



*NSF International Standard /
American National Standard*

NSF/ANSI 4 - 2016

Commercial Cooking,
Rethermalization, and Powered
Hot Food Holding and
Transportation Equipment



NSF International, an independent, not-for-profit, non-governmental organization, is dedicated to being the leading global provider of public health and safety-based risk management solutions while serving the interests of all stakeholders.

*This Standard is subject to revision.
Contact NSF to confirm this revision is current.*

Users of this Standard may request clarifications and interpretations, or propose revisions by contacting:

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>

NSF International Standard/
American National Standard
for Food Equipment —

**Commercial cooking, rethermalization,
and powered hot food holding
and transport equipment**

Standard Developer

NSF International

NSF International

Designated as a ANSI Standard

April 14, 2016

American National Standards Institute

Prepared by
The NSF Joint Committee on Food Equipment

Recommended for adoption by
The NSF Council of Public Health Consultants

Adopted by
The NSF Board of Directors
August 1958

Revised July 1967
Revised August 1968
Revised April 1970
Revised July 1971
Revised April 1973
Revised June 1986
Revised May 1992
Revised May 1996
Revised March 1997
Revised May 1999
Revised November 2000

Revised March 2002
Revised October 2005
Editorial revision November 2005
Revised February 2006
Editorial revision May 2006
Revised April 2007
Editorial revision May 2007
Revised April 2009
Addendum November 2009
Revised October 2014
Revised November 2016

Published by

NSF International
PO Box 130140, Ann Arbor, Michigan 48113-0140, USA

For ordering copies or for making inquiries with regard to this Standard, please reference the designation “NSF/ANSI 4 – 2016.”

Copyright 2016 NSF International

Previous Editions ©2014, 2009, 2007, 2006, 2005, 2002, 2000, 1999, 1997, 1996, 1992, 1986, 1973, 1971, 1970, 1968, 1967, and 1958

Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from NSF International.

Printed in the United States of America.

Disclaimers¹

NSF, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of NSF represent its professional judgment. NSF shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. NSF shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

NSF Standards provide basic criteria to promote sanitation and protection of the public health. Provisions for mechanical and electrical safety have not been included in this Standard because governmental agencies or other national standards-setting organizations provide safety requirements.

Participation in NSF Standards development activities by regulatory agency representatives (federal, local, state) shall not constitute their agency's endorsement of NSF or any of its Standards.

Preference is given to the use of performance criteria measurable by examination or testing in NSF Standards development when such performance criteria may reasonably be used in lieu of design, materials, or construction criteria.

The illustrations, if provided, are intended to assist in understanding their adjacent standard requirements. However, the illustrations may not include **all** requirements for a specific product or unit, nor do they show the only method of fabricating such arrangements. Such partial drawings shall not be used to justify improper or incomplete design and construction.

Unless otherwise referenced, the “normative” annexes are not considered an integral part of NSF Standards. The annexes are provided as general guidelines to the manufacturer, regulatory agency, user, or certifying organization.

¹ The information contained in this Disclaimer 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 Disclaimer 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.

This page is intentionally left blank.

Contents

1	General	1
1.1	Purpose	1
1.2	Scope	1
1.3	Alternative materials, design, and construction	1
1.4	Measurement	1
2	Normative references	2
3	Definitions	3
4	Materials	3
4.1	Conformance with NSF/ANSI 51	3
4.2	Solder	4
4.3	Gaskets	4
4.4	Fryer and steam cooker baskets	4
4.5	Fat/oil fryers and filters	4
4.6	Brick	4
5	Design and construction	4
5.1	General sanitation	5
5.2	Internal angles and corners	5
5.3	External angles and corners	6
5.4	Joints and seams	6
5.5	Fasteners	6
5.6	Insulation	7
5.7	Reinforcing and framing	7
5.8	Inspection and maintenance panels	7
5.9	Doors	7
5.10	Door tracks and guides	8
5.11	Door closers, handles, knobs, and pulls	8
5.12	Hinges	8
5.13	Covers	9
5.14	Edges and nosings	9
5.15	Openings into food zones	10
5.16	Louvers	10
5.17	Hardware	10
5.18	Latches and catches	10
5.19	Breaker strips	10
5.20	Equipment mounting	10
5.21	Legs and feet	11
5.22	Casters, rollers, and gliders	11
5.23	Shelving	11
5.24	Pipe chases	12
5.25	Enclosed spaces	12
5.26	Drawers	12
5.27	Insets	12
5.28	Food shields	12
5.29	Breakable glass components	12
5.30	Light fixtures	13
5.31	Plumbing connections	13
5.32	Grease receptacles	14
5.33	Fry top ranges and griddles	14
5.34	Open top ranges	14
5.35	Ovens	14
5.36	Reel-type ovens (revolving tray ovens)	14
5.37	Broilers, rotisseries and salamanders	15
5.38	Fat/oil fryers and fat/oil filters	15
5.39	Entry ports	15
5.40	Cappuccino machines with milk reservoirs	15
5.41	Coffee urns	16
5.42	Jacketed kettles and urns	16
5.43	Steam tables and bains-marie	16

5.44	Popcorn cabinets	16
5.45	Hot food holding and hot food transport equipment	16
5.46	Proofing boxes and proofing cabinets	17
5.47	Rethermalization equipment	17
5.48	Food warming equipment	17
6	Performance	17
7	Food equipment provided with a security package	24
8	Product literature	25
Annex A	.....	A1
Annex B	.....	B1
Annex C	.....	C1
Annex D	.....	D1
Annex E	.....	E1

Foreword²

The purpose of this Standard is to establish minimum food protection and sanitation requirements for the materials, design, construction and performance of commercial cooking, rethermalization, and powered hot food holding and transport equipment.

This Standard uses inch-pound units as the primary units with SI (metric) units provided in parentheses for informational purposes. The Joint Committee carried a motion that this convention be adopted in future revisions to this Standard. The SI units provided in parentheses generally represent a hard conversion of the inch-pound units, meaning that the SI value may have been rounded to provide a reasonable and measurable dimension.

This version of NSF/ANSI 4 – 2016 includes the following revisions:

Issue 18:

This issue added new language for Sections 5 and 8 regarding floorless heating compartments. In addition, this ballot proposes the addition of informative Annex D, *Flooring Recommendations for Proofers and Ovens Constructed Without Floors*.

Issue 23:

Section 4.6, regarding Beverage equipment was removed as it is now superseded by the requirement in NSF/ANSI 51 – 2014

Issue 24:

Language was added to the test method in sections 6.2.2.1 and 6.7.2.1 covering open top hot food holding equipment and open heated merchandisers.

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 at standards@nsf.org, or c/o NSF International, Standards Department, P.O. Box 130140, Ann Arbor, Michigan, 48113-0140, USA.

² The information contained in this Disclaimer 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 Disclaimer 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.

This page is intentionally left blank.

NSF/ANSI International Standard for Food Equipment —

Commercial cooking, rethermalization, and powered hot food holding and transport equipment

1 General

1.1 Purpose

This Standard establishes minimum food protection and sanitation requirements for the materials, design, construction, and performance of commercial cooking, rethermalization, and hot food holding and transport equipment and their related components. This Standard does not contain safety requirements.

1.2 Scope

Equipment covered by this Standard includes, but is not limited to, ranges, ovens, fat/oil fryers, fat/oil filters, griddles, tilting griddle skillets, broilers, steam and pressure cookers, kettles, rotisseries, toasters, coffee makers and other hot beverage makers, component water heating equipment, proofing boxes and cabinets, hot food holding equipment, rethermalization equipment, and hot food transport cabinets.

Section 7 of this Standard pertains to food handling and processing equipment that has been designed and manufactured for special use purposes. Food equipment designed and manufactured with a security package is utilized in environments such as correctional facilities, mental health facilities, or some schools. For these environments, where both sanitation and security are concerns, 7 contains exceptions to this Standard that shall only be applicable to the splash and non-food zones of food equipment provided with a security package.

Equipment components and materials covered under other NSF or NSF/ANSI Standards or Criteria shall also comply with 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 Alternative 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 intent of the applicable requirements herein.

1.4 Measurement

Decimal and SI conversions provided parenthetically shall be considered equivalent. Metric conversions and significant figure rounding 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 recent editions of the documents indicated below. The most recent published edition of the document shall be used for undated references.

40 CFR § 180.940, *Tolerance exemptions for active and inert ingredients for use in antimicrobial formulations (Food-Contact Surface Sanitizing Solutions)*³

ANSI Z97.1 – 2009, *Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test*⁴

ANSI/ASSE 1001 – 2008, *Atmospheric Type Vacuum Breakers*⁵

ANSI/ASSE 1020 – 2004, *Pressure Vacuum Breaker Assembly*⁴

ANSI/ASSE 1022 – 2003, *Backflow Preventer for Beverage Dispensing Equipment*⁴

ANSI/ASSE 1024 – 2004, *Dual Check Backflow Preventers*⁴

ANSI/UL 197 – 2004, *Standard for Commercial Electric Cooking Appliances*⁶

APHA, *Standard Methods for the Examination of Water and Wastewater*, 21st edition⁷

ASSE 1032 – 2004, *Dual Check Valve Type Backflow Preventers for Carbonated Beverage Dispensers – Post Mix Type*⁴

BS857:1967, *Specification for safety glass for land transport*⁸

IAPMO – *Uniform Plumbing Code* 2009⁹

ICC – *International Plumbing Code* 2009¹⁰

IEEE/ASTM SI 10 – 2010, *American National Standard for Metric Practice*¹¹

NSF/ANSI 18, *Manual food and beverage dispensing equipment*

NSF/ANSI 51, *Food equipment materials*

³ U. S. Government Printing Office, Washington, DC 20402 www.gpo.gov

⁴ American National Standards Institute, 25 West 43rd Street, New York, NY 10036 www.ansi.org

⁵ ASSE International Office, 901 Canterbury, Suite A, Westlake, OH 44145 www.asse.org

⁶ Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062 www.ul.com

⁷ American Public Health Association, 800 I Street NW, Washington, DC 20001 www.apha.org

⁸ British Standard, 389 Chiswick High Road, London W4 4AL United Kingdom www.bsi-global.com

⁹ International Association of Plumbing and Mechanical Officials (IAPMO), 5001 E. Philadelphia St., Ontario, CA 91761 www.iapmo.org

¹⁰ International Code Council (ICC), 5203 Leesburg Pike, Suite 600; Falls Church, VA 22041 www.iccsafe.org

¹¹ ASTM International, 100 Barr Harbor Dr., West Conshohocken, PA 19428 www.astm.org

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

The requirements contained in this section are intended to protect food from contamination and ensure that the materials used in the manufacture of commercial cooking, rethermalization, and powered hot food holding and transport equipment resist wear, penetration by vermin, and the effects of foods, heat, cleaning compounds, sanitizers, and other substances that may contact the materials in the intended use environment. Materials used in unexposed non-food zone areas shall be exempt from all requirements in 4.

4.1 Conformance with NSF/ANSI 51

4.1.1 Except as noted in 4.1.2, 4.1.3, and 4.1.4, materials shall conform to the requirements in NSF/ANSI 51 applicable to the zone in which the material is used.

4.1.2 Oven interiors: Oven interiors shall be nontoxic; corrosion-resistant metal; metal treated with a heat-resistant coating; or another nontoxic, corrosion-resistant, and cleanable material. The use of refractory concrete and other high-temperature ceramic materials, including fire brick, shall be limited to the following:

- Oven decks whose direct contact with food is restricted to pizza and bread products only. The oven may be used for cooking other types of food, provided that the food is cooked in or on pans or other containers to prevent spillage onto the oven deck.
- Interior surfaces (including walls, ceilings, and decks) of ovens intended for cooking pizza and bread products only. The oven shall have a permanent, heat-resistant label stating that its use is restricted to cooking pizza and bread products only. The label shall be clearly visible to the user after installation of the equipment.
- Interior surfaces (including walls, ceilings, and decks) of pyrolytic self-cleaning hearth ovens meeting the performance test requirements of 6.5, whose direct contact with food is restricted to pizza and bread products only. The oven may be used for cooking other types of food, provided that the food is cooked in or on pans or other containers to prevent spillage onto the oven deck. Manufacturers shall provide instructions for pyrolytic oven cleaning procedures in the operation manual.
- Oven decks and interiors may be constructed of asbestos cement if the asbestos cement is able to meet the abrasion resistance criteria of 6.6.

4.1.3 Materials that are not corrosion resistant may be used for the following applications:

- surfaces on fat/oil fryers and fat/oil filtration systems continually wetted by fat or oil during normal operation, including fryer bowl aprons and surrounding areas;
- the tops of hot-top ranges and griddles;
- cooking grates;
- burners and heating elements;
- splash guards on griddles;

- spreader plates; and
- supports located between a cooking surface and a burner.

4.1.4 Heated metal components used exclusively to generate steam by means of contact with potable water are not required to be corrosion resistant, provided that the components are not located in a food zone or splash zone and that any corrosion products are diverted to a drain.

4.1.5 Fluoropolymer coatings, such as polytetrafluoroethylene, may be used in a heated food zone provided that the substrate material conforms to the food zone material requirements in NSF/ANSI 51.

4.2 Solder

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

4.3 Gaskets

Gaskets shall be made of resilient rubber, rubber-like materials, or plastics. Gasket materials shall conform to NSF/ANSI 51 and shall function at any temperature to which they are exposed in normal operation. Oven gaskets may be made of woven fiberglass or similar materials that conform to NSF/ANSI 51.

4.4 Fryer and steam cooker baskets

Baskets on fat/oil fryers and steam cookers shall be constructed of stainless steel or metallic-coated steel conforming to the food zone material requirements in NSF/ANSI 51. Tin coatings, if used, shall be at least 95% pure tin.

4.5 Fat/oil fryers and filters

4.5.1 Materials used for the drain valves and piping of fat/oil fryers shall conform to the food zone requirements of NSF/ANSI 51.

4.5.2 The interiors of enclosure cabinets for fat/oil filters shall conform to the food zone materials requirements of NSF/ANSI 51, unless the filter is equipped with a protective cover. If a protective cover is provided, non-food zone material requirements shall apply to the cabinet interior.

4.5.3 Filter paper and filter aids for fat/oil filters shall not be required to be easily cleanable. Absorbent materials may be used.

4.6 Brick

Construction brick and similar uncleanable materials shall not be used except as permitted in 4.1.2. The use of fire brick is acceptable only on surfaces located behind or below cooking surfaces. Fire brick shall not be used on surfaces intended for direct food contact.

5 Design and construction

Unless otherwise specified, the interiors of heated compartments, such as those in ovens, steam cookers, pressure cookers, proofing cabinets, rethermalization equipment, hot food transport cabinets, and hot food holding cabinets, shall conform to the splash zone design and construction requirements of this Standard. Food zone material requirements shall apply.

NOTE — For floorless walk-in or roll-in equipment, food zone material requirements shall not apply to the floor.

5.1 General sanitation

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

5.1.2 Equipment shall be designed and manufactured so that food may be added, processed, finished, dispensed, removed, and/or served in a sanitary manner.

5.1.3 Food zones shall be readily accessible and easily cleanable or shall be designed for in-place cleaning when a readily accessible design is not feasible.

5.1.4 Food zones for which in-place cleaning is intended shall be designed and manufactured so that cleaning and sanitizing solutions may be circulated or passed throughout the fixed system. The design shall ensure that cleaning and sanitizing solutions contact all food contact surfaces. The system shall be self-draining or capable of being completely evacuated. Equipment and appurtenances designed for in-place cleaning shall have a section of the cleaned area accessible for inspection or shall provide for other acceptable inspection methods. The manufacturer shall provide written instructions for the cleaning and sanitizing of all food zone surfaces for which in-place cleaning is intended. The type and concentration of sanitizing agent recommended in the instructions by the manufacturer shall comply with 40 CFR, section 180.940.

NOTE — In-place cleaning procedures are not required for fat/oil filter systems that circulate filtered fat or oil throughout the fixed system.

5.1.5 Splash zone surfaces shall be accessible and easily cleanable.

5.1.6 Non-food zone surfaces shall be accessible and cleanable.

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

5.2 Internal angles and corners

5.2.1 Internal corners or angles of less than 135° in a food zone shall be smooth and have minimum continuous radii of $\frac{1}{8}$ in (0.13 in, 3.2 mm).

5.2.1.1 Internal angles on heated food zones that reach 180 °F (82 °C) or more during normal operation shall be exempt from the food zone radius requirement. This exemption applies to, but is not limited to, the following equipment:

- fat fryer/oil containers and filters (including filter screens);
- fat/oil fryer baskets;
- steam cooker baskets;
- griddles;
- broiler and salamander grates;
- coffee makers;
- pasta cookers; and
- hot water urns and similar equipment whose food contact is limited to hot water only.

5.2.1.2 Lesser radii may be used where necessary to ensure the proper functioning of parts (e.g., sealing ring grooves or precision operating parts) provided that they are easily cleanable.

5.2.1.3 Greater radii shall be provided where necessary to ensure adequate cleaning, product flow, and maintenance.

5.2.2 Solder and other fillet materials shall not be used to effect a required minimum radius of an internal angle. Solder may be used to effect the radius on internal angles on the underside of roll-type covers.

5.3 External angles and corners

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

5.4 Joints and seams

5.4.1 Permanent joints and seams in a food zone or splash zone shall be sealed and smooth. This requirement shall not apply to:

- oven interiors;
- tight-fitting seams formed by assembling working surfaces of fry top ranges and griddles; or
- fat/oil filter screens.

This requirement shall not apply to hot food transport cabinets provided that:

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

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

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

5.4.4 Sealants shall only be used to seal joints and seams that are structurally sound and are less than $\frac{1}{8}$ in (0.13 in, 3.2 mm) wide before sealing. Sealants may be used to fill spaces around collars, grommets, and service connections.

5.4.5 Solder and other fillet material shall be securely bonded to its substrate. All flux and catalytic materials shall be removed.

5.4.6 Equipment shall be designed and manufactured so that field joints may be made sanitary with the use of trim strips, welding, soldering, properly designed draw fastening, or other appropriate methods.

5.4.7 Walk-in or roll-in equipment without prefabricated floors shall be designed and manufactured so that the seams formed between the walls and floor or base may be closed and sealed upon assembly of the equipment.

5.5 Fasteners

5.5.1 Fasteners shall not be used in a food zone except as permitted in 5.5.6.

5.5.2 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 non flush-break pop rivets may be used in a splash zone or a non-food zone provided that the heads are capped or filled.

5.5.3 Fasteners shall be tight fitting to the surface except as permitted in 5.5.4.

5.5.4 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.

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

5.5.6 Fasteners shall not be used in a food zone, except in the following applications:

- drain valve systems, thermostat bulbs, heating element supports, and lids on fat/oil fryers and fat/oil filters; and
- coffee urns; and
- to attach handles to lids.

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 nonfood zone. Exposed threads on electrical cord strain relief devices in a nonfood zone shall be exempt.

NOTE — There may be exposed threads in a food zone or splash zone on: (1) drain valve systems, thermostat bulbs, heating element supports, and lids on fat/oil fryers and fat/oil filters; and (2) coffee urns.

5.6 Insulation

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

5.6.2 Joints and seams that may expose insulated space to condensation, spills, and seepage shall be sealed. Tight fitting, readily removable plugs complying with zone-specific material requirements may be used to seal openings to insulated spaces.

5.7 Reinforcing and framing

5.7.1 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.

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

5.7.3 Except as noted in 5.7.4, 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.

5.7.4 The requirements of 5.7.3 shall not apply to hollow sections that reach an air temperature of 212 °F (100 °C) during normal operation and are not exposed to routine splash or spillage.

5.8 Inspection and maintenance panels

Where 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.

5.9 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 4).

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 of 5.30.

5.9.5 Door gaskets

5.9.5.1 Exposed surfaces of door gaskets shall be easily cleanable. Hollow sections of door gaskets shall be sealed.

5.9.5.2 Gaskets shall be capable of being removed and reinstalled by hand or with the use of simple tools. Staples, pop rivets, nails, adhesives, and other similar items that cannot be reattached easily shall not be used to secure door gaskets.

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

5.10 Door tracks and guides

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

5.10.2 Tracks and guides shall:

- have clear open slots continuously or at intervals along their entire lengths; or
- have clean out holes at each end; or
- terminate at least ½ 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.

5.11 Door closers, handles, knobs, and pulls

5.11.1 Exposed surfaces shall meet the design and construction requirements of the zone of intended use.

5.11.2 Door closers, handles, knobs and pulls shall meet at least one of the following:

- be easily cleanable as installed on the equipment; or
- be removable for cleaning.

5.11.3 If locking features are provided, the keyway and lock are exempt from 5.11.2.

5.12 Hinges

5.12.1 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.

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

5.12.3 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).

5.12.4 Hinges on splash zone doors and covers weighing less than 80 lb (36 kg) shall conform to the requirements in 5.12.3 or to each of the following:

- the hinge pin shall be lift-off style or shall have a removable pin;
- 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).

5.12.5 Continuous hinges, including piano hinges, may be used on the exterior front corners and exterior side panels of powered hot food transport cabinets.

5.12.6 Continuous hinges, including piano hinges, may be used on microwave ovens.

5.13 Covers

5.13.1 Covers protecting a food zone shall overlap the opening and shall be sloped to provide drainage from the cover surface. Inset covers for stackable pans are exempt from the slope requirement. Areas of handles and knobs of covers are not required to be sloped.

5.13.2 Covers having slotted openings designed to allow serving utensils to remain in the food shall be exempt from 5.13.1. Slotted openings shall be no larger than $1\frac{1}{2} \times 1$ in (38 x 25 mm) and shall be protected by a raised rim of at least $\frac{3}{16}$ in (0.19 in, 5.0 mm).

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 5.12.

5.13.5 All surfaces on the underside and beneath covers shall be readily accessible and easily cleanable.

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

5.13.7 Hood mountings for covered pitchers shall be accessible.

5.13.8 All internal corners of roll covers, tilt covers, and other similar covers shall be more than 135° or shall have a minimum smooth radius of $\frac{1}{8}$ in (0.13 in, 3.2 mm). Solder or other fillet material may be used to provide a minimum radius on the underside of roll-type covers.

5.14 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 have a clearance of at least $\frac{3}{4}$ in (0.75 in, 19 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 in, 13 mm) and shall be angled downward at least 5° from the horizontal plane. This requirement does not apply to readily removable or knockdown shelves.

5.15 Openings into food zones

Openings into food zones shall be protected to prevent the entry of seepage, condensation, and spills. 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 liquid level (see figure 6).

5.16 Louvers

5.16.1 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.

5.16.2 If electrical safety requirements prohibit the use of readily removable louvers, then such louvers need only be removable.

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

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

5.17 Hardware

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

5.18 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.

5.19 Breaker strips

Breaker strips shall:

- be securely fastened around the entire perimeter with closed seams; 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 Equipment mounting

5.20.1 Floor-mounted equipment shall be designed and manufactured to be:

- portable;
- mobile;
- sealed to the floor;
- elevated on legs that provide a minimum unobstructed clearance beneath the unit of 6.0 in (150 mm); 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.

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

- portable;
- sealed to the counter;
- elevated on legs that provide a minimum unobstructed clearance beneath the unit of 4.0 in (100 mm);
- 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.

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

5.20.4 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.

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

5.21 Legs and feet

5.21.1 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.

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

5.21.3 If the outer dimension of a leg exceeds the outer dimension of its foot by $\frac{1}{2}$ in (0.50 in, 13 mm) or more in the same plane, then the foot shall extend 1.0 in (25 mm) below the leg at the minimum adjustment.

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

5.21.5 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.

5.22 Casters, rollers, and gliders

If used, casters, rollers, and gliders shall be easily cleanable and comply with NSF/ANSI 2.

5.23 Shelving

5.23.1 Shelving shall be easily cleanable.

5.23.2 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 4).

5.23.3 Diverting shelves intended to prevent seepage or retain splashes and spills shall have sealed corners and seams. The back and end edges shall be turned up a minimum of 1.0 in (25 mm) and the corners and seams shall be sealed. Shelf surfaces exposed to unpackaged foods shall conform to 5.2 (see figure 5).

5.23.4 The back and end edges of fixed interior shelving shall:

- be turned upward a minimum of 1.0 in (25 mm) and form a closed seam along an adjacent back or side panel;
- be spaced at least 1.0 in (25 mm) from an adjacent back or side panel; or
- form sealed seams with an adjacent back or side panel (see figure 6).

5.23.5 Support brackets and pilasters for readily removable shelving and adjustable shelving shall be readily removable or easily cleanable as installed (see figure 7).

5.24 Pipe chases

Pipe chases for gas, steam, electrical, and plumbing lines shall be constructed with removable access panels where possible. Pipe chases shall be designed to eliminate vermin harborage (see figure 8).

5.25 Enclosed spaces

Enclosed spaces shall be sealed or shall have removable access panels. Removable panels shall be provided where condensation is likely to occur within an enclosed space.

5.26 Drawers

Drawers and drawer pan assemblies shall be readily removable for cleaning except as noted below. Joints and seams between drawer pan assemblies and drawer slides shall be closed, drawer slides shall be closed, and recessed areas shall be minimized (see figure 9).

NOTE — Drawer tracks and slides need not be readily removable provided that they are easily cleanable as installed.

5.27 Insets

Insets and similar receptacles for unpackaged moist foods shall be readily removable. They shall be easily cleanable and be capable of being drained. They shall have an open-mouth type design. They shall have covers that conform to the requirements of 5.13.

5.28 Food shields

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

5.29 Breakable glass components

5.29.1 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.

5.29.2 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.

5.29.3 Glass shall conform to the requirements in NSF/ANSI 51 applicable to the zone in which the glass is used.

5.30 Light fixtures

5.30.1 Light fixtures shall meet the construction and materials requirements for the zone of intended use.

5.30.2 Glass components of light fixtures shall conform to the requirements of 5.29 of this Standard.

5.30.3 Fixtures shall allow for bulb replacement that conforms to the original lamp requirements of the fixture.

5.30.4 Vent or louvered openings on light fixtures shall conform to the requirements of 5.16. Vent or louvered openings into an otherwise closed space shall be protected with screening of not less than 16 mesh.

5.31 Plumbing connections

5.31.1 Water and waste piping and fittings attached to the equipment shall comply with the material requirements for the applicable zones.

5.31.2 Water and waste piping and connections shall comply with the International Plumbing Code 2003, International Code Council (ICC), or to the Uniform Plumbing Code 2003, International Association of Plumbing and Mechanical Officials (IAPMO).

5.31.3 Waste lines shall not drain into or through a food zone.

5.31.4 Backflow prevention

5.31.4.1 Units intended to be connected to a water supply system under pressure shall have one of the following:

- a vacuum breaker that conforms to ANSI/ASSE 1001, *Performance Requirements for Atmospheric Type Vacuum Breakers* (for intermittent pressure conditions);
- a vacuum breaker that conforms to ANSI/ASSE 1020, *Performance Requirements for Pressure Vacuum Breaker Assembly* (for continuous pressure conditions);
- a backflow prevention device that conforms to ANSI/ASSE 1022, *Performance Requirements for Backflow Preventer for Beverage Dispensing Equipment*;
- a backflow prevention device that conforms to ANSI/ASSE 1024, *Performance Requirements for Dual Check Backflow Preventers*;
- a backflow prevention device that conforms to ASSE 1032, *Performance Requirements for Dual Check Valve Type Backflow Preventers for Carbonated Beverage Dispensers – Post Mix Type*; or
- a statement in the installation instruction and on a label permanently affixed to the equipment that clearly indicates that the equipment is to be installed with adequate backflow protection to comply with applicable federal, state, and local codes.

5.31.4.2 A screen of at least 100 mesh (minimum 100 strands per inch) shall be installed immediately upstream of all check valve type backflow preventers used for water supply protection. The screen shall be accessible and removable for cleaning or replacement.

5.32 Grease receptacles

5.32.1 Grease receptacles shall be provided where grease routinely accumulates. Troughs or drains shall be provided where necessary to convey grease to the receptacle or reservoir without leakage. Troughs shall be easily cleanable.

5.32.2 Grease receptacles shall be readily removable and easily cleanable or shall be designed to be easily drained and cleaned in place.

5.32.3 A grease receptacle, or its overflow, shall be visible to the operator. Receptacles may be housed in an enclosure, provided that the enclosure is readily accessible for cleaning and is fabricated to convey or accumulate spillage where it can be readily removed.

5.33 Fry top ranges and griddles

5.33.1 Working surfaces of fry top ranges and griddles shall be of one-piece construction or in closely assembled units with tight-fitting seams.

5.33.2 Fry top ranges and griddles shall:

- have a perimeter grease trough that has an outlet to a collecting receptacle on at least one side;
- have a combination of raised sides or raised front and rear with a trough on the opposite side; or
- be otherwise designed to prevent the spillage of grease and to permit sanitary maintenance of the working surface.

A grease receptacle conforming to 5.32 shall be provided at each trough outlet.

5.34 Open top ranges

5.34.1 Areas directly under open top range burners shall be accessible.

5.34.2 To catch and retain drips and spills, an open top range shall have:

- readily accessible and easily cleanable drip tray(s) that covers the area beneath the burners; or
- a readily removable and easily cleanable bowl attached beneath each burner.

5.35 Ovens

5.35.1 Oven shelves, racks, and shelf guides shall be removable and easily cleanable or shall be easily cleanable in place.

5.35.2 Oven burners shall be accessible for inspection.

5.35.3 Oven thermometers, if provided, shall be graduated in increments of 25 °F (14 °C) or less over the intended use range. The intended use range shall start at a temperature of not less than 200 °F (93 °C). Oven thermometers shall be accurate to ± 25 °F (± 14 °C), when tested at 25% and 75% of the scale provided.

5.36 Reel-type ovens (revolving tray ovens)

5.36.1 Access doors, ports, or openings (other than loading doors) shall be provided in the oven housing so

that the entire oven interior is readily accessible.

5.36.2 Observation windows, if provided, shall be readily accessible for cleaning and constructed of heat-resistant and tempered glass.

5.36.3 Fans and agitators that are directly connected to the oven interior shall be accessible for cleaning and inspection. Openings through which food must pass shall be accessible for cleaning and inspection.

5.36.4 Air intakes shall be fabricated to prevent the entrance of seepage or splash. Air intakes shall be accessible for cleaning.

5.37 Broilers, rotisseries and salamanders

5.37.1 Gears and springs shall be readily removable or shall be protected from spills and the accumulation of food and grease.

5.37.2 Drip trays, if provided, shall be readily removable and shall have smooth, easily cleanable surfaces.

5.37.3 Guides shall be smooth and easily cleanable.

5.38 Fat/oil fryers and fat/oil filters

5.38.1 Fat/oil fryer baskets shall be easily cleanable and constructed of welded wire or welded perforated metal (see 4.4).

5.38.2 Fat/oil filter systems, except for the return piping, shall be essentially self-draining.

5.38.3 Mobile fat/oil filters shall have a protective lid that prevents debris from entering the filter without hindering safe operation of the system. Any fastening device(s) used to attach the lid to the filter shall be easily cleanable. Port openings through the lid shall be sized so that there is no more than ½ in (0.50 in, 13 mm) clearance around the tubing or nozzle where it passes through the cover.

5.38.4 If a fat/oil filter is protected by a lid conforming to 5.38.3, non-food zone design and construction requirements shall apply to the interior of the cabinet in which the filter system is housed. If no cover is provided, splash zone design and construction requirements shall apply.

5.39 Entry ports

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

5.40 Cappuccino machines with milk reservoirs

5.40.1 Except as noted in 5.40.2, milk reservoirs and all milk-conveying components on cappuccino machines shall conform to the temperature performance criteria of NSF/ANSI 18.

5.40.2 The requirements in 5.40.1 shall not apply to tubing used to convey milk, provided that the tubing is:

- designed so that it is completely drained of milk between uses;
- transparent enough to verify that it is void of milk; and
- no greater than 18 in (46 cm) in length.

5.40.3 Milk reservoirs and all milk conveying components, including tubing, shall conform to 5.1.3.

5.41 Coffee urns

5.41.1 Interior surfaces of urns contacting coffee shall be readily accessible for cleaning and inspection. Valves, gauges, and other parts contacting coffee shall conform to 5.1.3.

5.41.2 Drip-collecting pans shall have readily removable grids and shall be readily accessible and easily cleanable.

5.42 Jacketed kettles and urns

5.42.1 Draw-off tubes for drain outlets of jacketed kettles and urns shall be tangential or vertical one-piece tubing or pipe and shall be located to drain the contents of the kettle or urn completely.

5.42.2 A draw-off tube shall have uniform cross section throughout its length.

5.42.3 Interior surfaces of a draw-off tube shall be smooth.

5.42.4 A draw-off tube shall be flush with the opening on the draw-off valve.

5.42.5 Draw-off valves and faucets of jacketed kettles and urns shall have no sharp corners or crevices. Valves shall be readily accessible and easily cleanable.

5.42.6 Strainers in jacketed kettles and urns shall be constructed of perforated metal and shall be readily removable.

5.43 Steam tables and bains-marie

5.43.1 To facilitate cleaning, steam table tops shall be readily removable, or the openings shall be sized and located to permit access for cleaning the interior.

5.43.2 Water pans/bins on wet-type steam tables and bains-marie shall be readily removable, portable, or shall have a drain.

5.43.2.1 Water pans/bins that have a recommended fill-level resulting in a total unit capacity of 1.0 gal (3.8 L) or more and are not readily removable or portable shall be equipped with a drain that is a minimum 1.0 in (25 mm) Iron Pipe Size (IPS).

5.43.2.2 Water pans/bins that have a recommended fill-level resulting in a total unit capacity less than 1.0 gal (3.8 L) may be acceptable without a drain. However, if a drain is provided, it shall be a minimum ½ in (0.50 in, 13 mm) IPS.

5.44 Popcorn cabinets

The cleanability requirements of this Standard shall not apply to the electrical conduit to the popcorn kettle, if provided.

5.45 Hot food holding and hot food transport equipment

5.45.1 Powered hot food holding cabinets and powered hot food transport cabinets intended for the holding of potentially hazardous foods shall have a securely mounted temperature indicating device that clearly displays the air temperature in the cabinet. This requirement shall not apply to steam tables, bains-marie, kettles, heat lamps, and other radiant heat sources, and similar equipment.

5.45.2 The temperature display shall be visible immediately upon opening the door to the cabinet or shall be visible from the equipment exterior without opening the door to the cabinet. The temperature display shall

reflect the temperature in the coolest part of the cabinet where food is stored. The sensing element shall meet the applicable requirements for the zone in which it is located.

5.45.3 Temperature indicating devices shall be removable.

5.45.4 Temperature indicating devices shall be graduated in increments of 2 °F (1 °C) or less over the range of 140 °F to 175 °F (60 °C to 80 °C). Devices shall also show the range of temperatures from 100 °F to 140 °F (38 °C to 60 °C). Devices shall be accurate to ± 3 °F (± 2 °C) when tested at 145 °F (63 °C) and 170 °F (77 °C).

5.46 Proofing boxes and proofing cabinets

Air circulation ducts shall be totally enclosed and shall be located to prevent splash, spillage, and other contamination from entering the duct. Ducts shall be readily accessible for cleaning.

5.47 Rethermalization equipment

5.47.1 Rethermalization equipment shall have a data plate or permanent label that specifies the maximum capacity of the unit. At a minimum, the information shall include:

- the maximum number of food containers (e.g., pans, bags, trays) by container size that the unit is designed to accommodate; and
- the maximum total load capacity by weight and volume.

5.47.2 If rethermalization equipment is also designed to operate in a hot food holding mode, its operation instructions shall instruct the user that cold food is not to be added to the unit for rethermalization while hot food is being held.

5.48 Food warming equipment

Food warming equipment intended solely for the display of foods that are not potentially hazardous shall have a permanently attached label that states: "Not for the storage or display of potentially hazardous foods." The label shall be clearly visible to the user after installation of the equipment.

6 Performance

6.1 Enclosed hot food holding equipment and hot food transport cabinets

6.1.1 Performance requirement

Enclosed hot food holding equipment and hot food transport cabinets shall be capable of maintaining an internal air temperature of 150 °F (65 °C) or greater when tested in accordance with 6.1.2. There shall be no stratification in cabinet air temperature greater than 25 °F (14 °C).

NOTE 1 — Hot food holding wells in display cases shall conform to 6.2.1 of this Standard. If the case is also designed for holding hot food in the enclosed air space above the wells, 6.1.1 shall also apply.

NOTE 2 — These requirements shall also apply to ovens designed to hold hot food after cooking is complete.

NOTE 3 — These requirements shall not apply to proofing boxes and proofing cabinets.

NOTE 4 — These requirements shall not apply to food warming equipment marked "Not for storage or display of potentially hazardous foods."

6.1.2 Test method

6.1.2.1 The performance of enclosed hot food holding equipment and hot food transport cabinets shall be evaluated within a test chamber maintained under the following conditions for the duration of the test:

- ambient temperature of 73 ± 3 °F (23 ± 2 °C), as measured approximately 10 in (250 mm) from test unit and 36 in (90 cm) from the floor; and
- no vertical temperature gradient exceeding 1.5 °F per foot (2.5 °C per meter).

6.1.2.2 The equipment shall be preheated in accordance with the manufacturer's operating instructions or shall be allowed to cycle on and off at least two full cycles.

6.1.2.3 Thermocouples accurate to ± 1 °F (± 0.5 °C) shall be used to monitor the air temperature in the cabinet as close as possible to the following locations:

Thermocouple #1: (when facing the front of the unit) 5.0 ± 0.25 in (127 ± 6.0 mm) from the left interior wall, 5.0 ± 0.25 in (127 ± 6.0 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 (127 ± 6.0 mm) from the right interior wall, 5.0 ± 0.25 in (127 ± 6.0 mm) above the internal floor of the unit, and centered front-to-back.

If interior spatial constraints prohibit the placement of thermocouples as specified above, alternate locations shall be selected to comply with the intent of the Standard.

NOTE — The intent is for the thermocouples to form a diagonal in the unit while being 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 $\frac{3}{4}$ in (0.75 in, 19 mm). The brass slugs shall be placed at least $\frac{1}{2}$ in (0.50 in, 13 mm) from any heat conducting surface.

NOTE — If designed for use with food holding trays, the equipment shall be tested with one tray at the top, middle, and bottom of the hot holding cabinet.

6.1.2.4 The test shall be started upon verification that the temperature at each thermocouple location is 150 °F (65 °C) or greater. The temperature at each thermocouple location shall be recorded at 5-min intervals over a period of 2 h.

6.1.3 Acceptable criteria

The temperature at each thermocouple location shall be 150 °F (65 °C) or greater for the duration of the test. At each 5-min interval, the difference between the temperatures recorded at any two thermocouple locations shall not exceed 25 °F (14 °C).

6.2 Open top hot food holding equipment

6.2.1 Performance requirement

Hot food holding equipment whose hot food storage area is not completely enclosed shall be capable of maintaining a minimum product temperature of 150 °F (65 °C) when tested in accordance with 6.2.2. This requirement is intended to ensure that the equipment is capable of holding food at a minimum temperature of 140 °F (60 °C) under intended use conditions. This requirement applies to bains-marie, steam tables, display cases with hot food holding wells, soup stations, and similar open equipment in which hot food may be held

during service or display. This requirement shall not apply to heat lamps and similar overhead heating equipment designed to temporarily slow the cooling of food placed beneath them.

6.2.2 Test method

6.2.2.1 The performance of open hot food holding equipment shall be evaluated within a test chamber maintained under the following conditions for the duration of the test:

- ambient temperature of 73 ± 3 °F (23 ± 2 °C), as measured approximately 10 in (250 mm) from test unit and 36 in (914 mm) from the floor;
- no vertical temperature gradient exceeding 1.5 °F per foot (2.5 °C per meter); and
- no air currents with velocities greater than 50 ft/min (15.2 m/min) measured at a position that is:
 - 1) centered side-to-side in relation to the equipment under test, and
 - 2) 10 ± 1 in (254 ± 25 mm) above the top rim of the test pans, and
 - 3) 10 ± 1 in (254 ± 25 mm) in front of the unit.

6.2.2.2 The test unit shall be preheated in accordance with the manufacturer's operating instructions before the unit is loaded. The test unit shall be loaded with pans of test media prepared and conditioned in accordance with Annex A, section A.1 (including proper thermocouple placement). The time required to transfer a single pan from the oven/holding cabinet to the test unit shall not exceed 5 min. Care should be taken to limit the disturbance of the test media during transfer of the pans.

The test unit shall be loaded to the maximum capacity recommended by the manufacturer. If a unit is comprised of multiple, identical hot food holding wells that are individually heated and have separate controls, only a single well shall be loaded and tested. The remaining identical wells shall be kept empty and shall not be operational during the test.

Pan covers shall be removed before the start of the test.

6.2.2.3 The temperature at each thermocouple location shall be monitored immediately upon placement of the pans into the unit. The test shall be started upon verification that the media temperature at all thermocouple locations is 150 °F (65 °C) or greater (see the note below regarding temperature stabilization). The temperature at each thermocouple location shall be recorded at 5-min intervals over a test period of 2 h.

NOTE — If the temperature at any thermocouple location drops below 150 °F (65 °C) within 20 min of placing the media in the test unit, the start of the 2-h test period may be delayed until all temperatures are 150 °F (65 °C) or greater. The test period shall start no later than 20 min after the media has been placed in the test unit. The test shall be stopped if the temperature at any thermocouple location is less than 150 °F (65 °C) at the 20-min mark or if a temperature of less than 140 °F (60 °C) is recorded at any time.

6.2.3 Acceptance criteria

The media temperature at each thermocouple location shall be 150 °F (65 °C) or greater throughout the 2-h test period.

6.3 Rethermalization equipment

6.3.1 Performance requirement

Rethermalization equipment shall be capable of elevating product temperature from 40 °F (4 °C) to 165 °F (74 °C) within a period of 2 h.

6.3.2 Test method

6.3.2.1 Unless designed to operate within a refrigerated environment, rethermalization equipment shall be evaluated within a test chamber maintained under the following conditions for the duration of the test:

- ambient temperature of 73 ± 3 °F (23 ± 2 °C), as measured approximately 10 in (250 mm) from test unit and 36 in (90 cm) from the floor;
- no vertical temperature gradient exceeding 1.5 °F per foot (2.5 °C per meter); and
- maximum air current velocity of 50 ft/min (15.2 m/min).

Rethermalization equipment designed to operate within a refrigerated environment shall be evaluated within a test chamber maintained under the following conditions for the duration of the test:

- ambient temperature of 40 ± 3 °F (4 ± 2 °C), as measured approximately 10 in (250 mm) from test unit and 36 in (90 cm) from the floor;
- no vertical temperature gradient exceeding 1.5 °F per foot (2.5 °C per meter); and
- maximum air current velocity of 50 ft/min (15.2 m/min).

6.3.2.2 The unit shall be preheated in accordance with the manufacturer's operating instructions before the unit is loaded. The unit shall be loaded according to manufacturer's instructions with test media prepared in accordance with Annex A, section A.2 (including thermocouple placement). The unit shall be loaded to the maximum capacity specified by the manufacturer and as indicated on the product label.

If the equipment is designed to rethermalize containers of bulk foods, media temperatures shall be monitored in five evenly spaced container locations, including the top, middle, and bottom sections of the cabinet interior. Container covers shall be removed prior to the start of the test.

If the equipment is designed to rethermalize individual portions of food in separate serving containers, media temperatures shall be monitored in three containers located in the top, middle, and bottom sections of the cabinet interior. If the equipment is designed with dedicated heating elements for individual serving containers, the cabinet may be tested at less than full load conditions. Serving container covers, if provided, shall remain in place for the duration of the test.

6.3.2.3 The test shall be started upon verification that the temperature of the test media at each thermocouple location is 40 °F (4 °C) or less. The time required for the temperature at each thermocouple location to rise from 40 °F (4 °C) to 165 °F (74 °C) shall be determined. The test may be stopped if the media temperature at any thermocouple location has not reached 165 °F (74 °C) within 120 min.

6.3.3 Acceptance criteria

The time required for the media temperature at each thermocouple location to rise from 40 °F (4 °C) to 165 °F (74 °C) shall not exceed 120 min.

6.4 Cleaning and sanitization procedures

6.4.1 Performance requirement

Cleaning and sanitization procedures recommended by the manufacturer shall effectively clean and sanitize food contact surfaces.

NOTE — This requirement applies to manual cleaning and sanitizing procedures and to in-place cleaning and sanitizing procedures recommended by the manufacturer.

6.4.2 Test method

Microbiological methods for stock culture preparation, and enumeration/analysis of *Escherichia coli*, shall be performed as specified in Annex C.

6.4.2.1 The equipment shall be filled with the *E. coli* suspension.

6.4.2.2 The equipment shall be operated so that food contact surfaces are exposed to the *E. coli* suspension. The equipment shall then be cleaned in place according to the manufacturer's instructions and refilled with SBDW. The SBDW shall be dispensed and five 100-mL samples shall be collected at intervals from the start of the dispensing until the unit is empty. When adequate sample volumes cannot be realized, more SBDW shall be added accordingly. The equipment shall then be operated so that food contact surfaces intended for in-place cleaning are exposed to the SBDW. Sufficient SBDW shall then be dispensed. The challenge organisms present in each sample shall be collected and enumerated using the Standard Total Coliform Membrane Filter Procedure in accordance with APHA's *Standard Methods for the Examination of Water and Wastewater*.

6.4.3 Acceptance criteria

For each sample, R shall be greater than or equal to 6.0, where:

$$R = \log_{10} (N_i / N_f)$$

and

N_i = Initial inoculum density (CFU/mL)

N_f = The number of CFU/mL recovered in each sample.

If $N_f < 1$, the samples shall be considered acceptable.

6.5 Pyrolytic self-cleaning ovens

6.5.1 Performance requirement

Pyrolytic self-cleaning hearth ovens shall be capable of maintaining a minimum interior surface temperature of 650 °F (343 °C) at the point of coolest interior surface for a minimum period of at least 4 h when tested in accordance with 6.5.2. This requirement is intended to ensure that the equipment is capable of removing any possible accumulation of soil from the walls and ceiling of the oven through pyrolysis under intended use conditions. This requirement applies to hearth ovens with interior surfaces (including walls, ceilings, and decks) composed of refractory concrete or other high-temperature ceramic material.

6.5.2 Test method

The test unit shall be heated in accordance with the manufacturer's operating instructions to a minimum surface temperature of at least 650 °F (343 °C). Surface temperature shall be measured using three thermocouples accurate to ± 2 °F (± 1 °C) in conjunction with thermally protected wiring. The thermocouples shall be held in place using a high-temperature, thermally conductive, adhesive in the following locations:

- on an interior oven wall no more than 6.0 in (15 cm) from a ventilation exhaust opening;
- on the interior oven wall furthest from the heat source and no more than 6.0 in (15 cm) from the oven deck; and

- on an interior oven wall no more than 6.0 in (15 cm) from the hearth opening and no more than 6.0 in (15 cm) from the oven deck.

No thermocouple shall be placed within a 6.0 in (15 cm) radius of any other thermocouple used for this test.

Once the surface temperature has reached 650 °F (343 °C) in each of the specified locations, the surface temperatures shall be monitored at 15-min intervals for a period of at least 4 h.

NOTE — When operating an oven at temperatures above 600 °F (316 °C), temporary restriction of the oven doorway opening may cause ignition of oven vapors.

6.5.3 Acceptance criteria

The surface temperature shall be maintained at 650 °F (343 °C) or greater throughout the 4-h test period in each of the three thermocouple locations.

6.6 Abrasion resistance of asbestos cement flat sheet

6.6.1 Performance requirement

Asbestos cement flat sheet used as an oven deck shall be abrasion resistant.

6.6.2 Test method

The abrasion resistance of an asbestos cement flat sheet used as an oven deck shall be evaluated using three test tiles. Each test tile shall be 5.0 x 5.0 in (12.7 x 12.7 cm). The test tiles shall be conditioned and then weighed to the nearest milligram.

6.6.2.1 Conditioning

6.6.2.1.1 Place the samples in the unheated oven.

6.6.2.1.2 Then increase the temperature 100 °F (38 °C) / h until 600 °F (316 °C) is reached.

6.6.2.1.3 Maintain 600 °F (316 °C) for 1 h.

6.6.2.1.4 Allow samples to cool to room temperature.

6.6.2.2 The samples shall be mounted on a BYK¹² Abrasion Tester with a Stainless Steel Bristle Brush and an applied load of 4.5 lb (2 kg). Samples shall undergo a total of 500 wear cycles. After each 125 wear cycles, the sample shall be rotated 90° degrees.

The final mass of each sample shall be recorded and subtracted from its initial weight.

6.6.3 Acceptance criteria

The mass lost from each sample shall be less than 100 mg.

6.7 Open heated merchandisers

6.7.1 Performance requirement

Open heated merchandisers shall be capable of maintaining a minimum product temperature of 150 °F (65.5 °C) when tested in accordance with 6.7.2. This requirement is intended to ensure that the non-enclosed

¹² BYK-Gardner, 9104 Guilford Rd., Columbia, MD 21046 www.byk.com

equipment, which does not utilize food pans or food wells, is capable of holding packaged potentially hazardous food at a minimum temperature of 140 °F (60 °C) under intended use conditions.

NOTE — The test is designed for open hot food holding equipment that does not utilize wells and does not include test criteria for open top hot food holding equipment, which is covered under 6.2. This requirement shall not apply to heating equipment designed to temporarily slow the cooling of food.

6.7.2 Test method

6.7.2.1 The performance of open heated merchandisers shall be evaluated within a test chamber maintained under the following conditions for the duration of the test:

- ambient temperature of 73 ± 3 °F (23 ± 2 °C) as measured approximately 10 in (250 mm) from the test unit and 36 in (914 mm) from the floor;
- no vertical temperature gradient exceeding 1.5 °F per foot (2.5 °C per meter); and
- no air currents with velocities greater than 50 ft/min (15.2 m/min) measured at a position that is:
 - 1) centered side-to-side in relation to the equipment under test, and
 - 2) 10 ± 1 in (254 ± 25 mm) above the lowest heating surface, and
 - 3) 10 ± 1 in (254 ± 25 mm) in front of the unit.

6.7.2.2 The test unit shall be preheated in accordance with the manufacturer's operating instructions before the unit is loaded. The test unit shall be loaded with samples of test media prepared and conditioned in accordance with Annex A, including proper thermocouple placement. The time required to transfer a single sample from the oven/holding cabinet to the test unit shall not exceed 5 min. Care should be taken to limit the disturbance of the test media during transfer of test sample containers.

The test unit shall be loaded with five test sample containers in an "x" pattern according to figure 10 or as close as possible to that configuration if space or the shape of the unit limits the placement of test sample containers. In square or rectangular merchandiser units, the sample containers shall be placed 1.0 in (25 mm) from each side of a corner with the broadest side of the container aligned in parallel with the longer of the unit sides. For round, octagonal, or other merchandiser units, the sample containers shall be placed in the units so that the corners of the broadest side of a test sample container are 1.0 in (25 mm) from the side of the unit. If the unit has a center support or other obstruction, the center test sample shall be placed as close to the geometric center as possible with the broadest part of the test sample 1.0 in (25 mm) from the support or obstruction.

6.7.2.3 The temperature at each thermocouple location shall be monitored immediately upon placement of the samples into the unit. The test shall be started upon verification that the media temperature at all thermocouple locations is 150 °F (65.5 °C) or greater (see note below regarding temperature stabilization). The temperature shall be recorded at 5-min intervals over a test period of 2 h.

NOTE — If the temperature at any thermocouple location drops below 150 °F (65.5 °C) within 20 min of placing the media in the test unit, the start of the 2-h test period may be delayed until all temperatures are 150 °F (65.5 °C) or greater. The test period shall start no later than 20 min after the media has been placed in the test unit. The test shall be stopped if the temperature at any thermocouple location is less than 150 °F (65.5 °C) at the 20 min mark or if a temperature of less than 140 °F (60 °C) is recorded at any time.

6.7.3 Acceptance criteria

The media temperature at each thermocouple location shall not drop below 150 °F (65.5 °C) during the 2-h test period.

7 Food equipment provided with a security package

7.1 General

Food equipment provided with a security package may require the removal of security fasteners and other devices in order to be inspected, serviced, maintained, or cleaned.

7.2 Special tools

For food equipment provided with a security package, the use of special tools is acceptable for components that are required to be removable or accessible.

7.3 Fastening methods (splash zone)

Security fasteners may be used in a splash zone of food equipment provided with a security package.

7.4 Fastening methods (non-food zone)

Security fasteners may be used in a non-food zone of food equipment provided with a security package.

7.5 Hinges

Hinges in a splash or non-food zone of food equipment provided with a security package are not required to be of simple take-apart design. Fixed pin, fixed by other means, and continuous hinges are acceptable.

7.6 Hardware

Hardware on food equipment provided with a security package is not required to be easily replaced. Hardware that is removable or permanently attached is acceptable.

7.7 Shelf brackets, pilasters, slides, or cleats

Shelf brackets, pilasters, slides, or cleats on food equipment provided with a security package are not required to be readily removable. Shelf brackets, pilasters, slides, or cleats that are removable or permanently attached are acceptable, provided that they are easily cleanable.

7.8 Kick plate

Kick plates on food equipment provided with a security package are not required to be readily removable. Kick plates that are removable are acceptable.

7.9 Drawers

Drawers and drawer pan assemblies in food equipment provided with a security package are not required to be readily removable. Drawers and drawer pan assemblies that are removable are acceptable.

7.10 Conveyor units

Access panels on the base of conveyor units on food equipment provided with a security package are not required to be readily removable. Access panels that are removable are acceptable.

7.11 Labeling

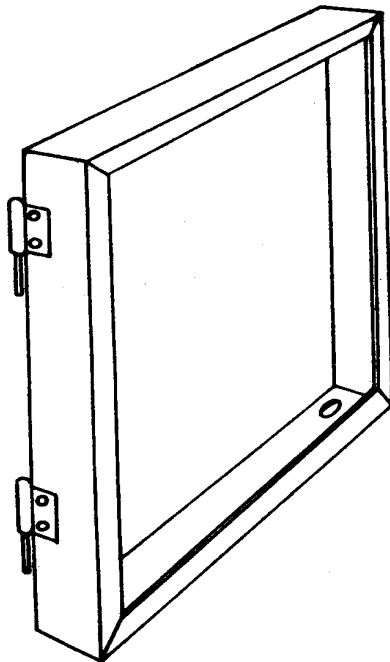
Food equipment provided with a security package shall have a permanent, conspicuous label stating: "Intended for use only in environments where security is a concern such as correctional facilities, mental health facilities, or some schools."

8 Product literature

The product manual and installation manual for floorless walk-in or roll-in equipment shall state the equipment is to be installed on flooring materials that are corrosion resistant and cleanable. Flooring materials meeting these requirements may include masonry materials.



Figure 1 – External corners or angles



Channel sections shall be shallow and wide enough to be easily cleanable, with cleanout holes.

Figure 2 – Single panel door

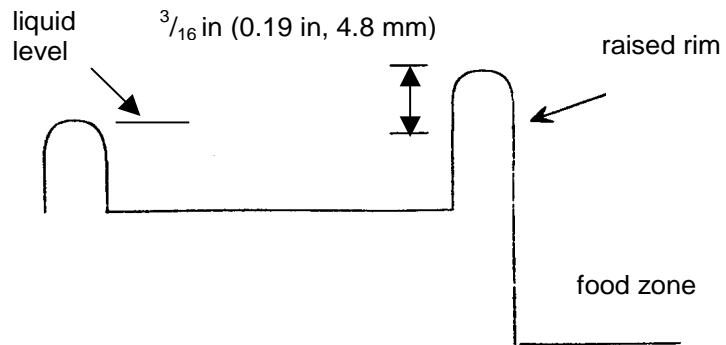


Figure 3 – Openings and rims – food zone

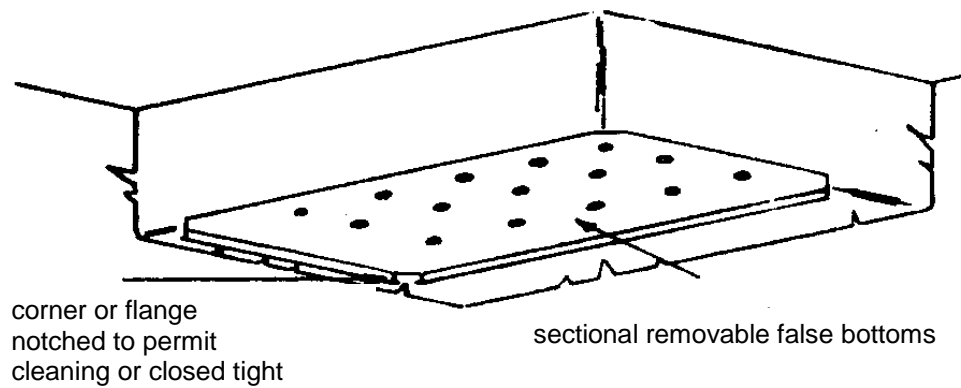


Figure 4 – Perforated false bottom

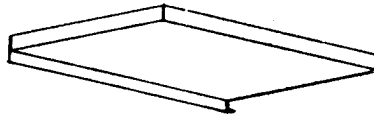


Figure 5 – Diverting shelves

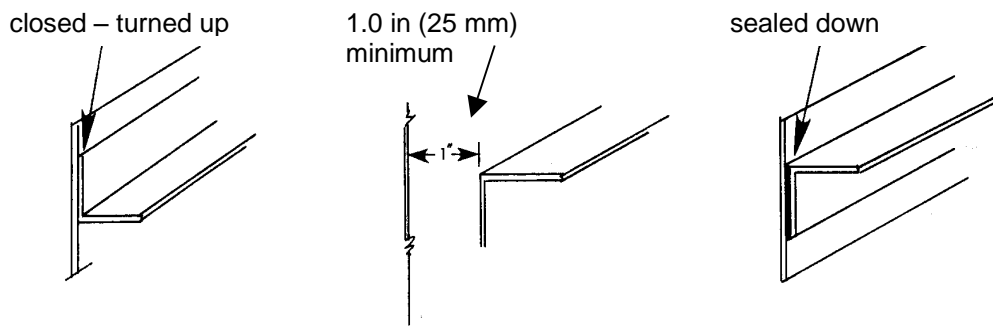


Figure 6 – Interior fixed shelves

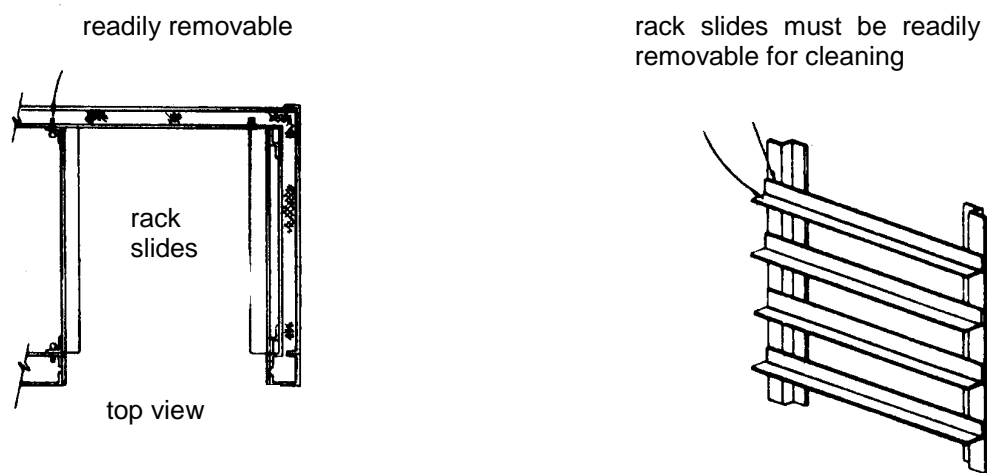


Figure 7 – Rack slides

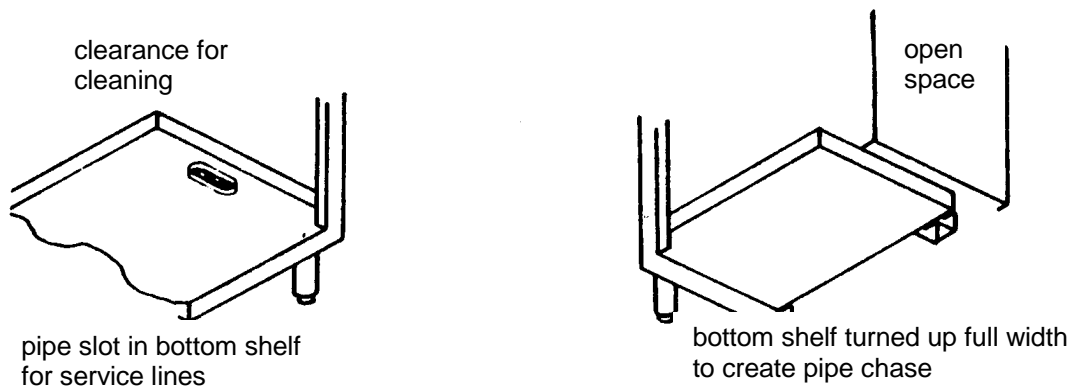


Figure 8 – Pipe chases

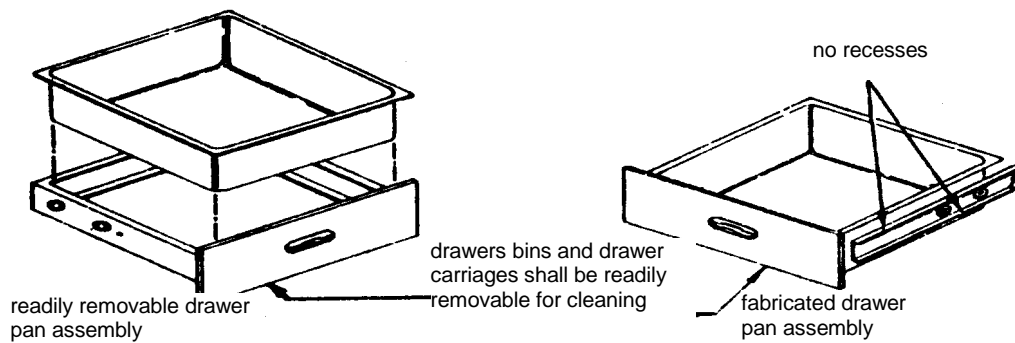
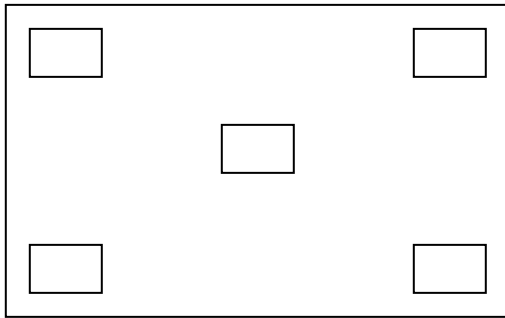
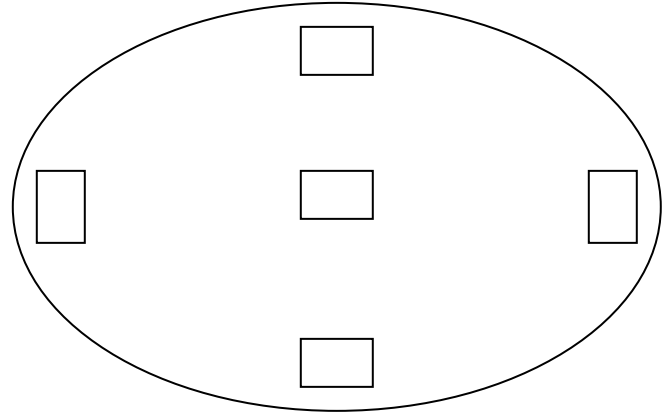


Figure 9 – Drawers



Square or rectangular units



Round, octagonal, or other units

Figure 10 – Test sample container pattern for open heated merchandisers

Annex A

(normative)

Procedures for the preparation of test media

A.1 Test media for open hot food holding equipment

The following are procedures for preparing test media to be used in the evaluation of the performance of open hot food holding equipment (e. g., steam tables, bains-marie, open display cases, soup stations).

A.1.1 Pan/container selection

Standard stainless steel hotel pans (12 x 20 x 4 in [30 x 50 x 10 cm]) shall be used for testing, unless the equipment being tested is specifically designed to hold alternate sized pans or containers. A sufficient number to fill the equipment as prescribed in 6.2.2 shall be prepared.

A.1.2 Media preparation

Each pan shall be filled with pine sawdust. Water shall be added slowly until the sawdust is completely saturated. Addition of water shall continue until a thin layer of water (approximately $\frac{1}{4}$ in [0.25 in, 6.0 mm] in depth) is formed on top of the sawdust. Enough sawdust and water shall be added that the water layer is approximately 1.0 in (25 mm) below the rim of the pan. 100% vegetable oil shall be slowly added to the surface so that a thin layer of oil (between $\frac{1}{8}$ in [0.13 in, 3.2 mm] and $\frac{1}{4}$ in [0.25 in, 6.0 mm] in depth) is formed on the sawdust/water mixture.

A.1.3 Thermocouple placement

If hotel pans or other rectangular pans are used, a thermocouple accurate to ± 1 °F (± 0.5 °C) shall be carefully inserted in each pan in the following locations:

- in the geometric center of the media;
- in one corner, approximately $\frac{1}{2}$ in (0.50 in, 13 mm) below the surface of the sawdust; and
- in the opposite corner, approximately $\frac{1}{2}$ in (0.50 in, 13 mm) from the bottom of the pan.

The corner thermocouples shall be located within 1.0 in (25 mm) of the side wall and end wall of the pan, but shall not be in direct contact with the pan.

If pots or other cylindrical containers are used, a thermocouple accurate to ± 1 °F (± 0.5 °C) shall be carefully inserted in each pan in the following locations:

- in the geometric center of the media;
- in the center of the pot, approximately $\frac{1}{2}$ in (0.50 in, 13 mm) below the surface of the sawdust; and
- in the center of the pot, approximately $\frac{1}{2}$ in (0.50 in, 13 mm) from the bottom of the pan.

A.1.4 Media conditioning

Each pan shall be covered with a tight fitting cover. The pans' media shall be heated and stored in a heated cabinet capable of stabilizing the temperature at each thermocouple location at 155 ± 5 °F (68 ± 3 °C) until ready for immediate transfer to the test unit.

A.2 Test media for rethermalization equipment

The procedures used to prepare test media depend upon the type of rethermalization equipment being tested. Separate media preparation procedures are provided for the following types of equipment:

- rethermalization equipment designed to rethermalize bulk foods in pans or other rigid containers;
- rethermalization equipment designed to rethermalize individual portions of food in separate serving containers such as plates or trays; and
- rethermalization equipment designed to rethermalize sealed bags of bulk food by immersion in a heated water bath.

A.2.1 Pans of media

- a) If the test equipment is designed to rethermalize bulk foods in pans or other rigid containers, the pans or containers used shall be of the greatest depth that the equipment is designed to accommodate and as specified on the product label. A sufficient number of containers to fill the rethermalization equipment to the maximum capacity specified by the manufacturer shall be prepared.
- b) Each container shall be filled with pine sawdust. Water shall be slowly added until the sawdust becomes completely saturated. Addition of water shall continue until a thin layer of water (approximately $\frac{1}{4}$ in [0.25 in, 6.0 mm] deep) is formed on top of the sawdust. Enough sawdust and water shall be added that the water layer is approximately 1.0 in (25 mm) below the rim of the pan. 100% vegetable oil shall be slowly added to the surface so that a thin layer of oil (approximately $\frac{1}{8}$ in [0.13 in, 3.2 mm] thick) is formed on the sawdust/water mixture.
- c) A thermocouple accurate to $\pm 1^\circ\text{F}$ ($\pm 0.5^\circ\text{C}$) shall be carefully inserted in the geometric center of the media in five of the containers. If the equipment being tested accommodates fewer than five containers, insert a thermocouple in each container.
- d) The containers shall be covered and refrigerated. A media temperature of $38 \pm 2^\circ\text{F}$ ($3 \pm 1^\circ\text{C}$) throughout shall be established prior to loading of the test unit. The covered containers of media may be stored in a refrigerator for up to 24 h before being used.

A.2.2 Individual serving containers

- a) If the test equipment is designed to rethermalize individual portions of food in separate serving containers, such as plates or trays, containers of the type specified by the manufacturer shall be used. A sufficient number of containers to fill the rethermalization equipment to the maximum capacity specified by the manufacturer shall be prepared. If the equipment is designed so that there are dedicated heating elements for individual serving containers, three containers of test media shall be prepared for placement at the top, middle, and bottom of the cabinet interior.
- b) Each individual serving container shall be filled with pine sawdust to a level $\frac{1}{2} \pm \frac{1}{8}$ in (0.50 ± 0.13 in, 13 ± 3.2 mm) below the rim or attached collar. Water shall be slowly added until the sawdust becomes completely saturated. Addition of water shall continue until a thin layer of water (approximately $\frac{1}{4}$ in [0.25 in, 6 mm] deep) is formed on top of the sawdust. 100% vegetable oil shall be slowly added to the surface so that a thin layer of oil (approximately $\frac{1}{8}$ in [0.13 in, 3.2 mm] deep) is formed on the sawdust/water mixture.
- c) A thermocouple accurate to $\pm 1^\circ\text{F}$ ($\pm 0.5^\circ\text{C}$) shall be carefully inserted in the geometric center of the media in three containers for placement in the top, middle and lower portions of the test equipment. The other containers serve as “dummy containers” and therefore do not require thermocouples.

- d) The serving containers shall be covered with the covers specified by the manufacturer, and refrigerated. A media temperature of 38 ± 2 °F (3 ± 1 °C) throughout shall be established prior to loading of the test unit. The covered media may be stored in a refrigerator for up to 24 h before being used.

A.2.3 Bulk food bags (cook-chill pouches)

- a) If the test equipment is designed to rethermalize sealed bags of bulk food by immersion in a heated water bath, the plastic bags used shall be of the largest volume that the equipment is designed to accommodate and as specified by the manufacturer.
- b) Each bag shall be filled to 80% of its capacity with pine sawdust. Water shall be slowly added until the sawdust becomes completely saturated. Addition of water shall continue until there is a small quantity of unabsorbed water in the bag.
- c) Before the bag is sealed, a thermocouple accurate to ± 1 °F (± 0.5 °C) shall be carefully inserted in the geometric center of the media in each bag. If necessary, a nonconductive device shall be used to support the thermocouple in the center of the media. The bags shall be sealed so that they are watertight. Heat-resistant tape or other means shall be used to attach the thermocouple lead securely to the bag to ensure that the thermocouple does not move during rethermalization.
- d) The bags of media shall be frozen and maintained in a frozen state until loaded in the unit for testing.

A.3 Test media for open heated merchandisers

The following are procedures for preparing the test samples to be used in the evaluation of the performance of open heated merchandisers.

A.3.1 Container selection

Single-use plastic containers with shallow bases and clear domed lids intended for use in open heated merchandisers shall be used unless the equipment being tested is specifically designed to hold specific pans or containers. Base dimensions shall be 9 ± 1 in by 7 ± 1 in (230 ± 25 mm by 180 ± 25 mm). The height from the bottom of the base to the top of the domed lid shall be 5 ± 1 in (130 ± 25 mm). Container wall thickness shall not exceed $1/32$ in (0.031 in, 0.79 mm). A sufficient number to fill the equipment as prescribed in 6.7.2.2 shall be prepared. All tests shall be run with the lid in place.

A.3.2 Media preparation

Each container shall be filled with 2.0 lb (900g) of a dough-like media. The media shall consist of approximately 1 cup flour, 1 cup water, $\frac{1}{2}$ cup salt, 2 tablespoons cream of tartar, and 1 tablespoon of vegetable oil. The ingredients shall be mixed and heated over low heat until a mass is formed. The 2.0 lb (900g) media mass shall be formed into a rectangular 6"L x 2"W x 3.75"H (150mm L x 50mm W x 95mm H) and placed in the center of the test containers.

A.3.3 Thermocouple placement

Lids shall remain on containers. Small holes, in each container lid, large enough for the thermocouples will be necessary in order to insert the thermocouples into the test media.

Thermocouples accurate to ± 1 °F (0.5 °C) shall be inserted in each test sample in the following locations:

- in the geometric center of the media mass;
- in the center of the end of the test sample farthest or equidistant from the geometric center of the merchandiser unit, approximately $\frac{1}{2}$ in (0.50 in, 13 mm) below the surface of the test media; and

- in the center of the opposite end, approximately $\frac{1}{2}$ in (0.50 in, 13 mm) from the bottom of the test container.

Thermocouples may enter the sample container through the side or through the top and down the side.

A.3.4 Media conditioning

The covered containers shall be heated and stored in a heated cabinet capable of stabilizing the temperature at each thermocouple location at 155 ± 5 °F (68 ± 3 °C) until ready for immediate transfer to the test unit.

Annex B

(normative)

Supplemental requirements for marine food equipment

This annex establishes supplemental requirements for food equipment specifically designated for use aboard marine vessels. These supplemental requirements are intended to ensure that marine food equipment is designed and manufactured so that it may be operated, cleaned, and maintained in a sanitary manner under shipboard conditions. In most cases, the requirements in this annex serve to modify or expand upon the requirements contained in other sections of this Standard. For ease of reference, the section number containing the relevant baseline requirement is provided immediately below the subject heading. Unless otherwise specified, the requirements in the other sections of this Standard shall also apply to marine food equipment.

B.1 Materials

B.1.1 Corrosion resistance

See 4.1.

B.1.1.1 Coatings, including metallic coatings, such as zinc (galvanized), zinc alloys, or chrome plating, shall not be used to render exposed materials corrosion resistant except on hinges, latches, and similar replaceable hardware.

B.1.1.2 Structural metal used in the fabrication of equipment, including panels, enclosures, and reinforcing and framing members, shall be AISI Type 304 or Type 316 stainless steel. Type 316 stainless steel shall be used on equipment designed for outdoor (weatherdeck) use.

B.1.1.3 Fasteners shall be AISI Type 304 or Type 316 stainless steel.

B.2 Design and construction

B.2.1 General

See introduction to 5.

B.2.1.1 Food zone design and construction requirements shall apply to the interiors of powered hot food transport cabinets.

B.2.1.2 Splash zone design and construction requirements shall apply to non-food zones on wheeled equipment covered by this Standard. Casters and wheels on such equipment shall meet non-food zone design and construction requirements.

B.2.2 Internal angles and corners

See 5.2.

The exemptions from the minimum food zone radius requirements, as listed in 5.2.1.1, shall not apply to marine food equipment.

B.2.3 Joints and seams

See 5.4.

B.2.3.1 Food zone surfaces on marine food equipment shall be seamless or shall have all permanent joints and seams continuously welded and polished smooth.

B.2.3.2 Permanent joints and seams in a splash zone shall be sealed or welded and polished smooth. Seams wider than $\frac{1}{8}$ in (0.13 in, 3.2 mm) shall be sealed by continuous weld or shall be flashed and sealed.

B.2.3.3 If exposed to seepage or condensation, permanent joints and seams in a non-food zone shall be sealed or welded and polished smooth. Seams wider than $\frac{1}{8}$ in (0.13 in, 3.2 mm) shall be sealed by continuous weld or shall be flashed and sealed.

B.2.4 Reinforcing and framing members

See 5.7.

Hollow sections of reinforcing and framing members, including vertical channels, shall be closed at each end. Seams wider than $\frac{1}{32}$ in (0.031 in, 0.79 mm) that are formed by reinforcing and framing members shall be sealed.

B.2.5 Doors

See 5.9.

Double panel doors shall be seamless or shall have all seams sealed.

B.2.6 Shelving

See 5.23.

Internal angles and corners on fixed shelving, regardless of its application, shall conform to the minimum food zone radius requirement.

B.2.7 Steam tables and bains-marie

See 5.43.

B.2.7.1 All water pans/bins on a steam table or bain-marie shall have a drain with a minimum internal diameter of 1.0 in (25 mm).

B.2.7.2 Steam heated bains-marie shall be equipped with a steam-jacketed sealed compartment or stainless steel pipes that are easily cleanable and enclosed in a compartment.

B.2.8 Coffee urns

See 5.41.

Drip trays on coffee urns shall be at least 1.0 in (25 mm) deep and shall have a drain with a minimum internal diameter of 1.0 in (25 mm).

Annex C

(normative)

Methods for preparing and analyzing in-place cleaning bacteria surrogate

C.1 Summary

E. coli is used as the challenge organism for the in-place cleaning test. Presented in this annex are the methods used for suspension preparation, controls, and analysis of the challenge organism.

C.2 Equipment

- autoclave, 121 ± 1 °C (250 ± 1 °F);
- incubator, 36 ± 1 °C (97 ± 1 °F);
- refrigerator, 5 ± 1 °C (41 ± 3 °F);
- water bath 50 ± 1 °C (122 ± 1 °F);
- freezer;
- vortex mixer;
- pH meter;
- colony counter;
- filtration units, autoclavable glass or plastic filtration units;
- sterile filtration apparatus;
- analytical balance;
- Bunsen burner;
- blunt tipped forceps;
- hot plate; and
- pipettor.

C.3 Microorganism

Escherichia coli (American Type Culture Collection #11229) shall be obtained from American Type Culture Collection, P. O. Box 1549, Manassas, VA 20108.

C.4 Supplies

- petri dishes, 50 x 9 mm, sterile;
- pipette tips, 1000 µL and 100 µL, sterile;
- disposable sterile 250-mL polypropylene container;
- test tubes, 16 x 125 mm;
- sterile inoculating loop;
- sterile 0.45 µm mixed cellulose esters membrane filters;
- French squares bottles (250 mL); and
- autoclavable containers capable of holding up to 10 L.

C.5 Reagents

- Sterile buffered dilution water (SBDW) shall be prepared according to the Standard Methods for the Examination of Water and Wastewater (dilution water: buffered water);

- Sodium Thiosulfate Solution 10% (NaS₂O₃) shall be prepared by adding 100 g reagent grade sodium thiosulfate per 900 mL DI water, and autoclaved for 30 min at 121 ± 1 °C (250 ± 1 °F);
- Sodium Hydroxide (NaOH) Solution. 1N shall be used to adjust pH of reagents;
- Hydrochloric Acid (HCl) Solution. 5 N shall be used to adjust pH of reagents;
- Neutralizer stock solution shall be prepared as follows: 40 gm lecithin, 280 mL Tween 80, and 1.25 mL phosphate buffer shall be mixed together with 1L distilled water. pH shall be adjusted to 7.2. Solution shall be dispensed into 100-mL portions and autoclaved 15 min at 121 ± 1 °C (250 ± 1 °F); and
- Phosphate buffer solution shall be prepared according to the *Standard Methods for the Examination of Water and Wastewater* (dilution water: buffered water).

C.6 Safety precautions and hazards

C.6.1 Steam sterilized samples and equipment shall be handled with protective gloves when being removed from the autoclave.

C.6.2 Cryogenic culture vials shall be handled with cryoprotective gloves.

C.6.3 All microbiological samples and contaminated test supplies shall be steam sterilized to 121 ± 1 °C (250 ± 1 °F) at 15 psi for a minimum of 20 min prior to being discarded.

C.7 Growth medium

NOTE 1 — Common bacteriological media may be purchased from bacteriological medium manufacturers and prepared according to the manufacturer's instructions.

NOTE 2 — The quality of the growth media shall be monitored by examining growth promotion and sterility prior to use.

C.7.1 TSB (Tryptic Soy Broth)

Ingredient	Amount
tryptone	1.7 g
soytone	0.3 g
dextrose	0.25 g
sodium chloride	0.5 g
dipotassium phosphate	0.25 g
DI water	100 mL
pH	7.3 ± 0.2

TSB shall be dissolved by boiling and adjusted to final pH. 8-mL aliquots shall be dispensed into 16 x 150 mm test tubes. TSB shall be autoclaved at 121 ± 1 °C (250 ± 1 °F) at 15 psi for 20 min. Cooled broth shall be stored at 5 ± 1 °C (41 ± 1 °F).

C.7.2 TSA (Tryptic Soy Agar)

Ingredient	Amount
tryptone	7.5 g
soytone	2.5 g
sodium chloride	2.5 g
bacto-agar	7.5 g
DI water	500 mL
pH	7.3 ± 0.2

TSA shall be dissolved by boiling, adjusted to final pH, and autoclaved at 121 ± 1 °C (250 ± 1 °F) at 15 psi for 20 min. Tempered media shall be poured into sterile petri dishes. Agar plates shall be stored at 5 ± 1 °C (41 ± 1 °F). Plates shall be allowed to come to room temperature before use.

C.7.3 Coliform growth media**C.7.3.1 Coliscan¹³® MFCulture medium**

Broth shall be purchased from the manufacturer. Broth shall be dispensed in 1.75 to 2 mL quantities into lower section of 50 x 9 mm sterile plastic petri dishes with pad. Broth shall be stored at 5 ± 1 °C (41 ± 1 °F).

C.7.3.2 CHROMagar¹⁴® culture medium

Agar shall be prepared according to manufacturer's directions. It shall be brought to a boil and cooled to 45 ± 1 °C (113 ± 1 °F). Agar shall be dispensed in 4 to 5 mL quantities into lower section of 50 x 9 mm sterile plastic petri dishes.

C.8 Culture of *E. coli***C.8.1 Stock culture preparation**

- E. coli* #11229 shall be obtained from ATCC.
- Stock culture shall be rehydrated with TSB and maintained in TSB. The culture shall then be incubated at 36 ± 1 °C (97 ± 1 °F).
- This working stock culture may be maintained at 3 ± 2 °C (37.4 ± 1 °F) for up to one month, at which time the culture shall be passed to a new TSB tube. Working stock culture shall be discarded after 12 months/passages and a new vial reconstituted from ATCC.

C.8.2 Challenge culture preparation

- 1 mL of the stock culture shall be transferred to a TSA slant prepared in a French bottle with a surface approximately 75 cm² in area. The media shall then be incubated at 36 ± 1 °C (97 ± 1 °F) for 24 h.

¹³ Micrology Laboratories, 1303 Eisenhower Dr., S. Goshen, IN 46526-5360 www.micrologylabs.com

¹⁴ Trademark by Dr. A. Rambach; available from multiple sources

- b) Cells shall be washed from agar surface with 5 mL of SBDW. Agar surface shall be scraped with sterile disposable loops.
- c) 0.5 mL of *E. coli* culture suspension shall be pipetted into 4 L of SBDW. This will give a density of 1 to 5×10^6 colony forming units (CFU) per mL.

C.8.3 Enumeration

- a) For each test sample, one 100-mL and 10-mL sample shall be aseptically processed using the membrane filter technique. A mixed cellulose ester membrane with a pore size of 0.45 μm shall be used. Test sample shall be plated on ColiScan®CHROMagar®, inverted, and incubated at 36 ± 1 °C (97 ± 1 °F) for 24 h.
- b) After incubation, plates containing 20 – 200 distinct colony forming units (CFU) shall be enumerated using a Colony Counter. Results shall be expressed as the number of CFU / 100 mL.

C.8.4 Negative control

- a) For the negative control samples, a 100-mL sample shall be aseptically processed using the membrane filter technique. A mixed cellulose ester membrane with a pore size of 0.45 μm shall be used. Test sample shall be plated on ColiScan®CHROMagar®, inverted, and incubated at 36 ± 1 °C (97 ± 1 °F) for 24 h.
- b) After incubation, plates containing 20 – 200 distinct colony forming units (CFU) using a Colony Counter shall be enumerated. Results shall be expressed as the number of CFU / 100 mL.

C.8.4 Positive challenge culture control

- a) For the positive challenge control samples, serial dilutions of the samples (10^0 - 10^{-4}) shall be made using SBDW. 10^{-4} and 10^{-5} dilutions shall be aseptically processed using the membrane filter technique. Test sample shall be plated on ColiScan®CHROMagar®, inverted, and incubated at 36 ± 1 °C (97 ± 1 °F) for 24 h.
- b) After incubation, plates containing 20 – 200 distinct colony forming units (CFU) shall be enumerated using a Colony Counter. Results shall be expressed as the number of CFU / 100 mL.

Annex D

(informative)

Flooring recommendations for proofers and ovens constructed without floors

D.1 General

This annex contains basic flooring recommendations for the installation of proofers and ovens that are constructed without integral floors. Before the equipment is installed, the manufacturer's installation instructions should be studied carefully.

D.2 Smoothness

Surfaces upon which floorless equipment is mounted must be smooth. NSF/ANSI 170, *Glossary of Food Equipment Terminology*, defines smooth as "free of pits, pinholes, cracks, crevices, inclusions, rough edges, and other surface imperfections detectably by visual and tactile inspection." As a further point of reference, for the purpose of smoothness as it pertains to floors, walls, and ceilings, the FDA Food Code¹⁵ states that surfaces "having an even or level surface with no roughness or projections that render it difficult to clean" are determined to be smooth.

D.3 Cleanability

Surfaces upon which floorless equipment is mounted shall be easily cleanable. NSF/ANSI 170, *Glossary of Food Equipment Terminology*, defines easily cleanable as being "manufactured so that food and other soiling material may be removed by manual cleaning methods." Coved moldings at the floor-wall juncture can further improve overall cleanability. Flooring materials must also be nonabsorbent.

D.4 Corrosion resistance

Surfaces upon which floorless equipment is mounted shall be corrosion resistant. NSF/ANSI 170, *Glossary of Food Equipment Terminology*, defines corrosion resistant as being capable of maintaining original surface characteristics under prolonged contact with the intended end use environment and exposure to appropriate cleaning compounds and sanitizing solutions.

D.5 Flooring

Floors must be able to withstand rolling and sliding of shelving units and carts, as well as the operating temperatures of the equipment. Ovens, with broader temperature swings, may have different needs than a proofer, which is intended to create a humid, low-heat environment. Floors should be inspected regularly for signs of wear, such as cracks in grout lines, with attention given to remedy these areas as needed. Examples of acceptable materials are likely to include, but are not limited to, non-shrinking concrete and quarry tile or similarly hard tile. Reinforcing concrete with materials such as rebar or steel mesh can help to prolong the integrity of the finished material. Overall, available flooring choices will vary. All state and local codes in effect in the area in which the installation is made should be followed. Some organic-based flooring materials, including sealants, may be prone to off-gassing. Consider the temperatures of use and limitations of the product when determining acceptable flooring materials.

¹⁵ Food and Drug Administration, *Food Code*, College Park, MD 20740 <www.fda.gov>

This page is intentionally left blank.

Annex E¹⁶

(informative)

Food Equipment Joint Committee¹⁷

Name	Company / organization	Interest category
Northcutt, Kirk	Auto-Chlor System	Industry
Perez, Michael ¹	Baring Industries	User
Tackitt, Steve	Barry-Eaton District Health Department	Public health / regulatory
Petersen Jr., James	C.i.i. Food Service Design	User
Bortolotti, Stefano	Carpigiani	Industry
Gagliardi, Tony ¹	Consultant - Public Health/Regulatory	Public health / regulatory
Burton-Zick, Sara ¹	DuPage County Health Department	Public health / regulatory
Liggans, Girvin	Food and Drug Administration	Public health / regulatory
Hall, Jon	Glastender Inc	Industry
Scanlon, John ¹	Hatco Corp.	Industry
Hipp, Joel ¹	Hobart Corp.	Industry
Schaefer, Stephen	Hoshizaki America, Inc.	Industry
Sickles, P.E., Willard ¹	InterMetro Industries Corp.	Industry
Coffman, Roger	Lake County Health Dept.	Public health / regulatory
Hurst, REHS, CP-FS, Bryan	Lincoln-Lancaster Co. Health Department	Public health / regulatory
Brasseur, Eric	Little Caesars Enterprises	User
Bhatt, Swati	Los Angeles County	Public health / regulatory
Negandhi, P.E., Dipak ¹	Manitowoc Foodservice	Industry
Steinbach, Pamela	Minnesota Dept. of Health	Public health / regulatory
Carotenuto, Anthony	Navy and Marine Corps Public Health Center	User
Dyer, Randy	Nestle	User
Kohler, Mike ¹	NSF International	User
Leonard, MPH, LEHP, James	Princess Cruises	User
Johnson, Tom	Qlean Tech Enterprises	User
Samarya-Timm, Michéle	Somerset County Department of Health	Public health / regulatory
Klouse, REHS, CP-FS, Paul	Southern Nevada Health District	Public health / regulatory
Brandt, Rex ¹	Taylor Co.	Industry
Maxon, Gary	The Delfield Co.	Industry
McNeil, Thomas, RS	U.S. Army	User
Brania, Jonathan ¹	UL LLC	User
Brady, Jim ¹	Wawa, Inc.	User
Standards Development Liaison: Al Rose		
Membership Balance:		
Industry: 10		
Regulatory: 10		
User: 10		
¹ Committee or task group chair		

¹⁶ 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.

¹⁷Food Equipment Joint Committee members on the date of publication - subject to change 11/14/2016

This page is intentionally left blank.

Standards¹⁸

The following standards established and adopted by NSF as minimum voluntary consensus standards are used internationally:

- 2 Food equipment
- 3 Commercial warewashing equipment
- 4 Commercial cooking, rethermalization, and powered hot food holding and transport equipment
- 5 Water heaters, hot water supply boilers, and heat recovery equipment
- 6 Dispensing freezers
- 7 Commercial refrigerators and freezers
- 8 Commercial powered food preparation equipment
- 12 Automatic ice making equipment
- 13 Refuse processors and processing systems
- 14 Plastics piping system components and related materials
- 18 Manual food and beverage dispensing equipment
- 20 Commercial bulk milk dispensing equipment
- 21 Thermoplastic refuse containers
- 24 Plumbing system components for recreational vehicles
- 25 Vending machines for food and beverages
- 29 Detergent and chemical feeders for commercial spray-type dishwashing machines
- 35 High pressure decorative laminates (HPDL) for surfacing food service equipment
- 36 Dinnerware
- 37 Air curtains for entranceways in food and food service establishments
- 40 Residential wastewater treatment systems
- 41 Non-liquid saturated treatment systems
- 42 Drinking water treatment units – Aesthetic effects
- 44 Residential cation exchange water softeners
- 46 Evaluation of components and devices used in wastewater treatment systems
- 49 Biosafety cabinetry: Design, construction, performance, and field certification
- 50 Equipment for swimming pools, spas, hot tubs, and other recreational water facilities
- 51 Food equipment materials
- 52 Supplemental flooring
- 53 Drinking water treatment units – Health effects
- 55 Ultraviolet microbiological water treatment systems
- 58 Reverse osmosis drinking water treatment systems
- 59 Mobile food carts
- 60 Drinking water treatment chemicals – Health effects
- 61 Drinking water system components – Health effects
- 62 Drinking water distillation systems
- 140 Sustainable carpet assessment
- 169 Special purpose food equipment and devices
- 170 Glossary of food equipment terminology
- 173 Dietary supplements
- 177 Shower filtration systems – Aesthetic effects
- 184 Residential dishwashers
- 222 Ozone generators
- 223 Conformity assessment requirements for certification bodies that certify products pursuant to NSF/ANSI 60: Drinking water treatment chemicals – health effects
- 240 Drainfield trench product sizing for gravity dispersal onsite wastewater treatment and dispersal systems
- 245 Wastewater treatment systems - nitrogen reduction
- 305 Personal care products containing organic ingredients
- 321 Goldenseal root (*Hydrastis canadensis*)
- 330 Glossary of drinking water treatment unit terminology
- 332 Sustainability assessment for resilient floor coverings
- 336 Sustainability assessment for commercial furnishings fabric
- 342 Sustainability assessment for wallcovering products
- 347 Sustainability assessment for single ply roofing membranes
- 350 Onsite residential and commercial water reuse treatment systems
- 350-1 Onsite residential and commercial greywater treatment systems for subsurface discharge
- 355 Greener chemicals and processes information
- 358-1 Polyethylene pipe and fittings for water-based ground-source “geothermal” heat pump systems
- 358-2 Polypropylene pipe and fittings for water-based ground-source “geothermal” heat pump systems
- 359 Valves for crosslinked polyethylene (PEX) water distribution tubing systems
- 360 Wastewater treatment systems – Field performance verification
- 363 Good Manufacturing Practices (GMP) for Pharmaceutical Excipients
- 372 Drinking water treatment system components – Lead content
- 401 Drinking water treatment units - Emerging compounds / incidental contaminants
- 416 Sustainability Assessment for Water Treatment Chemical Products
- 418 Residential wastewater effluent filters longevity testing
- 419 Public Drinking Water Equipment Performance – Filtration
- 14159-1 Hygiene requirements for the design of meat and poultry processing equipment
- 14159-2 Hygiene requirements for the design of hand held tools used in meat and poultry processing equipment
- 14159-3 Hygiene requirements for the design of mechanical belt conveyors used in meat and poultry processing equipment

¹⁸ 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.