



Energy and Internal Volume of Refrigerating Appliances

AHAM HRF-1-2008



PREFACE

The Association of Home Appliance Manufacturers develops standards in accordance with AHAM's "Policy and Procedures Governing Technical Standards" which states:

"AHAM Standards shall be in the best interest, mutually, of consumers who use appliances, the industries which provide and service appliances, and other interested parties. They shall relate to actual use conditions and be technically and scientifically sound."

Use or observance of AHAM standards is voluntary.

This standard contains test procedures that may be applied to any brand or model of electric refrigerator, refrigerator-freezer or freezer for measuring performance. Results of tests in accordance with this standard may be publicly stated. This standard is a technical revision of ANSI/AHAM HRF-1-2007. Section 4 replaces Sections 5, 6 and 7 of HRF-1-2007 with a simplified volume calculation procedure. In addition, standardized testing temperatures have been changed for fresh food and freezer compartments to harmonize with the IEC. Finally, this version more fully clarifies the process of removing ice cubes from an icemaker, and further clarifies general test set-up and requirements.

With regard to safety, AHAM recommends that all appliance products—both major and portable--manufactured or marketed in the United States be submitted to an appropriate independent laboratory for inspection and listing in conformance with the safety standards and procedures followed by such laboratories. The relevant standard for refrigerators, refrigerator-freezers and freezers is ANSI/UL 250 / CSA C22.2 No. 63, *Household Refrigerators and Freezers*.

AHAM welcomes comments and suggestions regarding this standard. Any standard may be reviewed and improved as needed. All standards must be updated or reconfirmed at least every five years. Any interested party, at any time, may request a change in an AHAM standard. Such request should be addressed to AHAM's President, and should be accompanied by a statement of reason for the request and a suggested alternate proposal.

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1 PURPOSE

1.1 The purpose of this standard is to establish a uniform and repeatable procedure or standard method for measuring specified product characteristics of refrigerators, wine chillers and freezers. The standard methods and the recommended levels of performance, where they appear, are intended to provide a means by which different brands and models of refrigerators, wine chillers and freezers can be compared and evaluated.

The standard methods are not intended to inhibit improvement and innovation in product testing, design or performance.

1.2 The following principles of interpretation shall be applied to AHAM HRF-1, and shall apply to and guide any revisions to the test procedure. The intent of the energy test procedure is to simulate typical room conditions (approximately 70 °F) with door openings, by testing at 90 °F without door openings.

Except for operating characteristics that are affected by ambient temperature (for example, compressor percent run time), the unit, when tested under this standard, shall operate equivalent to the unit in typical room conditions. The energy used by the unit shall be calculated when a calculation is provided by the standard.

Energy consuming components that operate in typical room conditions (including as a result of door openings, or a function of humidity), and that are not exempted by this standard, shall operate in an equivalent manner during energy testing under this standard, or be accounted for by all calculations as provided for in the standard.

Examples:

1. Energy saving features that are designed to operate when there are no door openings for long periods of time shall not be functional during the energy test.
2. The defrost heater shall not either function or turn off differently during the energy test than it would when in typical room conditions. Also, the product shall not recover differently during the defrost recovery period than it would in typical room conditions.
3. Electric heaters that would normally operate at typical room conditions with door openings shall also operate during the energy test.
4. Energy used during adaptive defrost shall continue to be tested and adjusted per the calculation provided for in this standard.

2 SCOPE

2.1 This standard applies to refrigerators as defined in Section 3.1, refrigerator freezers as defined in Section 3.2, freezers as defined in Section 3.3 and wine chillers as defined in Section 3.4.

2.2 This standard covers definitions, methods for computing volumes, methods for determining energy consumption and energy factor, and safety recommendations.

2.3 This standard does not include methods of testing refrigerators, wine chillers and freezers using gas fuel as defined in ANSI Standard Z21.19.

3 DEFINITIONS

For the purposes of this document, the following definitions apply.

3.1 Refrigerator

A cabinet or any part of a cabinet which is designed for the refrigerated storage of food at temperatures above 32°F (0°C) and below 39°F (3.9° C), configured for general refrigerated storage, having a source of refrigeration requiring a single phase, alternating current electric energy input only, and which is intended for household use. It may include a compartment for the freezing and storage of ice and/or for storage of food at temperatures below 32°F (0°C), but does not provide a separate low temperature compartment designed for the freezing and storage of food at temperatures below 8°F (-13.3°C).

NOTE All temperatures are measured in accordance with Section 5.5.5 when tested at 90°F (32.2° C) ambient.

3.1.1 Basic Refrigerator A refrigerator which includes a low temperature compartment for the freezing and storage of ice and intended for short-term storage of food at temperatures below 32°F (0°C) and normally above 8°F (-13.3°C). It is characterized by a refrigerated surface(s) that partially encloses the low temperature compartment and cools the fresh food compartment by natural convection. It frequently has a partition (called the chiller or drip tray) which when removed or adjusted exposes an additional area of the refrigerated surface to the fresh food compartment.

3.1.2 All-Refrigerator. A refrigerator which does not include a compartment for the storage of food at temperatures below 32°F (0°C). It may include a compartment of 0.5 cubic feet (14.2 liters) or less for freezing and storage of ice.

3.2 Combination Refrigerator-Freezer

A cabinet which consists of two or more compartments, with at least one of the compartments designed for the refrigerated storage of foods at temperatures above 32°F (0°C) and with at least one of the compartments designed for the freezing and storage of frozen foods at temperatures of 8°F (-13.3°C) average or below, and typically capable of being adjusted by the user to a temperature of 0°F (-17.8°C) or below.

3.3 Freezer

A cabinet designed for the freezing and storage of frozen foods at temperatures of 8°F (-13.3°C) average or below, and typically capable of being adjusted by the user to a temperature of 0°F (-17.8°C) or below.

3.3.1 Chest Type A freezer which is accessible from the top.

3.3.2 Upright (Vertical) Type. A freezer which is accessible from the front.

3.4 Wine Chiller

A cabinet designed and marketed exclusively for the cooling and storage of wine.

3.5 Air Ducts

Passages which direct the flow of air.

3.6 Anti-Sweat Heater

A device incorporated into the design of a refrigerator or freezer to prevent the accumulation of moisture on exterior surfaces of the cabinet. This heater may be switchable from fully-on to fully-off or to some condition of operation in-between.

3.7 Automatic Icemaker

A device, connected to a water supply, which automatically produces, harvests, and stores ice in a storage bin, with means to automatically interrupt the harvesting operation when the bin is filled to a pre-determined amount.

3.7.1 Cyclic Type. An automatic icemaker with separate and sequential water fill, freezing and harvesting phases of the ice-making operation.

3.7.2 Non-Cyclic (Continuous) Type. An automatic icemaker with simultaneous water supply, freezing and/or harvesting phases in the ice-making operation.

3.7.3 Harvest. The process of freeing or removing ice pieces from an icemaker.

3.8 Baffle

A plate, wall or partition which is designed to perform one or more of the following functions:

- (a) prevent contact of food with refrigerated surfaces;
- (b) prevent dripping of condensate on food;
- (c) regulate and/or direct circulation of refrigerated air.

3.9 Cabinet Breaker Strip

A separate insulating element or integral extension of the cabinet interior surfaces around the periphery of the cabinet door or drawer opening(s) which functions as a thermal barrier to minimize heat flow to the interior of the cabinet.

3.10 Cycle

The period of 24 hours for which the energy use of a refrigerator or freezer is calculated as though the consumer activated compartment temperature controls were set so that the desired compartment temperatures were maintained.

3.11 Cycle Type

The set of test conditions having the calculated effect of operating a refrigerator or freezer for a period of 24 hours, with the consumer activated controls other than those that control compartment temperatures set to establish various operating characteristics.

3.12 Defrost System

A means to remove frost and/or ice from the refrigerated surfaces. Types of defrost systems that apply to refrigerators and freezers are defined in Sections 3.12.1 through 3.12.4 below.

3.12.1 Manual Defrost. Manual defrost is one in which defrosting of the refrigerated surface is accomplished by natural or manual means with manual initiation and manual termination of the overall defrost operation.

3.12.2 Semi-Automatic Defrost. A system in which the defrost cycle is manually initiated and automatically terminated, with automatic resumption of normal refrigeration at the conclusion of the defrost operation. Defrost water is disposed of automatically or collected in a container for subsequent manual removal. A means of accelerating the rate of defrost may or may not be included in the product design. When testing for energy consumption, this is considered a manual defrost product.

3.12.3 Automatic Defrost (No-Frost). A system in which the defrost cycle is automatically initiated and terminated, with resumption of normal refrigeration at the conclusion of the defrost operation. The system automatically prevents the permanent formation of frost on all refrigerated surfaces. Nominal refrigerated food temperatures are maintained during operation of the automatic defrost system(s). The defrost water is disposed of automatically.

3.12.4 Partial Automatic Defrost (Refrigerators). A system in which the refrigerated surfaces of the freezer compartment are defrosted manually and the refrigerated surfaces of the fresh food compartment are defrosted automatically. Defrost water from the fresh food compartment is disposed of automatically or collected in a container for subsequent manual removal.

3.13 Drip (Drain) Trough

A device for channeling water.

3.14 Door

3.14.1 Right-hand Door. An external door that is hinged on the right-hand side when viewed facing the cabinet.

3.14.2 Left-hand Door. An external door that is hinged on the left-hand side when viewed facing the cabinet.

3.14.3 Drawer. An external drawer that is designed to pull or tip out.

3.14.4 Door Dike. A projection on the door which extends into the refrigerated compartment(s) and which functions primarily as a barrier to minimize heat flow to the interior of the cabinet.

3.15 Fan Shroud

A protective housing which surrounds the fan and which may also direct the flow of air.

3.16 Fresh Food Compartment

In a refrigerator, that compartment(s) designed for the refrigerated storage of food at an average temperature above 32°F (0°C). Special compartments designed for the storage of fresh foods at temperatures near 32°F (0°C) shall be considered part of the fresh food compartment. Special compartments of combination refrigerator-freezers operating at average temperatures between 8°F (-13.3°C) and 32°F (0°C) shall be considered part of the fresh food compartment.

3.17 Freezer Compartment

In a basic refrigerator, the compartment designed for short-term storage of food at temperatures below 32°F (0°C); in a combination refrigerator-freezer, the compartment(s) designed for storage of

foods at temperatures of 8°F (-13.3°C) average or lower; and in a freezer the compartment(s) designed for extended storage of frozen foods at an average temperature of 0°F (-17.8°C) or below and having inherent capability for freezing of food.

3.18 Ice Tray

A container for freezing water into ice.

3.18.1 Automatic Fill Ice Tray. A tray which is automatically filled with water for freezing into ice.

3.19 Liner

The enclosure forming the interior of the fresh food compartment and/or some freezer compartment(s). The complete liner comprises the compartment liner in the cabinet, the exposed breaker strip surfaces and the door liner(s).

3.20 Long-Time Automatic Defrost

An automatic defrost system where successive defrost cycles are separated by 14 hours or more of compressor-operating time.

3.21 Plaque and/or Sump

The volume generated by embossed areas on the interior surfaces of the fresh food and/or freezer compartment(s).

3.22 Quick Freeze/Quick Cool

An optional feature on freezers or refrigerators that is initiated manually. It bypasses the thermostat control and operates continually until the feature is terminated either manually or automatically.

3.23 Shelf

Any generally horizontal surface within the cabinet which is provided for the storage of food.

3.23.1 Adjustable Shelf. One that can have its vertical position changed without the use of tools.

3.23.2 Door Shelf. Any surface on the door that can be used for the storage of food.

3.23.3 Full Shelf. One which essentially fills the interior cross-section of the cabinet.

3.23.4 Fractional Shelf. One which is less than either the width or the depth, or both, of the full shelf.

3.23.5 Revolving Shelf. One which can be either partially rotated, fully rotated or pivoted on its support.

3.23.6 Roll-out or Sliding Shelf. One which can roll or slide on its support(s).

3.24 Special Compartments

Compartments designed for maintaining special environmental conditions for a particular type of product or purpose.

3.24.1 Butter, Margarine, Cheese and Similar Products Compartment(s). A compartment provided for the storage of butter, margarine, cheese and similar products.

3.24.2 Butter or Margarine Conditioner. An enclosed compartment which is provided for the storage of butter and/or margarine and which has an auxiliary temperature control.

3.24.3 Chiller or Drip Tray. A tray or drawer which is located beneath the refrigerated surfaces of a manual or semi-automatic defrosting refrigerator for chilling of food and/or collecting of water during defrosting. It may also serve as a baffle (Section 3.8) to regulate compartment temperature.

3.24.4 Crisper. An enclosed compartment or container provided primarily to retard the dehydration of fruits and vegetables.

3.24.5 Ice Storage Bin. A container in which ice can be stored.

3.24.6 Meat Keeper. An enclosed compartment or container which is designed for the storage of meat at or near 32°F (0°C).

3.25 Special Feature

Any item, including components of its design, not required for the basic operation of the unit.

3.26 Stabilization Period

The total period of time during which steady state conditions are being attained or evaluated.

3.27 Standard Cycle

The cycle type (Section 3.11) in which the anti-sweat heater (Section 3.6) control, when provided, is set in the highest energy consuming position.

3.28 Steady State Condition

Steady state conditions exist if the average temperature in each measured compartment taken at 4 minute intervals, or less, during a stabilization period are not changing at a rate greater than 0.042°F (0.023°C) per hour as determined by the applicable condition of (a) or (b) below.

(a) The average of the measurements during a 2 hour period if no cycling occurs or during a number of complete repetitive compressor cycles through a period of no less than 2 hours is compared to the average over an equivalent time period with at least 3 hours elapsed between the two measurement periods.

(b) If defrost controls are operative during the test and (a) above cannot be used, the average of the measurements during a number of complete repetitive compressor cycles through a period of no less than 2 hours and including the last complete cycle prior to a defrost period, or if no cycling

occurs, the average of the measurements during the last 2 hours prior to a defrost period is compared to the same averaging period prior to the following defrost period.

3.29 Variable Defrost Control

A long- time automatic defrost system (except the 14-hour defrost qualification does not apply) where successive defrost cycles are determined by an operating condition variable or variables other than solely compressor operating time. This includes any electrical or mechanical device.

A control scheme that changes the defrost interval from a fixed length to an extended length (without any intermediate steps) is not considered a variable defrost control. A variable defrost control feature should predict the accumulation of frost on the evaporator and react accordingly. Therefore, the times between defrost should vary with different usage patterns and include a continuum of lengths of time between defrosts as inputs vary.

3.30 Volume

3.30.1 Fresh Food Compartment Volume. That portion of the total refrigerated volume above 32°F (0°C) average for all refrigerators and combination refrigerator-freezers (Section 4.)

3.30.2 Freezer Compartment Volume. That portion of the total refrigerated volume below 32°F (0°C) average for basic refrigerators (see 3.30.1 for exception) and 8°F (-13.3°C) average or below for combination refrigerator-freezers and freezers. (See Section 4)

3.30.3 Total Volume. For a refrigerator, the sum of the fresh food compartment volume and the freezer compartment volume.

For a freezer, the freezer compartment volume.

3.30.4 Adjusted Total Volume. For refrigerators and refrigerator-freezers: The sum of (i) the fresh food compartment volume in cubic feet and (ii) the product of an adjustment factor and the freezer compartment volume in cubic feet (see Section 6.3).

4 METHOD FOR COMPUTING REFRIGERATED VOLUME OF REFRIGERATORS AND WINE CHILLERS

4.1 Scope

This section describes methods for computing total volume (Section 3.30.3) of refrigerators and wine chillers. Section 4 is intended to provide a uniform means of determining the size, taking into consideration the special features and/or functional components which are located within the refrigerated compartment(s). It is not intended to provide a means of measuring the food-storage capacity.

4.2 Total volume

4.2.1 Volume measurements

The fresh food compartment volume is to be recorded to the nearest 0.01 cubic feet (nearest 0.1 liter). The freezer compartment volume is to be recorded to the nearest 0.01 cubic feet (nearest 0.1 liter). The total volume shall be the sum of the volumes of all compartments and be recorded to the nearest 0.1 cubic feet (nearest 1.0 liter).

4.2.2 Determination of volume

The volume shall take into account the exact shapes of the walls including all depressions or projections. For through the door ice and water dispensers, the ice chute will be included in the volume up to the dispensing function.

When the volume is determined, internal fittings such as shelves, removable partitions, containers and interior light housings shall be considered as not being in place.

The items below shall be considered as being in place and their volumes deducted:

- The volume of control housings.
- The volume of the evaporator space (see Section 4.2.3).
- The volume of air ducts required for proper cooling and operation of the unit.
- Space occupied by shelves molded into the inner door panel.

For clarification, the through the door ice and water dispensers and the insulating hump are not included in the volume. No part of the dispenser unit shall be included as volume.

4.2.3 Volume of evaporator space

The volume of the evaporator space shall be the product of the depth, width and height.

The total volume to be deducted shall comprise the following:

- a) In the case of a forced air evaporator, the total volume of and behind the evaporator cover shall be deducted including volume occupied by the evaporator fan and the fan scroll.
- b) In the case of plate style (or roll-bond) evaporators, the volume behind vertically installed plate style evaporators and the volume above horizontally installed plate style evaporators if the distance between the horizontal plate style evaporator and the nearest above liner surface is less than 2 inches (50 mm). Removable drip trays/troughs shall be considered as not present.
- c) In the case of refrigerant filled shelving, the volume above the uppermost shelf and below the lowermost shelf, if the distance between the shelf and the nearest horizontal plane of the cabinet inner wall is less than 50 mm (or 2 inches). All other refrigerated shelves are considered as not present.

4.3 Legend for Figures 4-1 through 4-3

Figures 4-1 through 4-3 show typical configurations and are not intended to cover all design variations. A combination of components from the various figures may be used for other designs.

These figures graphically support procedures for determination of volume described in Sections 4.2.2 and 4.2.3.