartment shall be opened and shall remain open for 15 ± 0.5 min before being closed. The air temperature at each thermocouple location shall be recorded at 1-min intervals for 30 min.

9.15.3 Acceptance criteria

At the end of the 30-min recovery period, the air temperature at each thermocouple location shall not exceed 41°F (5 °C).

9.16 Performance - automatic lockout

The performance requirements in this section apply only to display refrigerators with automatic lockout.

9.16.1 Performance requirement

The automatic door lock shall activate if the air temperature in the food storage compartment is greater than 41 °F (5 °C) for more than 30 min. This requirement does not apply during the 30-min recovery period immediately following filling or servicing.

9.16.2 Test method

An abnormal operation test shall be conducted on display refrigerators with automatic lockout. This test will verify that the automatic door lock will activate when the air temperature of the food storage compartment is greater than 41 °F (5 °C) for more than 30 min. The test shall be conducted under no-load conditions. The tests shall be conducted in a test chamber in which the following conditions are maintained at the start of the test:

- ambient air temperature of $73 ± 4 \, ^\circ F (23 ± 2 \, ^\circ C)$; and
- no vertical temperature gradient exceeding $1.5 \, ^\circ F \, \text{per ft} (2.5 \, ^\circ C \, \text{per m})$.

Air temperatures within each empty refrigerated compartment shall be monitored using remote temperature-sensing devices (thermocouples) accurate to ± 1 °F (0.5 °C). The thermocouples shall be positioned as close as possible to the following locations:

**Thermocouple #1**: (when facing the front of the unit) 5.0 ± 0.25 in (130 ± 6.4 mm) from the left interior wall, 2.0 ± 0.25 in (50 mm ± 6.4 mm) above the bottom horizontal plane of the overhead cooling unit, (for units in which the evaporator is not suspended from the ceiling, the thermocouple shall be placed 5.0 ± 0.25 in [130 ± 6.4 mm] down from the ceiling) and centered front-to-back.

**Thermocouple #2**: centered front-to-back, centered top-to-bottom, centered left-to-right.

**Thermocouple #3**: (when facing the unit) 5.0 ± 0.25 in (130 ± 6.4 mm) from the right interior wall, 5.0 ± 0.25 in (130 ± 6.4 mm) above the internal floor of the unit, and centered front-to-back.

The thermocouples shall be in thermal contact with the center of a 1.6-oz (45-g) cylindrical brass slug with a diameter and height of ¾ in (0.75 in, 19 mm). The brass slugs shall be placed at least ½ in (0.50 in, 13 mm) from any heat-conducting surface.
The air temperature in the food storage compartment shall be allowed to stabilize at 41 °F (5 °C) or below before the test is started.

The power to the unit shall be interrupted, causing shut down. The air temperature in the food storage compartment shall be monitored. When the temperature of the food storage compartment exceeds 41 °F (5 °C) for 30 min +/- 30 seconds, an immediate attempt shall be made to open the door.

9.16.3 Acceptance criteria

The door shall not open after the compartment temperature exceeds 41 °F (5 °C) for 30 min +/- 30 seconds.

10 Rapid pull-down refrigerators and freezers

This section contains requirements for rapid pull-down refrigerators and freezers, which shall also meet the requirements of 4 and 5. Food storage compartments shall meet food zone material requirements of 4 and splash zone design and construction requirements of 5 and 10.

10.1 Internal angles and corners

10.1.1 Internal angles or corners of less than 135° in a food zone shall be smooth and shall have minimum continuous radii of ¼ in (0.25 in, 6.4 mm). The following internal angles are exempt from this requirement:

- angles formed by the ceiling and side walls of the interior liner of refrigerators and freezers; and
- angles formed where an evaporator is mounted to the interior liner of refrigerators and freezers.

Internal angles of less than 135° formed on the underside of roll-type covers, tilt-type covers, and similar-type covers for a food zone shall be smooth. The radius shall not be less than ⅛ in (0.13 in, 3.2 mm).

10.1.2 Solder and other fillet material shall not be used to effect the required minimum radius of an internal angle except at the intersection of the door mullion and the interior liner of refrigerated cabinets and on the underside of roll-type covers.

10.2 Refrigeration and cooling components

10.2.1 Refrigeration components shall be accessible for necessary cleaning and maintenance.

10.2.2 Evaporator coils and refrigerant tubing shall not be in direct contact with food contact surfaces and shall be installed so that condensate will not contact food or insulation.

10.2.3 If exposed to potential food splash or spillage, refrigeration coils shall be of finless design or shall be enclosed in a housing to protect them from being soiled. Their design shall provide for the drainage of condensate.

10.2.4 Air recirculation ducts outside the food zone shall be totally enclosed and protected from splash, spillage, and other contamination. Materials shall conform to splash zone materials requirements. Air ducts in the food zone shall conform to food zone requirements.

10.2.5 Evaporator drain pans shall be at least ½ in (0.50 in, 13 mm) deep and shall be accessible for cleaning. Drain connections to the evaporator drain pan shall not prevent the pan from being accessible for cleaning.

10.2.6 Upon installation, evaporator housings shall be sealed to the interior liner of the equipment or shall be located so that the space between the evaporator and the liner is readily accessible for cleaning.
10.2.6.1 Coil sections shall be either:

— accessible for cleaning; or

— designed to facilitate cleaning manually, or by flushing with water or other appropriate liquid in accordance with the manufacturer’s cleaning instructions.

10.2.7 Evaporator grills and interior panels having air discharge and return openings shall be removable. To facilitate cleaning upon removal, egg crate-type grills and honeycomb-type materials used in a food zone for air return and discharge shall not exceed 24 in (61 cm) in any dimension.

10.3 Temperature-indicating devices (thermometers)

10.3.1 Temperature-indicating devices, if used, shall be removable.

10.3.2 Temperature-indicating devices shall be accurate to ± 2 °F (± 1 °C) and shall be graduated in increments no greater than 2 °F (1 °C) in the intended range of compartment temperatures.

10.4 Equipment labeling and literature requirements

10.4.1 The manufacturer of a remote refrigerator shall specify the load requirements BTU/hr (kW/hr) and the applicable evaporator temperature for each unit at its test condition.

10.4.2 Rapid pull-down refrigerators and freezers shall have a permanently attached label that states: “This unit is capable of reducing the internal temperature of the contents from 135 °F (57 °C) to 40°F (4 °C) within 4 hours.” The label shall be clearly visible to the user after installation of the equipment.

10.5 Performance

10.5.1 Performance requirement

Rapid pull-down refrigerators and freezers shall be capable of reducing the internal temperature of their contents from 135 °F (60 °C) to 40 °F (4 °C) within a period of 4 h or in the time specified by the manufacturer, whichever is less.

10.5.2 Test method

A test shall be conducted to evaluate the ability of a rapid pull-down refrigerator or freezer to cool a food simulating test medium rapidly while operating with its door(s) closed. The test shall be conducted within a test chamber maintained under the following conditions for the duration of the test:

— ambient temperature of 100 ± 3 °F (38 ± 2 °C); and

— no vertical temperature gradient exceeding 1.5 °F/ft (2.5 °C/m).

Before the unit is loaded with test media, the unit shall be allowed to establish the starting internal compartment air temperature recommended by the manufacturer while operating at the ambient test conditions. The unit shall then be loaded with pans of test media (Annex A, section A.2) to the maximum capacity recommended by the manufacturer. All pans shall remain covered for the duration of the test. Thermocouples having accuracies of ± 1 °F (± 0.5 °C) shall be placed in the geometric center of each of the three test media pans (one pan at the top of the compartment, one pan at the center, and one pan at the bottom). The media temperature in each pan shall be recorded at 5-min intervals starting at the point at which the media in each pan reaches 135 °F (60 °C). The media temperature in each pan shall be

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11 This test method does not apply to prefabricated walk-in and roll-in rapid pull-down refrigerators or remote refrigerators not supplied with refrigeration. Adequate performance of these units, in accordance with 10, shall be ensured through the proper determination of refrigeration equipment demands.
recorded over a test duration of 4 h or the minimum cooling time claimed by the manufacturer, whichever is less.

10.5.3 Acceptance criteria

The product temperature recorded at the end of the test duration for each thermocouple location shall be 40 °F (4 °C) or lower.
Figure 1 – External corners or angles

Inverted hat channel bracing

Ends must be closed

Channel bracing

Angle bracing

Figure 2 – Reinforcing and framing members under tops and shelving
Channel sections shall be shallow and wide enough to be easily cleanable, with cleanout holes.

Figure 3 – Single panel door

Figure 4 – Glass doors
Corner or flange notched to permit cleaning or closed tight

Sectional removable false bottoms

Figure 5 – Openings and rims – food zone

Figure 6 – Perforated false bottom
When $X$ exceeds $Y$ by $\frac{1}{2}$ in (0.50 in, 13 mm) or greater then $Z$ must be 1.0 in (25 mm) below the leg at the minimum adjustment.

**Figure 7a – Example of leg and foot**

Leg must be closed against underside of the top

**Channel bracing**

**Figure 7b – Legs and feet**

**Space to facilitate cleaning**
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Annex A
(normative)

Procedures for the preparation of refrigeration performance test media

A.1 Open-top refrigeration test medium

The following procedure shall be used to prepare the pans of medium used in the evaluation of the temperature performance of open-top refrigeration equipment in accordance with 7.5. This procedure will make approximately 4.75 gal (18 L) of medium.

a) Dissolve 93 g sodium chloride into 1.59 gal (6.0 L) deionized water in a stainless steel kettle. Apply heat and maintain solution temperature between 176°F (80°C) and 194°F (90°C).

b) Slowly add 558 g hydroxypropyl methylcellulose (METHOCEL® 12 K4M [standard grade] or equivalent) to the salt solution while stirring with a paddle or large spoon. Using an electric hand mixer, disperse any lumps that form.

c) When all the hydroxypropyl methylcellulose is dispersed, slowly add 3.33 gal (12.6 L) cold deionized water to the suspension and stir until the mixture appears smooth and homogeneous.

d) Immediately pour the mixture into the pans to be used for testing. Standard half-size hotel pans (4 in [100 mm] deep) shall be used unless the equipment being evaluated is specifically and permanently designed to hold alternate size pans. Stainless steel pans shall be used unless otherwise specified by the manufacturer. Fill each pan to approximately ½ in (0.50 in, 13 mm) below the rim of the pan. If the pans are to be used in a tilted rail, fill each pan so that the medium at the bottom of the tilt is approximately ½ in (0.50 in, 13 mm) below the rim. Cover each pan. Refrigerate and maintain a medium temperature of 35 ± 2 °F (2 ± 1 °C) until loading of the test unit begins.

A.2 Rapid pull-down refrigeration test medium

The following procedure shall be used to prepare the pans of medium used in the evaluation of the temperature performance of rapid pull-down refrigerators in accordance with 10.5.

a) Prepare a 20% (v/v) propylene glycol (1,2-Propanediol) mixture in water.

b) In a large vat, pour the propylene glycol mixture over pine sawdust and mix until the sawdust becomes completely saturated.

c) Portion the saturated sawdust mixture into the pans to be used during testing. The size and type of pans used and quantity of sawdust mixture in each pan shall be in accordance with the manufacturer’s recommendation.

d) Cover each pan and apply heat for a minimum of 24 h and maintain a media temperature of at least 140 °F (60 °C) up to the start of the test. Pour off any excess liquid prior to the start of the test.

12 Dow Chemical, Midland, MI
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The requirements established in this Standard are intended to be consistent with the Food Code, 2005 recommendations of the U. S. Public Health Service, Food and Drug Administration.
### Annex C\(^1\)

#### (informative)

**Food Equipment Joint Committee**\(^2\)

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**Standards Development Liaison:** Al Rose

**Membership Balance:**
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- Regulatory: 10
- User: 10

\(^1\)Committee or task group chair

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\(^1\) The information contained in this annex is not part of the American National Standard (ANS) and has not been processed in accordance with ANSI’s requirements for ANS. As such, this annex may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.

\(^2\)Food Equipment Joint Committee members on the date of publication - subject to change 11/11/2016
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16 The information contained in this Standards page is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI’s requirements for an ANS. Therefore, this Standards page may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.
THE HOPE OF MANKIND rests in the ability of man to define and seek out the environment which will permit him to live with fellow creatures of the earth, in health, in peace, and in mutual respect.